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Always Pray For me

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ary 22, 2014
tani jets attack suspected militant hide-outs rth Waziristan for first time in years, signaling nment's willingness to take fight to center of ry's insurgency; air strikes appear to be in ation for recent terrorist bombings in Bannu Rawalpindi that killed at least 30 security members.

ıry 21, 2014
de bomber strikes near the Pakistani y's general headquarters in Rawalpindi, at least 13 people, including six soldiers.

ry 20, 2014
explodes inside vehicle at Pakistani military ound in the country's northwest, killing at 20 members of a paramilitary unit and ing 30 more.

ry 11, 2014
an's Prime Min Nawaz Sharif recommends igh civil award for bravery be bestowed on Hasan, teenager who was killed while g a suicide bomber from attacking his in northwestern Pakistan.

y 10, 2014
t in which 15-year-old Pakistani student Hasan tackled suicide bomber while on his school, only to be blown up by him, has deep nerve in Pakistan; citizens are calling hero, pointing out that he gave his own life that of hundreds of students.

10, 2014
mad Aslam Khan, Pakistani police official s Chaudhry Aslam who was at forefront of ns against the Pakistani Taliban, is killed blast in Karachi along with two others.

January 8, 2014
Special court panel examines medical report on former Pakistani military ruler Pervez Musharraf to determine whether he may be excused from attending treason proceedings against him; Musharraf was rushed to military hospital for sudden heart problem on Jan 3; deliberations raise speculation that deal to allow him to leave country may be underway.

January 7, 2014
Dubai Journal; news that Pakistan and Afghanistan cast their votes for cities other than Dubai in the competition for the 2020 World Expo infuriates the United Arab Emirates; Dubai has won the competition, which offers the city a chance to grab global attention and celebrate its resurgent affluence.

January 3, 2014
Former Pakistani military ruler Pervez Musharraf is taken to a military hospital due to an unexplained heard condition, derailing for third time a scheduled court hearing in treason proceedings against him.

January 2, 2014
Explosives are found for second time along route to hearing for Pakistan's former military ruler Pervez Musharraf; he is accused of subverting the Constitution when he imposed emergency rule in November 2007; judge warns if he fails to appear for next hearing he could face arrest.

Solved Model Paper of Physics for the Post of (SSE)

INSTRUCTIONS

Candidates must read and follow instructions given on reverse of the answer sheet before attempting the question paper.
All answers are required to be written on the answer sheet and NOT on the question paper.
Attempt all questions which carry equal marks.
Time allowed: 2 hours (120 mints) **Total MCQ's: 100**
Total Marks: 100

1. A metal conductor of length 1 m rotates vertically about one of its ends at angular velocity 5 radians per second. If the horizontal component of earth's magnetic field is 0.3×10^{-4} T, then the e.m.f. developed between the two ends of the conductor is
   A. depends on the nature of the metal used
   B. depends on the intensity of the radiation
   C. depends both on the intensity of the radiation and the metal used
   D. is the same for all metals and independent of the intensify of the radiation.

2. According to Einstein's photoelectric equation, the plot of the kinetic energy of the emitted photo electrons from a metal V_s the frequency, of the incident radiation gives straight line whose slope
   A. depends on the nature of the metal used
   B. depends on the intensify of the radiation
   C. depends both on the intensity of the radiation and the metal used
   D. is the same for all metals and independent of the intensity of the radiation

3. The work function of a substance is 4.0 eV. Then longest wavelength of light that can cause photoelectron emission from this substance approximately
   A. 540 nm B. 400 nm
   C. 310 nm D. 220 nm

4. A charged oil drop is suspended in a uniform field of 3×10^4 V/m so that it neither falls nor rises. The charge on the drop will be (take the mass of the charge = 9.9×10^{-15} kg and g = 10 m/s^2)
   A. 3.3×10^{-18} C
   B. 3.2×10^{-18} C
   C. 1.6×10^{-18} C
   D. 4.8×10^{-18} C

5. A nucleus disintegrates into two nuclear parts which have their velocities in the ratio 2: 1. The ratio of their nuclear sizes will be
   A. $2^{1/3}$: 1 **B. 1: $3^{1/2}$**
   C. $3^{1/2}$: 1 D. 1 : $2^{1/3}$

6. The binding energy per nucleon of deuteron ($_1^2H$) and helium nucleus ($_2^4He$) is 1.1 MeV and 7 MeV respectively. If two deuteron nuclei react to form a single helium nucleus, then the energy released is
   A. 13.9 MeV
   B. 26.9 MeV
   C. 23.6 MeV
   D. 19.2 MeV

7. An α-particle of energy 5 MeV is scattered through 180° by a fixed uranium nucleus. The distance of the closest approach is of the order of
   A. $\overset{\circ}{A}$ B. 10^{10} cm
   C. 10^{12} cm D. 10^{15} cm

8. When NPN transistor is used as amplifier
   A. electrons move from base to collector
   B. holes move from emitter to base
   C. electrons move from collector to base
   D. holes move from base to emitter.

9. For a transistor amplifier in common emitter configuration having load impedance of 1 kΩ (h_{fe} = 50 and h_{oe} = 25) the current gain is
   A. -5.2 B. -15.7
   C. -24.8 **D. -48.78**

10. A piece of copper and another of germanium are cooled from room temperature to 77 K, the resistance of
    A. each of them increases
    B. each of them decreases
    C. copper decreases and germanium increases
    D. copper increases and germanium decreases

11. The manifestation of band structure in solids is due to
    A. Heisenberg's uncertainty principle
    B. Pauli's exclusion principle
    C. Bohr's correspondence principle
    D. Boltzmann's law

12. When p-n junction diode is forward biased
    A. the depletion region is reduced and barrier height is increased
    B. the depletion region is widened and barrier height is reduced.
    C. both the depletion region and barrier height reduced.
    D. both the depletion region and barrier height increased.

13. A projectile can have the same range R for two angles of projection. If t_1 and t_2 be the times of flights in the two cases, then the product of the two time of flights is proportional to
    A. R^2 B. $1/R^2$
    C. 1/R **D. R**

14. An annular ring with inner and outer radii R_1 and R_2 is rolling without slipping with a uniform angular speed. The ratio of the forces experienced by the two particles situated on the inner and outer parts of the ring, F_1/F_2 is
    A. $\frac{R_2}{R_1}$ B. $\left(\frac{R_2}{R_1}\right)$
    C. 1 **D.** $\frac{R_1}{R_2}$

15. A smooth block is released at rest on a 45° incline and then slides a distanced. The time taken to slide is n times as much to slide on rough incline than on a smooth incline. The coefficient of friction is
    A. $\mu_k = 1-\frac{1}{n^2}$
    B. $\mu_k = \sqrt{1-\frac{1}{n^2}}$

C. $\mu_s = 1-\frac{1}{n^2}$
D. $\mu_s = \sqrt{1-\frac{1}{n^2}}$

16. The upper half of an inclined plane with inclination ϕ is perfectly smooth while the lower half is rough. A body starting from rest at the top will again come to rest at the bottom if the coefficient of friction for the lower half is given by
    A. $2\sin\phi$ B. $2\cos\phi$
    C. $2\tan\phi$ D. $\tan\phi$

17. A bullet fired into a fixed target loses half of its velocity after penetrating 3 cm. How much further it will penetrate before coming to rest assuming that it faces constant resistance to motion?
    A. 3.0 cm B. 2.0 cm
    C. 1.5 cm **D. 1.0 cm**

18. Out of the following pair, which one does NOT have identical dimensions is
    A. angular momentum and Planck's constant
    B. impulse and momentum
    C. moment of inertia and moment of a force
    D. work and torque

19. The relation between time t and distance × is $t = ax^2 + bx$ where and b are constants. The acceleration is
    A. $-2abv^2$ B. $2bv^3$
    C. $-2av^3$ D. $2av^2$

20. When a horse pulls a wagon, the force that causes the horse to move forward is the force:
    A. the ground exerts on him
    B. the exerts on the ground
    C. the wagon exerts on him
    D. he exerts on the wagon

21. A particle is moving eastwards with a velocity of 5 m/s in 10 seconds the velocity changes to 5 m/s northwards. The average acceleration in this time is
    A. $\frac{1}{\sqrt{2}} m/s^2$ towards north-east
    B. $\frac{1}{2} m/s^2$ towards north
    C. zero
    D. $\frac{1}{\sqrt{2}} m/s^2$ **towards northwest**

22. A parachutist after bailing out falls 50 m without friction. When parachute opens, it decelerates at 2 m/s^2. He reaches the ground with speed of 3 m/s. At what height, did he bail out?
    A. 91 m B. 182 m
    C. 293m D. 111 m

23. A spherical ball of mass 20 kg is stationary at the top of a hill of height 100 m. It rolls down a smooth surface to the ground, then climbs up another hill of height 30m and finally rolls down to a horizontal base at a height of 20 m above the ground. The velocity attained by the ball is
    A. 40 m/s B. 20 m/s
    C. 10 m/s D. $10\sqrt{30}$ m/s

24. A body A of mass M while falling vertically downwards under gravity breaks into two parts; a body B of mass 1/3 M and a body C of mass 2/3 M. The center of mass of bodies B and C taken together shifts compared to that of body A towards
A. depends on height of breaking
B. does not shift
C. body C
D. body B

25. The moment of inertia of a uniform semicircular disc of mass M and radius r about a line perpendicular to the plane of the disc through the center is
A. $\frac{1}{4}Mr^2$ B. $\frac{2}{5}Mr^2$
C. Mr^2 **D.** $\frac{1}{2}Mr^2$

26. A particle of mass 0.3 kg is subjected to a force F= – kx with k=15 N/m. What will be its initial acceleration if it is released from a point 20 cm away from the origin?
A. 3 m/s^2 B. 15 m/s^2
C. 5 m/s^2 **D. 10 m/s^2**

27. A 20 cm long capillary tube is dipped in water. The water rises up to 8 cm. If the entire arrangement is put in a freely falling elevator the length of water column in the capillary tube will be
A. 8 cm B. 10 cm
C. 4 cm **D. 20 cm**

28. If S is stress and Y is Young's modulus of material of a wire, the energy stored in the wire per unit volume is
A. 2S^{2}Y **B.** S^2/2Y
C. 2Y/S^2 D. S/2Y

29. Average density of the earth
A. does not depend on g
B. is a complex function of g
C. is directly proportional to g
D. is inversely proportional to g

30. A body of mass m is accelerated uniformly from rest to a speed v in a time T. The instantaneous power delivered to the body as a function time is given by
A. $\frac{mv^2}{T^2}t$ B. $\frac{mv^2}{T^2}t^2$
C. $\frac{1}{2}\frac{mv^2}{T^2}t$ D. $\frac{1}{2}\frac{mv^2}{T^2}t^2$

31. Consider a car moving on a straight road with a speed of 100 m/s. The distance at which car can be stopped is [μ_k = 0.5]
A. 800 m **B. 1000 m**
C. 100m D. 400 m

32. A body initially at 80°C cools to 64°C in 5 min and to 52°C in 10 min. The temperature of the body after 15 min. will be:
A. 42.7°C B. 35°C
C. 47°C D. 40°C

33. The change in the value of g at a height 'h' above the surface of the earth is the same as at a depth 'd' below the surface of earth. When both 'd' and 'h' are much smaller than the radius of earth, then which one of the following is correct?
A. $d=\frac{h}{2}$ B. $d=\frac{3h}{2}$
C. d = 2h D. d = h

34. A particle of mass 10 g is kept on the surface of a uniform sphere of mass 100 kg and radius 10 cm. Find the work to be done against the gravitational force between them to take the particle far away from the sphere
(You may take G = 6. 67 × 10^{-11} Nm^2 / kg^2)
A. 13.34 × 10^{-10} J
B. 3.33 × 10^{-10} J
C. 6.67 × 10^{-9} J
D. 6.67 × 10^{-10} J

35. A gaseous mixture consists of 16 g of helium and 16 g of oxygen. The ratio $\frac{C_p}{C_v}$ of the mixture is
A. 1.59 **B. 1.62**
C. 1.4 D. 1.54

36. The intensity of gamma radiation from a given source is I. On passing through 36 mm of lead, it is reduced to $\frac{I}{8}$. The thickness of lead which will reduce the intensity to $\frac{I}{2}$ will be
A. 6 mm B. 9 mm
C. 18 mm **D. 12 mm**

37. The electrical conductivity of a semiconductor increases when electromagnetic radiation of wavelength shorter than 2480 nm is incident on it. The band gap in (eV) for the semiconductor is
A. 1.1 eV B. 2.5 eV
C. 0.5 eV D. 0.7 eV

38. A photocell is illuminated by a small bright source placed 1 m away. When the same source of light is placed $\frac{1}{2}$ m away, the number of electrons emitted by photo cathode would
A. decrease by a factor of 4
B. increase by a factor of 4
C. decrease by a factor of 2
D. increase by a factor of 2

39. starting with a sample of pure ^{66}Cu, 7/8 of it decays into Zn in 15 minutes. The corresponding half-life is
A. 10 minutes
B. 15 minutes
C. 5 minutes
D. $7\frac{1}{2}$ minutes

40. If radius of $^{27}_{13}$Al nucleus is estimated to be 3.6 Fermi the radius $^{125}_{52}$Te nucleus is nearly
A. 6 Fermi B. 8 Fermi
C. 4 Fermi D. 5 Fermi

41. The function sin^2 (ωt) represents
A. a periodic, but not simple harmonic motion with a period 2π ω
B. a periodic, but not simple harmonic motion with a period π/ω
C. a simple harmonic motion with a period 2π/ω
D. a simple harmonic motion with a period π/ω.

42. A Young's double slit experiment uses a monochromatic source. The shape of the interference fringes formed on a screen is
A. hyperbola
B. circle
C. straight line
D. parabola

43. Two simple harmonic motions are represented by the equation $y_1 = 0.1 \sin\left(100\pi + \frac{\pi}{3}\right)$ and $y_2 = 0.1 \cos\pi t$. The phase difference of the velocity of particle 1 w.r. the velocity of the particle 2 is
A. $\pi/6$ B. $\pi/3$
C. π-/3 D. $\pi/6$

44. A fish looking up through the water sees the outside world contained in a circular horizon. If the refractive index of water is 4/3 and the fish is 12 cm below the surface, the radius of this circle in cm is
A. $36\sqrt{7}$ **B. $36/\sqrt{7}$**
C. $36\sqrt{5}$ D. $4\sqrt{5}$

45. Two point white dots are 1 mm apart on a black paper. They are viewed by eye of pupil diameter 3 mm. approximately, what is the maximum distance at which these dots can be resolved by the eye? [Take wavelength of light = 500 nm]
A. 5 m B. 1 m
C. 6 m D. 3 m

46. When U^{235} is bombarded with one neutron, the fission occurs and the products are three neutrons, $_{36}Kr^{94}$ and
A. $_{53}I^{142}$ B. $_{56}Ba^{139}$
C. $_{58}Ce^{139}$ D. $_{54}Xe^{139}$

47. If the kinetic energy of a free electron doubles. Its DE Broglie wavelength changes by the factor
A. $\frac{1}{2}$ B. 2
C. $\frac{1}{\sqrt{2}}$ D. $\sqrt{2}$

48. In a common base amplifier, the phase difference between the input signal voltage and output voltage is
A. $\frac{\pi}{4}$ B. π
C. 0 D. $\frac{\pi}{2}$

49. In a full wave rectifier circuit operating from 50 Hz mains frequency, the fundamental frequency in the ripple would be
A. 50 Hz B. 25 Hz
C. 100Hz D. 70.7 Hz

50. A nuclear transformation is denoted by $X(n, \alpha)^7_6Li$. Which of the following is the nucleus of element X?
A. $^{12}C_6$ **B. $^{10}_5B$**
C. $^{9}_5B$ D. $^{9}_4B$

51. A moving coil galvanometer has 150 equal divisions. Its current sensitivity is 10 divisions per mill ampere and voltage sensitivity is 2 divisions per millivolt. In order that each division reads 1 volt, the resistance in ohms needed to be connected in series with the coil will be
A. 10^3 B. 10^5
C. 99995 **D. 9995**

52. Two volt meters one of copper and another of silver, are joined in parallel. When a total charge q flows through the voltammeters, equal amount of metals are deposited. If the electrochemical equivalents of copper and silver are z_1 and z_2 respectively the charge which flows through the silver voltammeter is
A. $\frac{q}{1+\frac{z_1}{z_2}}$ B. $\frac{q}{1+\frac{z_2}{z_1}}$
C. $q+\frac{z_1}{z_2}$ D. $q+\frac{z_2}{z_1}$

53. Two sources of equal emf are connected to an external resistance R. The internal resistance of the two sources are R_1 and R_2 ($R_2 > R_1$). If the potential difference across the source having internal resistance R_2 is zero, then
A. $R = R_2 \times (R_1 + R_2)/R_2 - R_1)$
B. $R = R_2 - R$
C. $R = R_1 \times R_2 / (R_1 + R_2)$
D. $R = R_1R_2/ (R_2 - R_1)$

55. A heater coil is cut into two equal parts and only one part is now used in the heater. The heat generated will now be
A. doubled B. four times
C. One fourth D. halved

56. two thin, long parallel wires separated by a distanced' carry a current f 'i' A in the same direction. They will
A. attract each other with a force of $\mu_0 i^2/(2\pi d)$
B. repel each other with a force of $\mu_0 i^2/ (2\pi d)$
C. attracts each other with a force of $\mu_0 i^2 (2\pi d^2)$
D. repel each other with a force of $\mu_0 i^2/ (2\pi d^2)$

57. When a polarized light of intensity I_0 is incident on a polarizing sheet, the intensity of the light which does not get transmitted is
A. $\frac{1}{2}I_0$ B. $\frac{1}{4}I_0$
C. zero D. I_0

58. A parallel plate capacitor is made by stalking n equally spaced plates connected alternatively. If the capacitance between any two adjacent plates is C then the resultant capacitance is
A. (n -1)C B. (n +1)C
C. C D. NC

59. When two tuning forks (fork 1 and fork 2) are sounded simultaneously, 4 beats per second are heard. Now, some tape is attached on the prong of the fork 2. When the tuning forks are sounded again, 6 beats per second are heard. If the frequency of fork 1 is 200 Hz, then what was the original frequency of fork 2?
A. 200 Hz B. 202Hz
C. 19 Hz D. 204 Hz

60. If a simple harmonic motion is represented by $\frac{d^2x}{dt^2} + \alpha x = 0$, its time period is
A. $\frac{2\pi}{\alpha}$ **B. $\frac{2\pi}{\sqrt{\alpha}}$**
C. $2\pi\alpha$ D. $2\pi\sqrt{\alpha}$

61. The bob of a simple pendulum is a spherical hollow ball filled with water. A plugged hole near the bottom of the oscillation bob gets suddenly unplugged. During observation, till water is coming out, the time period of oscillation would
A. First increase and then decrease to the original value.
B. First decrease then increase to the original value.

C. remains unchanged.
D. increase towards a saturation value.

62. An observer moves towards a stationary source of sound with a velocity one fifth of the velocity of sound. What is the percentage increase in the apparent frequency?
A. zero. B. 0.5%
C. 5% **D. 20%**

63. If I_0 is the intensity of the principal maximum in the single slit diffraction pattern, then what will be its intensity when the slit width is doubled?
A. $2I_0$ B. $4I_0$
C. I_0 D. $I_0/2$

64. Two concentric coil each of radius equal to 2π cm are placed at right angles to each other. 3 Ampere and 4 ampere are the currents flowing in each coil respectively. The magnetic induction in Weber/m^2 at the center of the coils will be ($\mu_0 = 4\pi \times 10^{-7}$ Wb/A m)
A. 12×0^{-5} B. 10^{-5}
C. 5×10^{-5} D. 7×10^{-5}

65. A coil of inductance 300 MH and resistance 2Ω is connected to a source of voltage 2V. The current reaches half of its steady state value in
A. 0.05 s **B. 0.1 s**
C. 0.15 s D. 0.3 s

66. The self-inductance of the motor of an electric fan is 10 H. In order to impart maximum power at 50 Hz, it should be connected to a capacitance of
A. 4μF B. 8μF
C. 1μF D. 2μF

67. An energy source will supply a constant current into the load of its internal resistance is
A. equal to the resistance of the load
B. very large as compared to the load resistance
C. zero
D. non-zero but less than the resistance of the load

68. A circuit has a resistance of 12 Ωand an impedance of 15Ω. The power factor of the circuit will be
A. 0.8 B. 0.4
C. 1. 5 D. 0.125

69. The phase difference between the alternating current and emf is $\pi/2$. Which of the following cannot be the constituent of the circuit?
A. C alone **B. R.L**
C. L.C D. L alone

70. A uniform electric field and a uniform magnetic field are acting along the same direction in a certain region. If an electron is projected along the direction of the fields with a certain velocity then
A. its velocity will decrease.
B. its velocity will increase.
C. it will turn towards right of direction of motion.
D. it will turn towards left of direction of motion.

71. A charged particle of mass m and charge q travels on a circular path of radius r that is perpendicular to a magnetic field B. The time taken by the particle t complete one revolution is
A. $\frac{2\pi mq}{B}$ B. $\frac{2\pi q^2 B}{m}$
C. $\frac{2\pi qB}{m}$ **D.** $\frac{2\pi m}{qB}$

72. In a potentiometer experiment the balancing with a cell is at length 240 cm. On shunting the cell with a resistance of 2Ω the balancing length becomes 120cm. The internal resistance of the cell is
A. 1Ω B. 0.5Ω
C. 4Ω **D. 2Ω**

73. The resistance of hot tungsten filament is about 10 times the cold resistance. What will be the resistance of 100Wand 200 V lamps when not in use?
A. 40 Ω B. 20Ω
C. 400Ω D. 200Ω

74. A magnetic needle is kept in a non-uniform magnetic field. It experiences
A. a torque but not a force
B. neither a force nor a torque
C. a force and a torque.
D. a force but not a torque.

75. A T-shaped rod is hinged at O. Rod A and Rod B are identical. B is joined at mind point of A from one of its end and is hanged from its other end. Find moment of inertia about the axis passing through O. Mass of each rod is one kg and length is lm.
A. 4/3 B. 16/3
C. 17/12 D. 8/3

76. A particle executing S.H.M. at midpoint of mean position and extremity. What is potential energy in term of total energy (E)
A. $\frac{E}{4}$ B. $\frac{E}{16}$
C. $\frac{E}{2}$ D. $\frac{E}{8}$

77. A train is approaching with velocity 25 m/sec towards a pedestrian standing on track frequency of horn of train is I KHz. Frequency heard by the pedestrian (v = 350)
A. 1077 B. 1167Hz
C. 986 Hz D. 945 Hz

78. Focal length of objective and eyepiece of telescope are 200 cm and 4 cm respectively. What is the length of telescope for normal adjustment?
A. 196 cm **B. 204 cm**
C. 250 cm D. 225 cm

79. Two lenses of power 3D and – 1D are kept in contact. What is focal length and nature of combined lens?
A. 50 cm, convex
B. 200 cm, convex
C. 50 cm, concave
D. 200 cm, concave

80. Intensity of A is 9I, while B is I. What is maximum and minimum intensity in YDSE?
A. 82I, 80I B. 8 I, 10I
C. 16I, 4I D. 4I, I

81. What happens inside optical fiber?
A. diffraction
B. polarization
C. interference
D. total internal reflection

82. A sphere of mass M and radius R is dropped in a liquid, and then terminal velocity of sphere is proportional to
A. R B. $\frac{1}{R}$
C. R^2 D. $\frac{1}{R^2}$

83. A sphere of radius R is rolling without sliding. What is ratio of rotational kinetic energy and total kinetic energy associated with body (radius of gyration of body is K)

A. $\frac{2}{7}$ B. $\frac{2}{5}$

C. 1 D. $\frac{1}{2}$

84. A particle is projected with velocity $2\sqrt{gh}$ such that it just crosses two walls of height h and separated by h. Find the angle of projection

A. 15° **B. 75°**

C. 60° D. 30°

85. For a projectile, $(\text{Range})^2$ is 48 times of $(\text{maximum height})^2$ obtained. Find angle of projection

A. 60° B. 30°

C. 45° **D. 75°**

Pedagogy = 10

1. The teacher should know the following thing:
   (A) What information is required by children?
   (B) What is known to the children before hand?
   (C) In which field difficulty is faced by the children?
   (D) What was last known to the children?

2. Which of the following is not emphasized in memory level of teaching?
   (A) cramming of the learnt material
   (B) presenting the subject matter by giving least freedom to pupils
   (C) conducting tests along with teaching
   (D) Helping the pupils generalize the acquired knowledge

3. True or false items cannot provide accurate criterion of evaluation because
   (A) chance of guessing on the part of examinees is at highest probability
   (B) they do not require thorough study to attempt
   (C) they generally inflate actual scores due to guessing or cheating
   (D) All of the above

4. Teaching by small steps and frequent short assignment techniques are useful for:
   (A) Slow learners
   (B) Learning disabled
   (C) Educationally backward children
   (D) All of the above

5. Which of the following purposes is served by lesson plan?
   (A) Suitable learning environment can be created in the class
   (B) Psychological teaching is possible
   (C) A teacher can stick to his content

(D) All of the above

6. You are a famous teacher, but students are not satisfied with your teaching style. **How** you will teach them?
   (A) will tell about your style first
   (B) will change your style according to students
   (C) will take training again to reform the style
   (D) will make harmony with student's style

7. Which of the following conditions must be fulfilled for proper adjustment in the environment?
   (A) Physical fitness and health
   (B) Free from psychological diseases
   (C) Social acceptability of the person
   (D) All of the above

8. Generally students like those teachers who:
   (A) dictate notes in the class
   (B) reveal important Questions before examinations
   (C) remove the difficulties of the subject
   (D) are self- disciplined

9. If students do not understand what is taught in the class the teacher should:
   (A) repeat the lesson once again
   (B) teach the lesson again giving more examples
   (C) checkup the previous knowledge of the students in the topic
   (D) proceed to the next Lesson so that syllabus could be covered

10. The able teacher is one who:
    (A) helps all the students in passing the examination
    (B) inculcates the interest in the subject among students
    (C) maintains peace in the class
    (D) engaged the students in their work

General Knowledge = 5

1. Who is current Chairman of Pakistan Electronic Media Regularity Authority (PEMRA)?
   (A) Chaudhary Rashid Ahmad (B) Arfat Ahmad
   (C) Wasim Sajjad (D) Rao Tehsin

2. The 2013 World Population Data Sheet issued by the US Population Reference Bureau ranked Pakistan as the _____ most populous country of the world.
   (A) Sixth (B) Seven
   (C) Eight (D) Ninth

3. Which country moved nuclear capable Iskander Missiles closer to Europe's borders?
   (A) Russia (B) China
   (C) Poland (D) UK

4. The World Health Organization (WHO) announced that _____ is the largest endemic Poliovirus "reservoir" in the world.
   (A) Lahore (B) Multan
   (C) Peshawar (D) Hyderabad

5. The Current President of European Union belongs to which country?
   (A) Greece (B) Austrian
   (C) German (D) French

Solved Model Paper of Physics for the Post of (SSE)

INSTRUCTIONS

Candidates must read and follow instructions given on reverse of the answer sheet before attempting the question paper.
All answers are required to be written on the answer sheet and NOT on the question paper.
Attempt all questions which carry equal marks.
Time allowed: 2 hours (120 mints)

Total MCQs: 100
Total Marks: 100

1. A wire suspended vertically from one of its ends stretched by attaching weight of 200 N to the lower end. The weight stretches the wire by 1 mm. Then the elastic energy stored in the wire is
   A. 0.2J
   B. 10 J
   C. 20 J
   D. 0.1 J

2. The escape velocity for a body projected vertically upwards from the surface of earth is 11 km/s. If the body is projected at an angle of 45° with the vertical, the escape velocity will be
   A. $11\sqrt{2}$ km/s B. 22 km/s
   C. 11 km/s D. $11\sqrt{2}$ m/s

3. A mass M is suspended from a spring of negligible mass. The spring is pulled a little and then released so that the mass executes SHM of time period T. If the mass is increased by m, the time period becomes 5T/3. Then the ratio of m/M is
   A. 3/5 B. 25/9
   C. 16/9 D. 5/3

4. "Heat cannot by itself flow from a body at lower temperature to a body at higher temperature" is a statement of consequence of
   A. Second law of thermodynamics
   B. conversation of momentum
   C. conservation of mass
   D first law of thermodynamics.

5. Two particles A and B of equal masses are suspended from two massless springs of spring constants k_1 and K2 respectively. If the maximum velocities, during oscillations, are equal, the ratio of amplitudes of A and B is
   A. $\sqrt{\frac{k_1}{k_2}}$ B. $\frac{k_2}{k_1}$
   C. $\sqrt{\frac{k_2}{k_1}}$ D. $\frac{k_1}{k_2}$

6. The length of a simple pendulum executing simple harmonic motion is increased by 21%. The percentage increase in the time period of the pendulum of increased length is
   A. 11% B. 21%
   C. 42% **D. 10%**

7. The displacement y of wave travelling in the x-direction is given by

$y = 10^{-4}\sin\left(600t - 2x\frac{\pi}{3}\right)$ meters,

where x is expressed in meters and t in seconds. The speed of the wave motion, in ms^{-1} is

A. 300 B. 600
C. 1200 D. 200

8. When the current changes from + 2 A to 2 A in 0.05 second, an e.m.f of 8 V is induced in a coil. The coefficient of self-induction of the coil is
A. 0.2 H B. 0.4 H
C. 0.8H **D. 0.1 H**

9. In an oscillating L.C circuit the maximum charge on the capacitor is Q. The charge on the capacitor when the energy is stored equally between the electric and magnetic field is
A. Q/2 B. Q/√3
C. Q/√2 D. Q

10. The core of any transformer is laminated so as to
A. reduce the energy loss due to eddy currents
B. make it light weight
C. makes it robust and strong
D. increases the secondary voltage.

11. Let F be the force acting on a particle having position vector r and T be the torque of this force about the origin. Then
A. r .T = 0 and F.T ≠ =
B. r .T ≠ 0 and F. T = 0
C. r. T ≠ 0 and F.T ≠ 0
D. r .T = 0 and F. T = 0

13. The radioactive sample at any instant has its disintegration rate 5000 disintegrations per minute. After 5 minutes, the rate is 1250 disintegrations per minute.

A. 0.4 In 2 B. 0.2 In 2
C. 0.1 In 2 D. 0.8 In 2

14. A nucleus with Z = 92 emits the following in a sequence; α, α, β^-, β^-, α, α, α, α, β^-, β^-, α, β^+, β^+, α. The Z of the resulting nucleus
A. 76 **B. 78**
C. 82 D. 74

15. Two identical photo cathodes receive light of frequencies f_1 and f_2. If the velocities of the photoelectrons (of mass m) coming out are respectively v_1 and v_2, then

A. $v_1^2 - v_2^2 = \frac{2h}{m}(f_1 - f_2)$

B. $v_1 + v_2 = \left[\frac{2h}{m}(f_1 - f_2)\right]^{1/2}$

C. $v_1^2 + v_2^2 = \frac{2h}{m}(f_1 - f_2)$

D. $v_1 - v_2 = \left[\frac{2h}{m}(f_1 - f_2)\right]^{1/2}$

16. Which of the following cannot be emitted by radioactive substance during their decay?
A. protons B. neutrinos
C. helium nuclei D. electrons

17. A sheet of aluminium foil of negligible thickness is introduced between the plates of a capacitor. The capacitance of the capacitor
A. decreases
B. remains uncharged
C. becomes infinite
D. increases

18. The displacement of a particle varies according to the relation x = 4(cos πt + sin πt) the amplitude of the particle is
A. -4 B. 4
C. 4√2 D. 8

19. A thin spherical conduction shell of radius R has a charge q. Another charge Q is placed at the centre of the shell. The electrostatic potential at a point P at a distance R/2 from the centre of the shell is

A. $\frac{2Q}{4\pi\varepsilon_0 R}$

B. $\frac{2Q}{4\pi\varepsilon_0 R} - \frac{2q}{4\pi\varepsilon_0 R}$

C. $\frac{2Q}{4\pi\varepsilon_0 R} + \frac{2q}{4\pi\varepsilon_0 R}$

D. $\frac{(q+Q)}{4\pi\varepsilon_0}\frac{2}{R}$

20. The work done in placing a charge of 8 × 10^{-18} coulomb on a condenser of capacity 100 micro-farad is
A. 16 × 10^{-32} joule
B. 3.2 × 10^{-26} joule
C. 4 × 10^{-10} joule
D. 32 × 10^{-32} joule

21. The co-ordinates of a moving particle at any time t are given by $x = \alpha t^3$ and $y = \beta t^3$. The speed to the particle at time t is given by

A. $3t\sqrt{\alpha^2 + \beta^2}$

B. $3t^2\sqrt{\alpha^2 + \beta^2}$

C. $t^2\sqrt{\alpha^2 + \beta^2}$

D. $\sqrt{\alpha^2 + \beta^2}$

22. During an adiabatic process, the pressure of a gas is found to be proportional to the cube of its absolute temperature. The ratio $\frac{C_p}{C_v}$ for the gas is
A. 4/3 B. 2
C. 5/3 D. 3/2

23. Which of the following parameters does not characterize the thermodynamic state of matter?
A. temperature B. pressure
C. work D. volume

24. A cannot engine takes 3 × 10^6 cal of heat from a reservoir at 627°C, and gives it to a sink at 27°C. The work done by the engine is
A. 4.2 × 10^6 J **B. 8.4 × 10^6 J**
C. 16.8 × 10^6 J D. zero.

25. A spring of spring constant 5 × 10^3 N/m is stretched initially by 5 cm from the upstretched position. Then the work required to stretch is further by another 5 cm is
A. 12.50 N-m **B. 18.75 N-m**
C. 25.00 N-m D. 6.25 N-m

26. A metal wire of linear mass density of 9.8 gm is stretched with a tension of 10 kg-wt between two rigid supports 1 meter apart. The wire passes at its middle point between the poles of a per magnet and it vibrates in resonance when carrying an alternating current of frequency n. The frequency n of the alternating source is
A. 50 Hz B. 100 Hz
C. 200 Hz D. 25 Hz

27. A tuning fork of known frequency 256 Hz makes 5 beats per second with the

vibrating string of a piano. The beat frequency decreases to 2 beats per second when the tension in the piano string is slightly increased. The frequency of the piano string before increasing the tension was

A. (256 + 2) Hz B. (256 - 2) Hz
C. (256 - 5) Hz D. (256 + 5) Hz

28. A body executes simple harmonic motion. The potential energy (P.E.), the kinetic energy (K.E.) and total energy (T.E.) are measured as function of displacement x. Which of the following statement is true?
A. K.E. is maximum when x = 0
B. T.E. is zero when x = 0
C. K.E. is maximum when x is maximum
D. P.E. is maximum when x = 0

29. In the nuclear fusion reaction, ${}_1^2H + {}_1^3H \rightarrow {}_2^4He + n$ given that the repulsive potential energy between the two nuclei is $-7.7\times10^{-14}J$ the temperature at which the gases must be heated to initiate the reaction is nearly [Boltzmann's constant k = 1.38 x 10^{-23} J/K]
A. 10^7 K B. 10^5 K
C. 10^3 K **D. 10^9 K**

30. Which of the following atoms has the lowest ionization potential?
A. ${}_7^{14}N$
B. ${}_{55}^{133}CS$
C. ${}_{18}^{40}Ar$
D. ${}_8^{16}O$

31. The wavelengths involved in the spectrum of deuterium $({}_1^2D)$ are slightly different from that of hydrogen spectrum, because
A. sizes of the two nuclei are different
B. nuclear forces are different in the two cases
C. masses of the two nuclei are different
D. attraction between the electron and the nucleus is different in the two cases.

32. In the middle of the depletion layer of a reverse-biased p-n junction, the
A. electric field is zero
B. potential is maximum
C. electric field is maximum
D. potential is zero

33. If the binding energy of the electron in a hydrogen atom is 13.6 eV, the energy required to remove the electron from the first excited state of Li^{**} is
A. 30.6 eV B. 13.6 eV
C. 3.4 eV D. 122.4 eV.

34. A body is moved along a straight line by a machine delivering a constant power. The distance moved by the body in time t is proportional to
A. $t^{3/4}$ **B.** $t^{3/2}$
C. $t^{1/4}$ D. $t^{1/2}$

35. A rocket with a lift-off mass 3.5 x 10^4 kg is blasted upwards with an initial acceleration of 10 m/s^2. Then the initial thrust of the blast is
A. 3.5×10^5 N B. 7.0×10^5 N
C. 14.0×10^5 N D. 1.75×10^5 N

36. To demonstrate the phenomenon of interference we require two sources which emit radiation of
A. nearly the same frequency
B. the same frequency
C. different wavelength
D. the same frequency and having a definite phase relationship.

37. A 220 volt, 1000 watt bulb is connected across a 110 volt mains supply. The power consumed will be
A. 750 watt B. 500 watt
C. 250 watt D. 1000 watt

38. The image formed by an objective of a compound microscope is
A. virtual and diminished
B. real and diminished
C. real and enlarged
D. virtual and enlarged

39. The earth radiates in the infra-red region of the spectrum. The spectrum is correctly given by
A. Rayleigh Jeans law
B. Planck's law of radiation
C. Stefan's law of radiation
D. Wien's law

40. To get three images of a single object, one should have two plane mirrors at an angle of
A. 60° **B. 90°**
C. 120° D. 30°

41. According to Newton's law of cooling, the rate of cooling of a body is proportional to $(\Delta\theta)^n$, where $\Delta\theta$ is the difference of the temperature of the body and the surroundings, and n is equal to
A. two B. three
C. four **D. one**

42. The length of a given cylindrical wire is increased by 100%. Due to the consequent decrease in diameter the change in the resistance of the wire will be
A. 200% B. 100%
C. 50% **D. 300%**

43. Which one of the following represents the correct dimensions of the coefficient of viscosity?
A. $ML^{-1}T^{-2}$ B. MLT^{-1}
C. $ML^{-1}T^{-1}$ D. $ML^{-2}T^{-2}$

44. A particle moves in a straight line with retardation proportional to its displacement. Its loses of kinetic energy for any displacement x is proportional to
A. x^2 B. e^x
C. x D. $\log_e x$

45. A ball is released from the top of a tower of height h meters. It takes T seconds to reach the ground. What is the position of the ball in T/3 seconds?
A. h/9 meters from the ground
B. 7h/9 meters from the ground
C. 8h/9 meters from the ground
D. 17h/18 meters from the ground

46. If $\vec{A}\times\vec{B}=\vec{B}\times\vec{A}$, then the angle between A and B is
A. π B. π/3
C. π/2 D. π/4

47. A projectile can have the same range R for two angles of projection. If T_1 and T_2 be the time of flights in the two cases, then the product of the two times of flights is directly proportional to
A. $1/R^2$ B. 1/R
C. R D. R^2

48. Which of the following statements is false for a particle moving in a circle with a constant angular speed?
A. The velocity vector is tangent to the circle.
B. The acceleration vector is tangent to the circle.
C. The acceleration vector points to the centre of the circle.
D. The velocity and acceleration vectors are perpendicular to each other.

49. An automobile travelling with speed of 60 km/h, can brake to stop within a distance of 20 cm. If the car is going twice as fast, i.e. 120 km/h, the stopping distance will be
A. 20 m B. 40 m
C. 60 m **D. 80 m**

50. A machine gun fires a bullet of mass 40 g with a velocity 1200 ms^{-1}. The man holding it can exert a maximum force of 144 N on the gun. How many bullets can he fire per second at the most?
A. One B. four
C. Two **D. three**

51. A uniform chain of length 2 m is kept on a table such that a length 60 cm hangs freely from the edge of the table. The total mass of the chain is 4 kg. What is the work done in pulling the entire chain on the table?
A. 7.2J **B. 3.6 J**
C. 120 J D. 1200 J

52. A block rests on rough inclined plane making an angle of 30°, with the horizontal. The coefficient of static friction between the block and the plane is 0.8. If the frictional force on the block is 10 N, the mass of the block (in kg) is (take g = 10 m/s^2)
A. 2.0 B. 4.0
C. 1.6 D. 2.5

53. A force $F = (5\hat{i} + 3\hat{j} + 2\hat{k})$ N is applied over a particle which displaces it from its origin to the point $\vec{r} = (2\hat{i} - \hat{j})$ m. The work done on the particle in joules is
A. 7 B. +7
C. +10 D. +13

54. A body of mass m, accelerates uniformly from rest to v_1 in time t_1. The instantaneous power delivered to the body as a function of time t is
A. $\frac{mv_1t}{t_1}$ **B.** $\frac{mv_1^2t}{t_1^2}$
C. $\frac{mv_1t^2}{t_1}$ D. $\frac{mv_1^2t}{t_1}$

55. A particle is acted upon by a force of constant magnitude which is always perpendicular to the velocity of the particle; the motion of the particle takes place in a plane. It follows that
A. Its velocity is constant
B. Its acceleration is constant
C. Its kinetic energy is constant
D. It moves in a straight line.

56. A solid sphere is rotating in free space. If the radius of the sphere is increased keeping mass same which one of the following will not be affected?
A. moment of inertia
B. Angular momentum
C. angular velocity
D. rotational kinetic energy.

57. A ball is thrown from a point with a speed v_0 at an angle of projection θ. From the same point and at the same instant person starts running with a constant speed $v_0/2$ to catch the ball. Will the person be able to catch the ball? If yes, what should be the angle of projection?
A. yes, 60° B. yes, 30°
C. no D. yes, 45°

58. One solid sphere A and another hollow sphere B are of same mass and same outer radii. Their moment of inertia about their diameters are respectively I_A and I_B such that
A. $I_A = I_B$ B. $I_A > I_B$
C. $I_A < I_B$ D. $I_A/I_B = d_A/d_B$
Where d_A and d_B are their densities.

59. A satellite of mass m revolves around the earth of radius R at a height x from its surface. If g is the acceleration due to gravity on the surface of the earth, the orbital speed of the satellite is
A. gx
B. $\frac{gR}{R-x}$
C. $\frac{gR^2}{R+x}$
D. $\left(\frac{gR^2}{R+x}\right)^{1/2}$

60. The time period of an earth satellite in circular orbit is independent of
A. the mass of the satellite
B. radius of its orbit
C. both the mass and radius of the orbit
D. neither the mass of the satellite nor the radius of its orbit.

61. If g is the acceleration due to gravity on the earth's surface, the gain in the potential energy of object of mass m raised from the surface of the earth to a height equal to the radius R of the earth is
A. 2 mgr
B. $\frac{1}{2}mgR$
C. $\frac{1}{4}mgR$
D. mgr.

62. Suppose the gravitational force varies inversely as the nth power of distance. Then the time period planet in circular orbit of radius R around the sun will be proportional to
A. $R^{\left(\frac{n+1}{2}\right)}$ B. $R^{\left(\frac{n-1}{2}\right)}$
C. R^n D. $R^{\left(\frac{n-2}{2}\right)}$

63. A wire fixed at the upper end stretches by length by applying a force F. The work done in stretching is
A. F/2*l* B. F*l*
C. 2F*l* **D. F*l*/2**

64. Spherical balls of radius R are falling in a viscous fluid of viscosity η with a velocity v. The retarding viscous force acting on the spherical ball is
A. directly proportional to R but inversely proportional to v.
B. directly proportional to both radius R and velocity v.
C. inversely proportional to both radius R and velocity v.
D. inversely proportional to R but directly proportional to velocity v.

65. If two soap bubbles of different radii are connected by a tube.
A. air flows from the bigger bubble to the smaller bubble till the sizes are interchanged.
B. air flows from bigger bubble to the smaller bubble till the sizes are interchanged
C. air flows from the smaller bubble to the bigger.
D. there is no flow of air.

66. The bob of a simple pendulum executes simple harmonic motion in water with a period while the period of oscillation of the bob is t_0 in air. Neglecting frictional force of water and given that the density of the bob is.
$\left(\frac{4}{3}\right)\times 1000\ kg/m^3$
What relationship between t and t_0 i true?
A. $t = t_0$ B. $t = t_0/2$
C. $t = 2t_0$ D. $t = 4t_0$

67. A particle at the end of a spring executes simple harmonic motion with a period t_1, while the corresponding period for another spring is t_2. If the period of oscillation with the two springs in series is t, then
A. $T = t_1 + t_2$ B. $T^2 = t_1^2 + t_2^2$
C. $T^1 = t_1^1 + t_2^1$ D. $T^2 = t_1^2 + t_2^2$

68. The total energy of particle, executing simple harmonic motion is
A. $\propto x$
B. $\propto x^2$
C. independent of x
D. $\propto x^3$

69. The displacement y of a particle in a medium can be an expressed as $y = 10^{-6} \sin(110t + 20 \times + \pi/4)$ m, where t is in seconds and × in meter. The speed of the wave is
A. 2000 m/s **B. 5 m/s**
C. 20 m/s. D. 5π m/s

70. A particle of mass m is attached to a spring (of spring constant k) and has a natural angular frequency ω_0. An external force F(t) proportional to $\cos\omega t$ ($\omega \neq \omega_0$) is applied to the oscillator. The time displacement of the oscillator will be proportional to
A. $\frac{m}{\omega_0^2 - \omega}$ **B.** $\frac{1}{m(\omega_0^2 - \omega^2)}$
C. $\frac{1}{m(\omega_0^2 + \omega^2)}$ D. $\frac{m}{\omega_0^2 + \omega^2}$

71. In forced oscillation of a particle the amplitude is maximum for a frequency ω_1 of the force, while the energy is maximum for a frequency ω_2 of the force, then
A. $\omega_1 = \omega_2$
B. $\omega_1 > \omega_2$
C. $\omega_1 < \omega_2$ when damping is small and $\omega_1 > \omega_2$ when damping is large
D. $\omega_1 < \omega_2$

72. One mole of ideal monoatomic gas (γ = 5/30) is mixed with one mole of diatomic gas (γ = 7/5). What is γ for the mixture? γ denotes the ratio of specific heat at constant pressure, to that at constant volume.
A. 3/2 C. 23/15
B. 35/23 D. 4/3

73. If the temperature of the sun were to increa. from T to 2T and its radius from R to 2R, then the ratio of the radiant energy received on earth to what it was previously will be
A. 4 B. 16
C. 32 **D. 64**

74. Which of the following statements is correct for any thermodynamic system?
A. The internal energy changes in all processes.
B. Internal energy and entropy are state functions.
C. The change in entropy can never be zero.
D. The work done in an adiabatic process is always zero.

75. Two thermally insulated vessels 1 and 2 are filled with air at temperatures (T_1, T_2), volume (V_1, V_2) and pressure (P_1, P_2) respectively. If the valve joining two vessels is opened, the temperature inside the vessel at equilibrium will be
A. $T_1 + T_2$
B. $(T_1 + T_2)/2$
C. $\frac{T_1T_2(P_1V_1 + P_2V_2)}{P_1V_1T_2 + P_2V_2T_1}$
D. $\frac{T_1T_2(P_1V_1 + P_2V_2)}{P_1V_1T_1 + P_2T_2T_2}$

76. A radiation of energy E falls normally on a perfectly reflecting surface. The momentum transferred to the surface is
A. E/c **B. 2E/c**
C. Ec D. E/c^2

77. A plane convex lens of refractive index 1.5 and radius of curvature 30 cm is silvered at the curved surface. Now this lens has been used to form the image of an object. At what distance from this lens an object be placed in order to have a real image of the size of the object?
A. 20 cm B. 30 cm
C. 60 cm D. 80 cm

78. The angle of incidence at which reflected light totally polarized for reflection from air to glass (refractive index n), is
A. $\sin^{-1}(n)$ B. $\sin^{-1}(1/n)$
C. $\tan^{-1}(1/n)$ **D. $\tan^{-1}(n)$**

79. The maximum number of possible interference maxima for slit-separation equal to twice the wavelength in Young's double-slit experiment is:
A. infinite **B. five**
C. Three D. zero

80. An electromagnetic wave of frequency v = 3.0 MHz passes from vacuum into a dielectric medium with permittivity ε = 4.0. Then
A. wavelength is doubled and the frequency remains unchanged
B. wavelength is doubled and frequency becomes half
C. wavelength is halved and frequency remains unchanged
D. wavelength and frequency both remain unchanged.

81. Two spherical conductor B and C having equal radii and carrying equal charges in them repel each other with a force F when kept apart at some distance. A third spherical conductor having same radius as that of B but uncharged brought in contact with B, then brought in contact with C and finally removed away from both. The new force of repulsion, between B and C is

A. F/4 B. 3F/4
C. F/8 **D. 3F/8**

82. A charged particle q is shot towards another charged particle Q which is fixed, with a speed v it approaches Q up to a closest distance r and then returns. If q were given a speed 2v, the closest distances of approach would be
A. r B. 2r
C. r/2 **D. r/4**

83. Four charges equal to -Q are placed at the four corners of a square and a charge q is at its centre. If the system is in equilibrium the value of q is
A. $-\frac{Q}{4}(1+2\sqrt{2})$
B. $\frac{Q}{4}(1+2\sqrt{2})$
C. $-\frac{Q}{2}(1+2\sqrt{2})$
D. $\frac{Q}{2}(1+2\sqrt{2})$

84. Alternating current cannot be measured by D.O. ammeter because
A. A.C. cannot pass through D.C.
B. A.C. changes direction
C. average value of current for complete cycle is zero
D. D.C. ammeter will get damaged.

85. The resistance of the series combination of two resistances is S. When they are joined in parallel through total resistance is P. If S = nP, then the minimum possible value of n is
A. 4 B. 3
C. 2 D. 1

Pedagogy = 10

1. Child development is marked by interrelated processes. Which one is not one of them?
(A) differentiation (B) integration
(C) motivation (D) learning

2. Generally students like those teachers who:
(A) dictate notes in the class
(B) reveal important Questions before examinations
(C) remove the difficulties of the subject
(D) are self-disciplined

3. The students learn most from those teachers who:
(A) are gentle
(B) express their ideas comprehensively and clearly
(C) are always ready for discussion
(D) works hard

4. The able teacher is one who:
(A) helps all the students in passing the examination
(B) inculcates the interest in the subject among students
(C) maintains peace in the class
(D) engages the students in their work

5. Through which action children learn fast?
(A) facial expression
(B) study
(C) write
(D) walk

6. The job of a school teacher is more attractive than in the past because of:
(A) higher social status
(B) higher pay
(C) more training institution
(D) greater job satisfaction

7. The students learn most from those teachers who:
(A) are gentle
(B) express their ideas comprehensively and clearly
(C) are always ready for discussion
(D) works hard

8. The able teacher is one who:
(A) helps all the students in passing the examination
(B) inculcates the interest in the subject among students
(C) maintains peace in the class
(D) engages the students in their work

9. If one child gives answers to all the questions at first in your class but disturbs the rest of the children and roams here and there in the class then what will you do?
(A) punish him
(B) tell him not to do like that
(C) complain the guardians that his child is breaking the discipline
(D) engage that child in more activities than rest of the children of the class so that he may learn new things

10. On which basis the ability of teachers can be judged?
(A) publication of the books
(B) period of the service
(C) to fulfil the needs of the students
(D) personality of the teacher

General Knowledge = 5

1. When the Nuclear scientist Dr. Abdul Qadeer Khan dissolved his Political Party Tehreek-i-Tahafuz-i- Pakistan?
   (A) 27-Jan-2014
   (B) 18-Jan-2014
   (C) 1-Jan 2014
   (D) 10-Jan-2014

2. Who visited Pakistan, agreed to deepen their defence cooperation and support each other's position on regional issues, including Syria and Afghanistan?
   (A) Saudi Foreign Minister
   (B) American Foreign Minister
   (C) German Foreign Minister
   (D) French Foreign Minister

3. The government issued a notification for appointment of _____ as foreign secretary.
   (A) Aizaz Chaudhary
   (B) Saleem Qureshi
   (C) Chaudhry Kashif Khan
   (D) Ahmad Zahoor

4. Attorney General _____ resigned from his post.
   (A) Munir A Malik
   (B) Irfan Qadir
   (C) Aslam Shad
   (D) Farhan Qureshi

5. Who took over as the chairman of national Assembly's Kashmir Committee?
   (A) Molana Fazal ur Rehman
   (B) Hamad Azam
   (C) Qamar uz zaman Qaira
   (D) Umair Anjum ch

Course Outline of Physics for Educators (SSE)

1. CLASSICAL MECHANICS
2. QUANTUM MECHANICS
3. WAVES AND OSCILLATIONS
4. HEAT AND THERMODYNAMICS
5. ELECTROMAGNETIC THEORY
6. ELECTRONICS
7. MATHEMATICAL METHODS OF PHYSICS
8. NUCLEAR PHYSICS
9. COMPUTATIONAL PHYSICS
10. SOLID STATE PHYSICS

11 DIGITAL ELECTRONICS

12 ATOMIC & MOLECULAR PHYSICS

13 MEDICAL PHYSICS

14 SEMICONDUCTOR PHYSICS

- Homogeneous Semiconductors
- Inhomogeneous Semiconductors

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What you need to know?

The Educator/Subject Specialist Employment Test for Physics is designed to help selection committee/board assess the qualifications of applicants in the field of physics. Scores on the test are intended to indicate knowledge of the subject matter emphasized in many college level programs as preparation for teaching. Because past achievement is usually a good indicator of future performance, the scores are helpful in predicting success in teaching physics. Because the test is standardized (uniform for all applicants), the test scores permit comparison of students from different institutions with different undergraduate programs.

This book is MORE than just a practice book

The book in your hand is more than just a practice work book. It is complete guide to prepare Educator/Subject Specialist Employment Test. You can crack the test for more than required score.

How to use this Book

Most people don't know how to make the optimal use of the resources, and which other study material to read for the preparation of the Educator/Subject Specialist Employment Test. The course material during your college and university studies is perhaps the best material you can get for revising basic as well as advanced concepts, but only if you use it the right way. Reading the right stuff at the right time can make a world of difference. This is why it is so important to have a pre-planned strategy in mind. Review the suggestions and start preparing your targeted test.

Content of the Physics Test

The subject test consists of 85 four-choice questions, some of which are grouped in sets.

The aim of the test is to determine the extent of the examinees' grasp of fundamental principles and their ability to apply these principles in the solution of problems.

Most test questions can be answered on the basis of a mastery of the first three years of undergraduate physics.

The test questions are constructed to simplify mathematical manipulations. As a result, neither calculators nor tables of logarithms are needed.

The International System (SI) of units is used predominantly in the test. A table of information representing various physical constants and a few conversion factors among SI units is presented in the test book. Whenever necessary, additional values of physical constants are printed with the text of the question.

The approximate percentages of the test on the major content topics have been set by the committee of examiners, keeping in mind nationwide undergraduate physics curricula.

Nearly all the questions in the test will relate to material in this listing; however, there may be some questions on other topics not explicitly listed here.

CLASSICAL MECHANICS

Such as kinematics, Newton's laws, work and energy, oscillatory motion, rotational motion about a fixed axis, dynamics of systems of particles, central forces and celestial mechanics, three-dimensional particle dynamics, non-inertial reference frames, elementary topics in fluid dynamics.

ELECTROMAGNETISM

Such as electrostatics, currents and DC circuits, magnetic fields in free space, Lorentz force, induction, Maxwell's equations and their applications, electromagnetic waves, AC circuits, magnetic and electric fields in matter.

OPTICS AND WAVE PHENOMENA

Such as wave properties, superposition, interference, diffraction, geometrical optics, polarization, Doppler effect.

THERMODYNAMICS AND STATISTICAL MECHANICS

Such as the laws of thermodynamics, thermodynamic processes, equations of state, ideal gases, kinetic theory, statistical concepts and calculation of thermodynamic quantities, thermal expansion and heat transfer.

QUANTUM MECHANICS

Such as fundamental concepts, spin, angular momentum, wave function symmetry, elementary perturbation theory.

ATOMIC PHYSICS

Such as properties of electrons, Bohr model, energy quantization, atomic structure, atomic spectra, selection rules, black-body radiation, x-rays, atoms in electric and magnetic fields.

SPECIAL RELATIVITY

Such as introductory concepts, time dilation, length contraction, simultaneity, energy and momentum, four-vectors and Lorentz transformation, velocity addition.

SPECIALIZED TOPICS

Nuclear and Particle physics (e.g., nuclear properties, radioactive decay, fission and fusion, reactions, fundamental properties of elementary particles), Condensed Matter (e.g., crystal structure, x-ray diffraction, thermal properties, electron theory of metals, semiconductors, superconductors), Miscellaneous (e.g., astrophysics, mathematical methods, computer applications)

Those taking the test should be familiar with certain mathematical methods and their applications in physics.

Preparing for Physics Subject Test

Educator / Subject Specialist Employment Test questions are designed to measure skills and knowledge gained over a long period of time. Although you might increase your scores to larger extent through preparation a few weeks or months before you take the test.

The following information may be helpful.

A general review of your college courses is probably the best preparation for the test.

However, the test covers a broad range of subject matter, and no one is expected to be familiar with the content of every question.

✓ **Use this practice book to become familiar with the types of questions in the Test.**

If you are serious about getting a high score and getting the best out of this book, follow the steps:

Skim through this book at the very beginning when you first start preparing for the test. This will give you a good understanding of what you should expect to see when you take the actual test.

The Diagnostic Test is designed for students to assess their strengths and weaknesses in physics principles and applications. Your score in diagnostic test will

- **indicate your position before the preparation**
- **provide you guideline for effective preparation**

Keep your performance in diagnostic test safe for future progress comparison.

If your performance score in the diagnostic test is above 75, you can start taking topic exercises – Sweet Candies and Brain Buster. On the other hand if, unfortunately the score is below 50, you must revise physics course you have learnt in college and university.

If you feel you are truly comfortable with all the concepts involved in the diagnostic test - go ahead and crack every topic set of questions in this book and you'll be good to go. If you feel you lack some if not all of the

CLASSICAL MECHANICS

Mechanics is the branch of Physics dealing with the study of motion. In a detailed perspective Mechanics is the branch of science concerned with the behaviour of physical objects when subjected to forces or displacements, and the subsequent effects of the objects on their environment.

No matter what your interest is? Whether you want to study Physics as a subject or to prepare an employment test of Physics, mechanics will be important for you. You cannot ignore this section because about 40% of MCQs in actual test will be from this section.

The major division of the mechanics discipline separates classical mechanics from quantum mechanics. Here in this section we are concerned with classical mechanics - originated with Isaac Newton's laws of motion.

What is in this section?

Mechanics can be divided into two areas - kinematics, dealing with describing motions, and dynamics, dealing with the causes of motion.

Based on the syllabus of the employment test you are going to take, following topics are included in the section:

Kinematics:

- ✓ Kinematics in One Dimension
- ✓ Projectile Motion

Dynamics:

- ✓ Newton's Laws
- ✓ Momentum and Conservation of Momentum (in One Dimension)
- ✓ Energy and Conservation of Energy

Advanced Topics:

- ✓ Circular Motion
- ✓ Centre of Gravity
- ✓ Rotational Mechanics
- ✓ Universal Gravitation

Are you ready?

Before going to take practice exercise given below, you must have gone through all topics included in this section.

How to Learn?

Major concepts of mechanics can be interpreted by using mathematical relations of physical quantities. If you can apply relationship of quantities in solving questions effectively then you will be comfortable on the test.

Some of the most useful relations are given below.

- Horizontal Distance (Constant velocity)

$$D = v_x t$$

- Horizontal distance (Constant acceleration)

$$d = \frac{1}{2}(V_f + V_i)t$$

- Equations of Motion

$$V_f = V_i + at$$
$$V_f^2 = V_i^2 + 2ad$$
$$D = v_i t + \frac{1}{2}at^2$$

- Hooke's Law

$$F_s = -K\,\Delta X$$

- The amount of work done to compress the spring (The amount of energy stored in a spring)

$$\frac{1}{2}kx^2 = U_{spring}$$

- Kinetic Energy

$$KE = \frac{1}{2}(mv^2)$$

- Potential Energy

$$PE = mgh$$

- Conservation of Energy

$$E_{total} = KE + PE$$

OR

$$KE_{initial} + PE_{initial} = KE_{final} + PE_{final}$$

- Work

$$W = \Delta E$$

OR

$$W = FdCos\,\theta$$

- Conservation of momentum

$$M_a V_a + M_b V_b = M_a V_a' + M_b V_b'$$

- Perfectly Inelastic Collision

$$V'_a = V'_b = V'$$
$$M_a V_a + M_b V_b = (M_a + M_b)V'$$

- Impulse

$$J = F\,\Delta T = \Delta P$$

OR

$$F\,\Delta T = M\,\Delta V$$

- Universal Law of Gravitation

$$F = G\,M_1 M_2 / r^2$$

- Kepler's third law

$$T_1^2 / T_2^2 = r_1^3 / r_2^3$$

- Orbital Period of a Planet

$$T = 2\pi r / v$$

- Centripetal Force

$$F_c = mv^2 / r$$

- Velocity on a banked curve

$$V = \sqrt{rg\tan\theta}$$

- Torque

$$T = Fr\,Sin\,\theta$$

After taking review of all topics in detail and after memorizing all mathematical relations take an easy exercise.

MCQ Set 1

MCQ Set 1 is consisted of the questions from the topic of Classical Mechanics. The set takes you from very basic level (Sweet Candies) to the very tough level (Brain Buster).

Sweet Candies

Directions:

You are given following questions from the topics of this section, with four choices A through D. Select the choice that will answer the question best by filling the appropriate circle at the end of each question.

Answer of each question has been bolded for convenience.

1. Which is an interdisciplinary area of physics?
   A. Geophysics
   B. Hydrodynamics
   C. Special Relativity
   D. Super Fluidity

2. Which set of units includes a supplementary unit
   A. Kg , A , Sr
   B. A , K , cd
   C. A , mol , s
   D. Kg , s , m

3. The physical sciences deal with the
   A. Living things
   B. Non-Living things
   C. Composition of objects
   D. Structure of objects

4. SI units of electric current is
   A. Ampere
   B. Kelvin
   C. Candela
   D. Meter

5. What type of science is physics
   A. Living things
   B. Non-Living things
   C. Experimental science
   D. Study of action and reaction

6. Plasma physics is the branch of physics that deals with
   A. Atoms
   B. Molecules
   C. Ions
   D. Crystals

7. $1\ km^2 =$
   A. $1 \times 10^3\ m^2$
   B. $1x10^6\ m$
   C. $1x10^5\ cm^2$
   D. $1x10^{10}\ cm^2$

8. Derived quantities are those which can
   A. Be subdivided
   B. Be derived from other quantities
   C. Not derived
   D. Other quantities are derived from them

9. High energy physics is the physics of
   A. Nucleus
   B. Subatomic particles
   C. Plasma physics
   D. Astrophysics

10. The relativistic mechanics is the field of study in which object move with the velocity
    A. Less than C
    B. Greater than C
    C. Equal to C
    D. That approach to C

11. Which is not associated with random error
    A. Inconsistent errors
    B. Based on an unknown reason
    C. Average of many readings can reduce it
    D. Consistence difference in readings

12. If the measuring scale has a least count of 10 Kg then in 8,000 kg the significant figures are
    A. 4
    B. 1
    C. 3
    D. 0

14. The distance to the nearest galaxy is (approximately)
    A. $10^{10}\ m$
    B. $10^{19}\ m$
    C. $10^{30} m$
    D. $10^3 m$

15. The number of significant figures in all the given number 25.12, 2009, 4.156 and 1.257×10^{-4} are
    A. 1
    B. 2
    C. 3
    D. 4

16. Steradian is an angle of
    A. One dimension
    B. Two dimensions
    C. Three dimensions
    D. Zero dimension

17. Which of the following quantity is dimensionless?
    A. Gravitational constant
    B. Plank's constant
    C. Power of lens and gas constant
    D. Refractive Index

18. Based on scientific notation, the number 134.7 should be written as
    A. 13.47×10^2
    B. 1.347×10^2
    C. 13.47×10^3
    D. 1347×10^{-1}

19. The motion without consideration of its cause is studied in
    A. Kinematics
    B. Mechanics
    C. Statics
    D. Modern Physics

20. One year is equal to
    A. 4.3×10^{10} sec
    B. 4.4×10^8 sec
    C. 3.12×10^7 sec
    D. 3.2×10^6 sec

21. Period of vibration of an atom in a solid is
    A. 1×10^{-10} sec
    B. 1×10^{-13} sec
    C. 1×10^{-16} sec
    D. 1×10^{-19} sec

22. The error of any measurement may occur due to
    A. Negligence of the observer
    B. Faulty apparatus used to measure
    C. Inappropriate method employed
    D. All of these

23. The branch of science which deals with the study of matter and energy and the relationship between them is called
    A. Astronomy B. Geology
    C. Biology **D. Physics**

24. According to equation $E=mc^2$, 1Kg mass is equivalent to
    A. 8×10^{15} j of energy
    B. 9×10^{17} j of energy
    C. 9×10^{16} j of energy
    D. 8×10^{14} j of energy

25. The precision of measurement in physics depends on
    A. Average values of the readings
    B. Least count of instruments
    C. Error free instruments
    D. B and C

26. Which of the following is the fundamental unit of angle in a plane in SI system of units?
    A. omega
    B. Degree
    C. Radian
    D. Hertz

27. Accuracy of a measurement depends on
    A. Least Count
    B. Uncertainty
    C. Absolute uncertainty
    D. Average values

28. The dimensions of frequency are
A. LT B. LT^{-1}
C. MT^{-1} **D. T^{-1}**

29. Light year is the unit of
A. Time **B. Length**
C. Speed D. Mass

30. The SI unit of heat is
A. Calorie
B. Horse power
C. Joule
D. Watt

31. How many wavelengths of Kr^{86} are there in one meter?
A. 1553164.13
B. 1650763.73
C. 2348123.73
D. 652189.63

32. The dimensional formula for modulus of rigidity is
A. $ML^{-1}T^{-1}$ B. $ML^{-2}T^{2}$
C. MLT^{-1} **D. $ML^{-1}T^{-2}$**

33. Base quantities are
A. Scalar
B. Vector
C. Tensors
D. Time arrow

34. Supplementary SI units radian and steradian were established to measure
A. Geometrical quantities
B. Luminous intensity
C. Electric current
D. Temperature

35. The number 1678 .9 should be written in scientific notation as
A. 16.789×10^{3}
B. 1.6789×10^{3}
C. 1678.9×10^{3}
D. None of these

36. Numerical value of magnitude of a physical quantity is
A. Independent of system of units
B. Directly proportional to magnitude of the unit
C. Inversely proportional to magnitude of the unit
D. Independent of its unit

37. Length cannot be measured by
A. Fermi **B. Debye**
C. Micron D. Light year

38. S.I unit of magnetic flux is
A. Weber meter^{-2}
B. Weber
C. Weber per meter
D. Weber per meter^{4}

39. Which of the following is not the unit of energy?
A. Calorie B. Joule
C. Electron-volt **D. Watt**

40. Which of the following quantity is expressed as force per unit area?
A. Work **B. Pressure**
C. Volume D. Area

41. The dimensional formula of torque is:
A. $[ML^{2}T^{-2}]$ B. $[MLT^{-2}]$
C. $[ML^{-1}T^{-2}]$ D. $[ML^{-2}T^{-2}]$

Achievement Key

Correct Answers	You Got
More than 35	
Below 30	

If you got thumb down, you must consider learning more about the measurements and units of physics.
If you got thumb up, be prepare to have a hard exercise based on measurements and units of physics.

Brain Busters

1. The velocity v of water waves may depend on their wavelengthsλ, the density of water ρ and the acceleration due to gravity g. Which of the following relations represent the correct relationship?
A. $v^{2} \propto g^{-1}\lambda^{-1}$ **B. $v^{2} \propto g\lambda$**
C. $v^{2} \propto g\lambda\rho$ D. $v^{2} \propto g^{-1}\lambda^{-3}$

2. Indicate, which pair of physical quantities given below has the same units and dimensions?
A. Momentum and impulse
B. Torque and angular momentum
C. Acceleration and gravitational field strength
D. Pressure and modulus of elasticity

3. Of the following quantities, which one has dimensions different from the remaining three?
A. Energy per unit volume
B. Force per unit area
C. Product of voltage and charge per unit volume
D. Angular momentum

4. The dimensional formula of angular velocity is:
A. $M^{0}L^{0}T^{-1}$ B. MLT^{-1}
C. $M^{0}L^{0}T^{1}$ D. $ML^{0}T^{-1}$

5. The dimensional formula of light year is
A. LT^{-1} B. T
C. $ML^{2}T^{-2}$ D. L

6. The unit of permittivity of free space ε_0 is:
A. Newton-meter^{2}/coulomb
B. Coulomb/Newton×meter
C. Coulomb^{2}/(Newton×meter)^{2}
D. Coulomb^{2}/(Newton×meter)^{2}

7. If L and R denote inductance and resistance respectively, then the dimensional formula of L/R is
A. $(M^{0}L^{0}T^{0})$ **B. $M^{0}L^{0}T$**
C. $(M^{2}L^{0}T^{2})$ D. (MLT^{2})

8. Which of the following quantities has not been expressed in proper units?
A. $\frac{\text{Stress}}{\text{Strain}}$ =Newton/metre^{2}
B. Surface tension = Newton/metre
C. Energy = kg m/s
D. Pressure = newton/metre^{2}

9. A student measured the diameter of a wire using a screw gauge with least count 0.001cm. The correct measurement is
A. 5.3 cm B. 5.32 cm
C. 5.320 cm D. 5.3200cm

10. From the following pairs, choose the pair that does not have identical dimensions
    A. Angular momentum and Planck's constant
    B. Moment of inertia and Moment of force
    C. Work and Torque
    D. Impulse and Momentum

11. The unit of inductance is equivalent to
    A. $\frac{\text{volt} \times \text{ampere}}{\text{second}}$
    B. $\frac{\text{ampere}}{\text{volt} \times \text{second}}$
    C. $\frac{\text{volt}}{\text{ampere} \times \text{second}}$
    D. $\frac{\text{volt} \times \text{second}}{\text{ampere}}$

12. Which one of the following groups has quantities that do not have the same dimensions?
    A. Velocity, speed
    B. Pressure, stress
    C. Force, impulse
    D. Work, energy

13. Wb/m^2 is equal to
    A. Henry B. Watt
    C. Tesla D. Dynes

14. The unit of focal power of a lens is
    A. Watt
    B. Horse power
    C. Dioptre
    D. Kilo watt

15. The dimensions of Planck's constant is equal to that of
    A. Energy
    B. Momentum
    C. Angular momentum
    D. Power

16. Identify the pair whose dimensions are equal
    A. Torque and work
    B. Stress and energy
    C. Force and stress
    D. Force and work

17. The unit of Planck's constant h is same as that of
    A. Energy
    B. Work
    C. Linear momentum
    D. Angular momentum

18. Which of the following quantity is dimensionless?
    A. Gravitational constant
    B. Plank's constant
    C. Power of lens and gas constant
    D. Steradian

19. The dimensions of the quantities in one of the following pairs are the same. Identify the pairs.
    A. Torque and work
    B. Angular momentum and work
    C. Energy and Young's modulus
    D. Light year and time

20. Which of the following is the smallest unit?
    A. Millimetres
    B. Angstrom
    C. Fermi
    D. Metre

21. If unit of length, mass and time each be doubled, the unit of work done is increased by
    A. 4 times
    B. 6 times
    C. 8 times
    D. 2 times

22. The length breadth and thickness of a block are given by L = 12 cm, B = 6 cm and T = 2.45 cm. The volume of the block according to the idea of significant figures should be:
    A. $1 \times 10^2\ cm^3$
    B. $2 \times 10^2\ cm^3$
    C. $1.763 \times 10^2\ cm^3$
    D. None of these

23. The percentage errors in the measurement of mass and speed are 3% and 4% respectively. The maximum error in the measurement of kinetic energy is
    A. 11% B. 10%
    C. 8% D. 9%

24. When comparing systematic and random errors, the following pairs of properties of errors in an experimental measurement may be contrasted:
    P_1 : error can possibly be eliminated
    P_2 : error cannot possibly be eliminated
    Q_1: error is of constant sign and magnitude
    Q_2 : error is of varying sign and magnitude
    R_1 : error will be reduced by averaging repeated measurements
    R_2 : error will not be reduced by averaging repeated measurements
    Which properties apply to **random** errors?
    A. P_1, Q_1, R_2
    B. P_2, Q_2, R_1
    C. P_1, Q_2, R_2
    D. P_2, Q1, R_2

25. If current flowing in a conductor changes by 1%, then power will change by
    A. 10% B. 1%
    C. 100% **D. 2%**

26. Total mass when silver coins are added to box as 2.2 Kg, 0.01001 Kg and 0.01002Kg correct to appropriate precision
    A. 2.3 Kg
    B. 2.2 Kg
    C. 2.43 Kg
    D. 2.67 Kg

27. The dimensional formula for latent heat is
    A. $M^0L^2T^{-2}$
    B. ML^2T^{-2}
    C. MLT^{-2}
    D. ML^2T^{-1}

28. Unit of universal gas constant is SI is
    A. $W\,K^{-1}\,mol^{-1}$
    B. $J/NK^{-1}\,mol^{-1}$
    C. $JK^{-1}\,mol^{-1}$
    D. $erg\,K^{-1}\,mol^{-1}$

29. The dimensional formula for angular momentum is
    A. $(M^0L^2T^{-2})$ **B. (ML^2T^{-1})**
    C. (MLT^{-1}) D. (ML^2T^{-2})

30. The fundamental unit which has same power in the dimensional formula of surface tension and viscosity is
    A. Mass
    B. Length
    C. Time
    D. None

31. The velocity v of a particle at time t is given by:

$$v = at + \frac{b}{t+c}$$

The dimensional formula of a, b and c care respectively:

A. L^2; T and LT^2
B. LT^2; LT and L
C. LT^{-2}; L and T
D. L; LT and T^{-2}

32. The percentage errors in the measurements of mass and speed are 2% and 3% respectively. How much will be the maximum error in the estimate of the kinetic energy obtained by measuring mass and speed

A. 11% **B. 8%**
C. 5% D. 1%

33. Which of the following is equal to $\frac{\text{joule} \times \text{ohm}}{\text{volt} \times \text{second}}$?

A. Ampere **B. Volt**
C. Watt D. Tesla

34. The unit of inductance is equivalent to

A. V × s/A B. V × A/s
C. A× s/v D. V/A× s

35. Scapitaksiemens is the SI unit of

A. Resistance
B. Specific Resistance
C. Conductance
D. Inductance

36. The volt/metre is the unit of

A. Potential
B. Work
C. Force
D. Electric field intensity

37. SI unit of the intensity of wave is

A. $Jm^{-2}s^{-2}$ B. $Jm^{-1}s^{-1}$
C. Wm^{-2} D. Jm^{-2}

38. The dimensional formula of gravitational constant G is

A. MLT^{-2} B. ML^3T^{-2}
C. $M^{-1}L^3T^{-2}$ D. $M^{-1}LT^{-2}$

39. The unit of Stefan Boltzman constant σis:

A. W/mK^4
B. Cal/m^3K^2
C. W/m^2K^4
D. K/m^2K^4

40. If C and R denote capacity and resistance, the dimensional formula of CR is

A. $M^0L^0T^1$
B. $M^0L^0T^0$
C. $M^0L^0T^0$
D. Not expressible in terms of MLT

Achievement Key

Correct Answers	You Got
More than 32	
Below 28	

If you got thumb down, you must consider learning more about the measurements and units of physics.

Arrange the topics in order of increasing performance and study underlying concepts and mathematical relations of the quantities based on your performance.

If you got thumb up, go to the next exercise.

VECTORS

A vector can also be defined as an element of a vector space. Vectors are sometimes referred to by the number of coordinates they have, so a 2-dimensional vector is often called a two-vector, an n-dimensional vector is often called an n-vector, and so on.

Important Formulas of Vector

The important formulas of vectors are given below:

$$\overline{AB} = (x_2 - x_1, y_2 - y_1, z_2 - z_1)$$

$$\vec{u} = (u_1, u_2, u_3)$$
$$|\vec{u}| = \sqrt{u_1^2, u_2^2, u_3^2}$$

$$d(A,B) = |\overline{AB}| = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2 + (z_2 - z_1)^2}$$

$$\vec{u}_{\vec{v}} = \frac{\vec{v}}{|\vec{v}|}$$

$$\vec{u} = (u_1, u_2, u_3) \quad \vec{v} = (v_1, v_2, v_3)$$
$$\vec{u} + \vec{v} = (u_1 + v_1, u_2 + v_2, u_3 + v_3)$$

$$k.\vec{u} = (ku_1, ku_2, ku_3)$$

$$\vec{u} = k\vec{v} \quad (u_1, u_2, u_3) = (kv_1, kv_2, kv_3)$$

$$\frac{u_1}{v_1} = \frac{u_2}{v_2} = \frac{u_3}{v_3} = k$$

$$\begin{vmatrix} u_1 & u_2 & u_3 \\ v_1 & v_2 & v_3 \\ w_1 & w_2 & w_3 \end{vmatrix} = 0$$

$$\begin{vmatrix} u_1 & u_2 & u_3 \\ v_1 & v_2 & v_3 \\ w_1 & w_2 & w_3 \end{vmatrix} \neq 0$$

$$\vec{u}.\vec{v} = |\vec{u}|.|\vec{v}|.\cos\alpha$$

$$\vec{u}.\vec{v} = u_1.v_1 + u_2.v_2 + u_3.v_3$$

$$|\vec{u}| = \sqrt{\vec{u}.\vec{u}} = \sqrt{u_1.v_1 + u_2.v_2 + u_3.v_3} = \sqrt{u_1^2, u_2^2, u_3^2}$$

$$\cos\alpha = \frac{U_1.V_1 + U_2.V_2 + U_3.V_3}{\sqrt{U_1^2 + U_2^2 + U_3^2}.\sqrt{V_1^2 + V_2^2 + V_3^2}}$$

$$\vec{U}.\vec{V} = U_1.V_1 + U_2.V_2 + U_3.V_3 = 0$$

$$\cos\alpha = \frac{x}{\sqrt{x^2 + y^2 + z^2}}$$

$$\cos\beta = \frac{y}{\sqrt{x^2 + y^2 + z^2}}$$

$$\cos\gamma = \frac{z}{\sqrt{x^2 + y^2 + z^2}}$$

$$\cos^2\alpha + \cos^2\beta + \cos^2\gamma = 1$$

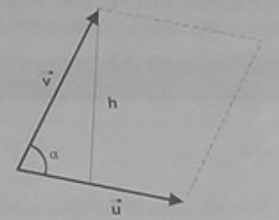
14 Cross Product

$$\vec{u} \times \vec{v} = \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ u_1 & u_2 & u_3 \\ v_1 & v_2 & v_3 \end{vmatrix} = \begin{vmatrix} u_2 & u_3 \\ v_2 & v_3 \end{vmatrix}\vec{i} - \begin{vmatrix} u_1 & u_3 \\ v_1 & v_3 \end{vmatrix}\vec{j} + \begin{vmatrix} u_1 & u_2 \\ v_1 & v_2 \end{vmatrix}\vec{k}$$

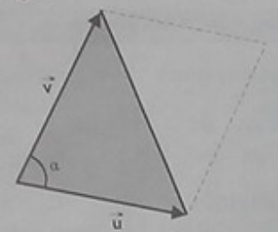
$$|\vec{u} \times \vec{v}| = |\vec{u}||\vec{v}|\,sen\,\alpha$$

15 Area of a Parallelogram

$$A = |\vec{u}|.h = |\vec{u}||\vec{v}|\,sen\,\alpha\,|\vec{u} \times \vec{v}|$$



16 Area of a Triangle



$$A = \frac{1}{2}|\vec{u} \times \vec{v}|$$

17 Scalar Triple Product

$$\left[\vec{u}, \vec{v}, \vec{w}\right] = \vec{u}.(\vec{v} \times \vec{w})$$

$$[\vec{u},\vec{v},\vec{w}] = \begin{vmatrix} u_1 & u_2 & u_3 \\ v_1 & v_2 & v_3 \\ w_1 & w_2 & w_3 \end{vmatrix}$$

18 Volume of a Parallelepiped

$\vec{u} = (3,-2,5)$ $\vec{v} = (2,2,-1)$ $w = (-4,3,2)$

19 Volume of a tetrahedron

$$V = \frac{1}{6}\begin{vmatrix} u_1 & u_2 & u_3 \\ v_1 & v_2 & v_3 \\ w_1 & w_2 & w_3 \end{vmatrix}$$

MCQ Set 1

MCQ Set 1 is consisted of the questions from the topic of Vectors. The set takes you from very basic level (Sweet Candies) to the very tough level (Brain Buster).

Sweet Candies

Directions:

You are given following questions from the topics of this section, with four choices A through D. Select the choice that will answer the question best by filling the appropriate circle at the end of each question.

Answer of each question has been bolded for convenience.

1. A scalar is a physical quantity which is completely specified by
   A. Direction only
   B. Magnitude only
   C. Both magnitude and direction
   D. None of these
2. Vectors are those physical quantities which requires
   A. Magnitude
   B. Magnitude and directions
   C. Direction
   D. None of these
3. Which of the following is a scalar quantity
   A. Density
   B. Displacement
   C. Torque
   D. Weight
4. Which of the following is an axis at right angle to both X and Y axes and points in space?
   A. Unit vector axis
   B. Zero vector axis
   C. Z –axis
   D. none of these

5. Two forces of 10N and 15N are acting simultaneously on an object in the same direction. Their resultant is
   A. Zero B. 5N
   C. 25N D. 150N
6. If two non-zero vector $\vec{A}$ and $\vec{B}$ are parallel to each other, then $\vec{A}.\vec{B}$ is equal to
   A. Zero **B. AB**
   C. A + B D. A – B
7. The vector product of two vectors is zero, when
   A. They are parallel to each other
   B. They are equal vectors
   C. They are perpendicular to each other
   D. They are inclined at angle of 60^0
8. If $\vec{A}.\vec{B} = 0$ and also $\vec{A}\times\vec{B} = 0$, then
   A. $\vec{A}$ and $\vec{B}$ are perpendicular to each other
   B. $\vec{A}$ and $\vec{B}$ are anti-parallel to each other
   C. $\vec{A}$ and $\vec{B}$ are parallel to each other
   D. Either $\vec{A}$ or $\vec{B}$ is a null vector
9. Position vector is a vector, which describes the
   A. Location of a point with respect to origin
   B. Location of a point with respect to any point
   C. Location of a point with respect to some related point
   D. None of these
10. Two vectors AB and BC act on point B at right angle to each other. The magnitude of their resultant is 13 and the magnitude of BC is 12, then the magnitudeof AB is
    A. 24 B. 7
    C. 5 D. 2
11. The position vector in two dimensions is represented as
    A. $r = a\hat{i} + b\hat{j}$
    B. $r = a\hat{j} + b\hat{i}$
    C. $r = \sqrt{a^2 + b^2}$
    D. A and C
12. The magnitude of the scalar product is
    A. AB Sin θ
    B. AB Cos θ
    C. AB
    D. None of these
13. Which of the following may be the rectangular components of force of 10 Newton?
    A. 6 and 8Newton
    B. 2.5 and 25 Newton
    C. 2 and 5 Newton
    D. 3 and 5 Newton

14. The scalar product of two parallel vectors is of
A. Maximum value
B. Minimum value
C. Zero
D. Sum of vectors

15. The position vector of a point in xz-plane is given by
A. $\vec{r} = x\,\hat{i} + y\,\hat{j}$
B. $\vec{r} = y\,\hat{i} + z\,\hat{k}$
C. $\vec{r} = x\,\hat{i} + y\,\hat{j} + z\hat{k}$
D. $\vec{r} = x\,\hat{i} + z\hat{k}$

16. In right hand rule, the direction of the product vector will be
A. Along the thumb erect
B. Perpendicular to the erect thumb
C. Along the rotation of fingers
D. None of these

17. Which of the following is the angle between the rectangular components of a vector?
A. 0° **B. 90°**
C. 120° D. 60°

18. The cross product of $\hat{j} \times \hat{k}$ given by
A. $\hat{i}$ B. $\hat{j}$
C. $\hat{k}$ D. $-\hat{k}$

19. The dot product of two vectors is negative if
A. They are parallel vectors
B. They are perpendicular vectors
C. They are anti-parallel vectors
D. They are negative vectors

20. The self-cross product of vector is
A. Zero
B. Square of vector
C. Only same vector
D. Two times the vector

21. Can the magnitude of a vector have a negative value
A. Always No
B. Always Yes
C. Yes in some cases
D. No in some cases

22. Two forces are acting together on an object. The magnitude of their resultant is of minimum value when the angle between the force is
A. 0^0 B. 60^0
C. 120^0 **D. 180^0**

23. Negative of vector can be made by
A. taking absolute value
B. making the direction reserves of axis
C. reserving the direction
D. Taking its self-dot product

24. When a vector is multiplied by a scalar of positive value, the product of the quantity will be
A. multiple of the vector quantity in the same direction
B. multiple of the vector quantity in the opposite direction
C. multiple of the vector quantity perpendicular to the original vector
D. none of the above

25. If $\vec{A} = A_1\hat{i} + A_2\hat{j}$ and $\vec{B} = B_1\hat{i} + B_2\hat{j}$ are non-parallel vectors, then the direction of $\vec{A} \times \vec{B}$ is
A. Along $\vec{B}$
B. Along x-axis
C. Along y-axis
D. Along z-axis

26. Which of the following is the only vector quantity
A. Temperature
B. Energy
C. Power
D. Momentum

27. Which of the following lists of physical quantities consists only of vectors
A. Time, temperature, velocity
B. Force, volume, momentum
C. Velocity, acceleration, mass
D. Force, acceleration, velocity

28. A force of 10N is acting along y-axis. Its component along x-axis is
A. 10N
B. 20N
C. 100N
D. Zero N

29. Two forces of 10N and 15N are acting simultaneously on an object in the same direction. Their resultant is
A. Zero
B. 5N
C. 25N
D. 150N

30. If the dot product of two non-zero vectors vanishes, the vectors will be
A. In the same direction
B. Opposite to each other
C. Perpendicular to each other
D. Anti-parallel

31. The dot product of two vectors is negative when
A. They are parallel vectors
B. They are anti-parallel vectors
C. They are perpendicular vectors
D. None of the above is correct

32. The vector product of two non-zero vectors is zero, when
A. They are parallel to each other
B. They are perpendicular to each other
C. They are equal vectors
D. They are inclined at angle of 60^0

33. Identify the vector quantity
A. Heat
B. Angular momentum
C. Time

D. work

34. Which of the following quantities is a scalar?
A. Magnetic moment
B. Acceleration due to gravity
C. Electric field
D. Electrostatic potential

35. The magnitudes of vectors $\vec{A}, \vec{B}$ and $\vec{C}$ are 3, 4 and 5 units respectively. If $\vec{A} + \vec{B} = \vec{C}$, the angle between $\vec{A}$ and $\vec{B}$ is:
A. $\pi/2$
B. $\cos^{-1} 0.6$
C. $\tan^{-1} 7/5$
D. $\pi/4$

36. The angle between two vectors $-2\hat{i}+3\hat{j}+\hat{k}$ and $\hat{i}+2\hat{j}-4\hat{k}$ is
A. 0°
B. 90°
C. 180°
D. None of the above

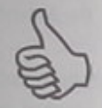
37. The angle between $\vec{A}$ and $\vec{B}$ is θ. The value of the triple product $\vec{A}.(\vec{B}\times\vec{A})$ is
A. A^2B
B. Zero
C. $A^2B \sin\theta$
D. $A^2B \cos\theta$

38. Five equal forces of 10N each are applied at one point moving with constant velocity and all are lying in one plane. If the angles between them are equal, the resultant force will be of
A. Zero N B. 10 N
C. 20 N D. $10\sqrt{2}$ N

39. Angular momentum is
A. A scalar
B. A vector
C. Neither A. nor B.
D. Either A. or B.

40. Which of the following is a scalar quantity?
A. Displacement
B. Electric field
C. Acceleration
D. Work

Achievement Key

Correct Answers	You Got
More than 35	
Below 30	

WHAT TO DO

If you got thumb down, you must consider learning more about the measurements and units of physics.

If you got thumb up, be prepare to have a hard exercise based on vectors.

Brain Busters

1. If $(\vec{a}\times\vec{b})$ points along positive z-axis, then the vectors $\vec{a}$ and $\vec{b}$ must lie in
A. .yz-plane
B. .zx-plane
C. .xy-plane
D. None of the above

2. A force of 10N is acting along y-axis towards the origin. Its component along x-axis is
A. 10N B. 20N
C. 100N **D. Zero N**

3. When R_x is negative and R_y is positive, the resultant lies in the second quadrant and its direction is
A. $\theta = 90 + \phi$
B. $\theta = 180 - \phi$
C. $\theta = 180 + \phi$
D. $\theta = 0$

4. If two non-zero vectors $\vec{A}$ and $\vec{B}$ obey the relation $|\vec{A} + \vec{B}| = |\vec{A} - \vec{B}|$, then the angle between them is:
A. 120° **B. 90°**
C. 60° D. 0°

5. Find the angle between two forces of equal magnitude of their resultant is also equal to the magnitude of either of these forces
A. 60° **B. 120°**
C. 180° D. 360°

6. Find the projection of $\vec{A} = 2\hat{i} - 8\hat{j} + \hat{k}$ in the direction of the vector $\vec{B} = 3\hat{i} - 4\hat{j} - 12\hat{k}$.
A. 43 B. 4
C. 2 D. 1

7. A boat which has a speed of 5 km/h in still water crosses a river of width 1 km along the shortest path in 15 minutes. The velocity of the river in km/s is:
A. 1 **B. 3**
C. 4 D. $\sqrt{41}$

8. Which of the following is a scalar quantity
A. weight of a person
B. Displacement from Multan to Lahore
C. Temperature of Quetta during December
D. Linear Velocity

9. Which of the following quantities is a vector
A. Volume
B. Temperature
C. Displacement
D. Density

10. The resultant of two equal forces is double of either of the force. The angle between them is

A. 0° B. 60°
C. 90° D. 120°

11. If $\vec{A} \times \vec{B} = \vec{B} \times \vec{A}$, then the angle between A and B is
A. π B. $\pi/3$
C. $\pi/2$ D. $\pi/4$

12. The sum of two forces acting at a point is 16 N. If the resultant force is 8 N and its direction is perpendicular to minimum force then the forces are
A. 6 N and 10 N
B. 8 N and 8 N
C. 4 N and 12 N
D. 2 N and 14 N

13. The magnitude of vector $\vec{A}$, $\vec{B}$ and $\vec{C}$ are respectively 12, 5 and 13 units and $\vec{A} + \vec{B} = \vec{C}$ then the angle between $\vec{A}$ and $\vec{B}$ is
A. 0
B. π
C. $\pi/2$
D. $\pi/4$

14. If resultant of two equal forces (F and F) acting on a point is also F, then the angle between two forces is
A. 0°
B. 45°
C. 60°
D. 120°

15. A boy walks uniformly along the sides of a rectangular park of size 400 m × 300 m, starting from one corner to the other corner diagonally opposite. Which of the following statements is incorrect?
A. He has travelled a distance of 700 m
B. His displacement is 700 m
C. His displacement is 500 m
D. His velocity is not uniform throughout the walk.

16. Which pair of the following forces will never give resultant force of 2N?
A. 2 N and 2 N
B. 1 N and 1 N
C. 1 N and 3 N
D. 1 N and 4 N

17. Two forces 3 N and 2 N are at an angle θ such that the resultant is R. The first force is now increased to 6 N and the resultant becomes 2R. The value of θ is
A. 30° B. 60°
C. 90° **D. 120°**

18. If the resultant of n forces of different magnitudes acting at a point is zero, then the minimum value of n is
A. 1 B. 2
C. 3 D. 4

19. The rectangular components of force 5 dyne are
A. 3 and 4 dyne
B. 2.5 and 25 dyne
C. 1 and 2 dyne
D. 2 and 3 dyne

20. Two forces of 4 dyne and 3 dyne act upon a body. Which of the following may be the resultant?
A. 2 N
B. 5 N
C. 8 N
D. 0 N

21. Two forces are such that the sum of their magnitudes is 18 N and their resultant is perpendicular to the smaller forces and the magnitude of resultant is 12. Then the magnitude of the forces are
A. 12 N, 6 N
B. 13 N, 5 N
C. 10 N, 8 N
D. 16 N, 2 N

22. The maximum and minimum magnitudes of the resultant of two given vectors are 17 units and 7 units respectively. If these two vectors are at right angles to each other, the magnitude of their resultant is
A. 14 B. 16
C. 18 **D. 13**

23. The vector sum of two forces is perpendicular to their vector differences. In that case, the forces
A. Are equal to each other in magnitude
B. Are not equal to each other in magnitude
C. Cannot be predicted
D. Are equal to each other

24. Which of the following sets of concurrent forces may be in equilibrium?
A. $F_1 = 3$ N, $F_2 = 5$ N, $F_3 = 6$ N
B. $F_1 = 3$ N, $F_2 = 5$ N, $F_3 = 15$ N
C. $F_1 = 3$ N, $F_2 = 5$ N, $F_3 = 1$ N
D. $F_1 = 3$ N, $F_2 = 5$ N, $F_3 = 9$ N

25. Three vectors satisfy the relation $\vec{A}$. $\vec{B} = 0$ and $\vec{A}$. $\vec{C} = 0$, then $\vec{A}$ is parallel to
A. $\vec{B} \times \vec{C}$ B. $\vec{B}$. $\vec{C}$
C. $\vec{C}$ D. $\vec{B}$

26. A person walks first 10 km north and 20 km east, then the resultant vector is
A. 22.36 km
B. 22.46 km
C. 25.23 km
D. 20.36 km

27. Two forces P and Q have a resultant perpendicular to P. The angle between the forces is:
A. $\tan^{-1}(-P/Q)$
B. $\tan^{-1}(P/Q)$
C. $\sin^{-1}(P/Q)$
D. $\cos^{-1}(-P/Q)$

28. An airplane flies 400 m north and then flies 400 m south and then flies

1200 m upwards then net displacement is

A. 1200 m B. 1300 m
C. 1400 m D. 1500 m

29. Two equal forces (of magnitude P each) act at a point inclined to each other at an angle of 120°. The magnitude of their resultant is

A. P/2 B. P/4
C. P D. 2P

30. Vector A lies in the XY-plane. what orientation with both of its rectangular components be negative

A. I-quadrant
B. II-quadrant
C. III-quadrant
D. None of these

31. In which quadrant the two rectangular components of a vector have same sign?

A. 1st
B. 2nd
C. both 1st and 3rd
D. 4th

32. Two vectors A and B are making angle x with each other. The scalar projection of vector B on vector A is written as

A. A.B/A B. A.B/B
C. A Cos x D. B/A.B

33. Which one is not a correct relation?

A. $A \times B = -B \times A$
B. $|A \times B| = -|B \times A|$
C. $A \times B = AB \sin\theta \hat{n}$
D. $B \times A = -AB \sin\theta \hat{n}$

34. Torque acting on a body determines

A. acceleration
B. linear acceleration
C. angular acceleration
D. direction of motion of the body

35. Which one is not a type of dynamic equilibrium?

A. rotational equilibrium
B. translational equilibrium
C. static equilibrium
D. both a and c are correct answer

36. Three coplanar forces acting on a body keep it in equilibrium. They should therefore be

A. concurrent
B. non concurrent
C. parallel
D. non parallel

37. A central force is that which

A. can produce torque
B. cannot produce torque
C. sometime can produce torque some time can not
D. has no relation with torque

38. It is easier to turn a steering wheel with both hands than with a single hand because

A. accelerating force increases on the wheel
B. two forces act on the wheel
C. two hands provide firm grip
D. couple acts on the wheel

39. The cross product of two vectors is a negative vector when

A. they are parallel vectors
B. they are anti-parallel vectors
C. they are perpendicular vector
D. they are rotated through 270 degree

40. If you drive west at 20 km/h for one hour, then drive east at 15 km/h for one hour, your net displacement will be

A. 5 km east
B. 35 km west
C. 35 km east
D. 5 km west

Achievement Key

Correct Answers	You Got
More than 32	
Below 28	

WHAT TO DO

If you got thumb down, you must consider learning more about the vectors.

If you got thumb up, go to the next exercise.

CHAPTER

3

MOTION AND FORCE

Speed $v = \frac{s}{t}$

where v is speed in metres per second, s is distance in metres, and t is time in seconds

Velocity $v = \frac{d}{t}$

where v is velocity in metres per second, d is displacement in metres, and t is time in seconds

Acceleration $a = \frac{v}{t}$

where a is acceleration in m/s^2, v is change in velocity in metres per second, and t is time in seconds

Weight $W = mg$

where W is weight, m is mass in kilograms and g is acceleration due to gravity in m/s^2(on Earth, acceleration due to gravity is approximately 9.8 m/s^2)

Force $F = ma$

where F is force in newton, m is mass in kilograms, and a is acceleration in m/s^2

Work Done $W = Fs$

where W is work in joules, F is force in newtons, and s is the distance over which the force is applied

Gravitational Potential Energy $GPE = mgh$

where GPE is gravitational potential energy in joules, m is mass in kilograms, g is the acceleration due to gravity in m/s2, and h is height in metres (on Earth, acceleration due to gravity is approximately 9.8 m/s^2)

Elastic Potential Energy $EPE = \frac{1}{2}kx^2$

where EPE is elastic potential energy in joules, k is the spring constant of the object, and x is the length of extension or compression in metres

Power $P = \frac{W}{t}$

where P is power in watts, W is work in joules, and t is time in seconds

Mechanical Advantage $MA = \frac{effort}{load}$

where MA is the mechanical advantage and the load and effort are measured in newtons

or

$$MA = \frac{\text{distance of effort from fulcrum}}{\text{distance of load from fulcrum}}$$

where both distances are measured in metres in a first or second class lever

MCQ Set 1

MCQ Set 1 is consisted of the questions from the topic of Motion and Forces. The set takes you from very basic level (Sweet Candies) to the very tough level (Brain Buster).

Sweet Candies

Directions:

You are given following questions from the topics of this section, with four choices A through D. Select the choice that will answer the question best by filling the appropriate circle at the end of each question.

Answer of each question has been bolded for convenience.

1. Everything in the vastness of space is in a state of
   A. Rest
   B. Rectilinear motion
   C. Perpetual motion
   D. Circular motion

2. If the slope of the velocity-time graph increases at constant rate, with time, then the body is said to have
   A. Uniform retardation
   B. Uniform negative acceleration
   C. Average acceleration

D. Uniform positive acceleration

3. The magnitude of displacement is
   A. Distance between two points
   B. Distance in a curved path
   C. Shortest distance between two points
   D. Perpendicular distance

4. The time rate of change of displacement is called
   A. Speed
   B. Velocity
   C. Acceleration
   D. Times Arrow

5. Velocity is a physical quantity which is a
   A. Scalar
   B. Vector
   C. Time arrow
   D. None of these

6. The dimension of velocity are
   A. $[LT]$
   B. $[LT^2]$
   C. $[LT^{-1}]$
   D. $[LT^{-2}]$

7. Which law is applicable in the motion of the rocket in space
   A. Conservation of mass
   B. Conservation of energy
   C. Conservation of angular momentum
   D. Conservation of linear momentum

8. If a body is moving with constant velocity, then
   A. Its direction may be changing
   B. Its acceleration is variable
   C. Its acceleration is zero
   D. None of the above

9. In case of average velocity, a body may follow
   A. Straight path
   B. Curved path
   C. Variable motion
   D. All of them

10. If the velocity of a body is uniform, the velocity-time graph is a straight line which is
    A. Parallel to x-axis
    B. Parallel
    C. At an angle of 45^0 with the x-axis
    D. Along the y-axis

11. If the instant velocity does not change, the body is moving with a
    A. Initial velocity
    B. Variable velocity
    C. Uniform velocity
    D. None of these

12. Acceleration is
    A. Scalar quantity
    B. Vector quantity
    C. Constant quantity
    D. None of these

13. Declaration means the speed of the body is
    A. Increasing
    B. Decreasing
    C. Just moving
    D. None of these

14. At the highest point vertical component of the velocity of the projectile becomes
    A. Zero
    B. Maximum
    C. Minimum
    D. -1

15. When the velocity of a body is increasing the acceleration produced is
    A. No acceleration produced
    B. Negative acceleration n
    C. Positive acceleration
    D. None of these

16. When the velocity of a car is constant. The velocity time graph is a
    A. Straight line
    B. Straight line rises the same height for equal intervals of time
    C. Horizontal straight line
    D. None of these

17. Raindrops fall towards the ground with constant velocity. This suggests that
    A. Gravitational field does not act on rain drops
    B. gravitational force acting on rain drops is zero
    C. There is some resistive force acting in the direction opposite to the gravity
    D. The size of the raindrop is so small that acceleration does not build up

18. When a car moves with increasing acceleration, the velocity time graph is a
    A. Straight line
    B. Horizontal straight line
    C. Curve
    D. None of these

19. Which of the following can be zero when the particle is in motion for some time?
    A. Speed
    B. Displacement
    C. Distance covered
    D. none of these

20. Instantaneous velocity is equal to the average velocity if a body moves with a
    A. Uniform Velocity
    B. Variable Velocity
    C. Uniform Acceleration
    D. Variable Acceleration

21. By calculating the area under the velocity time graph; we can find the
    A. Acceleration
    B. Velocity
    C. Distance
    D. None of these

22. Newton's third law concerns the forces of interaction between two bodies. Which of the following statements relating to the third law is not correct?
    A. The two forces must be of the same type

B. **The two forces are equal and opposite so the bodies are in equilibrium**
C. The two forces are always opposite in direction
D. The two forces are at all times equal in magnitude.

23. The equations for uniformly accelerated motion can also be applied to free fall motion of the objects moving with
A. Acceleration
B. Constant velocity
C. Instantaneous acceleration
D. Negative acceleration

24. The minimum force required to move a body of mass m vertically upward is:
A. mg
B. mg/2
C. More than 2mg
D. More than mg

25. A frame of reference stationed on Earth is approximately an example of
A. Inertial frame
B. None-Inertial frame
C. Every frame
D. None of these

26. A force applied on a body produces acceleration in
A. Its opposite direction
B. Its own direction
C. Right angle to the force
D. Circle

27. At what angle of projection the horizontal range of a projectile is maximum?
A. 30^0
B. 45^0
C. 60^0
D. 90^0

28. For a fixed force, larger is he mass of a body
A. Greeter is the acceleration
B. Smaller is the acceleration
C. No effect on acceleration
D. Greater is the velocity

29. After terminal velocity, a fog droplet falls vertically with an acceleration
A. Equal to g
B. Less than g
C. Greater than g
D. Equal to zero

30. A collision in which the Kinetic Energy is not conserved is called
A. Elastic collision
B. Inelastic collision
C. Pair Production
D. Pair Annihilation

31. The frame of reference in which Newton's first law of motion holds is known as
A. Inertial frame of reference
B. Non-Inertial frame of reference
C. Every frame of reference
D. Earth frame of reference

32. At the top of the trajectory of a projectile, the acceleration is
A. The maximum
B. The minimum
C. Zero
D. g

33. A boy is dropped from a tower with zero velocity, reaches ground in 4s. The height of the tower is about
A. 80 m
B. 20 m
C. 160 m
D. 40 m

34. Unit of impulse in
A. Newton
B. Kg m
C. Kg m/s
D. Joule

35. The horizontal range of a projectile, at a certain place, depends upon:
A. The mass of the projectile
B. The velocity of projection
C. The angle of projection
D. The angle as well as velocity of projection

36. The velocity and acceleration of a body moving with uniform speed in circle are
A. Parallel
B. Opposite
C. Mutually perpendicular
D. None of the above

37. If an iron ball and a wooden ball of the same radius was released from a height 'h' in vacuum, then time taken by both of them to reach ground will be
A. Unequal
B. Exactly equal
C. Roughly equal
D. zero

38. Which of the following statements for an object in equilibrium is not true?
A. The object must be at rest
B. The object can be at rest
C. The object is moving at constant speed
D. The acceleration of the object is zero

39. At the top of the trajectory of a projectile, the directions of its velocity and acceleration are
A. Perpendicular to each other
B. Parallel to each other
C. Inclined to each other at an angle of 45°
D. Antiparallel to each other

40. When a body is moving on a surface, the force of friction is called
A. Static friction
B. Dynamic friction
C. Limiting friction
D. Rolling friction

Achievement Key

Correct Answers	You Got
More than 35	
Below 30	

If you got thumb down, you must consider learning more about the motion and Force.
If you got thumb up, be prepare to have a hard exercise based on vectors.

Brain Busters

1. To get a resultant displacement of 10 m, two displacement vectors of magnitude 6 m and 8 m should be combined
   A. Parallel
   B. Antiparallel
   C. At angle 60°
   D. Perpendicular to each other

2. If the values of instantaneous and average velocities are equal, the body is said to be moving with
   A. Uniform acceleration
   B. Uniform speed
   C. Variable velocity
   D. Uniform velocity

3. The velocity of a particle at an instant is 10 m/s and after 5s the velocity of the particle is 20 m/s. The velocity 3s before in m/s is:
   A. 8
   B. 4
   C. 6
   D. 7

4. In case when there is no total displacement and average velocity, then the motion is described by
   A. Variable velocity
   B. Instantaneous velocity
   C. Initial velocity
   D. None of these

5. A motorist travels A to B at a speed at 40 km/h and returns at speed of 60 km/h. His average speed will be:
   A. 40 km/h
   B. 48 km/h
   C. 50 km/h
   D. 60 km/h

6. The sum of the magnitude of two forces acting at a point is 18 and the magnitude of their resultant is 12. If the resultant is at 90° with the force of the smaller magnitude, then their magnitudes are
   A. 3, 15
   B. 4, 14
   C. 5, 13
   D. 6, 12

7. A train of 150 m length is going towards north direction at a speed of 10 ms^{-1}. A parrot flies at a speed of 5 ms^{-1} towards south direction parallel to the railway track. The time taken by the parrot to cross the train is equal to
   A. 12 s
   B. 8 s
   C. 15 s
   D. 10 s

8. A person standing in an elevator, which goes up with constant upward acceleration exerts a push on the floor of the elevator whose value
   A. is always equal to his weight
   B. is always greater than his weight
   C. is always less than his weight
   D. Is zero

9. A particle starts with initial velocity 10 ms^{-1}. It covers a distance of 20 m along a straight line in two seconds. What is the acceleration of the particle?
   A. 20 ms^{-2}
   B. 10 ms^{-2}
   C. 1 ms^{-2}
   D. Zero

10. What will be the ratio of the distance moved by a freely falling body from rest in 4^{th} and 5^{th} seconds of journey?
    A. 4 : 5
    B. 7 : 9
    C. 16 : 25
    D. 1 : 1

11. When a person jumps off the ground, the reaction force of the ground is
    A. Greater than the weight of the person
    B. Smaller than the weight of the person
    C. Equal to the weight of the person
    D. zero

12. The initial velocity of a body moving along a straight line is 7 m/s. It has a uniform acceleration of 4 m/s^2. The distance covered by the body in the 5th second of its motion is
    A. 25 m B. 35 m
    C. 50 m D. 85 m

13. Which of the following four statements is false?
    A. A body can have zero velocity and still be accelerated
    B. A body can have a constant velocity and still have a varying speed
    C. A body can have a constant speed and still have a varying velocity
    D. The direction of the velocity of a body can change when its acceleration is constant

14. A ball is thrown upwards with a velocity of 100 m/s. It will reach the ground in
    A. 10 s
    B. 20 s

C. 5 s
D. 40 s

15. A boy walks to his school at a distance of 6 km with a speed of 2.5 km/h and walks back with a constant speed of 5 km/h. His average speed for round trip expressed in km/h is
A. 24/13
B. 10/3
C. 3
D. 4.8

16. An airplane is flying horizontally with a velocity of 600 km/h and at a height of 1960 m. When it is vertically above a point A on the ground, a bomb is released from it. The bomb strikes the ground, at point B. The distance AB is
A. 1200 m
B. 0.33 km
C. 3.33 km
D. 33 km

17. A car moves for half of its time at 80 km/h and for rest half of time at 40 km/h. Total distance covered is 60 km. What is the average speed of the car?
A. 60 km/hr
B. 80 km/hr
C. 120 km/hr
D. 180 km/hr

18. A ball of mass m moving with uniform speed collides elastically with another stationary ball. The incident ball will lose maximum kinetic energy when mass of the stationary ball is
A. m
B. 2 m
C. 4 m
D. Infinity

19. A 120 m long train is moving in a direction with speed 20 m/s. A train B moving with 30 m/s in the opposite direction and 130 m long crosses the first train in a time
A. 6 s
B. 36 s
C. 38 s
D. None of these

20. By which velocity a ball be projected vertically so that the distance covered by it in 5th seconds is twice the distance it covers in its 6th second ($g = 10\ m/s^2$).
A. 58.8 m/s
B. 49 m/s
C. 65 m/s
D. 19.6 m/s

21. A ball falls on the surface from 10 m height and rebounds to 2.5 m. If the duration of contact with the floor is 0.01 seconds then the average acceleration during contact is
A. $2100\ m/s^2$
B. $1400\ m/s^2$
C. $700\ m/s^2$
D. $400\ m/s^2$

22. If a car at rest accelerates uniformly to a speed of 144 km/h in 20 s it covers a distance of
A. 20 m
B. 400 m
C. 1440 m
D. 2880 m

23. A vehicle of mass 120 kg is moving with a uniform velocity of 108 km/h. The force required to stop the vehicle in 10s is
A. 120×10.8 N
B. 180 N
C. 720 N
D. 360 N

24. A lift is descending at a constant speed V. A passenger in the lift drops a coin. The acceleration of the coin towards the floor will be
A. Zero
B. g
C. -g
D. V + g

25. A monkey sits on the pan of spring scale kept in an elevator. The reading of the spring scale will be maximum when
A. Elevator is stationary
B. Elevator cable breaks and it falls freely towards earth
C. Elevator accelerates downwards
D. Elevator accelerates upward

26. A lift is moving up with acceleration equal to 1/5 of that due to gravity. The apparent weight of a 60 kg man standing in lift is:
A. 60 kg wt
B. 72 kg wt
C. 48 kg wt
D. Zero

27. The mass of a body measured by a physical balance in a lift at rest is found to be m. If the lift is going up with an acceleration a, its mass will be measured as:
A. $m(1 - a/g)$
B. $m(1 + a/g)$
C. m
D. Zero

28. A person is sitting in a traveling train and facing the engine. He tosses up a coin and the coin falls behind him. It can be concluded that the train is
A. Moving forward and gaining speed
B. Moving forward and losing speed
C. Moving forward with uniform speed
D. Moving backward with uniform speed

29. A ball of mass m_1 and another ball of mass m_2 are dropped from equal heights. If time taken by the balls are t_1 and t_2 respectively then
A. $t_1 = \frac{t_2}{2}$ **B.** $t_1 = t_2$
C. $t_1 = 4t_2$ D. $t_1 = \frac{t_2}{4}$

30. If a body starts from rest and travels 120 cm in the 6th second then what is the acceleration?
A. 0.20 m/s²
B. 0.027 m/s²
C. 0.218 m/s²
D. 0.03 m/s²

31. If vectors P, Q and R have magnitude 5, 12 and 13 units and $\vec{P}+\vec{Q}=\vec{R}$, the angle between Q and R is
A. $\cos^{-1}\frac{5}{12}$
B. $\cos^{-1}\frac{5}{13}$
C. $\cos^{-1}\frac{12}{13}$
D. $\cos^{-1}\frac{7}{13}$

32. A body falls freely from rest. It covers as much distance in the last second of its motion as covered in the first three seconds. The body has fallen for a time of
A. 3 s
B. 5 s
C. 7 s
D. 9 s

33. A car travels first half distance between two places with a speed of 30 km/h and remaining half with a speed of 50 km/h. The average speed of the car is
A. 37.5 km/h
B. 10 km/h
C. 42 km/h
D. 40 km/h

34. If a train traveling at 72 kmph is to be brought to rest in a distance of 200 meters, then its retardation should be
A. 20 ms⁻²
B. 10 ms⁻²
C. 2 ms⁻²
D. 1 ms⁻²

35. A ball is dropped downwards After 1 second another ball is dropped downwards from the same point. What is the distance between them after 3 seconds?
A. 25 m
B. 20 m
C. 50 m
D. 9.8 m

36. Distance travelled by a body falling from rest in the first, second and third second is in the ratio of
A. 1 : 2 : 3
B. 1 : 3 : 5
C. 1 : 4 : 9
D. None of the above

37. If speed of electron is 5×10^5 m/s. How long does it take one electron to traverse 1 m?
A. 1×10^6 s
B. 2×10^6 s
C. 2×10^5 s
D. 1×10^5 s

38. If the water falls from a dam into a turbine wheel 19.6 m below, then the velocity of water at the turbine, is
(Take g = 9.8 m/s²)
A. 9.8 m/s
B. 19.6 m/s
C. 39.2 m/s
D. 98.0 m/s

39. Range of a projectile is R, when the angle of projection is 30°. Then, the value of the other angle of projection for the same range, is:
A. 45°
B. 60°
C. 50°
D. 40°

40. A man sitting in a bus traveling in a direction from west to east with a speed of 40 km/h observes that the rain-drops are falling vertically down to the another man standing on ground the rain will appear
A. To fall vertically down
B. To fall at an angle going from west to east
C. To fall at an angle going from east to west
D. The information given is insufficient to decide the direction of rain.

Achievement Key

Correct Answers	You Got
More than 32	
Below 28	

If you got thumb down, you must consider learning more about the motion and force.
If you got thumb up, go to the next exercise.

CHAPTER

4

WORK AND ENERGY

1 Work;

$$\text{Work} = \text{Force.Distance.Cos}\theta$$

2 Power;

$$\text{Power} = \frac{\text{Work}}{\text{time interval}}$$

3 Gravitational Potential Energy;

PE=mg.h, m is the mass, g is the gravitational acceleration and h is the distance

4 Potential Energy of the Spring;

$Ep=1/2.k.x^2$, k is the spring constant and x is the amount of compression or stretching

4 Kinetic Energy;

$Ek=1/2mv^2$, m is the mass, v is the velocity

MCQ Set 1

MCQ Set 1 is consisted of the questions from the topic of Work and Energy. The set takes you from very basic level (Sweet Candies) to the very tough level (Brain Buster).

Sweet Candies

Directions:

You are given following questions from the topics of this section, with four choices A through D. Select the choice that will answer the question best by filling the appropriate circle at the end of each question.

Answer of each question has been bolded for convenience.

1. Work is defined as the dot product of force and displacement but it is a
   A. Scalar quantity
   B. Vector quantity
   C. Constant quantity
   D. None of these

2. The work done in a gravitational field is independent of
   A. Its distance
   B. Its mass
   C. Its path
   D. Its potential energy

3. SI unit of work is
   A. N- m
   B. $N-m^2$
   C. $N-ms^{-1}$
   D. $N-MS^{-2}$

4. The work done by the body is maximum when it has an angle of
   A. 30^0
   B. 60^0
   C. 90^0
   D. 0^0

5. Work done is a gravitational field along a closed loop is
   A. Maximum B. Minimum
   C. 1 **D. Zero**

6. Geothermal energy with in the earth is generated by
   A. Radioactive decay
   B. Residual heat of the earth
   C. Compression of material
   D. All

7. Which of the following is conservative field
   A. Electrostatic field

B. Frictional field
C. Viscous field
D. All of these

8. A body of mass 10 kg is dropped to the ground from a height of 10 meters. The work done by the gravitational force is ($g = 9.8 m/s^2$)
A. - 490 Joules
B. + 490 Joules
C. - 980 Joules
D. + 980 Joules

9. The field, in which is the work done is independent of the path followed, is called
A. Conservative fields
B. Non-conservative field
C. Varying intensity field
D. None of these

10. If a body falls from a height, the relation between its kinetic and potential energies is
A. Gain in K.E = Loss in P.E. – Work done against friction
B. Gain in P.E = Loss in K.E. + Work done against friction
C. Loss in K.E = Gain in P.E. + Work done against friction
D. Loss in P.E = Gain in K.E. – Work done against friction

11. A meteor of mass mentors the Earth's atmosphere at an angle θ to the horizontal with an initial velocity v. Which of the following is true about
A. It remains constant throughout the motion.
B. It increases throughout the motion
C. It decreases throughout the motion.
D. None

12. The K.E. of a light and a heavy object is same. Which object has maximum momentum?
A. Light object
B. Heavy object
C. Both have the same momentum
D. Data is not sufficient

13. For the same velocity, the momentum is maximum for :
A. An electron
B. A proton
C. A deuteron
D. An α particle

14. The escape velocity of moon in Kms^{-1} is
A. 1.23 B. 2. 43
C. 2. 40 D. 2.59

15. The work done in taking a particle from the floor to a table depends on
A. The actual path taken
B. The time taken in this work
C. The speed of the particle
D. The height of the table

16. The atmosphere is held to the earth by
A. Winds
B. Gravity
C. Clouds
D. The rotation of earth

17. The Escape velocity of Earth in Kms^{-1}
A. 9.75
B. 11.2
C. 12.3
D. 15.6

18. The initial velocity with which a body projected upward and never comes back is called
A. Kinetic energy
B. Terminal velocity
C. Escape velocity
D. Extreme velocity

19. A boat moving at constant speed v through still water experiences a total frictional drag F. What is the power developed by the boat?
A. $0.5Fv$
B. Fv
C. $0.5\ Fv^2$
D. Fv^2

20. If it is assumed that a frictional force f is present, during the downward motion of an object of mass, which of the following relation is true.
A. $mgh - f = \frac{1}{2}mV^2$
B. $2mg - f = \frac{1}{2}mV^2$
C. $mgh - f = \frac{1}{2}mV^2$
D. None of these

21. A bullet is shot from a rifle. As a result the rifle recoils. The kinetic energy of rifle as compared to that of bullet is
A. Less
B. Greater
C. Equal
D. Cannot be concluded

22. Which of the following is not a perfectly inelastic collision?
A. Striking of two glass balls
B. A bullet striking a bag of sand
C. An electron captured by a proton
D. A man jumping onto a moving cart

23. Which of the following is true?
A. Neither momentum nor kinetic energy is conserved in inelastic collisions
B. Momentum is conserved in all collisions but kinetic energy is conserved only in inelastic collisions
C. Momentum is conserved in all collisions but not kinetic energy
D. Both momentum and kinetic energy are conserved in all collisions

24. If the force applied is F and the velocity gained is v, then the power developed is
A. $\frac{F}{v}$
B. $\frac{v}{F}$
C. Fv

D. Fv^2

25. A solar cell converts sun's energy into:
A. Heat energy
B. Electric energy
C. Light
D. Sound

26. Which is constant for a satellite in orbit?
A. Velocity
B. K.E.
C. Angular Momentum
D. Potential Energy

27. The kinetic energy of a body of mass 2 kg and momentum of 2 Ns is
A. 1 J
B. 2 J
C. 3 J
D. 4 J

28. A body is subjected to a force such that its velocity is doubled, then
A. Its acceleration is also doubled
B. Its momentum is also doubled
C. Its potential energy is also doubled
D. Its kinetic energy is also doubled

29. A light body A and a heavy body B have equal linear momentum. Then the K.E. of the body A
A. is equal to that of B
B. is greater than that of B
C. is smaller than that of B
D. is zero

30. The escaping velocity at the surface of earth can be found by the formula:
A. $V = \sqrt{2gR_e}$
B. $V = \sqrt{gR_e}$
C. $V = \frac{1}{2}\sqrt{gR_e}$
D. $V = 2g\sqrt{R_e}$

31. A constant force F is applied to keep the particle moving with uniform velocity V. Then the power required is
A. $\frac{1}{2}FV^2$
B. FV^2
C. FV
D. F/V

32. The K.E. of a light and a heavy object is same. Which object has higher momentum?
A. Light object
B. Heavy object
C. Both have the same momentum
D. Data is not sufficient

33. The decrease in potential energy of a ball of mass 20 kg which falls from a height 50 cm is:
A. 968 J
B. 98 J
C. 1980 J
D. None of these

34. While passing through the atmosphere, total energy is reduced by the dust particles, Water vapours and other gases due to
A. Reflection
B. Scattering
C. Absorption
D. All of these

35. A body of mass 10 kg is dropped to the ground from a height of 10 meters. The work done by the gravitational force is ($g = 9.8 m/s^2$)
A. - 490 Joules
B. + 490 Joules
C. - 980 Joules
D. **+ 980 Joules**

36. No work is done by the body when angle between force and displacement is
A. 0°
B. 45°
C. 90°
D. 60°

37. According to Work energy principle, work done on the body is equal to
A. Change in power
B. Change in K.E.
C. Change in acceleration
D. Change in angular velocity

38. The weight of the body at the centre of the earth is
A. 9.8 N
B. Zero
C. 19.6 N
D. None of these

39. The energy stored in a dam is
A. Kinetic energy
B. Electrical energy
C. Potential energy
D. None of these

40. The work done by the body is maximum when the angle between force and displacement is
A. 30°
B. 60°
C. 90°
D. 0°

Achievement Key

Correct Answers	You Got
More than 35	
Below 30	

If you got thumb down, you must consider learning more about the work and energy.

If you got thumb up, be prepare to have a hard exercise based on work and energy.

Brain Busters

1. Two masses of 1 g and 4 g are moving with equal kinetic energies. The ratio of the magnitudes of their linear momenta is:
   A. 4 : 1
   B. $\sqrt{2}$: 1
   C. 1 : 2
   D. 1 : 16

2. A body moves a distance of 10 m along a straight line under the action of a force of 5 Newton. If the work done is 25 joules, the angle which the force takes with the direction of motion of the body is
   A. 0°
   B. 30°
   C. 60°
   D. 90°

3. A body of mass 2 kg is thrown up vertically with K.E. of 490 joules. If the acceleration due to gravity is 9.8 m/s^2, the height at which the K.E. of the body becomes half its original value is given by:
   A. 50 m **B. 12.5 m**
   C. 25 m D. 10 m

4. Two bodies of masses m_1 and m_2 have equal momentum their kinetic energies E_1 and E_2 are in the ratio
   A. $\sqrt{m_1} : \sqrt{m_2}$
   B. $m_1 : m_2$
   C. $m_2 : m_1$
   D. $m_1^2 : m_2^2$

5. Two bodies with masses M_A and M_B are moving with equal kinetic energy. Their linear momenta are numerically in a ratio $|P_A| : |P_B|$ will be :
   A. $M_B : M_A$
   B. $M_A : M_B$
   C. $\sqrt{M_A} : \sqrt{M_B}$
   D. $M_A^2 : M_B^2$

6. How much water a pump of 2kW can raise in one minute to a height of 10 m, take g = 10 m/s^2 ?
   A. 1000 litres
   B. 1200 litres
   C. 100 litres
   D. 2000 litres

7. A body of mass M kg is lifted by a man to a height of one meter in 30 s. Another man lifts the same mass to the same height in 60 s. The work done by them is in ratio
   A. 1 : 2
   B. 1 : 1
   C. 2 : 1
   D. 4 : 1

8. The kinetic energy acquired by a mass m in traveling a certain distance d, starting from rest, under the action of a constant force is directly proportional to
   A. $\sqrt{m}$
   B. Independent of m
   C. $1/\sqrt{m}$
   D. m

9. Two bodies of 4 g and 16 g have same kinetic energy. What is the ratio of their momenta?
   A. 1 : 4
   B. 1 : 2
   C. 2 : 1
   D. 4 : 1

10. A second pendulum is mounted in a rocket. Its period of oscillation decreases when the rocket (A pendulum having time period of 2 seconds is called as second pendulum)
    A. Comes down with uniform acceleration
    B. Moves round the earth in a geostationary orbit
    C. Moves up with a uniform velocity
    D. Moves up with uniform acceleration

11. If g is the acceleration due to gravity on earth then increase in potential energy of a body of mass m up to a distance equal to the radius of the earth from the earth surface is
    A. $\frac{1}{2}$ mgR
    B. 2mgR
    C. mgR
    D. $\frac{1}{4}$ mgR

12. A body of mass 'm' is moved to a height 'h' equal to the radius of the earth. The increase in potential energy is
    A. 2 mgR
    B. mgR
    C. 1/2 mgR
    D. 1/4 mgR

13. A person A is going up in a balloon while another person is going down into a mine. Both are measuring the gravitational field.
    A. The field measured by both A and B goes on increasing.
    B. The field measure by A increases while that measured by B decreases
    C. The field measured by A decreases while that measured by B decreases

D. The field measured by A decreases while that measured by B increases

14. The escape velocity from the earth's surface is 11 km/s. A certain planet has a radius twice that of the earth but its mean density is the same as that of the earth. The value of the escape velocity from this planet would be
A. 22 km/s
B. 11 km/s
C. 5.5 km/s
D. 16.5 km/s

15. If the acceleration due to gravity at the earth's surface is 9.8 m/s^2 and the mass of the earth is 80 times that of the moon and radius of earth 4 times that of moon, the value of G at the moon's surface will be:
A. 9.8 m/s^2
B. 1.96 m/s^2
C. 4.9 m/s^2
D. None of above

16. If the earth suddenly stops rotating the value of 'g' at equator would:
A. Decrease
B. Remain unchanged
C. Increase
D. Become zero

17. The value of g on the moon whose diameter is ¼ that of earth is 1/6 of that of earth. The ratio of escape velocities at moon and earth's surface is nearly:
A. 1 : 5
B. 1 : 1
C. 2 : 5
D. 5 : 1

18. A truck and a car are moving with equal velocity. On applying the brake both will stop after certain distance then
A. Truck will cover less distance before rest
B. Car will cover less distance before rest
C. Both will cover equal distance
D. None

19. A ball whose kinetic energy is E, is thrown at an angle of 45° with the horizontal, its kinetic energy at the highest point of its flight will be
A. E
B. $\frac{F}{\sqrt{2}}$
C. $\frac{E}{2}$
D. Zero

20. If momentum is increased by 20% then K.E. increases by
A. 44% B. 55%

C. 66% D. 77%

21. If the K.E. of a body becomes four times of the initial value, then new momentum will
A. Become twice its initial value
B. Become three times, its initial value
C. Become four times, its initial value
D. Remains constant

22. Two bodies with kinetic energies in the ratio of 4: 1 are moving with equal linear momentum. The ratio of their masses is
A. 1 : 2
B. 1 : 1
C. 4 : 1
D. 1 : 4

23. A body of mass 5 kg is moving with a momentum of 10 kg m/s. A force of 0.2 N acts on it in the direction of motion of the body for 10 seconds. The increase in its kinetic energy is
A. 2.8 joule
B. 3.2 joule
C. 3.8 joule
D. 4.4 joule

24. The energy associated with an electron of velocity 10^6 m/s is:
A. 4.5×10^{-10} J
B. $\mathbf{4.5 \times 10^{-19}}$ **J**
C. 3×10^{-10} J
D. 3×10^{-19} J

25. A force of 10 N displaces an object by 10 m. If work done is 50 J then direction of force makes an angle with direction of displacement.
A. 120°
B. 90°
C. 60°
D. None of these

26. A 50 kg man with 20 kg load on his head climbs up 20 steps of 0.25 m height each. The work done in climbing is
A. 5 J
B. 350 J
C. 100 J
D. 3430 J

27. A particle of mass 'm' at rest is acted upon by a force 'P' for a time 't'.Its kinetic energy after an interval 't' is
A. $\frac{P^2t^2}{m}$
B. $\frac{P^2t^2}{2m}$
C. $\frac{P^2t^2}{3m}$
D. $\frac{Pt}{2m}$

28. If force and displacement of particle in the direction of force are doubled. Work would be

A. Double
B. 4 times
C. Half
D. ¼ times

29. The momentum of particle is numerically equal to its kinetic energy. What will be the velocity of the particle?
A. 4 m/s
B. 1 m/s
C. 2 m/s
D. None of these

30. A thief stole a box with valuable article of weight W and jumped down a wall of height h. Before he reached ground he experienced a load of
A. 2W
B. W
C. W/2
D. Zero

31. What is the weight of a 700 g of body on a planet whose mass is 1/7th of that of earth and radius is 1/2 of earth?
A. 400 gf
B. 300 gf
C. 700 gf
D. 500 gf

32. Height at which value of 'g' becomes one-fourth to hat on earth is
A. R
B. 2R
C. (3/2)R
D. 4R

33. If we move from equator to pole, value of g
A. Increases
B. Decreases
C. Remains same
D. First (A) and then (B)

34. If the speed of an object is tripled, its kinetic energy is
A. $\frac{1}{9}$ times
B. $\frac{1}{3}$ times
C. 3 times
D. 9 times

35. What is the power required to give a body of mass *m* a forward acceleration a when it is moving with velocity v up a frictionless track inclined at an angle θ to the horizontal?
A. mavg sin θ
B. mav + mgv sin θ
C. mav sin θ + mgv
D. (mav + mgv) sin θ

36. An electric motor is required to haul a cage of mass 400 Kg up a mineshaft through a vertical height of 1200 m in 2 minutes. What will be the electrical power required if the overall efficiency is 80%.
A. 3.2kW
B. 5kW
C. 32kW
D. 50kW

37. The radius of moon is 1600 km and its mass is the value of g is 1.6 m/s^2. The escape velocity of an object from the moon is
A. 1.6 Km s^{-1}
B. 200 Km s^{-1}
C. 2262.7 m s^{-1}
D. 0.001 Km s^{-1}

38. A 2 kg body and a 3 kg body have equal momentum. If the kinetic energy of 3 kg body is 10 J, the KE of 2 kg body will be
A. 6.66 J
B. 15 J
C. 22.5 J
D. 45 J

39. A car of mass m has an engine, which can deliver power P. What is the minimum time in which the car can be accelerated from rest to a speed v?
A. .mv/P
B. P/mv
C. $.mv^2/2P$
D. $2P/mv^2$

Achievement Key

Correct Answers	You Got
More than 32	
Below 28	

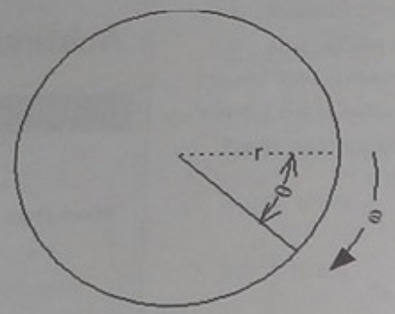
If you got thumb down, you must consider learning more about the waves and oscillations.

If you got thumb up, go to the next exercise.

CHAPTER

5

CIRCULAR MOTION FORMULAS



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1 Angular Velocity

Angular velocity can be expressed as (angular velocity = constant):

$$\omega = \theta / t \qquad (2a)$$

where

ω = *angular velocity (rad/s)*
θ = *angular displacement (rad)*
t = *time (s)*

2 Radians

Angular velocity can also be expressed as (angular acceleration = constant):

$$\omega = \omega_o + \alpha t \qquad (2b)$$

where

ω_o = *angular velocity at time zero (rad/s)*
α = *angular acceleration (rad/s^2)*

3 Angular Displacement

Angular displacement can be expressed as (angular acceleration is constant):

$$\theta = \omega_o t + 1/2\ \alpha t^2 \qquad (2c)$$

Combining 2a and 2c:

$$\omega = (\omega_o^2 + 2\ \alpha\ \theta)^{1/2}$$

4 Angular Acceleration

Angular acceleration can be expressed as:

$$\alpha = d\omega / dt = d^2\theta / dt^2 \qquad (2d)$$

where

$d\theta$ = *change of angular displacement (rad)*
dt = *change in time (s)*

5 Angular Momentum or Torque

Angular momentum or torque can be expressed as:

$$T = \omega\ I \qquad (2e)$$

where

T = *angular momentum or torque (Nm)*
I= *moment of inertia* ($lb_m\ ft^2$, $kg\ m^2$)

MCQ Set 1

MCQ Set 1 is consisted of the questions from the topic of Circular Motion. The set takes one from very basic level (Sweet Candies) to the very rough level (Brain Buster).

Sweet Candies

Directions:

You are given following questions from the topics of this section, with four choices A through D. Select the choice that will answer the question best by filling the appropriate circle at the end of each question.

1. Angle subtended at the centre of the circle by a body is called
   A. Angular velocity
   B. Linear velocity
   C. Angular displacement
   D. Linear displacement

2. When a body moves in a circle in the clockwise direction, the angular displacement 2θ is taken as
   A. Positive
   B. Negative
   C. Neutral
   D. Absolute

3. The torque on a body will be zero if the angle between r and F is
   A. 90° B. 180°
   C. 270° D. 45°

4. The direction of angular displacement is determined by using
   A. Head to tail rule
   B. Opening left hand rule
   C. Right angle rule
   D. None of these

5. If the distance between two mass particle is doubled, the gravitational force between them
   A. Is reduced to half of the orginal value
   B. Is reduced to one fourth of the original value
   C. Becomes double
   D. Becomes four times

6. Angular displacement generally expressed in
   A. Degrees
   B. Revolution
   C. Radian
   D. All of these

7. Radian is the unit of angular displacement which is
   A. Less than degree
   B. Greater than degree
   C. Equal
   D. None of these

8. A couple produces
   A. Purely linear motion
   B. Purely rotational motion
   C. Linear and rotational motion
   D. No motion

9. One radian is equal to
   A. $\frac{180^\circ}{\pi}$
   B. 58°
   C. 57°
   D. 57.3°

10. The angular speed of a flywheel making 120 revolutions/minute is
    A. π rad/s
    B. 2π rad/s
    C. 4π rad/s
    D. 3π rad/s

11. The rate at which the angular displacement is changing with time is called
    A. Angular acceleration
    B. Angular velocity
    C. Average angular velocity
    D. None of these

12. In a uniform circular motion (horizontal) of a ball tied with a string, velocity at any time is at any angle θ with acceleration, then θ is
    A. $\theta = 60^\circ$
    B. $\theta = 30^\circ$
    C. $\theta = 90^\circ$
    D. None of the above

13. The angular velocity at some particular instant is the instantaneous angular velocity
    A. $\omega_i = \lim_{\Delta t \to 0} \frac{\Delta S}{\Delta t}$
    B. $\omega_i = \lim_{\Delta t \to 0} \frac{\Delta t}{\Delta S}$
    C. $\omega_i = \lim_{\Delta t \to 0} \frac{\Delta \theta}{\Delta t}$
    D. $\omega_i = \lim_{\Delta t \to 0} \frac{1}{\Delta t^2}$

14. S.I unit of angular velocity is
    A. Radian per second
    B. Revolution per minute
    C. Degree per second
    D. None of these

15. If a particle covers half the circle of radius R with constant speed then
    A. Momentum change is mv
    B. Change in KE is $\frac{1}{2}mv^2$
    C. Change in KE is mv^2
    D. Change in KE is zero

16. As the Δt approaches to zero, the limit of ratio $\frac{\Delta \theta}{\Delta t}$ becomes
    A. Average acceleration
    B. Variable angular acceleration

MCQ Set 1

MCQ Set 1 is consisted of the questions from the topic of Circular Motion. The set takes you from very basic level (Sweet Candies) to the very tough level (Brain Buster).

Sweet Candies

Directions:

You are given following questions from the topics of this section, with four choices A through D. Select the choice that will answer the question best by filling the appropriate circle at the end of each question.

Answer of each question has been bolded for convenience.

1. Angle subtended at the centre of the circle by a body is called
   A. Angular velocity
   B. Linear velocity
   C. Angular displacement
   D. Linear displacement

2. When a body moves in a circle in the clockwise direction, the angular displacement $\Delta\theta$ is taken as
   A. Positive
   B. Negative
   C. Neutral
   D. absolute

3. The torque on a body will be zero if the angle between $\vec{r}$ and is
   A. 90^0 B. 180^0
   C. 270^0 D. 45^0

4. The direction of angular displacement is determined by using
   A. Heat-to-tail rule
   B. Fleming left hand rule
   C. Right angle rule
   D. None of these

5. If the distance between two mass particles is doubled, the gravitational force between them
   A. Is reduced to half of the original value
   B. Is reduced to one fourth of the original value
   C. Becomes double
   D. Becomes four times

6. Angular displacement generally expressed in
   A. Degrees
   B. Revolution
   C. Radian
   D. All of these

7. Radian is the unit of angular displacement which is
   A. Less than degree
   B. Greater than degree
   C. Equal
   D. None of these

8. A couple produces
   A. Purely linear motion
   B. Purely rotational motion
   C. Linear and rotational motion
   D. No motion

9. One radian is equal to
   A. $\frac{360^0}{\pi}$
   B. 58^0
   C. 57^0
   D. 57.3^0

10. The angular speed of a flywheel making 120 revolutions/minute is:
    A. π rad/s
    B. 2π rad/s
    C. 4π rad/s
    D. 6π rad/s

11. The rate at which the angular displacement is changing with time is called
    A. Angular acceleration
    B. Angular velocity
    C. Average angular velocity
    D. None of these

12. In a uniform circular motion (horizontal) of a ball tied with a string, velocity at any time is at any angle θ with acceleration, then θ is
    A. $\theta = 60^0$
    B. $\theta = 30^0$
    C. $\theta = 90^0$
    D. None of the above

13. The angular velocity at some particular instant is the instantaneous angular velocity
    A. $\omega_i = \lim_{\Delta t \to 0} \frac{\Delta S}{\Delta t}$
    B. $\omega_i = \lim_{\Delta t \to 0} \frac{\Delta t}{\Delta S}$
    C. $\omega_i = \lim_{\Delta t \to 0} \frac{\Delta \theta}{\Delta t}$
    D. $\omega_i = \lim_{\Delta t \to 0} \frac{\Delta t}{\Delta \theta}$

14. S .I. unit of angular velocity is
    A. Radian per second
    B. Revolution per minute
    C. Degree per second
    D. None of these

15. If a particle covers half the circle of radius R with constant speed then
    A. Momentum change is mvr
    B. Change in KE is $\frac{1}{2}mv^2$
    C. Change in KE is mv^2
    D. Change in KE is zero

16. As the Δt approaches to zero, the limit of ration $\frac{\Delta\omega}{\Delta t}$ becomes
    A. Average acceleration
    B. Variable angular acceleration

C. Instantaneous angular acceleration instantaneous
D. None of these

17. Angular acceleration is a
A. Scalar quantity3
B. Variable quantity
C. Vector quantity
D. None of these

18. The units of angular acceleration is
A. Radian
B. Radian per second
C. Radian persecond^2
D. None of these

19. The axis of ration of an object will not change its orientation unless
A. Internal torque acts
B. Internal torque acts in one direction
C. External torque acts
D. None of these

20. The linear velocity in a circle is called
A. Linear velocity
B. Angular velocity
C. Tangential velocity
D. None of these

21. At the top of the trajectory of a projectile, the acceleration is
A. Maximum
B. Minimum
C. Zero
D. g

22. The relation between linear acceleration and angular acceleration is
A. $a = r\omega\alpha$
B. $a = \frac{r}{\omega}a$
C. $a = \frac{\omega r}{a}$
D. $a_t = ra$

23. For keeping a body in circular motion, the force required is
A. Centripetal
B. Centrifugal
C. Radial
D. Tangential

24. In a uniform circular motion of a particle, the direction changes but not its
A. Angular displacement
B. Magnitude of velocity
C. Force towards centre
D. b and c

25. The quantity mr^2 is known as
A. Moment arm
B. Moment of inertia
C. Moment of force
D. None of these

26. Moment of inertia depends on mass and also on
A. r
B. r^2
C. r^3
D. None of these

27. If a force acts on a body, whose action line does not pass through its centre of gravity, then the body will experience
A. Angular acceleration
B. Linear acceleration
C. No acceleration
D. None of these

28. Moment of inertia of a thin ring or hoop is
A. mr^2
B. $\frac{2}{3}mr^2$
C. $\frac{5}{6}mr^2$
D. $\frac{1}{3}mr^2$

29. If the particle is moving in a circle of radius s with uniform angular velocity ω. The angle between r and tangential velocity is
A. 0^0
B. 90^0
C. 180^0
D. 270^0

30. The orbital radius as the revolving body is revolving with low speed is
A. Smaller
B. Larger
C. Independent of speed
D. Equal to angular momentum

31. The angular momentum of a particle having uniform velocity about a fixed origin:
A. Varies with its position w.r.t. the origin
B. Varies with time
C. Remains constant
D. Is zero

32. The angular momentum is a vector quantity
A. Perpendicular to the axis of rotation
B. Along the axis of rotation
C. At the axis of rotation
D. None of these

33. A body moving in circular motion with constant speed has
A. Constant velocity
B. Constant acceleration
C. Constant kinetic energy
D. Constant displacement

34. Angular momentum is
A. Vector (axial)
B. Vector (polar)
C. Scalar
D. None of these

35. What remains constant when the earth revolves around the sun?
A. Angular momentum
B. Linear momentum
C. Angular kinetic energy
D. Linear kinetic energy

36. A couple produces

A. Purely linear motion
B. Purely rotational motion
C. Linear and rotational motion
D. Vibratory motion

37. In which case application of angular velocity is useful?
A. When a body is rotating
B. When velocity of body is in a straight line
C. When velocity is in a straight line
D. None of these

38. Which of the following is the relation of centripetal force?
A. $\frac{mv^2}{r}$ B. $\frac{mv}{r}$
C. $\frac{mv^3}{r}$ D. $\frac{mv^3}{r^2}$

39. The angular speed of a flywheel making 120 revolutions/minute is:
A. π rad/s
B. 2π rad/s
C. 4π rad/s
D. 6π rad/s

40. A cyclist bends while taking a turn to:
A. Reduce friction
B. Generate required centripetal force
C. Reduce apparent weight
D. Reduce speed

Achievement Key

Correct Answers	You Got
More than 35	
Below 30	

If you got thumb down, you must consider learning more about the circulatory motion.
If you got thumb up, be prepare to have a hard exercise based on circulatory motion.

Brain Busters

1 A stone attached to a string is being whirled in a vertical circle. The string is likely to break when the stone is
A. At the lowest position
B. At the highest position
C. At any point during motion
D. None of the above

2. A body of mass m moves in a horizontal circle of radius r at constant speed V. The work done by the centripetal force is
A. $2mv^2$ B. mv^2
C. πmv^2 **D. Zero**

3. A cylinder cannot roll on
A. A rough horizontal plane
B. A smooth horizontal plane
C. A rough inclined plane
D. A smooth inclined plane

4. Rotatory motion of a body is produced by applying a
A. Couple
B. Impulse of a force
C. Force
D. None of these

5. A body is whirled in a horizontal circle of radius 20cm. It has angular velocity of 10 rads^{-1}. What is its linear velocity at any point on circular path?
A. 10 ms^{-1}
B. 2 ms^{-1}
C. 20 ms^{-1}
D. $\sqrt{2}$ ms^{-1}

6. An electric fan rotating to bend the normally straight path of the particle into acicular path is called
A. + 1.267revs^{-2}
B. 0027revs^{-2}
C. -0.167revs^{-2}
D. -0.152revs^{-2}

7. A 4 kg mass and a 1 kg mass are moving with equal energies. The ratio of the magnitudes of their linear momenta is
A. 1 : 2 B. 1 : 1
C. 2 : 1 D. 4 : 1

8. A 10 Kg car is turning around a corner at 10 ms^{-1} .he radius of the circular arc is 10. Find the force between the types and pavement
A. 1.0×10^5N
B. 1.0×10^4 N
C. 1.0×10^3 N
D. None of these

9. A particle reaches its highest point when it has covered exactly one half of its horizontal range. The corresponding point on the displacement time graph is characterized by
A. Negative slope and zero curvature
B. Zero slop and negative curvature
C. Zero slope and positive curvature
D. Positive slope and zero curvature

10. The centripetal force for a car moving on a road is given by
A. Friction due to tires
B. Force of brakes
C. The driver of the car
D. Force by steering wheel

11. Rotational kinetic energy of a disc is
A. $K.E_{rot} = \frac{1}{2}mV^2$
B. $K.E_{rot} = \frac{1}{3}mV^2$
C. $K.E_{rot} = \frac{1}{4}mV^2$
D. None of these

12. If the earth were to rotate faster, than its present speed the weight of an object will
A. Increase at the equator but remain unchanged at the poles
B. Decrease at the equator but remain unchanged at the poles
C. Remain unchanged at the decrease but decrease at the poles
D. Remain unchanged at the equator but increase at the poles

13. Centre of mass is a point
A. Which is geometric centre of a body
B. From which distance of particles are same
C. Where the whole mass of the body is supposed to be centred
D. Which is the origin of reference frame

14. What will be the duration of the day and night (in hour) if the diameter of the earth is suddenly reduced to half its original value, the mass remaining constant?
A. 12
B. 6
C. 3
D. 2

15. A person standing on a rotating platform has his hands lowered. He suddenly outstretches his arms. The angular momentum
A. Becomes zero
B. Increases
C. Decreases
D. Remains the same

16. A body of mass 100 g is rotating in a circular path of radius r cm with constant velocity. The work done in one complete revolution is
A. 100 rJ
B. (r/100) J
C. (100/r) J
D. Zero

17. The angular velocity of a particle rotating in a circular orbit 100 times per minute is
A. 1.66 rad/s
B. 10.47 rad/s
C. 10.47 deg/s
D. 60 deg/s

18. Under a constant torque, the angular momentum of a body changes from A to 4A in 4 second. Find the torque.
A. (3/4)A
B. (1/4)A
C. 3A
D. (4/3)A

19. A 500kg car takes a round turn of radius 0 m with a velocity of 36 km/h. The centripetal force is
A. 250 N
B. 750 N
C. 1000 N
D. 1200 N

20. Coin of radius R is beaten uniform to make a disc of radius 2R. Its moment of inertia.
A. Decreases
B. Increases
C. Remains the same
D. Decreases or increases depending on the actual value

21. A cylinder cannot roll on
A. A rough horizontal plane
B. A smooth horizontal plane
C. A rough inclined plane
D. A smooth inclined plane

22. For a body moving with constant speed in a horizontal circle, which of the following remains constant?
A. Velocity
B. Centripetal force
C. Acceleration
D. Kinetic energy

23. Angular momentum has the same unit as
A. impulse × distance
B. linear momentum × time
C. work × frequency
D. power × time

24. The acceleration of a motor car is 8 m/s^2. If the diameter of its wheel be 2 meter, its angular acceleration will be
A. 8 m/s^2
B. 8 radian/s^2
C. 16 m/s^2
D. 16 radian/s^2

25. What is true between centre of gravity and centre of mass?
A. They are always at the same point
B. Centre of gravity changes as one goes away from the earth but centre of mass remains same
C. Centre of mass changes but centre of gravity is always same
D. None of these

26. Which of these statements is not correct?
A. Moment of inertia is independent of shape and size of the body
B. Moment of inertia depends on choice of axes
C. Moment of inertia does not depend on mass of body
D. None of these

27. In a uniform circular motion (horizontal) of a ball tied with a string, velocity at any time is at any angle θ with acceleration, then θ is
A. $\theta = 60^\circ$
B. $\theta = 30^\circ$
C. $\theta = 90^\circ$
D. None of the above

28. The angular momentum of a system of particles is not conserved
A. When net external force is acting upon the system

B. **When a net external torque is acting upon the system**
C. When a net external impulse is acting upon the system
D. None of these

29. If a force acts on a body, whose action line does not pass through its centre of gravity, then the body will experience
A. Angular acceleration
B. Linear acceleration
C. No acceleration
D. None of these

30. The torque acting on a body is the rotational analogue of
A. Mass of the body
B. Linear kinetic energy of the body
C. Linear velocity of the body
D. Force in linear motion

31. If solid sphere and solid cylinder of same mass and density rotate about their own axis, the moment of inertia will be greater for
A. Solid sphere
B. Solid cylinder
C. Both
D. Equal both

32. If a particle covers half the circle of radius R with constant speed then
A. Momentum change is mvr
B. Change in KE is $\frac{1}{2}mv^2$
C. Change in KE is mv^2
D. Change in KE is zero

33. The angular momentum of a body is conserved if
A. Force acting on it is zero
B. Torque acting on it is zero
C. Force acting on it is constant
D. Torque acting on it is constant

34. A particle is moving in a vertical circle. The tensions the string when passing through two positions at angles 30° and 60° from vertical (lowest positions) are T_1 and T_2 respectively. Then
A. $T_1 = T_2$
B. $T_2 > T_1$
C. $T_1 > T_2$
D. Tension in the string always remains the same

35. When torque acting upon a system is zero which of the following will be constant?
A. Force
B. Linear momentum
C. Linear impulse
D. None of these

36. Motorcycle drivers double its velocity when he is having a turn. The force exerted outwardly will by
A. Double
B. Half
C. 4 times
D. 1/4 time

37. A particle undergoes uniform circular motion. About which point on the plane of the circle, will the angular momentum of the particle remain conserved?
A. Centre of the circle
B. On the circumference of the circle
C. Inside the circle
D. Outside the circle

38. For keeping a body in circular motion, the force required is
A. Centripetal
B. Centrifugal
C. Radial
D. Tangential

39. Moment of inertia of an object does not depend upon
A. Mass of object
B. Mass distribution
C. Angular velocity
D. Axis of rotation

40. A particle is acted upon by a force of constant magnitude, which is always perpendicular to the velocity of the particle; the motion of the particle takes place in a plane. It follows that
A. Its velocity is constant
B. Its acceleration is constant
C. Its kinetic energy is constant
D. Its moves in straight line

Achievement Key

Correct Answers	You Got
More than 32	
Below 28	

If you got thumb down, you must consider learning more about the circulatory motion.
If you got thumb up, go to the next exercise

6

FLUID DYNAMICS EQUATIONS

Bernoulli's Equation

$$P\rho g + v22g + z = K$$

where,

- $P\rho g$ = pressure energy per unit weight fluid or pressure head
- $V22g$ = kinetic energy per unit weight or kinetic head
- z = energy per unit weight or potential head
- P = pressure
- ρ = Density
- K = constant

Equation of Continuity

For incompressible it is: $A_1V_1 = A_2V_2$

For compressible fluid it is: $p_1A_1V_1 = p_2A_2V_2$

where, A_1 and A_2 are Areas

p_1 and p_2 are pressures

V_1 and V_2 are Volumes

MCQ Set 1

MCQ Set 1 is consisted of the questions from the topic of Fluid Dynamics. The set takes you from very basic level (Sweet Candies) to the very tough level (Brain Buster).

Sweet Candies

Directions:

You are given following questions from the topics of this section, with four choices A through D. Select the choice that will answer the question best by filling the appropriate circle at the end of each question.

Answer of each question has been bolded for convenience.

1. The equation of continuity of fluid is based on the
   - **A. Law of conservation of energy**
   - B. Law of conservation of mass
   - C. Law of conservation of momentum
   - D. Third law of motion

2. The Bernoulli's equation is based on the
   - **A. Law of Conservation of energy**
   - B. Law of conservation of mass
   - C. Law of conservation of momentum
   - D. Third law of motion

3. The rain drop falling from the sky reach the ground with
   - **A. Constant terminal velocity**
   - B. Constant gravitational acceleration
   - C. Variable acceleration
   - D. Variable speed

4. If v is the velocity of flow of liquid through a tube of area of cross-section A, then according to equation of continuity
   - A. v/A = constant
   - B. A/v = constant
   - **C. Av=constant**
   - D. None

5. Which of the following substances has high resistance to flow?
   - A. Honey
   - B. Thick tar
   - C. Mobile oil
   - **D. All of these**

6. Substance which flows easily are
   - A. Water
   - B. Kerosene oil
   - C. Petrol
   - **D. All of these**

7. A flowing liquid possesses
   A. K.E.
   B. P.E.
   C. Pressure Energy
   D. All

8. The Drag force increases as the speed of the object
   A. Decreases
   B. Increases
   C. Decreases rapidly
   D. None of these

9. At terminal velocity, fluid friction is
   A. Maximum
   B. Minimum
   C. Zero
   D. Decreasing

10. As the droplet accelerates the net force acting on it is
    A. Increase
    B. Decreases
    C. Zero
    D. None of these

11. With increase of temperature , the viscosity of liquid and gases
    A. Increases for both
    B. Decrease for both
    C. Increase for liquids and decreases for gases
    D. Decreases for liquids and increase for gases

12. The flow is said to be streamline or laminar when every particle
    A. Moves in different direction
    B. Moves along the same path as
    C. Slowly moves in one direction
    D. None of these

13. Ventura relation is used to measure
    A. Speed of liquid flow
    B. Height of the pipe
    C. Pressure of the liquid
    D. Density of the liquid

14. The maximum velocity of an object falling freely through air is called
    A. Initial velocity
    B. Final velocity
    C. Terminal velocity
    D. Instantaneous velocity

15. In deriving Bernoulli's equation, it is assumed that the fluid is
    A. Incompressible
    B. Non-viscous
    C. In a steady state
    D. All of these

16. The pressure will be low where the speed of the fluid is
    A. Zero
    B. High
    C. Low
    D. Constant

17. A chimney works best when it is
    A. Tall
    B. Exposed to air currents
    C. Wide
    D. A and B

18. orce of friction is present in
    A. Liquid
    B. Solid
    C. Gases
    D. All of above

19. $V=\sqrt{2g(h_1-h_2)}$ shows the
    A. Equation of continuity
    B. Bernoulli's theorem
    C. Torricelli's theorem
    D. Equation for compressible fluids

20. In Torricelli's theorem, the speed of efflux is equal to
    A. h_1-h_2
    B. Action of gravity
    C. (h_1-h_2) and falling under gravity
    D. None of these

21. The relation $P_1-P_2=\frac{1}{2}\rho V_2^2$ shows the
    A. Bernoulli's equitation
    B. Torricelli's theorem
    C. Ventura relation
    D. None of these

22. The maximum drag force on a falling sphere is 9.8 N, its weight is
    A. 1 N
    B. 9.8 N
    C. 4.9 N
    D. Cannot be calculated

23. The mass of fluid passing through any cross-section per unit time is called
    A. Electric flux
    B. Magnetic flux
    C. Both a and b
    D. Mass flux

24. Sphygmomanometer measures
    A. Density of water
    B. Blood pressure
    C. Milk density
    D. None of these

25. At high altitude the blood oozes out of the nose and ear because
    A. The blood pressure increase at high altitudes
    B. The percentage of oxygen in the air increase
    C. The atmospheric pressure decreases there
    D. The density of blood decreases at high altitudes

26. The velocity of falling raindrops attains limited value because of
    A. Up thrust of air
    B. Air currents of the earth atmosphere
    C. Surface tension effect
    D. Viscous force exerted by air

27. The terminal velocity of a small size spherical body of radius R moving in a fluid varies as
    A. R
    B. R^2
    C. $\frac{1}{R}$
    D. $\left(\frac{1}{R}\right)^2$

28. Ball pen functions on the principle of
A. Viscosity
B. Boyle's law
C. Gravitational force
D. Surface tension

29. With the increase of temperature viscosity
A. Increase
B. Decrease
C. Remains same
D. Doubles

30. According to Stokes law, drag force depends on
A. Initial velocity
B. Final velocity
C. Terminal velocity
D. Instantaneous velocity

31. The smooth or steady stream-line flow is known as
A. Laminar flow
B. Turbulent flow
C. Both a and b
D. None of the above

32. Blood has a density
A. Equal to water
B. Greater then water
C. Lesser then water
D. None of these

33. The pressure will be low where the speed of the fluid is
A. Zero
B. High
C. Low
D. Constant

34. At high altitude the blood oozes out of the nose and ear because
A. The blood pressure increase at high altitudes
B. The percentage of oxygen in the air increase
C. The atmospheric pressure decreases there
D. The density of blood decreases at high altitudes

35. The maximum drag force on a falling sphere is 9.8 N, it weight is
A. 1 N
B. 9.8 N
C. 4.9 N
D. Cannot be calculated

36. Internal friction of fluid is called
A. Surface tension
B. Viscosity
C. Resistance
D. Cohesive force

37. When the velocity of a liquid flowing steadily in a tube increases, its pressure?
A. Decreases
B. Increases
C. Remains same
D. Zero

38. The electrical forces between the molecules of a liquid are
A. Repulsive
B. Attractive
C. Both A and B
D. None

39. In case of streamed lined flow of liquid, the loss of energy is
A. Maximum
B. Minimum
C. Infinite
D. equal to what is in turbulent flow

40. Water is filled up to a height 'H' in a tank. A hole is made at depth 'h' below the water level. The velocity of efflux of the fluid is
A. 2gh
B. .gh
C. $\sqrt{2gh}$
D. $\sqrt{gh}$

Achievement Key

Correct Answers	You Got
More than 35	
Below 30	

If you got thumb down, you must consider learning more about the fluid dynamics.

If you got thumb up, be prepare to have a hard exercise based on fluid dynamics.

Brain Busters

1. If $r = 1.0 \times 10^{-4}$ m $\rho = 1000 kgms^{-3}$ $\eta = 19 \times 10^{-6}$ $kgm^{-1}s^{-1}$ find V_t terminal velocity
A. $1.02\ 10^{-3}\ ms^{-1}$
B. $0.12\ 10^{-3} ms^{-1}$
C. $1.1 ms^{-1}$
D. $1.21 ms^{-1}$

2. Fire fighters have a jet attached to the head of their water pipes in order to
A. Increase the mass of water flowing per second
B. Increase the volume of water flowing per second
C. Increase the velocity of water flowing out
D. Avoid wastage of water

3. Surface tension of water is due to
A. Inter molecular attractions
B. Intermolecular spaces
C. Inter molecular repulsion
D. Intra molecular forces

4. A water hose of internal diameter of 20 mm discharge 30 kg of water in 60 sec. Calculate speed of water (ρ for water is 1000 kgm^{-3})
A. $1.2\ ms^{-1}$
B. $1.6\ ms^{-1}$
C. $1.8\ ms^{-1}$
D. $2.1\ ms^{-1}$

5. A car engine is based on the principle of

A. Bernoulli's equation
B. Ventura relation
C. Torricelli's theorem
D. None of these

6. In a surface tension experiment with a capillary tube water rises up to 0.1 m. If the same experiment is repeated on an artificial satellite, which is revolving around the earth, water will rise in the capillary tube up to a height of
A. 0.1 m
B. 0.2 m
C. 0.98 m
D. Full length of the capillary tube

7. In a container having water filled up to a height h, a hole is made in the bottom. The velocity of water flowing out of the hole is
A. Independent of h
B. Proportional to $h^{1/2}$
C. Proportional to h
D. Proportional to h^2

8. In a surface tension experiment with a capillary tube water rises up to 0.1 m. If the same experiment is repeated on an artificial satellite, which is revolving around the earth, water will rise in the capillary tube up to a height of
A. 0.1 m
B. 0.2 m
C. 0.98 m
D. Full length of the capillary tube

9. A body is floating in a liquid. The up thrust on the body is
A. Equal to weight of liquid displaced
B. Zero
C. Less than the weight of liquid displaced
D. Weight of body-weight of liquid displaced

10. Pressure exerted by a gas on the walls of its container is due to
A. adhesion between the gas molecules and the container
B. cohesion between the gas molecules and the container
C. collision between the gas molecules and the container
D. surface tension of the gas

11. The term Brownian movement refers to
A. irregular motions of small particles suspended in a fluid
B. convection currents in a liquid or gas
C. convection currents in a gas but not in a liquid
D. the stretching of a body beyond its elastic limit

12. The density of water is 10^3 kg/m^3. The water pressure on a submarine is 2.0×10^7 N/m^2. The depth of the submarine below the surface of the water, in meters, is approximately
A. 200 m
B. 11000 m
C. 200 m
D. 8000 m

13. The force exerted by the fluid in a hydraulic pump on the piston is 2000 N. If the area of the piston is 10 cm^2, the fluid pressure on the piston is, in N/cm^2,
A. 20
B. 200
C. 2000
D. 20,000

14. Deep water almost runs still when surface water flow in rivers. What does it explains
A. Magnus effect
B. Equation of continuity
C. Surface energy
D. Bernoulli's equation

15. The terminal velocity of for a water droplet of radius 10^{-5} m is of the order of
A. 1 cm/s
B. 1 mm/s
C. 1 nm/s
D. 1 μm/s

16. If water rises 4 cm in a long, thin tube because of capillary action, then, under corresponding conditions of use, the rise (in the tube) of a liquid whose density is 2 g/cm^3 will be
A. 1 cm
B. 2 cm
C. 8 cm
D. None

17. A container has a small hole in the bottom. Air can go through this hole, but water cannot. This can be best explained by the statement that
A. water contains hydrogen atoms, air does not
B. water molecules are larger than molecules in the air
C. water molecules are smaller than molecules in the air
D. surface tension of the water prevents it from

18. The two thin tubes which show most correctly the behaviour of water are

A. 1 and2
B. 2and3
C. 3and4
D. 4and5

19. Two water pipes of diameters 4 cm and 8 cm are connected with a supply line. The velocity of flow of water in the pipe 4 cm diameter is
A. ¼ times
B. 4 times
C. Twice
D. ½ of 8 cm diameter pipe

20. A tube is tapered from 20 cm diameter to 2 cm diameter, the velocity at the first cross-section is 50 cm/s, then the velocity at the second cross-section is
A. 50 m/s
B. 20 m/s
C. 40 cm/s
D. 5 cm/s

21. Two boats rowing close to one another tend to collide. This is due to the
A. Air velocity between the narrow gap increases
B. Pressure between the narrow gap decreases
C. Both A and B
D. None

22. Which of the following is a suitable device for measuring the internal diameter of a capillary tube with diameter less than 0.5 mm.
A. Meter Rule
B. Venire Callipers
C. Micrometre Screw Gauge
D. Travelling Microscope

23. When fluid is incompressible then
A. velocity of the fluid is constant
B. flow of the fluid is straight line
C. density of the fluid is constant
D. volume of the fluid is constant

24. According to equation of continuity $A_1V_1 = A_2V_2 = k$.
The constant is equal to
A. flow rate
B. volume of fluid
C. mass of fluid
D. density of fluid

25. Equation of continuity is obtained by apply in law of conservation of
A. mass
B. energy
C. momentum
D. all

26. Speed of efflux can be determined by applying
A. Bernoulli theorem
B. Torricelli's theorem
C. venture relation
D. all

27. A man standing near a fast moving train may fall
A. on the train
B. away from the train
C. towards the train
D. on himself

28. The density of water in F.P.S. system is:
A. 50 lb/ft^2
B. 625 ft/lb
C. 62.5kft/lb^3
D. 62.5 lb/ft^3

29. In cricket when a bowler produce reverse swing the ball will move towards
A. shinning side of the ball
B. rough side
C. seam of the ball
D. goes straight

30. The effect of the decrease in pressure with the increase of the speed of fluid in a horizontal pipe is known as
A. Bernoulli effect
B. Torricelli effect
C. Venturi effect
D. Stokes effect

31. In a normal shock wave in one dimensional flow
A. pressure, density and temperature increase
B. velocity, temperature and density increase
C. pressure, density and temperature decrease
D. velocity, pressure and density decrease

32. Centre of buoyancy is
A. The point of intersection of buoyant force and centre line of the body
B. Centre of gravity of the body
C. Centric of displaced volume fluid
D. Midpoint between C.G. and metacentric.

33. A small plastic boat loaded with pieces of steel rods is floating in a bath tub. If the cargo is dumped into the water allowing the both to float empty, the water level in the tub will
A. Rise
B. Fall
C. Remains same
D. Rise and then fall

34. In equilibrium condition, fluids are not able to sustain
A. Shear force
B. Resistance to viscosity
C. Surface tension
D. Geometric similitude

35. Flow occurring in a pipeline when a valve is being opened is
A. Steady **B. Unsteady**
C. Laminar D. Vortex

36. Total pressure on 1 m x 1 m gate immersed vertically at a depth of 2 m below the free water surface will be
A. 1000 kg
B. 2000 kg
C. 4000 kg
D. 8000 kg

37. In steady flow of a fluid, the acceleration of any fluid particle is
A. Constant B. Variable
C. Zero D. Never zero

38. Two dimensional flow occurs when the
A. Directional and magnitude of the velocity at all points are identical

B. Velocity of successive fluid particles, at any point, is same at successive periods of time
C. Magnitude and direction of velocity, do not change from point to point in the fluid
D. Fluid particles move in a plane or parallel planes and the streamline patterns are identical in each plane

39. A piece of wood having weight 5 kg floats in water with 60% of its volume under the liquid. The specific gravity of wood is
A. 0.83
B. 0.6
C. 0.4
D. None of the above

40. Separation of flow occurs due to reduction of pressure gradient to
A. Zero
B. Negligibly low value
C. The extent such that vapour formation starts
D. None of the above

41. The Air in a large paper bags be heated the bag is then found to rise through the surrounding cold air is because:
A. The air in the bag has become less dense
B. The mass of the paper bag has decreased
C. Heat always rises
D. The mass of air in the bag has increase

Achievement Key

Correct Answers	You Got
More than 35	
Below 30	

If you got thumb down, you must consider learning more about the fluid dynamics.
If you got thumb up, go to the next exercise.

CHAPTER 7

Waves and Oscillations

Description	Equation
Amplitude of a driven oscillation	$A=\frac{F_0}{\sqrt{m^2\left(\omega_0^2-\omega^2\right)^2+b^2\omega^2}}$
Angular frequency for a damped oscillation	$\omega'=\omega_0\sqrt{1-\left(\frac{b}{2m\omega_0}\right)^2}=\omega_0\sqrt{1-\frac{1}{4Q^2}}$
Beat frequency	$f=f_1-f_2$
Displacement of a driven oscillator	$x=A\cos(\omega t+\delta)$
Displacement of a slightly damped oscillator	$x=A_0\exp\left(-\frac{b}{2m}t\right)\cos(\omega' t+\delta)$
Energy change in a damped oscillation	$\frac{\Delta E}{E}=-\frac{b}{m}T$
Energy change in a damped oscillation	$E=E0\exp\left(-\frac{b}{m}t\right)=E_0\exp\left(-\frac{t}{\tau}\right)$
Energy transmitted by a harmonic wave	$\Delta E=\frac{1}{2}\mu\omega^2A^2\Delta x=\frac{1}{2}\mu\omega^2A^2\upsilon\Delta t$
Harmonic wave function	$y(x,t)=A\sin\left[2\pi\left(\frac{x}{\lambda}-\frac{t}{T}\right)\right]$
Harmonic wave function	$y(x,t)=A\sin\left[k(x-\upsilon t)\right]$

Kinetic energy of simple harmonic motion	$K=\frac{1}{2}kA^2\sin^2(\omega t+\delta)$
Phase constant of a driven oscillation	$\tan\delta=\frac{b\omega}{m(\omega_0^2-\omega^2)}$
Potential energy of simple harmonic motion	$U=\frac{1}{2}kA^2\cos^2(\omega t+\delta)$
Power transmitted by a harmonic wave	$P=\frac{dE}{dt}=\frac{1}{2}\mu\omega^2A^2\upsilon$
Standing-wave function	$y(x,t)=A_n\cos(\omega_n t+\delta_n)\sin(k_n x)$
Superposition of standing waves on a string with both ends fixed	$y(x,t)=\sum_n A_n\cos(\omega_n t+\delta_n)\sin(k_n x)$
Total energy of simple harmonic motion	$E_{Total}=\frac{1}{2}kA^2$
Velocity at resonance frequency of a driven oscillator	$\upsilon=+A\omega\cos(\omega t)=-A\omega\sin\left(\omega t-\frac{\pi}{2}\right)$

MCQ Set 1

MCQ Set 1 is consisted of the questions from the topic of Waves and Oscillations. The set takes you from very basic level (Sweet Candies) to the very tough level (Brain Buster).

Sweet Candies

Directions:

You are given following questions from the topics of this section, with four choices A through D. Select the choice that will answer the question best by filling the appropriate circle at the end of each question.

Answer of each question has been bolded for convenience.

A. F = ma

B. F = kx
C. F = ½ kx
D. F = –kx

2. Oscillatory motion is a type of motion which is
   A. To and fro
   B. Vibratory motion
   C. Periodic motions
   D. All of these

3. Simple harmonic motion is mathematically represented as
   A. Aα– x B. Aα x
   C. V α– x D. F α– x

4. The body oscillates due to a
   A. Applied force
   B. Restoring force
   C. Frictional force
   D. Air pressure

5. In vibratory motion which parameter remains constant?
   A. P.E. Energy
   B. K.E. Energy
   C. Total Energy
   D. Angular Momentum

6. The vibrating bodies produce
   A. Sound
   B. Waves
   C. Disturbance
   D. All of these

7. The speed of a particle executing SHM along a circular path is given by the relation
   A. $V=r^2-x^2$
   B. $V=\sqrt{r^2-x^2}$
   C. $V=\omega\sqrt{r^2-x^2}$
   D. None of the above

8. Hook's law is defined as
   A. F and X are directly proportional
   B. F and X are inverse proportional
   C. F and X has no relation
   D. Product of F and X is proportional to friction

9. The frequency of second pendulum is
   A. 1 hertz
   B. 2 hertz
   C. 0.5 hertz
   D. None of the above

10. Which of the following factors imparts in simple harmonic motion
    A. Acceleration is directly proportional to displacement
    B. Acceleration is directed towards the mean position
    C. Acceleration produced is due to restoring force
    D. All of these

11. If a simple pendulum is shifted from Multan to Mount Everest, then its time period
    A. Increases
    B. Decreases
    C. Remains constant
    D. Becomes zero

12. One vibration means, the motion of mass from its
    A. Means position to upper extreme position

B. From extreme position
C. From means position to back to its means position
D. All of these

13. Frequency is the term used for
A. Number of vibration for second
B. Time to take one Vibration
C. Number of vibrations per minute
D. None of these

14. If mass attached to a spring increases, then its time period
A. Increases
B. Decreases
C. Remains constant
D. Becomes zero

15. The relation for the displacement in SHM is
A. $X = X_0 \cos \omega t$
B. $X = X_0 \sin \omega t$
C. $X = X_0 \cos(\omega t + \phi)$
D. None of these

16. If the length of the pendulum becomes four times, its time period will become
A. Twice
B. Four times
C. Three times
D. Nine times

17. The velocity of the body changes at different points, It is maximum at
A. Mean position
B. Extreme position
C. Between mean and extreme position
D. None of these

18. Phenomenon of resonance is very often employed to determine the
A. Wavelength of the various bodies
B. Wavelength of the various bodies
C. Amplitudes of the various bodies
D. None of the above

19. The type of motion in which an oscillating disturbance is transmitted from one position to the next without the actual rectilinear translation of the particles of the medium is called
A. Periodic motion
B. Rotatory motion
C. Wave motion
D. Rectilinear motion

20. A simple pendulum is defined as
A. Small heavy mass
B. Friction less support
C. Light inextensible string
D. All of these

21. In case of a vibrating Pendulum, the potential energy is maximum at
A. Mean Position
B. Extreme Position
C. Both A and B
D. None

22. The restoring force applied on the pendulum
A. $mg \cos\theta$ B. $mg \sin\theta$
C. $-mg \sin\theta$ D. $-mg \cos\theta$

23. Tuning of a radio set is an example of
A. Mechanical resonance
B. Musical resonance
C. Electrical resonance
D. Free vibrations

24. Which of the following relation shows the elastic potential energy stored in a stretched spring?
A. $P.E. = \frac{1}{2} KX^2$
B. $P.E. = \frac{1}{2} K^2 X^2$
C. $P.E. = \frac{1}{2} KX_0^2$
D. None of these

25. Which of the following does not hold in simple harmonic motion (SHM)?
A. The force on the particle is maximum at the ends
B. The acceleration is minimum at the mean position
C. The potential energy is maximum at the mean position
D. The kinetic energy is maximum at the mean position.

26. The frequency of free oscillations is known as
A. Minimum frequency
B. Maximum frequency
C. Natural frequency
D. None of these

27. In a progressive wave, the distance between two consecutive crests is
A. $\frac{\lambda}{2}$ B. λ
C. $\frac{3}{2}\lambda$ D. 2λ

28. A driven harmonic oscillator is the device in which, a physical system undergoes
A. Free vibrations
B. Forced vibration
C. Powerful vibration
D. None of these

29. The energy of the oscillation comes from the
A. Applied force
B. Driving source
C. Starting source
D. None of these

30. The potential energy of a spring executing SHM is given by the
A. Kx^2 B. $\frac{1}{2} kx^2$
C. Kx D. $\frac{1}{2} kx$

31. The damped oscillations are produced due to
A. System friction
B. Air resistance
C. Frictional support of the system
D. All of these

32. Specific response of a system which is able to oscillate with a certain period, to an external force acting with the same period is called
A. Time period
B. Wavelength
C. Resonance
D. Doppler's effect

33. The damping depends upon
A. Amplitude
B. Time period
C. Frequency
D. Mass of the oscillating object

34. The time period of a pendulum executing simple harmonic motion depends upon
A. Amplitude
B. Friction
C. Mass
D. gravity

35. The process whereby energy is dissipated from the oscillating system is called
A. Resonance
B. Oscillation
C. Damping
D. None

36. The waveform of simple harmonic motion will be
A. Saw tooth waveform
B. Square wave
C. Sine wave
D. Rectangular waves

37. Which one of the following is a simple harmonic motion?
A. Wave moving through a string fixed at both ends.
B. Earth spinning about its own axis
C. Ball bouncing between two rigid vertical walls
D. Particle moving in a circle with uniform speed.

38. In case of a vibrating Pendulum, if the mass of the pendulum is doubled then its time period
A. Becomes one half
B. Becomes double
C. Remains same
D. Become one fourth

39. The restoring force of S.H.M. is maximum when
A. Displacement is maximum
B. Displacement is half of the amplitude
C. The object crosses the mean position
D. The object is at rest

40. If mass attached to a spring increases, then its time period
A. Increases
B. Decreases
C. Remains constant
D. Becomes zero

Achievement Key

Correct Answers	You Got
More than 35	
Below 30	

If you got thumb down, you must consider learning more about the waves and oscillations.

If you got thumb up, be prepare to have a hard exercise based on waves and oscillations.

Brain Busters

1. Which device can be used to measure the value of g at a certain point or place?
A. Simple Pendulum
B. Horizontal spring Oscillator
C. Lever
D. Vertical spring contents

2. Two springs of spring constants 1500 N/m and 3000 N/m respectively are stretched with the same force. They will have potential energy in the ratio
A. 4 : 1
B. 1 : 4
C. 2 : 1
D. 1 : 2

3. A block weighing 40 kg extends a spring by 0.16 m from its unscratched position. What is the value of K
A. 170 kgs^{-2}
B. 245 kgs^{-2}
C. 215 kgs^{-2}
D. 201 kgs^{-2}

4. A pendulum clock set to give correct time in Karachi is taken to Quetta. It would give correct time if
A. The mass of the pendulum is increased
B. The mass of the pendulum is decreased
C. The length of the pendulum is increased
D. The length of the pendulum is decreased

5. When T= 1.0 sec and g = ms^{-2} Find its frequency of such a pendulum
A. 1 Hz
B. 2 Hz
C. 10Hz
D. 0.1 Hz

6. If the hollow bob of a simple pendulum be filled with mercury that drains out slowly, its time period
A. Increases continuously
B. Decreases continuously
C. Remains same

D. First increases and then decreases

7. Find the distance through which the mass must be pulled down and then released with a velocity of 1.0 ms^{-1} and given that $\omega = 8.94\ s^{-1}$
   A. 0.12m
   B. 0.11m
   C. 0.10m
   D. 0.09m

8. In a simple harmonic motion the kinetic energy (KE) and the potential energy (PE), are such that throughout the motion
   A. KE remains constant
   B. PE remains constant
   C. KE/PE is constant
   D. KE + PE remains constant

9. A spring of spring constant K is halved then the new constant is
   A. 2 K
   B. K/2
   C. 4 K
   D. K/4

10. A spring is vibrating with frequency n having some mass. If it is cut into two equal parts and same mass is suspended, then the new frequency is
    A. $\frac{n}{2}$
    B. n
    C. $n\sqrt{2}$
    D. $\frac{n}{\sqrt{2}}$

11. A simple harmonic oscillator has a period T and energy E. The amplitude of the oscillator is doubled. Choose the correct answer
    A. Period and energy get doubled
    B. Period gets doubled while energy remains the same
    C. Energy gets doubled while period remains the same
    D. Period remains the same and energy becomes 4 times.

12. The potential energy of a particle executing SHM with amplitude A is Eat the extreme position. What is its kinetic energy at y = A/2?
    A. 0.86 E
    B. 0.75 E
    C. 0.50 E
    D. 0.25 E

13. The kinetic energy of a particle, executing S.H.M., is 16 J when it is in its mean position. If the amplitude of oscillations is 25 cm, and the mass of the particle is 5.12 kg, the time period of its oscillations is
    A. $\pi/5$ s
    B. 2π s
    C. 20π s
    D. 5π s

14. A simple harmonic oscillator has a period of 0.01 second and an amplitude of 0.2 m. The magnitude of the velocity in ms^{-1} at the centre of oscillation is
    A. 100
    B. 100π
    C. 20π
    D. 40π

15. Two springs of spring constants 1500 N/m and 3000 N/m respectively are stretched with the same force. They will have potential energy in the ratio
    A. 4 : 1
    B. 1 : 4
    C. 2 : 1
    D. 1 : 2

16. If a simple pendulum oscillates with an amplitude 50 mm and time period of 2s, then its maximum velocity, is
    A. 0.10 m/s
    B. 0.15 m/s
    C. 0.8 m/s
    D. 0.16 m/s

17. A particle performs simple harmonic motion of amplitude 0.020 m and frequency 2.5 Hz. What is its maximum speed?
    A. 0.008 m s^{-1}
    B. 0.050 m s^{-1}
    C. 0.125 m s^{-1}
    D. 0.314 m s^{-1}

18. A particle executes a simple harmonic motion of time period T. Find the time taken by the particle to go directly from its mean position to half the amplitude
    A. T/2
    B. T/4
    C. T/8
    D. T/12

19. For motion of a simple pendulum to be simple harmonic
    A. Amplitude of motion will be every small
    B. Amplitude of motion will be very large
    C. Independent of amplitude of motion
    D. None of these.

20. The length of the second's pendulum on the surface of Earth is 1m. Its length on the surface of moon, where g is $\frac{1}{6}$th the value of g on the surface of Earth, is:
    A. $\frac{1}{6}$m
    B. 6 m
    C. $\frac{1}{36}$m
    D. 36 m

21. A spring-mass system oscillates with a frequency v. if it is taken in an elevator slowly accelerating upward, the frequency will
    A. Increase
    B. Decrease
    C. Remains same
    D. Become zero

22. If the period of oscillation of mass m suspended from a spring is one second, then the period of 4 m will be:
A. $\frac{1}{2}$ sec
B. $\frac{1}{4}$ sec
C. 2 sec
D. 4 sec

23. Two particles A and B of equal masses are suspended from two mass less springs of spring constants k_1 and k_2 respectively. If the maximum velocities, during oscillation, are equal, the ratio of amplitudes of A and B is:
A. $\frac{k_1}{k_2}$
B. $\sqrt{\frac{k_1}{k_2}}$
C. $\frac{k_2}{k_1}$
D. $\sqrt{\frac{k_2}{k_1}}$

24. Which one of the following statements is true for the speed v and the acceleration α of a particle executing simple harmonic motion?
A. Value of α is zero, whatever may be the value of v
B. When v is zero, α is zero
C. When v is maximum, α is zero
D. When v is maximum, α is

25. Maximum acceleration of an object in simple harmonic motion is 24 m/s^2 and maximum velocity is 16 m/sec. Then amplitude of SHM is
A. $\frac{32}{3}$ m
B. $\frac{3}{32}$ m
C. $\frac{2}{3}$ m
D. $\frac{3}{2}$ m

26. One spring has force constant 200 Nm^{-1}, another has force constant 500 Nm^{-1}. If they are joined in series, the force constant will be nearest to
A. 700 Nm^{-1} B. 300 Nm^{-1}
C. 143 Nm^{-1} D. 100 Nm^{-1}

27. A pendulum clock that keeps correct time on the Earth is taken to the Moon. It will run
A. At correct rate
B. 6 times faster
C. $\sqrt{6}$ times faster
D. $\sqrt{6}$ times slower

28. A mass m attached to a spring oscillate every 2 sec. If the mass increases by 2 kg, then time period increases by 1 sec. The initial mass of the body is:
A. 12.6 kg
B. 9.6 kg
C. 3.2 kg
D. 1.6 kg

29. In vibratory motion which parameter remains constant?
A. P.E. Energy
B. K.E. Energy
C. Total Energy
D. Angular Momentum

30. A body with frequency f would complete one vibration in
A. F seconds
B. $\frac{1}{f}$ **seconds**
C. 1 second
D. $\frac{1}{T}$ seconds

31. The length of a spring is 'α' when a force of 4N is applied on it. The length is β when 5N force is applied. Then the length of spring when 9N force is applied is
A. $5\beta - 4\alpha$ B. $\beta - \alpha$
C. $5\alpha - 4\beta$ D. $9(\beta - \alpha)$

32. If the magnitude of displacement is numerically equal to that of acceleration, then the time period is
A. 1 second
B. π second
C. 2π **second**
D. 4π second

33. A pendulum suspended from the ceiling of a train has a period T when the train is at rest. When the train is accelerating with a uniform acceleration, the period of oscillation will
A. Increase
B. Decrease
C. Remain unaffected
D. Become infinite

34. A vertical mass-spring system executes simple harmonic oscillations with a period of 2s. A quantity of this system which exhibits simple harmonic variation with a period of 1s is
A. Velocity
B. Potential energy
C. Phase difference between acceleration and displacement
D. Difference between kinetic energy and potential energy

35. In which of the following lists are all three quantities constant when a particle moves in un-damped simple harmonic motion?
A. Acceleration, force, total energy
B. Amplitude, angular frequency, acceleration
C. angular frequency, acceleration, force
D. total energy, amplitude, angular frequency

36. To make the frequency double of a spring oscillator, we have to
A. Reduce the mass to one fourth
B. Quadruple the mass
C. Double the mass
D. Half the mass

37. In a garden, a boy is swinging in the standing position. How will the time period of the swing be affected if the boy sits down on the swing?
A. Time period will not change
B. Time period will increase
C. Time period will decrease
D. Time period will depend on the weight of the boy.

38. In a Seconds pendulum, mass of the bob is 30 gm. If it is replaced by 90 g mass. Then its time period will be
A. 1 s B. 2 s
C. 4 s D. 3 s

39. Two springs of spring constants k_1 and k_2 are joined in series. The effective spring constant of the combination is given by
A. $(k_1 + k_2)/2$
B. $k_1 + k_2$
C. $k_1 k_2/(k_1 + k_2)$
D. $\sqrt{k_1 k_2}$

40. Identify the exact statement among the following:
A. The greater the mass of a pendulum bob, the shorter is its frequency of oscillation
B. A simple pendulum with a bob of mass M swings with an angular amplitude of 40°. When its angular amplitude is 20°, the tension in the string is less than Mg cos 20°.
C. As the length of a simple pendulum is increased, the maximum velocity of its bob during its oscillation will also increase
D. The fractional change in the time period of a pendulum on changing the temperature is independent of the length of the pendulum.

Achievement Key

Correct Answers	You Got
More than 32	
Below 28	

If you got thumb down, you must consider learning more about the waves and oscillations.
If you got thumb up, go to the next exercise.

MCQ Set 2

MCQ Set 2 is consisted of the questions from the topic of Waves and Oscillations. The set takes you from very basic level (Sweet Candies) to the very tough level (Brain Buster).

Sweet Candies

Directions:

You are given following questions from the topics of this section, with four choices A through D. Select the choice that will answer the question best by filling the appropriate circle at the end of each question.

Answer of each question has been bolded for convenience.

1. The various features of wave phenomenon can be very conveniently studies by an apparatus called
A. Sonometer
B. Ripple tank
C. Hydrometer
D. Barometer

2. Waves without transport of matter, transport
A. Velocity
B. Energy
C. Sound
D. All of these

3. When two waves, having the same frequency and amplitude, traveling in the opposite direction meet one another the resulting interference pattern gives rise to
A. Transverse waves
B. Longitudinal waves
C. Stationary waves or standing waves
D. Electromagnetic waves

4. Waves disturbances may also come in a concentrated bundles like stock waves from an aeroplane flying at
A. Sonic speed
B. Supersonic speed
C. Extra supersonic speed
D. None of these

5. In standing wave pattern antinodes are the point of
A. Zero amplitude
B. Unit amplitude
C. Maximum amplitude
D. Minimum amplitude

6. The wave is generated by an oscillation in the vibrating body and

propagation of wave an through space is by means of oscillation are
A. Electric and magnetic waves
B. Mechanical waves
C. Water waves
D. None of these

7. The mechanical waves are generated by
A. In ropes
B. Coil of springs
C. Water waves
D. All of these

8. Reflection of radar waves from the aero planes is an example of
A. Resonance
B. Doppler effect
C. Interference
D. Beat phenomenon

9. A highly directional beam of ultrasonic waves can be made to travel in water in
A. Many meters
B. Many kilometre
C. Several kilometres
D. None of these

10. The bouncing back of a wave from the boundary of two different media is known as
A. Refraction
B. Transmission
C. Diffraction
D. Reflection

11. A wave in which the displacement of the wave travel perpendicular to the direction of propagation of waves is called
A. Longitudinal waves
B. progressive wave
C. Transverse wave
D. None of these

12. Sound cannot propagate through
A. Walls B. Grass
C. Wood **D. Vacuum**

13. Velocity of sound obtained from Newton's formula comes out to be
A. 2800 ms^{-1}
B. 1800 ms^{-1}
C. 3300 ms^{-1}
D. 1100 ms^{-1}

14. The SI units of intensity of sound are
A. $Watt/m^2$ B. $Joule/s^2$
C. $Erg\ m^{-2}s$ D. **$Watt/m^2$**

15. Which of the following is the correct term for the response of the human ear to the loudness of sound?
A. Logarithmic
B. Exponential
C. Linear
D. Hyperbolic

16. The distance between two consecutive crests or trough is called
A. Amplitude
B. Frequency
C. Wavelength

D. None of these

17. The human ear is most sensitive in the frequency range of:
A. 2,000 to 4,000 Hz
B. 4,000 to 8,000 Hz
C. 3,000 to 6,000 Hz
D. 5,000 to 11,000 Hz

18. One wavelength is the distance covered in a time is called
A. One second
B. Time period
C. 2 second
D. None of these

19. Applications of the results of scientific studies of sound in the designs of buildings etc. is called
A. Optics
B. Wave mechanics
C. Acoustics
D. Statics

20. Which of the following is correctly describes compressional waves?
A. Compressions only
B. Rarefactions only
C. Compression and rarefactions
D. Motion of the waves perpendicular to the compression

21. The frequency of sound greater than 20,000 hertz is called
A. Bass Frequencies
B. Shrill
C. Ultrasonic
D. Ultraviolet

22. Which one of the following instances are the plane-polarized waves?
A. Ultra-violet rays
B. Visible light
C. Infra-red radiation
D. Gamma rays

23. Ultra Violet rays differ X rays in that ultra violet rays
A. Cannot be diffracted
B. Cannot be polarized
C. Do not affect photographic plate
D. Have a lower frequency

24. The distance between node and antinode is
A. λ B. $\lambda/2$
C. $\lambda/4$ D. 2λ

25. Decibel is unit of
A. Intensity of light
B. x-ray radiation capacity
C. Sound loudness
D. Energy of radiation

26. An oscillating mass-spring system generates
A. Ultra violet rays
B. Periodic waves
C. Progressive waves
D. Superimposed waves

27. In stationary waves
A. Energy is uniformly distributed
B. Energy is minimum at nodes and maximum at antinodes

C. **Energy is maximum at nodes and minimum at antidotes**
D. Alternating maximum and minimum energy producing at nodes and antinodes

28. The points of a wave path at which the distances are separated by λ, $2\lambda, 3\lambda, \ldots$ are
A. In phase
B. Out of phase by 90 degree
C. Out of phase by 45 degree
D. Out of phase by 120 degree

29. Laplace formula is derived from
A. Isothermal change
B. Adiabatic change
C. Isobaric change
D. Isochoric change

30. The gases have a
A. Large elastic modulus
B. Smaller elastic modules
C. No elastic modulus
D. Infinite elastic modulus

31. When two bodies of slightly different frequencies are sounded simultaneously there are rises and falls in the loudness of the resultant sound. This type of rise and fall of loudness is called
A. Alternations
B. Beads
C. Beats
D. Simple harmonic motion

32. Y is the ratio of molar specific heat at constant pressure to the molar specific heat at constant volume. What is the value of Y?
A. 1.56 **B. 1.40**
C. 1.26 D. 1.35

33. When a gas is heated at constant pressure, its volume is increased and its density
A. Increased
B. Increased rapidly
C. Decreased
D. None of these

34. When sound waves travel from air to water which of these remains constant?
A. Velocity
B. Frequency
C. Wavelength
D. Path

35. Two sources of sound are said to be coherent if
A. They produce sounds of equal intensity
B. They produce sounds of equal frequency
C. They produce sound waves vibrating with the same phase
D. They produce sound waves with zero or constant phase difference all instant of time.

36. For production of beats the two sources must have
A. Different frequencies and same amplitude
B. Different frequencies
C. Different frequencies, same amplitude and same phase
D. Different frequencies and same phase.

37. With the propagation of a longitudinal wave through a material medium, the quantities transmitted in the propagation direction are
A. Energy, momentum and mass
B. Energy
C. Energy and mass
D. Energy and linear momentum

38. The distance between node and anti-node is
A. λ
B. $\lambda/2$
C. $\lambda/4$
D. 2λ

39. Which waves are used in sonography?
A. Microwaves
B. Infra-red waved
C. Sound waves
D. Ultrasonic waves

40. Which of the following is the longitudinal wave?
A. Sound waves
B. Waves on plucked string
C. Water waves
D. Light waves

Achievement Key

Correct Answers	You Got
More than 35	
Below 30	

If you got thumb down, you must consider learning more about the waves and oscillations.
If you got thumb up, be prepare to have a hard exercise based on waves and oscillations.

Brain Busters

1. There is no net transfer of energy by particles of medium in
A. Longitudinal wave
B. Transverse wave
C. Progressive wave
D. Stationary wave

2. Two sources of sound have frequencies f_1 and f_2 respectively, f_1 being slightly greater than f_2. What is the period of the beats heard when the sources operate simultaneously?
A. $f_1 - f_2$
B. $\frac{1}{f_1 - f_2}$
C. $\frac{2}{f_1 - f_2}$

D. $\frac{f_1 - f_2}{f_1 \times f_2}$

3. Progressive waves of frequency 300 Hz are superimposed to produce a system of stationary waves in which adjacent nodes are 1.5 m apart. What is the speed of the progressive waves?
   A. 100 ms^{-1}
   B. 200 ms^{-1}
   C. 450 ms^{-1}
   D. 900 ms^{-1}

4. Data transmitted along glass-fibre cables is in the form of pulses of monochromatic red light each of duration 2.5 ns. Which of the following is the best estimate of the number of wavelengths in each pulse?
   A. 10^3
   B. 10^6
   C. 10^9
   D. 10^{12}

5. Which of the following is the temperature at which the speed of sound becomes double as was at 27°C?
   A. 273°C
   B. 0°C
   C. 927°C
   D. 1027°C

6. If the amplitude of sound is doubled and the frequency reduced to one-fourth, the intensity of sound at the same point will be
   A. Increasing by a factor of 2
   B. Decreasing by a factor of 2
   C. Decreasing by a factor of 4
   D. Unchanged

7. Velocity of sound in a diatomic as is 300 m/sec, what is its rms velocity?
   A. 400 m/sec
   B. 40 m/sec
   C. 430 m/sec
   D. 300 m/sec

8. The principle of superposition states that
   A. The total displacement due to several waves is the sum of the displacements due to those waves acting individually.
   B. Two stationary waves super-impose to give two progressive waves.
   C. A diffraction pattern consists of many interference patterns superimposed on one another.
   D. Two progressive waves super-impose to give a stationary wave.

9. Which one of the following could be the frequency of ultraviolet radiation?
   A. 1.0×10^6 Hz
   B. 1.0×10^9 Hz
   C. 1.0×10^{12} Hz
   D. 1.0×10^{15} Hz

10. If a wave can be polarized, it must be
    A. An electromagnetic wave.
    B. A longitudinal wave.
    C. A progressive wave.
    D. A transverse wave.

11. When temperature increases, the frequency of a tuning fork
    A. Increases
    B. Decreases
    C. Remains same
    D. Increases or decreases depending on the material

12. In stationary waves
    A. Energy is uniformly distributed
    B. Energy is minimum at nodes and maximum at antinodes
    C. Energy is maximum at nodes and minimum at antidotes
    D. Alternating maximum and minimum energy producing at nodes and antinodes

13. In standing waves if $\lambda = L$, then the number of loops formed will be equal to
    A. One B. Two
    C. Three
    D. Four

14. The velocity of sound in air depends upon
    A. Density and elasticity of gas
    B. Pressure and volume of the gas
    C. Wavelength of sound
    D. Amplitude and frequency of sound

15. Which of the following changes at an antinode in a stationary wave?
    A. Density only
    B. Pressure only
    C. Both pressure and density
    D. Neither pressure nor density

16. When two waves with same frequency and constant phase difference interfere.
    A. There is a gain of energy
    B. There is a loss of energy
    C. The energy is redistributed and the distribution changes with time
    D. The energy is redistributed and the distribution remains constant with time

17. To hear a clear echo, the reflecting surface must be at a minimum distance of
    A. 10 m
    B. 16.5 m
    C. 33 m
    D. 66 m

18. If two waves of length 50 cm and 51 cm produced 12 beats per second, the velocity of sound is
    A. 360 m/s
    B. 306 m/s
    C. 331 m/s
    D. 340 ms

19. It is possible to recognize a person by hearing his voice even if he is hidden behind a solid wall. This is due to the fact that his voice.
    A. Has a definite pitch
    B. Has a definite quality

C. Has a definite capacity
D. Can penetrate the wall

20. The ratio of velocity of sound in air at 4 atm pressure and that at 1 atm pressure would be
A. 1 : 2
B. 4 : 1
C. 1 : 4
D. 2 : 1

21. A sound source is moving towards stationary listener with 1/10th of the speed of sound. The ratio of apparent to real frequency is
A. $\frac{11}{10}$
B. $\left(\frac{11}{10}\right)^2$
C. $\left(\frac{9}{10}\right)^2$
D. $\frac{10}{9}$

22. The loudness and pitch of a sound note depends on
A. Intensity and velocity
B. Frequency and velocity
C. Intensity and frequency
D. Frequency and number of harmonic

23. Fidelity refers to
A. Reproduction of original sound
B. Reproduction of original image
C. Reproduction of music
D. Reproduction of a CD from original copy.

24. For production of beats the two sources must have
A. Different frequencies and same amplitude
B. Different frequencies
C. Different frequencies, same amplitude and same phase
D. Different frequencies and same phase

25. Energy is not carried by
A. Transverse progressive waves
B. Longitudinal vibration
C. Stationary waves
D. Electromagnetic waves

26. What is frequency of radio waves transmitted by a station, if the wavelength of those waves is 300 m?
A. 1 MHz B. 10 Hz
C. 1 GHz D. 100000 Hz

27. Which one is not produced by sound waves in air?
A. Polarization
B. Diffraction
C. Refraction
D. Reflection

28. A rod is fixed between 2 points and is vibrating. The length of the rod for the first harmonic will be
A. λ **B.** $\lambda/2$
C. 2λ D. $\lambda/4$

29. The velocity of sound at same temperature is maximum in
A. H_2
B. N_2
C. O_2
D. NH_3

30. A stationary sound wave has frequency 165 Hz (speed of sound in air = 330 m/s) then distance between two consecutive nodes is
A. 2 m
B. 1 m
C. 0.5 m
D. 4 m

31. Through which character we can distinguish the light waves from sound waves
A. Interference
B. Refraction
C. Polarization
D. Reflection

32. If two waves of amplitude 'a' produce a resultant wave of amplitude a, then the phase difference between them will be
A. 60°
B. 90°
C. 120°
D. 180°

33. Velocity of sound in vacuum (in m/s) is
A. 330
B. 1000
C. 156
D. 0

34. The velocity of sound is greatest in
A. Water
B. Air
C. Vacuum
D. metal

35. The function $\sin^2(\omega t)$ represents
A. a periodic, but not simple harmonic, motion with a period π/ω
B. a periodic, but not simple harmonic, motion with a period of $2\pi/\omega$
C. a simple harmonic motion with a period π/ω
D. a simple harmonic motion with a period $2\pi/\omega$

36. A mass M is suspended from a spring of negligible mass. The spring is pulled a little and then released, so that the mass executes S.H.M. of Time period T. If the mass is increased by m, the time period becomes 5T/3. The ratio m/M is
A. 5/3
B. 3/5
C. 16/9
D. 25/9

37. Length of a simple pendulum executing simple harmonic motion is increased by 21%. The percentage increase n the time-period of the pendulum of increased length is
A. 10%
B. 1%
C. 21%
D. 42%

38. If a spring of force constant k is cut into three equal parts, then force constant of each p rat well be

A. k / 3 B. K
C. 3 k D. 6 k

39. A simple pendulum has a time period T1 when on the earth's surface, and T2 when Taken to a height R above the earth's surface where R is the radius of the earth. The value of T2 / T1 is

A. 1 B. v2
C. 4 **D. 2**

40. If the frequency of the particle executing S.H.M. is n, the frequency of its kinetic energy becoming maximum is

A. n / 2
B. n
C. 2 n
D. 4 n

Achievement Key

Correct Answers	You Got
More than 32	
Below 28	

If you got thumb down, you must consider learning more about the waves and oscillations.

If you got thumb up, go to the next exercise.

CHAPTER

8

PHYSICAL OPTICS

Phase difference between the first and last waves for a single-slit diffraction pattern	$\phi = \frac{2\pi}{\lambda} a \sin\theta$
Refractive index	$n = \frac{\sin i}{\sin r} = \frac{depth}{apparentdepth}$
single-slit diffraction pattern points of zero intensity	$a \sin\theta = m\lambda$

MCQ Set 1

MCQ Set 1 is consisted of the questions from the topic of Physical Optics. The set takes you from very basic level (Sweet Candies) to the very tough level (Brain Buster).

Sweet Candies

Directions:

You are given following questions from the topics of this section, with four choices A through D. Select the choice that will answer the question best by filling the appropriate circle at the end of each question.

Answer of each question has been bolded for convenience.

1. According to the electromagnetic theory, the speed of light is approximately:
   A. $3 \times 10^{6}\ ms^{-1}$
   B. $3 \times 10^{8}\ ms^{-1}$
   C. $3 \times 10^{-10}\ ms^{-1}$
   D. $3.1 \times 10^{8}\ ms^{-1}$

2. Light is a type of energy which produces sensation of
   A. Sound
   B. Feeling
   C. Vision
   D. None of these

3. The locus of all points in the same phase of vibration is called
   A. Wavelength
   B. Waveform
   C. Wave front
   D. Wave number

4. According to Huygens, every point on a wave front may be regarded as a ..... of secondary wavelets.
   A. Base
   B. Source
   C. Producer
   D. Origin

5. Wave front is the locus of all points in vibration are in the same
   A. Frequency
   B. Phase
   C. Wavelength
   D. All of these

6. One condition for interference is that the two sources should be coherent and:
   A. Close together
   B. At a far off distance
   C. Opposite to each other
   D. Coinciding

7. A spherical wave front is that which has
   A. A source
   B. A point source
   C. An extended source
   D. None of these

8. For constructive interference the path difference is
   A. $m\lambda$
   B. $(m-1)\lambda$
   C. $m^2\lambda$
   D. $\frac{1}{2} m\lambda$

9. Every point of a wave front may be considered as a
   A. Source
   B. Source of wave front
   C. Source of secondary wave front
   D. None of these

10. In Young's experiment, a dark fringe is observed when:
    A. $d \sin\theta = (m + \frac{1}{2})\lambda$
    B. $m \sin\theta = (d + \frac{1}{2})\lambda$
    C. $\frac{1}{2} d \sin\theta = m\lambda$
    D. $2\pi \sin\theta = (m + \frac{1}{2})\lambda$

11. An oil surface floating on water surface exhibits beautiful colour patter, which is due to
    A. Reflection of light
    B. Diffraction of light
    C. Interference of light
    D. None of these

12. When the two surfaces of a thin film are parallel and the light is incident at a certain angle, ... fringes are formed.
    A. Circular B. Elliptical
    C. Parabolic D. Straight

13. Can two head lights of car can produce interference
    A. Yes
    B. No
    C. Partly produce interference
    D. None of these

14. Which of the following lens is used to form Newton's rings?
    A. Plano-concave
    B. Plano-convex
    C. Convexo-concave
    D. Double-convex

15. Huygens's wave fronts sends out secondary wavelets with a speed equal to
    A. Speed of propagation of the wave
    B. Speed of propagation greater than wave
    C. Speed of propagation less than the wave
    D. None of these

16. The phenomenon of bending of light waves around the edges of an obstacle or a narrow opening is called
    A. Refraction
    B. Reflection
    C. Transmission
    D. Diffraction

17. The condition for the bright fringes formed due to constructive interference in a diffraction grating is:
    A. $.md \cos\theta = \lambda$
    B. $.d \sin\theta = m\lambda$
    C. $.d \sin\theta = \frac{m}{2}\lambda$
    D. $.d \sin\theta = 2\lambda.m$

18. Which of the following relations is related to the interference in X-ray diffraction?
    A. Laue's pattern
    B. Bragg's law
    C. Compton effect
    D. Huygens's formula

19. The phenomenon of Polarization occurs only in which of the following wave type?
    A. Electromagnetic
    B. Longitudinal
    C. Mechanical waves
    D. Matter waves

20. Which of the following phenomena is used in curtain less windows?
    A. Diffraction

B. Transmission
C. Absorption
D. Polarization

21. In the phenomenon of interference, the bright and dark fringes are
A. Of different width
B. Of equal width
C. Dark fringes are thicker than bright fringes
D. Bright fringes are thicker than dark fringes

22. Huygens's wave theory of light cannot explain
A. Diffraction
B. Interference
C. Polarization
D. Photoelectric effect

23. Which of the following is not related to the light produced by a laser?
A. incoherent
B. Monochromatic
C. Narrow beam
D. Electromagnetic

24. Which one of the following phenomena is not explained by Huygens's construction of wave front?
A. Refraction
B. Reflection
C. Diffraction
D. Origin of spectra

25. On a rainy day, if there is an oil drop on tar road, coloured rings are seen around this drop. This is because of
A. Interference pattern produced due to thin oil film
B. Diffraction pattern
C. Polarization
D. Total internal reflection of light

26. In Newton's rings the point of contact of the lens and the glass plate, the air film is
A. Minimum
B. Maximum
C. Zero
D. Equal to the thickness of plane glass

27. Which of the following is conserved when light waves interfere?
A. Intensity
B. Energy
C. Amplitude
D. Momentum

28. The principle used in Michelson's interferometers is
A. Refraction
B. Dispersion
C. Interference
D. Reflection

29. A prism splits a beam of white light into its seven constituent colours. Which of the following is the fundamental reason of this phenomenon?
A. Phase of different colours is different
B. Amplitude of different colours is different
C. Energy of different colours is different
D. Velocity of different colours is different

30. Light appears to travel in straight lines since
A. It is not absorbed by the atmosphere
B. It is reflected by the atmosphere
C. Its wavelength is very small
D. Its velocity is very large

31. Which one of the following phenomena is not explained by Huygens's construction of wave front?
A. Refraction
B. Reflection
C. Diffraction
D. Origin of spectra

32. Huygens's wave theory of light cannot explain
A. Diffraction
B. Interference
C. Polarization
D. Photoelectric effect

33. Interference was observed in interference chamber, when air was present, now the chamber is evacuated and if the same light is used, a careful observer will see
A. No interference
B. Interference with bright bands
C. Interference with dark bands
D. Increased fringe width

34. If a source of light is moving away from stationary observer, then frequency of light wave appears to change because of
A. Doppler's effect
B. Interference
C. Diffraction
D. Reflection

35. For the sustained interference of light, which of the following is the necessary condition?
A. Both light rays must have constant phase difference
B. Both light beams must be narrow
C. Both light rays must be close to each other
D. Both light rays must be of same amplitude

36. Signal from a remote control to the device operated by it travels with the speed of
A. Sound
B. Light
C. Ultrasonic
D. supersonics

37. If a wave can be polarized, it must be
A. An electromagnetic wave
B. A longitudinal wave
C. A sound wave
D. A matter wave

38. Which of the following frequency ranges includes most of the electromagnetic waves emitted by the ultra – violet tubes used in a sun bed?
A. 5×10^5 to 5×10^8 Hz
B. 5×10^8 to 5×10^{11} Hz
C. 5×10^{11} to 5×10^{14} Hz
D. 5×10^{14} to 5×10^{17} Hz

39. Ultra – violet rays differ from X-rays in that ultra – violet rays
A. Cannot be diffracted
B. Cannot be polarized
C. Do not affect a photographic plate.
D. Have a lower frequency

Achievement Key

Correct Answers	You Got
More than 35	
Below 30	

If you got thumb down, you must consider

Brain Busters

1. The path difference and phase difference of light are related to each other as
A. Phase difference = 2π× path difference
B. Phase difference = $\frac{\lambda}{2\pi}$ × path difference
C. Phase difference = $\frac{2\lambda}{\pi}$ × path difference
D. Phase difference = $\frac{2\pi}{\lambda}$ × path difference

2. In case of diffraction grating, if d = 0.25 cm Y = 0.059 cm L = 100 cm m = 2 then λ is equal to
A. 567 nm
B. 569 nm
C. 590 nm
D. 596 nm

3. If yellow light emitted by sodium lamp in Young's double slit experiment is replaced by monochromatic blue light of the same intensity,
A. Fringe width will decrease
B. Fringe width will increase
C. The fringe width will remain unchanged
D. Fringes will become less intense

4. When seen in green light, white and green portions of our National Flag will appear to be
A. Black
B. Black and green respectively
C. Green
D. Green and yellow respectively

5. One cannot see through fog because
A. Fog absorbs light
B. The refractive index of fog is infinity
C. Light suffers total reflection at the droplet in a fog
D. Light is scattered by the droplets in fog

6. At sun rise or sun set, the sun looks reddish because:
A. The sun is coldest at these times
B. Of the effects of reflection and refraction
C. The sun is hottest at these times
D. Of the scattering of light

7. The twinkling of stars is due to
A. The fact that stars do not emit light continuously
B. The refractive index of the earth's atmosphere fluctuate
C. Intermittent absorption of star light by its own atmosphere
D. None of these

8. In Young's experiment, two coherent sources are placed 0.90 mm apart and the fringes are observed one meter away. If its produces the second dark fringe at a distance of 1 mm from the central fringe, the wavelength of monochromatic light used would be
A. 60×10^{-4} cm
B. 10×10^{-4} cm
C. 10×10^{-5} cm
D. 6×10^{-5} cm

9. The sky appears blue because
A. Red light is absorbed
B. Blue light is scattered the most
C. Blue light is absorbed
D. It is its natural colour

11. A thin lens of focal length f has aperture d. It forms an image of intensity I. Inner part of the lens up to n diameter $\frac{d}{2}$ is painted black, the intensity of the image will be
A. $\frac{I}{4}$ B. $\frac{I}{2}$
C. $\frac{3I}{4}$ D. I

12. In Young's double slit experiment on interference, the ratio of the

intensities of a bright band and a dark band is 6 : 1. The ratio of the amplitudes o the interfering waves is

A. 16
B. $\frac{5}{3}$
C. 4
D. $\frac{1}{4}$

13. In a spectrometer experiment, monochromatic light is incident normally on a diffraction grating having 4.5×10^5 lines per meter. The second order line is seen at an angle of 30^0 to the normal. What is the wavelength of the light?

A. 200 nm
B. 430 nm
C. 500 nm
D. 556 nm

14. Light of wavelength λ is incident normally on a diffraction grating for which the slit spacing is equal to 3λ. What is the Sine of the angle between the second order maximum and the normal?

A. $\frac{1}{6}$
B. $\frac{1}{3}$
C. $\frac{2}{3}$
D. 1

15. The meter was defined in terms of the wavelength λ of the orange spectral line emitted by excited atoms of Krypton-86. Thus 1 meter = $n\lambda$, where n is the number of wavelengths in 1 meter of vacuum. What is the best value for n

A. 1.43×10^4
B. 1.65×10^6
C. 2.00×10^8
D. 3.33×10^{12}

16. Which of the following gives three regions of the electromagnetic spectrum in order of increasing wavelength?

A. Gamma rays, microwaves, visible radiation
B. Radio waves, ultraviolet, X-rays
C. Ultraviolet, infra-red microwaves
D. Visible radiation, gamma rays, radio waves

17. A parallel beam of white light is incident normally on a diffraction grating. It is noted that the second-order and third-order spectra partially overlap. Which wavelength in the third-order spectrum appears at the same angle as the wavelength of 600 nm in the second-order spectrum?

A. 300 nm
B. 400 nm
C. 600 nm
D. 900 nm

18. Two monochromatic radiations X and Y are incident normally on a diffraction grating. The second order intensity maximum for X coincides with the third order intensity maximum for Y. What is the ratio $\frac{\text{wavelength of X}}{\text{wavelength of Y}}$?

A. $\frac{1}{2}$
B. $\frac{2}{3}$
C. $\frac{3}{2}$
D. $\frac{2}{1}$

19. The tip of a needle does not give a sharp image. It is due to

A. Polarization
B. Interference
C. Diffraction
D. None of these

20. Plane microwaves are incident on a long slit having a width of 5 cm. The wavelength of the microwaves if the first minima is formed at 30^0 is

A. 25 cm
B. 5 cm
C. 2.5 cm
D. 5 mm

21. Inverse square law of intensity $\left(I \propto \frac{1}{r^2}\right)$ is valid for a

A. Point source
B. Line source
C. Plane source
D. Cylindrical source

22. In Young's double slit experiment, the separation between the slit is halved and distance between the slit and screen is doubled. The fringe width is

A. Unchanged
B. Halved
C. Doubled
D. quadrupled

23. The separation between successive fringes in a double slit arrangement is x. If the whole arrangement is dipped under water what will be the new fringe separation? [The wavelength of light being used is 5000 Å]

A. 1.5x
B. X
C. 0.83x
D. 2x

24. The difference between 1st ring fringe and 1st dark fringe is measured as

A. $\frac{\lambda D}{2d}$ B. $\frac{\lambda D}{d}$
C. $\frac{\lambda D}{4d}$ D. $\frac{2\lambda D}{d}$

25. Sun has elliptical shape, when it rises and sets due to
A. Refraction
B. Reflection
C. Scattering
D. dispersion

26. In Young's double slit experiment, the separation between the slits is made 3 fold, the fringe width becomes
A. $\frac{1}{3}$ times B. $\frac{1}{9}$ times
C. 3times D. 9times

27. Consider telecommunication through optical fibres. Which of the following statements is not true?
A. Optical fibres may have homogeneous core with a suitable cladding
B. Optical fibres can be of graded refractive index
C. Optical fibres are subject to electromagnetic interference from outside
D. Optical fibres have extremely low transmission loss

28. What is the angle between the direction of a ray of light the wave front?
A. 0 degree
B. 45 degree
C. 180 degree
D. 90 degree

29. A thin glass (refractive index 1.5) lens has optical power -5 D in air. Its optical power in a liquid medium with refractive index 1.6 will be
A. -1 D **B. 1 D**
C. -25 D D. 25 D

30. A Plano-convex lens of refractive index 1.5 and radius of curvature 30 cm is silvered at the curved surface. Now this lens has been used to form the image of an object. At what distance from this lens, an object be placed in order to have a real image of
The size of the object?
A. 20 cm B. 30 cm
C. 60 cm D. 80 cm

31. To get three images of a single object, one should have two plane mirrors at an angle of
A. 30° B. 60°
C. 90° D. 120°

32. The image formed by an objective of a compound microscope is
A. real and enlarged
B. virtual and enlarged

C. real and diminished
D. virtual and diminished

34. A person having the nearest distance of distinct vision of 32 cm uses a reading lens of8 cm focal length. The magnification of his reading lens is
A. 5 B. 4
C. 3 D. 2

35. Consider telecommunication through optical fibres. Which of the following statements is Not true?
A. Optical fibres can be of graded refractive index.
B. Optical fibres have extremely low transmission loss.
C. Optical fibres are subject to electromagnetic interference from outside.
D. Optical fibres may have homogeneous core with a suitable cladding.

36. A ray of light passing through a prism having $\mu = \sqrt{2}$ suffers minimum deviation. If angle of incidence is double the angle of refraction within prism, the angle of prism is
A. 30° B. 45°
C. 60° **D. 90°**

37. Which of the following forms a virtual and erect image for all positions of the Object?
A. convex lens
B. concave lens
C. convex mirror
D. concave mirror

38. Spherical aberration in a thin lens can be reduced by
A. using a monochromatic light
B. using a doublet combination
C. using a circular annular mask over the lens
D. increasing the size of the lens

39. A converging lens is used to form an image on a screen. When the upper half of the lens is covered by an opaque screen
A. half the image will disappear
B. complete image will be formed
C. intensity of the image will increase
D. intensity of the image will decade

40. When a ray of light enters a glass slab from air
A. its wave night increases
B. neither its wavelength nor its frequency changes

C. i s frequency increases
D. its wavelength decreases

41. A real image of a distant object is formed by a plan convex lens on its principal axis. Spherical aberration
A. is absent
B. is smaller if the curved surface of the lens faces the object
C. is smaller if the plane surface of the lens faces the object
D. is the same whichever side of the lens faces the object

42. A point object is placed at the centre of a glass sphere of radius 6 cm and refractive Index 1.5. The distance of the virtual image from the surface of the sphere is
A. 2 cm B. 4 cm
C. 6 cm D. 12 cm

Achievement Key

Correct Answers	You Got
More than 32	
Below 28	

If you got thumb down, you must consider learning more about the optics.
If you got thumb up, go to the next exercise.

CHAPTER
9

HEAT & THERMODYNAMICS

Net power radiated by an object	$P_{net} = e\sigma A\left(T4 - T_0^4\right)$
Radiation absorbed by an object	$P_a = e\sigma AT_0^4$
Stefan-Boltzmann law	$P = e\sigma AT^4$
Thermal conduction	$I = \frac{\Delta Q}{\Delta t} = kA\frac{\Delta T}{\Delta x}$
Thermal resistance	$R = \frac{\Delta x}{kA}$

MCQ Set 1

MCQ Set 1 is consisted of the questions from the topic of Heat and Thermodynamics. The set takes you from very basic level (Sweet Candies) to the very tough level (Brain Buster).

Sweet Candies

Directions:

You are given following questions from the topics of this section, with four choices A through D. Select the choice that will answer the question best by filling the appropriate circle at the end of each question.

Answer of each question has been bolded for convenience.

1. Thermodynamic is the branch of physics that deals with the conversions of heat energy into
   A. Electrical energy
   B. Mechanical energy
   C. Solar energy
   D. None of these

2. Which is not an example of adiabatic process
   A. Tyre burst
   B. Passage of sound wave through air
   C. Cloud formation
   D. Steam engine

3. Which is not related to internal energy
   A. It has absolute value
   B. It is a state function
   C. Dependent on temperature
   D. It depends on kinetic energy of molecules

4. Which is a reversible process
   A. Slow liquefaction
   B. Slow evaporation
   C. Slow compression
   D. All

5. What does the $\frac{m}{l^3}$ show?
   A. Pressure
   B. Mass
   C. Density
   D. None of these

6. The value of Boltzmann constant is
   B. $1.38\times10^{-23}\,JK^{-1}$
   C. $1.38\times10^{-28}\,JK^{-1}$
   D. $1.35\times10^{-29}\,JK^{-1}$

7. The internal energy of molecules of a substance is
   A. K. Energy
   B. P. Energy
   C. Vibrational energy
   D. All of these

8. In a system ABC the initial heat contents are less than that of final heat contents, the entropy is
   A. Increasing
   B. Decreasing
   C. Constant
   D. Independent

9. For an ideal gas system, the internal energy and temperature are
   A. Directly proportional
   B. Inversely proportional
   C. Neither direct nor inversely proportional
   D. None of these

10. In liquefaction of wax, the entropy is
    A. Positive
    B. Negative
    C. Zero
    D. Neutral

11. When tow objects are rubbed together, their internal energy increases because of
    A. Kinetic energy
    B. Mechanical work
    C. Potential energy
    D. Increased size of the molecules

12. First law of thermodynamic is special case of
    A. Law of conservation of energy
    B. Charles's law
    C. Law of conservation of mass
    D. Boyle's law

13. Which of the following statement is related to the first law of thermodynamics?
    A. Conversion of heat energy into mechanical energy
    B. Conversion of heat energy into vibrational energy
    C. Conversion of heat energy into translational energy
    D. All of these

14. Rate of diffusion is
    A. Faster in solids than in liquids and gases
    B. Faster n liquids than in solids and gases
    C. Equal to solids, liquids and gases
    D. Faster in gases than in liquids and solids

15. In an isothermal process, the change in internal energy is
    A. Maximum
    B. Zero
    C. Very small
    D. None of these

16. A fixed mass of gas in a thermally insulated container is compressed. After compression, the temperature of the gas will have
    A. Fallen, since more molecules bombard the container and so they must be moving slower.
    B. Fallen, since the molecules collide more frequently with one and so their average speed is lower.
    C. Remained constant if the compression is very slow.
    D. Risen, since doing work on the gas increases the kinetic energy of the molecules.

17. At 0K which of the following properties of a gas will be zero?
    A. Kinetic energy
    B. Potential energy
    C. Vibrational energy
    D. Density

18. In an adiabatic process
    A. Temperature remains constant
    B. Volume remains constant
    C. No change internal energy
    D. No heat enters or leaves the system

19. An isochoric process is one which take place at
    A. Constant internal energy
    B. Constant entropy
    C. Constant volume
    D. Constant pressure

20. The relation of the adiabatic change is
    A. PV=constant
    B. PV^2 = constant
    C. PV^r = constant

D. PV^{γ}=constant

21. Rate of diffusion is
A. Faster in solids than in liquids and gases
B. Faster n liquids than in solids and gases
C. Equal to solids, liquids and gases
D. Faster in gases than in liquids and solids

22. A reversible process is one which can be retracted in exactly reverse order with change in the
A. System
B. Surroundings
C. Pressure
D. volume

23. The process of liquefaction and evaporation of a substance performed slowly are
A. Reversible
B. Practically reversible
C. Not reversible
D. None of these

24. The second law of thermodynamics is concerned with the:
A. Conservation of energy
B. Conservation of number of moles
C. Transformation of heat energy into work
D. Conservation of temperature

25. All changes which occur suddenly are irreversible through
A. Conduction
B. Convection
C. Radiation
D. All of these

26. A highly irreversible process is
A. Expansion
B. Explosion
C. Compression
D. Heating

27. Internal energy per mole of gas depends on
A. Viscosity
B. Density
C. Temperature
D. Thermal conductivity

28. The relation between Cp and Cv is given by
A. Cp=Cv
B. Cp<Cv
C. Cp>Cv
D. $C_p + C_v$ = Constant

29. At constant volume temperature is increased. Then
A. Collision on walls will be less
B. Number of collisions per unit time will increase
C. Collisions will be in straight lines
D. Collisions will not change

30. Boyle's law is applicable in
A. Isochoric process
B. Isothermal process
C. Isobaric process
D. Isotonic process

31. The product of the pressure and volume of an ideal gas is
A. A constant
B. Approximately equal to the universal gas constant
C. Directly proportional to its temperature
D. Inversely proportional to its temperature

32. Brownian motion increases due to
A. Increase in size of Brownian particle
B. Increase in density of medium
C. Increase in temperature of medium
D. Increase in viscosity of medium

33. An isochoric process is one which take place at
A. Constant internal energy
B. Constant entropy
C. Constant volume
D. Constant pressure

34. According to kinetic theory of gases, molecules of a gas behave like
A. Inelastic spheres
B. Perfectly elastic rigid sphere
C. Perfectly elastic non-rigid spheres
D. Inelastic non-rigid spheres

35. Pressure of a gas at constant volume is proportion to
A. Total energy of gas
B. Average P.E. of molecules
C. Average K.E. of molecules
D. Total internal energy of gas

36. On colliding in a closed container, the gas molecules
A. Transfer momentum to the walls
B. Momentum becomes zero
C. Move in opposite directions
D. Perform Brownian motion

37. Which of the following is incorrect regarding the first law of thermodynamics?
A. It is the restatement of the principle of conservation of energy
B. It is not applicable to any cyclic process
C. It introduces the concept of entropy
D. It introduces the concept of the internal energy

Ans: B and C

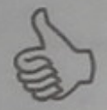
38. Heat cannot by itself flow from a body at lower temperature to a body at higher temperature is a statement as a consequence of
A. conservation of mass
B. conservation of momentum
C. first law of thermodynamics
D. second law of thermodynamics

39. Which of the following statements is correct for any thermodynamic system?
A. The internal energy changes in all processes.
B. Internal energy and entropy are state functions.

C. The change in entropy can never be zero.
D. The work done in an adiabatic process is always zero.

40. Boltzman constant K in terms of universal gas constant R and Avogadro's number N is give as
A. K = RN
B. K = R/N
C. K = N/R
D. K = nRN

Achievement Key

Correct Answers	You Got
More than 35	
Below 30	

If you got thumb down, you must consider learning more about the heat and thermodynamics.
If you got thumb up, be prepare to have a hard exercise based on heat and thermodynamics.

Brain Busters

1. Internal energy can be increased without supply of
A. Heat
B. Work
C. Heat or Work
D. Neither heat nor work

2. The efficiency of Carnot engine is
A. 100%
B. Independent of nature of working substance
C. Independent of temperature differences
D. Independent of mass of the working substance

3. Triple point of water is
A. 273.16 °C **B. 273.16 K**
C. 100° C D. 4K

4. Find the average speed of oxygen molecule in the air at S.T.P.
A. 591 ms^{-1} **B. 461 ms^{-1}**
C. 396 ms^{-1} D. 372 ms^{-1}

5. Kelvin scale can be applied at very low temperature because
A. It is independent of nature of working substance
B. It is linear over a wide range of temperature
C. It is based on triple point of water
D. None

6. In cross-sectional area is 0.10m^2, pressure of the gas is 8000 Nm^{-2}. Distance moved by the piston is 4.0.Find its work done
A. 20J
B. 36J
C. 32J
D. 30J

7. Which one of the following thermometers would be most suitable for monitoring the temperature of gases in a factory chimney if the temperature can vary over a range of 200 K in a minute?
A. Thermoelectric
B. Alcohol in glass
C. Mercury in glass
D. Platinum resistance

8. On a cold morning a metal surface will feel colder to touch than a wooden surface, because
A. Metal has high specific heat
B. Metal has high thermal conductivity
C. Metal has low specific heat
D. Metal has low thermal conductivity

9. Two samples A and B of a gas initially of the same temperature and pressure are compressed from a volume V to a volume V/2 such that A is compressed isothermally and B adiabatically. The final pressure
A. A is greater than that of B
B. A is equal to that of B
C. A is less than that of B
D. A is twice the pressure of B

10. Relation between pressure (P) and energy (E) of a gas is
A. $P=\frac{2}{3}E$
B. $P=\frac{1}{3}E$
C. $P=\frac{3}{2}E$
D. $P=3E$

11. The number of translation degrees of freedom for a diatomic gas is
A. 2
B. 3
C. 5
D. 6

12. Which of the following is not thermo dynamical function?
A. Enthalpy
B. Work done
C. Gibb's energy
D. Internal energy

13. What is the ratio of r.m.s. velocity for O_2 to H_2?
A. $\frac{1}{4}$ B. 4
C. $\sqrt{4}:1$ D. $1:\sqrt{4}$

14. What is the average energy of N molecules of mono-atomic gas?
A. $\frac{1}{2}NkT$
B. NkT

C. $\frac{3}{2}NkT$

D. $\frac{5}{2}NkT$

15. Maximum density of H_2O is at the temperature
A. 32°F
B. 39.2°F
C. 42°F
D. 4°F

16. R.M.S. velocity of a particle is V at pressure P. If pressure increases by two times, then R.M.S. velocity becomes
A. 2V
B. 3V
C. 0.5V
D. V

17. Every gas behaves like an ideal gas at
A. High temperature and low pressure
B. Low temperature and high pressure
C. Both (A) and (B)
D. None

18. The volume of a gas will be double of what it is at 0°C (pressure remaining constant) at
A. 546 K
B. 273 K
C. 546 °C
D. 273 °C

19. If the ratio of densities of two gases is 1 : 4, then the ratio of their rates of diffusion into one another is:
A. 2 : 1
B. 4 : 1
C. 1 : 4
D. 3 : 4

20. 10 CC of each of oxygen and hydrogen are kept in separate flasks. Then which of the following relations is correct?
A. Each have same number of molecules
B. Don't have same number of molecules
C. Can't be predicted
D. None

21. A real gas can be approximated to an ideal gas at
A. Low density
B. High pressure
C. High density
D. Low temperature

22. If the volume of the gas is to be increased by 4 times, then
A. Temperature and pressure must be doubled
B. At constant P the temperature must be increased by 4 times
C. At constant T the pressure must be increased by four times
D. It cannot be increased

23. The temperature of gas is produced by

A. At potential energy of its molecules
B. The kinetic energy of its molecules
C. The attractive force between its molecules
D. The repulsive force between its molecules

24. Pressure exerted by a gas is
A. Independent of density of the gas
B. Inversely proportional to the density of the gas
C. Directly proportional to the square of the density of the gas
D. Directly proportional to the density of the gas

25. At constant temperature, on increasing the pressure of a gas by 5%, its volume will decrease by
A. 5%
B. 4.26%
C. 5.26%
D. 4.76%

26. A gas at temperature of 27°C is heated at constant pressure to triple its volume. The final temperature of the gas will be
A. 81 K
B. 355 K
C. 627 K
D. 627°C

27. The kinetic energy of one molecule of a gas at normal temperature and pressure will be (k = 8.31 J/mole k):
A. 1.7×10^3J
B. 10.2×10^3J
C. 3.4×10^3J
D. 6.8×10^3J

28. Hydrogen and helium of same volume V at same temperature T and same pressure P are mixed to have same volume V. The resulting pressure of the mixture will be:
A. R/2
B. P
C. 2P
D. Depending on the relative mass of the gases

29. The length of a metallic rod is 5 meter at 100°C. The coefficient of cubical expansion of the metal will be
A. 2.0×10^{-5}/°C
B. 4.0×10^{-5}/°C
C. 6.0×10^{-5}/°C
D. 2.33×10^{-5}/°C

30. Two metal rods A and B have their initial lengths in the ratio 2 : 3 and coefficients of linear expansion in the ratio of 4:3. When they are heated through same temperature difference the ratio of their linear expansion is
A. 1 : 2 B. 2 : 3
C. 3 : 4 **D. 8 : 9**

31. The coefficient of linear expansion of Iron is 0.000011 per °K. An iron rod is 10 meter long at 27°C. The length of the rod will be decreased by 1.1 mm when the temperature of the rod changes to:
A. 0°C B. 10°C
C. 17°C D. 20°C

32. For making cooking utensils, which of the following pairs of properties is most suited?
A. Low specific heat and high conductivity
B. Low specific heat and low conductivity
C. High specific heat and high conductivity
D. High specific heat and low conductivity

33. Heat travels through vacuum by
A. Conduction
B. Convection
C. Radiation
D. Refraction

34. On a cold morning a metal surface will feel colder to touch than a wooden surface, because
A. Metal has high specific heat
B. Metal has high thermal conductivity
C. Metal has low specific heat
D. Metal has low thermal conductivity

35. Amount of heat required to raise the temperature of a body through 1K is called its
A. Specific heat
B. Water equivalent
C. Thermal capacity
D. Entropy

36. What temperature is the same on Celsius scale as well as on Fahrenheit scale?
A. 32°C
B. -32°C
C. -40°C
D. -212°C

37. If water in a closed bottle is taken up to the moon and opened, the water gets
A. No change
B. Boiled
C. Dissociated into O_2 and H_2
D. Condensed by low temperature

38. Specific heat at constant pressure is greater than the specific heat at constant volume because
A. Heat is used up to increase temperature at constant pressure
B. Heat is used by gas for expansions purposes at constant pressure
C. Heat is use dup to increase internal energy
D. The above statement is invalid

39. An amount of water of mass 20g at 0°C is mixed with 40g of water at 10°C. Final temperature of mixture is
A. -20°C
B. 6.67°C
C. 5°C
D. 0°C

40. Melting point of ice
A. Increases with increasing pressure
B. Decreases with increasing pressure
C. Is independent of pressure
D. Is proportional to pressure

Achievement Key

Correct Answers	You Got
More than 32	
Below 28	

If you got thumb down, you must consider learning more about the waves and oscillations.
If you got thumb up, go to the next exercise.

CHAPTER

10

ELECTROSTATIC

Electrostatic Force (Newton)	$= q_1 E$ $= k q_1 q_2 / d^2$
Electric field (N/C)	= Force/charge $= k q_2 / d^2$
Potential Energy (Joules)	= work = Force * distance $= (-) q_1 E d$
Potential (voltage)	= energy/charge or work/charge $= k q_2 / d$
Charge 1C	$= 6.3 \times 10^{18}$ electrons
1e	$= -1.60 \times 10^{-19}$ C
Mass 1 electron	$= 9.11 \times 10^{31}$ kg
1 proton	$= 1.67 \times 10^{-27}$ kg
Coulomb constant (Nm^2/C^2):k	$= 8.99 \times 10^9$ Nm^2/C^2

MCQ Set 1

MCQ Set 1 is consisted of the questions from the topic of Elctrostatic. The set takes you from very basic level (Sweet Candies) to the very tough level (Brain Buster).

Sweet Candies

Directions:

You are given following questions from the topics of this section, with four choices A through D. Select the choice that will answer the question best by filling the appropriate circle at the end of each question.

Answer of each question has been bolded for convenience

1. The value of Coulomb's constant 'K' in terms of permittivity of free space is given as:
   - A. $K = \frac{1}{4\pi\varepsilon_0}$
   - B. $K = \frac{1}{2\varepsilon_0}$
   - C. $K = \frac{1}{2\pi\varepsilon_0}$
   - D. $K = \frac{1}{2\pi^2\varepsilon_0}$

2. The constant K in Coulomb's Law depend upon
   - A. Nature of medium
   - B. System of units
   - C. Intensity of charge
   - **D. A and B**

3. The value of constant K in Coulomb's Law
   - A. 9×10^{-9} NM^2C^{-2}
   - B. 9×10^{-10} NM^2C^{-2}
   - **C. 9×10^{9} NM^2C^{-2}**
   - D. 9×10^{10} NM^2C^{-2}

4. The electric flux through the surface of a sphere of radius "r" due to a point charge q placed at its centre depends upon:
   - A. The radius of the sphere
   - B. The surface area of the sphere
   - C. The quantity of charge outside of the sphere
   - **D. The quantity of charge inside of the sphere**

5. The direction of Electric intensity E is along the
   - A. increasing potential
   - **B. Decreasing Potential**
   - C. may be decreasing or increasing
   - D. None of choice

6. If C = Capacity, Q = charge, V = Potential of a conductor, then the relation between these quantities is expressed by the equation:
   A. $C = \frac{Q}{V}$
   B. $C = QV$
   C. $C = \frac{V}{Q}$
   D. None of the Choices

7. An electric field lines provides the information about
   A. Electric force
   B. Direction
   C. Medium
   D. All of them

8. Capacitor is a device used for:
   A. Storing voltage
   B. Storing current
   C. Storing electric charge
   D. Producing charges

9. If a charge of one coulomb produces a potential difference of one volt between the plates of a parallel plate capacitor, the capacitance of the capacitor is
   A. Zero Farad
   B. 1.6×10^{-19} Farad
   C. 3.4 Farad
   D. 1 Farad

10. The force between two charges is 8 N. Now placed a mica of relativity 4 between two charges as a medium, the force then reduced to
   A. 2 N
   B. 4 N
   C. 6 N
   D. 8 N

11. The Coulomb force due to point charges is F, If a medium of relative permittivity ε_r is placed between the charges, now the force is given by:
   A. $F' = \frac{\varepsilon_r}{F}$
   B. $F' = \frac{F}{\varepsilon_r}$
   C. $F' = F_{\varepsilon_r}$
   D. $F' = \frac{F}{\varepsilon_0 \varepsilon_r}$

12. Two similar charges of equal magnitude of one coulomb are placed in vacuum at what distance they will exert force of 9×10^9 N?
   A. 10 meters
   B. 100 meters
   C. 0 meters
   D. 1 meters

13. Electric potential is a
   A. Scalar Quantity
   B. Vector quantity
   C. Null vector
   D. Tensor

14. The SI. Unit of an electric flux is
   A. NmC^{-1} B. NmC^{-2}
   C. Nm^2C^{-1} D. Nm^2C^{-2}

15. The electric intensity due to an infinite sheet of charge is

   A. $\frac{\sigma}{\varepsilon_r}$
   B. $\frac{\sigma}{\varepsilon_o}$
   C. $\frac{\sigma}{2\varepsilon_o}$
   D. $\frac{2\varepsilon_o}{\sigma}$

16. In a charged capacitor the energy is stored in the form of
   A. Electric Field
   B. Magnetic field
   C. Nuclear Field
   D. Gravitational Field

17. The electric field is uniform
   A. Near a positive point charge
   B. Near a negative point charge
   C. Between two parallel oppositely charged plates.
   D. Near a charged plate

18. If a closed surface contains two equal and opposite charges, the net electric flux from the surface is
   A. Positive
   B. Negative
   C. Zero
   D. None of the above

19. One electron volt is equal to
   A. 1.6×10^{-19} C
   B. 1.6×10^{-16} J
   C. 1.6×10^{-19} J
   D. 1.6×10^{-27} J

20. Which of the following is the property of electrostatic field lines
   A. Electrostatic field lines always start on positive charge and end on negative charges
   B. The number of lines that originate form, or terminate on a charge is proportional to the magnitude of the charge
   C. The direction of the field at a point is along the tangent to the line of force
   D. All Choices are.

21. Force on a charged particle due to an electrostatic field is called:
   A. Force of gravity
   B. Electrostatic force
   C. Magnetic force
   D. Nuclear force

22. The unit of intensity of electric field is
   A. newton/coulomb
   B. joule/coulomb
   C. volt ×meter
   D. newton/meter

23. Consider a spherical shell of metal at the centre of which a positive point charge is kept
   A. The electric field is zero outside the shell
   B. The electric field is zero everywhere
   C. The electric field is zero in the region inside the shell

D. The electric field is non-zero in both regions outside and inside the shell

24. A charge is placed at the centre of cube, the flux emitted through its one face is

A. $\frac{q}{\varepsilon_0}$ B. $\frac{q}{2\varepsilon_0}$

C. $\frac{q}{6\varepsilon_0}$ D. $\frac{q}{12\varepsilon_0}$

25. An electric dipole is at the centre of a hollow sphere of radius r. The total normal electric flux through the sphere is (here Q is the charge and d is the distance between the two charges of the dipole)

A. $Q/4\pi r^2$ B. $2Q/4\pi r^2$

C. Q.d **D. Zero**

26. A hollow insulated conduction sphere is given a positive charge of 10μC. What will be the electric field at the centre of the sphere if its radius is 2 meters?

A. Zero

B. $5\mu C\ m^{-2}$

C. $20\mu C\ m^{-2}$

D. $8\mu C\ m^{-2}$

27. A point charge Q is placed at the mid-point of a line joining two charges, 4q and q. If the net force on charge q is zero, then Q must be equal to

A. -q

B. +q

D. +4q

28. An electron of charge e coulomb passes through a potential difference of V volts. Its energy in 'joules' will be

A. V/e

B. eV

C. e/V

D. V

29. Equal charges are given to two spheres of different radii. The potential will

A. Be more on the smaller sphere

B. Be more on the bigger sphere

C. Be equal on both the sphere

D. Depend on the nature of the material of the sphere

30. If the distance of separation between two charges is increased, the electrical potential energy of the system will

A. Increase

B. Decrease

C. May increase or decrease

D. Remain the same

31. A cube of metal is given a positive charge Q. For the above system, which of the following statements is true?

A. Electric potential at the surface of the cube is zero

B. Electric potential within the cube is zero

C. Electric filed is normal to the surface of the cube

D. Electric field varies within the cube

32. The volt is equal to

A. C/q

B. N/m^2

C. joule/coulomb

D. Nm^2/C

33. Some charge is being given to a conductor. Then its potential

A. Is maximum at surface

B. Is maximum at centre

C. Is remain same throughout the conductor

D. Is maximum somewhere between surface and centre

34. At any point on the right bisector of the line joining two equal and opposite charges

A. At electric field is zero

B. The electric potential is zero

C. The electric potential decreases with increasing distance from the centre

D. The electric field is perpendicular to the line joining the charges

35. In bringing an electron towards another electron, electrostatic potential energy of system

A. Decreases

B. Increases

C. Remains uncharged

D. Becomes zero

36. An alpha particle is accelerated through a potential difference of 10^6 volt. Its kinetic energy will be

A. 1 MeV B. **2 MeV**

C. 4 MeV D. 8 MeV

37. On moving a charge of 20 coulombs by 2 cm, 2 J of work is done, then the potential difference between the points is

A. 0.1 V B. 8 V

C. 2 V D. 0.5 V

38. If we increase the distance between two plates of the capacitor, the capacitance will

A. Increase

B. Decrease

C. Remain same

D. First increase then decrease

39. The capacity of a condenser, when a dielectric is placed in between its plates

A. Increases

B. Decreases

C. Does not change

D. None of the above

40. In a charged capacitor the energy is stored in

A. Both in positive and negative charges

B. Positive charges

C. The edges of the capacitor plates

D. The electric field between the plates

Achievement Key

Correct Answers	You Got
More than 35	
Below 30	

If you got thumb down, you must consider learning more about the work and energy. If you got thumb up, be prepare to have a hard exercise based on work and energy.

Brain Busters

1. Which Force can be shielded
   A. Gravitational Force
   B. Electrostatic force
   C. Both (a) and (b)
   D. None of (a) and (b)
2. How many electrons are in one Coulomb?
   A. 6.2×10^{-23} B. 6.2×10^{-21}
   C. 6.2×10^{-19} D. Zero
3. The negative of the electric potential gradient is
   A. Electric flux
   B. Electric intensity
   C. Electric potential
   D. Electron volt
4. Two charges 4mm apart exert a force of 2 N on each other. If the distance between them is reduced to 2mm, the force between them becomes
   A. 1 N
   B. 2 N
   C. 4 N
   D. 8 N
5. Two opposite point charges, each of magnitude q are separated by a distance 2d. What is the electric potential at midpoint between them?
   A. 8 V
   B. 0 V
   C. 4 V
   D. 2 V
6. Minimum value of charge on a body can be
   A. 1.6×10^{-19} C B. 9×10^{9} C
   C. 1 C D. 1.6 C
7. The work done in moving a positive charge of two coulombs from one point to another point when the potential difference between them is 5 volt
   A. 5 Joules **B. 10 Joules**
   C. 15 Joules D. 20 Joules
8. The force between two charges 0.06 m apart is 5 N. If each charge is moved towards the other by 0.01 m, then the force between them will become
   A. 7.20 N **B. 11.25 N**
   C. 22.50 N D. 45.00
9. Tow point charge +3μC and +8μC repel each other with a force of 40 N. If a charge of -5μC is added to each of them, then the force between them will become
   A. -10 N
   B. +10 N
   C. +20 N
   D. -20 N
10. In a Millikan's oil drop experiment the charge on an oil drop is calculated to be 6.35×10^{-19} C. The number of excess electrons on the drop is
    A. 3.9
    B. 4
    C. 4.2
    D. 6
11. A point charge A of charge +4μC and another B of charge -1μC are placed in air at a distance 1 m apart. Then the distance of the point on the line joining the charge B, where the resultant electric field is zero, is (in m)
    A. 2
    B. 1
    C. 0.5
    D. 1.5
12. Two point charges placed at distance of 20 cm in air repel each other with a certain force. When a dielectric slab of thickness 8 cm and dielectric constant K is introduced between these point charges, force of interaction becomes half of its previous value. Then K is approximately.
    A. 2
    B. 4
    C. $\sqrt{2}$
    D. 1
13. When a Na ion and a Cl ion are placed in air, a force F acts between them when they are separated by a distance of 1 cm from each other. The permittivity of air and the dielectric constant of water are ε_0 and K respectively. When a piece of salt is placed in water, then the force between Na^+ and Cl^- ions separated by a distance of 1 cm will be
    A. F B. FK/ε_0
    C. $F/K\varepsilon_0$ **D. F/K**
14. The force of repulsion between two point charges is F, when these are at a distance 0.1 m apart. Now the point charges are replaced by spheres of radii 5 cm each having the same charge as that of the respective point charges. The distance between their centre is again kept 0.1 m; then the force of repulsion will:
    A. Increase
    B. Decrease
    C. Remain F
    D. Become $\frac{10F}{9}$

15. A charge Q is divided into two parts q and Q – q and separated by a distance R. The force of repulsion between them will be maximum when:
A. q = Q/4
B. q = Q/2
C. q = Q
D. None of these

16. The excess (equal in number) of electrons that must be placed on each of two small spheres spaced 3 cm apart, with force of repulsion between the spheres to be 10^{-19} N, is
A. 25 B. 225
C. 625 D. 1250

17. The electric field due to an infinitely long thin wire at a distance R varies as
A. 1/R
B. $1/R^2$
C. R
D. R^2

18. If a charged spherical conductor of radius 10 cm has potential V at a point distance 5 cm from its centre, then the potential at a point distance 15 cm from the centre will be
A. $\frac{1}{3}V$ B. $\frac{2}{3}V$
C. $\frac{3}{2}V$ D. 3V

...tial at the surface of

A. 9×10^5 V B. 9 V
C. 8×10^6 V D. 80 V

20. A proton is about 1840 times heavier than an electron. When it is accelerated by a potential difference of 1 kV, its kinetic energy will be:
A. 1840 keV
B. 1/1840 keV
C. 1 keV
D. 920 keV

21. A capacitor is charged with a battery and then it is disconnected. A slab of dielectric is now inserted between the plates, then
A. The charge in the plates reduces and potential difference increase
B. Potential difference between the plates increases, stored energy decreases and charge remains the same
C. Potential difference between the plates decreases, stored energy decreases and charge remains unchanged
D. None of the above

22. A parallel plate capacitor is first charged and then a dielectric slab is introduced between the plates. The quantity that remains unchanged is
A. Charge Q
B. Potential V
C. Capacity C

23. Force acting upon a charged particle kept between the plates of a charged condenser is F. If one of the plates of the condenser is removed, force acting on the same particle will become
A. Zero
B. F/2
C. F
D. 2F

24. Energy per unit volume for a capacitor having area A and separation d kept at potential difference V is given by
A. $\frac{1}{2}\varepsilon_0\frac{V^2}{d^2}$
B. $\frac{1}{2\varepsilon_0}\frac{V^2}{d^2}$
C. $\frac{1}{2}CV^2$
D. $\frac{Q^2}{2C}$

25. A medium of dielectric constant 'K' is introduced between the plates of parallel plate condenser. As a result its capacitance
A. Increase k time
B. Decreases k times
C. Decreases $\frac{1}{k}$ times
D. Remains unchanged

26. A one microfarad capacitor of a TV is subjected to 4000 V potential difference. The energy stored in capacitor is
A. 8 J
B. 16 J
C. 4×10^{-3} J
D. 2×10^{-3} J

27. A parallel plate condenser with oil between the plates (dielectric constant of oil k = 2) has a capacitance C. If the oil is removed, then capacitance of the capacitor becomes
A. $\sqrt{2}C$
B. 2C
C. $\frac{C}{\sqrt{2}}$
D. $\frac{C}{2}$

28. A metal plate of thickness half the separation between the capacitor plates of capacitance C is inserted. The new capacitance is
A. C
B. C/2
C. Zero
D. 2C

29. A condenser of capacity 50 μF is charged to 10 V. The energy stored is
A. 1.25×10^{-3} J
B. 3.75×10^{-3} J
C. 2.5×10^{-3} J
D. 5×10^{-3} J

30. The capacity of a parallel plat capacitor depends on the
A. Type of metal used
B. Thickness of plates
C. Potential applied across the plates
D. Separation between the plates

31. If the distance between the plates of a parallel plate condenser of capacity 10 μF is doubled then new capacity will be
A. 5 μF
B. 20 μF
C. 10 μF
D. 15 μF

32. A capacitor of capacity 1 μF is charged to 1 kV. The energy stored in J
A. 5
B. 0.5
C. 0.005
D. 50

33. When a dielectric material is introduced between the plates of a charged condenser the electric field between the plates
A. Decreases
B. Increases
C. No change
D. May increase or decrease

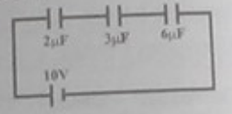
34. The energy required to charge a capacitor of 5 μF by connecting D.C.
C. 2 kJ D. 1 kJ

35. A sheet of aluminium foil of negligible thickness is introduced between the plates of a capacitor. The capacitance of the capacitor:
A. Increases
B. Decreases
C. Remain unchanged
D. Becomes infinite

36. The nature of capacity of electrostatic capacitor depends on
A. Shape
B. Size
C. Thickness of plates
D. Area

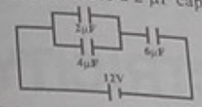
37. Taking the earth to be a spherical conductor of diameter 12.8×10^3 km. Its capacity will be:
A. 711 μF
B. 611 μF
C. 811 μF
D. 511 μF

38. In the figure below, the charge on 3 μF capacitor is



A. 5 μF
B. 10 μF
C. 3 μF
D. 6 μF

39. Two capacitors 2 μF and 4 μF are connected in parallel. A third capacitor of 6 μF capacity is connected in series. The combination is connected across a 2 μF capacity is



A. 2V B. 6V
C. 8V D. 1V

40. What is the magnitude of a point charge which produces an electric field of 2 N/C at a distance of 60 cm)? $(1/4\pi\varepsilon_0 = 9 \times 10^9\ Nm^2/C^2)$
A. 8×10^{-11} coulomb
B. 2×10^{-12} coulomb
C. 3×10^{-11} coulomb
D. 6×10^{-10} coulomb

Achievement Key

Correct Answers	You Got
More than 32	
Below 28	

If you got thumb down, you must consider learning more about the waves and oscillations.
If you got thumb up, go to the next exercise.

CHAPTER

11

CURRENT ELECTRICITY

Voltage: V = I*R (Voltage = current*resistance)

Power: P = I*V (or V^2/R or I^2*R)

Cost: cents= rate (8 cents/kw-hr) * Power (kw) * time (hrs)

1 horsepower = 746 watts (watts is energy per second)

MCQ Set 1

MCQ Set 1 is consisted of the questions from the topic of Current Electricity. The set takes you from very basic level (Sweet Candies) to the very tough level (Brain Buster).

Sweet Candies

Directions:

You are given following questions from the topics of this section, with four choices A through D. Select the choice that will answer the question best by filling the appropriate circle at the end of each question.

Answer of each question has been bolded for convenience.

1. If potential difference across the conductor is one volt and one ampere current is flowing, then resistance of the conductor is
   A. One farad
   B. One ohm
   C. One coulomb
   D. One ampere

2. The reciprocal of the resistance of a conductor is called:
   A. Specific resistance
   B. Current
   C. Conductance
   D. Effective resistance

3. The drift velocity of free electrons in a metallic conductor is
   A. 10^{-3} ms^{-1}
   B. 10^{-4} ms^{-1}
   C. 10^{-5} ms^{-1}
   D. 10^{-6} ms^{-1}

4. Every source of current converts some non-electrical energy into
   A. Chemical energy
   B. Mechanical energy
   C. Solar energy
   D. All of these

5. When the temperature of a metallic conductor is increased its resistance
   A. Always decreases
   B. Always increases
   C. May increase or decrease
   D. Remains the same

6. The passage of an electric current produces
   A. Heating effect
   B. Magnetic effect
   C. Chemical effect
   D. All of them

7. The resistance of a conductor increases with the increase in its
   A. Cross-sectional area
   B. Diameter
   C. Both diameter and cross-sectional area
   D. Length

8. The potential difference across each resistance in series combination, if the resistances are different, is
   A. Same
   B. Different
   C. greater than highest resistance
   D. None of the above

9. The electric motors uses the effect of current passing through them is
   A. Heating effect
   B. Magnetic effect
   C. Chemical effect
   D. None of these

10. In a house circuit, all electrical appliances are connected in parallel to each other between the line and neutral wires to get
    A. Same current
    B. Same current and potential difference

C. **Different current but same potential difference**
D. Difference current and different potential difference

11. Three resistors of resistance 2, 3 and 6 ohms are connected in parallel, their equivalent resistance is
A. 0.1 ohm **B. 1 ohm**
C. 3 ohms D. 2 ohms

12. As the current flows through an object, the value of resistance offered by the object depends upon
A. Nature of the material of the object
B. Dimension of the object
C. Physical state of the object
D. All of them

13. Power dissipated in the form of V and R can be determine as
A. $P = \frac{V}{I}$
B. $P = \frac{V^2}{R}$
C. $P = \frac{R}{V^2}$
D. $P = \frac{I}{V^2}$

14. A conductor which obeys Ohm's law is called
A. Ohmic device
B. Non-Ohmic device
C. Neither Ohmic nor non Ohmic
D. None of these

15. Heat energy dissipated in resistors is given by which of the following relation
A. VI
B. I^2Rt
C. Vt/I
D. It/V

16. A 100 watt bulb is operated by 200 volt, the current flowing through the bulb is
A. 1 ampere
B. 0.5 amperes
C. Zero amperes
D. 2 amperes

17. Thermocouples convert:
A. Electrical energy into heat energy
B. Heat energy into electrical energy
C. Kinetic energy into potential energy
D. Light energy into electrical energy

18. The unit of conductance of a material is
A. mho
B. Siemen
C. Ohm
D. All of them

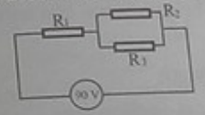
19. In liquids and gases, the current is due to the motion of:
A. Positive charges
B. Negative charges
C. Both positive and negative charges
D. Free electrons

20. The resistivity ρ of copper in Ω m is
A. 1.52×10^{-8}
B. 1.54×10^{-8}
C. 1.56×10^{-8}
D. None of these

21. Two resistances of 2Ω and 3Ω connected in series are attached to a source of 20V. The potential difference across 3Ω resistance is
A. 12 V
B. 10 V
C. 20 V
D. 15 V

22. The resistively ρ of Tungsten in Ω m is
A. 4.00×10^{-8}
B. 4.8×10^{-8}
C. 5.00×10^{-8}
D. None of these

23. In the circuit each of the three resistances has a resistance 30 Ω. The potential difference across R_1 is



A. 30 V
B. 60 V
C. 90 V
D. 0 V

24. The colour coded resistances are made by
A. High grade Silver rods
B. High grade ceramic rods
C. High grade copper rods
D. High grade Iron rods

25. Photovoltaic cell converts:
A. Light energy into electrical energy
B. Heat energy into electrical energy
C. Chemical energy into electrical energy
D. None of the above

26. In carbon colour coded resistance, the fourth Gold band indicates the tolerance of
A. ±5%
B. ±10%
C. ±20%
D. ±1%

27. What type of temperature coefficient of resistance is thermistor?
A. Negative only
B. Positive only
C. Neutral
D. Positive and negative

28. High negative temperature coefficient thermistors are very accurate for measuring temperatures in the range of
A. 15 K **B. 10 K**
C. 15 KJ D. 20 K

29. Electromotive force is measured in
A. Coulomb
B. Ampere
C. Volt
D. None of these

30. The electromotive force of a battery or cell is the voltage between its terminals when:
A. The circuit is closed
B. The circuit is open
C. Its internal resistance is minimum
D. Its internal resistance is maximum

31. Kirchhoff's first rule is also known as
A. Kirchhoff's point rule
B. Law of conservation of charge
C. Kirchhoff's current rule
D. All of them

32. Conventional current (I) is due to the
A. Flow of positive charges
B. Flow of negative charges
C. Flow of neutrons
D. Flow of positrons

33. When the resistors are connected in series, the equivalent resistance is always
A. Greater than the greatest resistance in series
B. Equal to the greatest resistance in series
C. Less than the largest resistance in series

34. The conductivity of a super-conductor is
A. Infinite
B. Very large
C. Very small
D. Zero

35. In a voltmeter the conduction takes place due to
A. Electrons only
B. Holes only
C. Electrons and holes
D. Electrons and ions

36. A certain charge liberates 0.8 g of oxygen. The same charge will liberate, how many g of silver?
A. 108 g **B. 10.8 g**
C. 0.8 g D. $\frac{108}{0.8}$ g

37. Cause of heat production in a current carrying conductor is
A. Collisions of free electrons with one another
B. High drift speed of free electrons
C. Collisions of free electrons with atoms or ions of conductor
D. High resistance value

37. Specific resistance of a wire depends upon
A. Length
B. Cross-section area
C. Mass
D. None

39. A car battery has e.m.f. 12 volt and internal resistance 5×10^{-3} ohm. If it draws 60 ampere current, the terminal voltage of the battery will be
A. 5 volt
B. 3 volt
C. 15 volt
D. 9 volt

40. Potentiometer is more sensitive than voltmeter, because
A. Voltmeter has a very high resistance
B. Voltmeter has a very low resistance
C. Potentiometer does not draw any current from a source of unknown potential difference
D. Potentiometer is sensitive

Achievement Key

Correct Answers	You Got
More than 35	
Below 30	

If you got thumb down, you must consider learning more about the waves and oscillations.
If you got thumb up, be prepare to have a hard exercise based on waves and oscillations.

Brain Busters

1. A 10 μF capacitor is charged to a potential difference of 50V and is connected to another uncharged capacitor in parallel. Now the common potential difference becomes 20volt. The capacitance of second capacitor is
A. 10 μF
B. 20 μF
C. 30 μF
D. 15 μF

2. A piece of fuse wire melts when a current of 15 ampere flows through it. With this current, if it dissipates 22.5 W, the resistance of fuse wire will be
A. Zero
B. 10 Ω
C. 1 Ω
D. 0.10 Ω

3. A conducting wire is drawn to double its length. Final resistivity of the material will be
A. Double of the original one
B. Half of the original one
C. One-fourth of the original one
D. Same as original one

4. The powers of two electric bulbs are 100 W and 200 W. Both of them are joined with 220 V mains. The ratio

of resistances of their filaments will be

A. 1 : 2 B. 2 : 1
C. 1 : 4 D. 4 : 1

5. In a building, there are 15 bulbs of 40 watts, 5 bulbs of 100 watts, 5 fans of 80 watts and a heater of 1 kilowatt. The voltage of the electric main is 220 volts. The minimum efficiency of the main fuse of the building will be

A. 0.4 A B. **11.4 A**
C. 9.8 A D. 10.6 A

6. A 100 W, 200 V bulb is connected to a 160 volts supply. The actual power consumption would be

A. 64 W
B. 80 W
C. 100 W
D. 125 W

7. A ten ohm electric heater operates on a 110 V line. Calculate the heat produced in watts

A. 1310 W
B. 670 W
C. 810 W
D. 1210 W

8. Two electric bulbs of 200 W and 100 W have same voltage. If R_1 and R_2 be their resistance respectively then

A. $R_1 = 2R_2$
B. $R_2 = 2R_1$
C. $R_2 = 4R_1$
D. $R_1 = 4R_2$

9. A wire of radius r has resistance R. If it is stretched to a wire of $\frac{r}{2}$ radius, then the resistance becomes

A. 2R
B. 4R
C. 16R
D. Zero

10. A 50 volt battery is connected across 10 ohm resistor. The current is 4.5 A. The internal resistance of the battery is

A. Zero
B. 0.5 Ω
C. 1.1 Ω
D. 5.0 Ω

11. If 2.2 kilowatt power is transmitted through a 10 ohm line at 22000 volt, the power loss in the form of heat will be

A. 0.1 watt
B. 1 watt
C. 10 watt
D. 100 watt

12. Resistance of 8 Ω, 10 Ω, and 12 Ω are connected in parallel to a battery of voltage 12 volt. The current in 10 Ω resistor is

A. 2 A
B. 1.2 A
C. 1 A
D. 0.8 A

13. Three resistors of resistance R each are combined in various ways. Which of the following cannot be obtained?

A. 3R Ω
B. $\frac{2R}{4}\Omega$
C. $\frac{R}{3}\Omega$
D. $\frac{2R}{3}\Omega$

14. If two bulbs one of 60 W and other of 100 W are connected in parallel, then which one of the following will glow more?

A. 60 W bulb
B. 100 W bulb
C. Both equally
D. None of these.

15. The resistance of 20 cm long wire is 10 Ω. When the length is changed to 40 cm. The new resistance is

A. 10 Ω
B. 20 Ω
C. 30 Ω
D. 40 Ω

16. 10^6 electrons are moving through a wire per second, the current developed is

A. 1.6×10^{-19} A
B. 1 A
C. 1.6×10^{-15} A
D. 10^6 A

17. A factory gets its electrical power from a generator two miles away. The wires connecting the generator to the factory terminals have a resistance of 0.04 Ω/miles. When the generator supplies 50 Ampere to the factory, the terminal voltage at the generator is 120 Volts. A voltmeter connected to the factory terminals should then read

A. 100 V
B. 110 V
C. 112 V
D. 118 V

18. A cell of emf 1.56 Volt is connected directly to an ammeter of resistance 0.05 Ω. if the current in the circuit is 2.0A, the internal resistance of the cell is

A. 0.7 Ω
B. 0.8 Ω
C. 0.9 Ω
D. 0.1 Ω

19. A battery having emf 4V and internal resistance 0.5 Ω is connected with a resistance of 4.5 Ω, then the voltage at the terminals of battery is

A. 4.5 V
B. 4 V
C. 0 V
D. 2 V

20. Two resistances of 2 Ω and 3 Ω connected in parallel are attached to a source of 20 V. The current through 3Ω resistance is

A. 8 A B. 15 A
C. 20 A D. 5 A

21. Calculate the amount of charge flowing in 2 minutes in a wire of resistance 10 Ω when a potential difference of 20 V is applied between its ends
A. 120 C B. **240 C**
C. 20 C D. 4 C

22. A uniform resistance wire of length L and diameter d has a resistance R. Another wire of same material has length, 4L and diameter 2d, the resistance will be
A. 2 R
B. R
C. R/2
D. R/4

23 For two resistance wires joined in parallel, the resultant resistance is $\frac{6}{5}$ ohm. When one of the resistance wire breaks, the effective resistance becomes 2 ohm. The resistance of the broken wire is
A. $\frac{3}{5}$ ohm
B. 2 ohm
C. $\frac{6}{5}$ ohm
D. 3 ohm

24. A current of 1.6 A is passed through a solution of $CuSO_4$. How many Cu^{2+} ions are liberated in one minute?
A. 3×10^{20} B. 3×10^{10}
C. $\times 10^{20}$ D. 6×10^{10}

25. When a wire is stretched and its radius becomes r/2, then its resistance will be
A. 16 R
B. 4 R
C. 2 R
D. 0

26. The minimum resistance that can be obtained by connecting 5 resistance of $\frac{1}{4}\Omega$ each is
A. $\frac{4}{5}\Omega$
B. $\frac{5}{4}\Omega$
C. 20 Ω
D. 0.05 Ω

27. Two copper wires are of same length one of them is twice as thick as the other. Then the resistance of the two wires are in the ratio of:
A. 1 : 16
B. 1 : 8
C. 1: 4
D. 1 : 2

28. Two wires of the same dimensions but resistivity's ρ_1 and ρ_2 are connected in series. The equivalent resistivity of the combination is
A. $2(\rho_1 + \rho_2)$
B. $\sqrt{\rho_1 \rho_2}$
C. $\frac{\rho_1 + \rho_2}{2}$
D. $\rho_1 + \rho_2$

29. A wire of resistance 3.0 W is stretched to twice its original length, the resistance of the new wire will be
A. 1.5 Ω B. 3.0 Ω
C. 6.0 Ω **D. 12 Ω**

30. A battery of emf 12V and internal resistance 0.5 is charged by a battery charger which supplied a 132 V d.c. supply using a series resistance of 11.5. What is the terminal voltage of the battery during changing?
A. 15 V
B. 16 V
C. 17 V
D. 18V

31. When three identical bulbs of 60 watt, 200 volt rating are connected in series to a 200 volt supply, the power drawn by them will be
A. 180 watt
B. 10 watt
C. 20 watt
D. 60 watt

32. In Pakistan electricity is supplied for domestic use at 220 V. It is supplied at 110 V in USA. If the resistance of a 60 W bulb for use in Pakistan is R, the resistance of a 60 W bulb for use in USA will be
A. 2 R
B. R/4
C. R/2
D. R

33. Current provided by a battery is maximum when
A. Internal resistance equal to external resistance
B. Internal resistance is greater than external resistance
C. Internal resistance is less then external resistance
D. None of these

34. The colour sequence in a carbon resistor in red, brown, orange and silver. The resistance of the resistor is
A. $21 \times 10^3 \pm 10\%$
B. $23 \times 10^3 \pm 10\%$
C. $21 \times 10^3 \pm 5\%$
D. $12 \times 10^3 \pm 5\%$

35. A heater coil rated at (1000 W – 200 V) is connected to 110 volt line. What will be the power consumed?
A. **200 W**
B. 302.5 W
C. 250 W
D. 350 W

36. A 60 W bulb operates on 220 V supply. The current flowing through the bulb is
A. 11/3 A
B. 3 A
C. 3/11 A
D. 6

37. An energy source will supply a constant current into the load if its internal resistance is
A. very large as compared to the load resistance
B. equal to the resistance of the load
C. non- e o but less than the resistance of the load
D. zero [AIEEE 2005]

38. A 3 volt battery with negligible internal resistance is connected in a circuit as shown in the figure. The cu rent in the circuit will be
A. 1 /3 A B. 1 A
C. 1.5 A D. 2 A

39. The length of a given cylindrical wire is increased by 100 %. Due to this decrease in its diameter, the change in the resistance of t e wire will be
A. 300 % B. 200 %
C. 100 % D. 50 %

40. Using the resistors R1 and R2 singly, in series and in parallel combination, we can get4, 5, 20 and 25 Ω. Then R1, R2 are
A. 4, 5 **B. 5, 20**
C. 20, 25 D. 25, 4

Achievement Key

Correct Answers	You Got
More than 32	
Below 28	

If you got thumb down, you must consider learning more about the waves and oscillations.
If you got thumb up, go to the next exercise.

CHAPTER 12

ELECTROMAGNETISM

Acceleration of a particle in an electric field	$a=\frac{q}{m}E$
Amperes law	$\oint_c Bdl=\mu_0 I_c$
Biot-Savart law	$dB=\frac{\mu_0}{4\pi}\frac{Idl\times\hat{r}}{r^2}$
Capacitance of a cylindrical capacitor	$C=\frac{Q}{V}=\frac{2\pi\varepsilon_0 L}{\ln\left(b/a\right)}$
Capacitance of a parallel-plate capacitor	$C=\frac{Q}{V}=\frac{\varepsilon_0 A}{S}$
Change in electrostatic potential energy for a point charge	$\Delta U=U_b-U_a=\int_a^b dU=-\int_a^b q_0 E.dl$
Change in potential	$\Delta V=V_b-V_a=\frac{\Delta U}{q_0}=-\int_a^b E.dl$
Current in a conducting strip	$I=nAqv_d$
Electric current	$I=\frac{\Delta Q}{\Delta t}=nqAv_d$
Electric field and magnetic field relationship for an electromagnetic wave	$E=cB$
Electric field on the axis of a ring charge	$Ex=\frac{kQx}{\left(x^2+a^2\right)^{3/2}}$
Electric flux defined	$\phi=\int_S E\cdot\hat{n}dA$

EMF (Electromotive Force) defined	$\xi = \oint_C E \cdot dl$
Gauss law	$\phi_{net} = \int_S E_n dA = \frac{1}{\varepsilon_0} Q_{inside} = 4\pi k Q_{inside}$
Magnetic dipole moment of a current loop	$m = N I A \hat{n}$
Magnetic field inside a solenoid	$B = \mu_0 n I$
Magnetic flux defined	$\phi_m = \int_S NB \cdot \hat{n} dA = \int_S NB_n dA$
Magnetic force on a moving charge	$F = qv \times B$
Maxwells equation - Faradays law	$\oint_C E \cdot dl = -\frac{d}{dt} \int_S B_n dA$
Maxwells equation - Gauss law	$\oint_S E_n dA = \frac{1}{\varepsilon_0} Q_{inside}$
Number density of charge carriers	$n = \frac{I}{Aq\upsilon_d} = \frac{I}{wte\upsilon_d}$
Ohms Law	$V = IR = I\left(\frac{L}{\sigma A}\right) = I\left(\frac{\rho L}{A}\right)$
Potential due to a line charge	$V = -2k\lambda \ln \frac{r}{a}$
Poynting vector	$S = \frac{E \times B}{\mu_0}$
Resistance	$R = \frac{L}{\sigma A} = \frac{\rho L}{A}$
Self inductance of a solenoid	$L = \frac{\phi m}{I} \mu_0 n^2 Al$
Torque on a current loop	$\tau = m \times B$
Voltage equation	$V = IR$
Wave equation for magnetic field	$\frac{\partial^2 B}{\partial x^2} = \frac{1}{c^2} \frac{\partial^2 B}{\partial t^2}$
Yukawa Potential	$V = \frac{V_0 e^{-kr}}{r}$

MCQ Set 1

MCQ Set 1 is consisted of the questions from the topic of Electormagnetism. The set takes you from very basic level (Sweet Candies) to the very tough level (Brain Buster).

Sweet Candies

Directions:

You are given following questions from the topics of this section, with four choices A through D. Select the choice that will answer the question best by filling the appropriate circle at the end of each question.

Answer of each question has been bolded for convenience.

1. The path along which an isolated north pole of a magnet moves in the magnetic field is called
   A. Magnetic field
   B. Magnetic Field Lines
   C. Loop
   D. Electric Lines of Force

2. The S.I. units of magnetic field is
   A. Wb
   B. Wb m^{-1}
   C. Wb m^{-2}
   D. None of these

3. The magnetic force F_m acting on charge q when it moves with a velocity v through a magnetic field B is given by
   A. $F_m = q\,v \times B$
   B. $F_m = q\,v^2 \times B$
   C. $F_m = q\,v^3 \times B$
   D. $F_m = q\,v^4 \times B$

4. The SI unit of magnetic induction is
   A. Tesla
   B. Weber
   C. Gauss
   D. Ampere

5. One tesla is equal to
   A. 1 Nm A^{-1}
   B. 1 NA^{-1} m^{-1}
   C. 1 Nm^{-1} A
   D. None of these

6. Ampere's law in analogous to
   A. Faraday's law
   B. Gauss's law
   C. Lenz's law
   D. None of the above

7. The field inside the solenoid is
   A. Weak
   B. Strong
   C. Very strong
   D. None of these

8. When the magnetic flux changes through a loop on a coil, an induced emf is produced in it. This is called
A. Ampere's law
B. Faraday's law
C. Lenz's law
D. Gauss's law

9. When a proton enters into a magnetic field perpendicularly, the proton will experience a force along the
A. Upward direction
B. Downward direction
C. Un-deflected
D. Parallel to field

10. A device which produces a voltage difference between two terminals by changing flux through the coil is called
A. Resistance box
B. Electric motor
C. Electric generator
D. Transformer

11. Electric force is the force which is experienced by a positive charge to produce
A. Displacement
B. Work
C. Attraction
D. None of these

12. Which type of field is generated by electric current?
A. magnetic
B. Electric
C. magnetic flux
D. None of above

13. Cathode ray oscilloscope is a very versatile electronic instrument which is in fact
A. Current measuring device
B. Resistance measuring device
C. High speed graph plotter
D. All of them

14. CRO works by beam of electrons.
A. deflecting
B. reflecting
C. refracting
D. None of above

15. The saw tooth waveform generate in C.R.O is due to
A. Increases linearly
B. Drop suddenly
C. Increase linearly and drops to zero
D. None of these

16. The C.R.O can measure
A. Voltage
B. Frequency
C. Phase
D. All of them

17. Choose the correct statement
A. Both an ammeter and voltmeter should have small resistance
B. Both an ammeter and a voltmeter should have large resistance
C. An ammeter should have large resistance and a voltmeter should have small resistance
D. An ammeter should have small resistance and a voltmeter should have large resistance.

18. The torque 'τ' produced by the coil of the galvanometer is
A. NBA $\cos\alpha$
B. NIBA $\sin\alpha$
C. NIAB $\cos\alpha$
D. None of these

19. An electron is projected along the axis of a circular conductor carrying some current. Electron will experience force
A. Along the axis
B. Perpendicular to the axis
C. At an angle of 4° with axis
D. No force experienced

20. The current passing through the coil of moving coil galvanometer is directly proportional to
A. Number of turns
B. Angle of deflection
C. Magnetic field
D. None of these

21. In order to convert galvanometer into voltmeter, a resistor is connected in series with the galvanometer
A. A low resistor
B. Capacitor
C. Semi-conductor
D. A very high resistor

22. In case of a suspended coil galvanometer the Restoring torque =
A. BAN
B. cθ
C. Cv
D. None of the above

23. The resistance of voltmeter must have very high resistance because
A. It does not draw any current
B. It is very accurate
C. It does not change considerably
D. None of these

24. According to Ampere Circuital law, the sum of the quantities $B.\Delta L$ for all path elements into which the complete loop has been divided =
A. $\mu_0 I$
B. $\varepsilon_0 I$
C. Zero
D. None of the above

25. For the core of an electromagnet, the most suitable material is
A. Steel
B. Nickel
C. Soft Iron
D. Cobalt

26. When an electron strikes the screen of a C.R.O. a visible flash appears due to
A. Tungsten target
B. Polished surface
C. Fluorescent screen
D. None of these

27. Velocity (V), Magnetic force (F), and magnetic field (B) are
A. mutually perpendicular
B. Parallel
C. V and B are perpendicular
D. F and B are Perpendicular

28. Magnetic flux passing normally, through a unit area is called
A. Magnetization
B. Magnetic field Intensity
C. Magnetic flux density
D. All of these

29. When a charged particle is projected perpendicularly in a magnetic field, its trajectory is
A. Cycloid
B. Parabola
C. Circular
D. Helix

30. When a charged particle q is moving with velocity v in region where there is an electric field E and magnetic field B, the total force F is given as
A. F = qE + q(Vx B)
B. F = E + B
C. F = Eq
D. F = qE + qB

31. Working of a galvanometer depends on
A. Force exerted on a coil
B. Torque on a coil
C. Induced emf
D. None of these

32. The direction of Lorentz force depends on the sign of change in a magnetic field
A. Negative
B. Positive
C. No change
D. Both positive and negative

33. DMM is
A. like CRO
B. digital version of AVO meter
C. Digital version of Ohm meter
D. Digital version of Ammeter

34. A digital millimetre is preferred over ordinary AVO meter because
A. No needle is used
B. Error free reading
C. No battery is used
D. None of these

35. The relation between Tesla (T) and Gauss (G) is given as
A. $1\ T = 10^4\ G$
B. $1\ T = 10^6$
C. $1\ T = 10^4\ G$
D. $1\ T = 10^6\ G$

36. The voltage that is applied across the X plates is usually provided by a circuit that is built in the CRO. It is known as
A. time base generator
B. electric generator
C. x supplier
D. Power supply

37. If a diamagnetic substance is brought near north or south pole of a bar magnet it is
A. Attracted by the poles
B. Repelled by the poles
C. Repelled by north pole and attracted by the south pole
D. Attracted by the north pole and repelled by the south pole

38. A moving charge will gain energy due to the application of
A. Electric field
B. Magnetic field
C. Both of these
D. None of these

39. The incorrect statement regarding the lines of force of the magnetic field B is
A. Magnetic intensity is a measure of lines of force passing through unit area held normal to it
B. Magnetic lines of force form a close curve
C. Inside a magnet, its magnetic lines of force move from north pole of a magnet towards its south pole.
D. Due to a magnet magnetic lines of force never cut each other.

40. The magnetic moment of a circular coil carrying current is
A. Directly proportional to the length of the wire in the coil
B. Inversely proportional to the length of the wire in the coil
C. Directly proportional to the square of the length of the wire in the coil
D. Inversely proportional to the square of the length of the wire in the coil

Achievement Key

Correct Answers	You Got
More than 35	
Below 30	

If you got thumb down, you must consider learning more about the optics.
If you got thumb up, be prepare to have a hard exercise based on optics.

Brain Busters

1. A circular coil has 250 turns and a mean diameter of 20 cm. if carries a current of 5A. What is the strength of the magnetic field at a point on its axis at a distance of 5m from the centre of the coil?
A. $4\pi \times 10^{-7}$ T
B. $2\pi \times 10^{-7}$ T
C. $2\pi \times 10^{-8}$ T
D. $2\pi \times 10^{-8}$ T

2. A solenoid that has been bent into a circle is called
A. Resistor B. Toroid
C. Transformer D. Capacitor

3. A 20.0cm wire carrying a current of 10.0 A is placed in a uniform magnetic field of 0.30T. If the wire makes an angle of 40° with the direction of magnetic field, the magnitude of the force acting on the wire is
   A. 0.34N
   B. 0.36N
   C. 0.38N
   D. 0.39N

4. Shunt resistance must be connected across a galvanometer of 50.0 Ω resistance which gives full scale deflection with 2.0m A current, so as to convert it into an ammeter of range 10.0 A is
   A. Rs = 0.1 Ω
   B. Rs = 0.01Ω
   C. Rs = 0.001 Ω
   D. 0.011Ω

5. A voltmeter has resistance of 2000 ohms and it can measure up to 2V. If we want to increase its range to 10V then required resistance in series will be
   A. 2000 Ω
   B. 4000 Ω
   C. 6000 Ω
   D. 8000 Ω

6. The unit of electric current 'ampere' is the amount of current flowing through each of two parallel wires 1 m apart and of infinite length will give rise to a force between them equal to
   A. 1 N/m
   B. 2×10^{-7} N/m
   C. 1×10^{-2} N/m
   D. $4\pi \times 10^{-7}$ N/m

7. Choose the correct statement
   A. Both an ammeter and voltmeter should have small resistance
   B. Both an ammeter and a voltmeter should have large resistance
   C. An ammeter should have large resistance and a voltmeter should have small resistance
   D. **An ammeter should have small resistance and a voltmeter should have large resistance.**

8. Shunt required in an ammeter of resistance R to decrease its deflection from 30 ampere to 10 ampere is
   A. R/4
   B. R/3
   C. R/2
   D. R

9. Which of the following particles would experience the largest magnetic force when projected with the same velocity perpendicular to a magnetic field?
   A. Proton
   B. Electron
   C. He^+
   D. Li^+

10. The hard ferromagnetic material is characterized by
    A. Narrow hysteresis loop
    B. Fat hysteresis loop
    C. High mechanical hardness, all over
    D. Mechanically hard surface

11. An ammeter gives full deflection when a current of 2 amperes flows through it. The resistance of ammeter is 12 ohms. If the same ammeter is to be used for measuring a maximum current of 5 amperes, then the ammeter must be connected with a resistance of
    A. 8 ohms in series
    B. 18 ohms in series
    C. 8 ohms in parallel
    D. 18 ohms in parallel

12. A material is placed in a magnetic field and it is thrown out of it by the field. Then the material is
    A. Paramagnetic
    B. Diamagnetic
    C. Ferromagnetic
    D. Non-magnetic

13. Neutrons enter a magnetic field B in different directions with the same speed V. Which of the following statements is true?
    A. No force acts on the neutrons
    B. Force is maximum when the angle between B and V is 90°
    C. Force is maximum when the angle between B and V is 60°
    D. Force is maximum when the angle between B and V is 0°

14. A voltmeter of resistance 20000 Ω reads 5 volt. To make it read 20 volt, the extra resistance required is
    A. 40000 Ω in parallel
    B. 60000 Ω in parallel
    C. 60000 Ω in series
    D. 40000 Ω in series

15. If a current is passed through a spring then the spring will
    A. Expand
    B. Compress
    C. Remain same
    D. None of these

16. The defection in moving coil galvanometer falls from 50 division to 10 division, when a shunt of 12 Ω is applied, the resistance of galvanometer coil is
    A. 24 Ω
    B. 12 Ω
    C. 50 Ω
    D. 48 Ω

17. Which particles will have minimum frequency of revolution when projected with the same velocity perpendicular to a magnetic field?
    A. Li^+ B. Electron
    C. Proton D. He^+

18. A superconductor exhibits perfect
    A. Ferromagnetism
    B. Permanent Magnet
    C. Diamagnetism
    D. Para magnetism

19. A proton, an electron and an α particle accelerated through the same potential difference enter a region of uniform magnetic field, moving at right angles to the magnetic field $\vec{B}$. The ratio of their kinetic energies is
A. 2 : 1 : 1 B. 2 : 2 : 1
C. 1 : 2 : 1 **D. 1 : 1 : 1**

20. A current loop of area 0.01 m^2 and carrying a current of 10 A is held perpendicular to a magnetic field of intensity 0.1 T. the torque acting on the loop (in N-m) is
A. 1.1
B. 0.8
C. 0.001
D. 0.01

21. A resistance of a galvanometer G = 6 Ω, maximum current of 2 amp is measured by it. Then required resistance to convert it into an ammeter reading up to 6 A, will be:
A. 5 Ω
B. 4 Ω
C. 3 Ω
D. 2 Ω

22. An ammeter reads up to 1 ampere. Its internal resistance is 0.81 ohm. To increase then range to 10 A the value of the required shunt is:
A. 0.09 Ω
B. 0.03 Ω
C. 0.3 Ω
D. 0.9 Ω

23. A long solenoid carrying a current produces a magnetic field B along its axis. If the current is doubled and the number of turns per cm is halved, the new value of the magnetic field is:
A. B
B. 2B
C. 4B
D. B/2

24. The electric current in a circular coil of two turns produced a magnetic induction of 0.1 T at its centre. The coil is unwound and is rewound into a circular coil of four turns. The magnetic induction at the centre of the coil now is, in tesla, (if same current flows in the coil)
A. 0.2
B. 0.4
C. 0.6
D. 0.8

25. 20 ampere current is flowing in a long straight wire. The intensity of magnetic field at a distance 10 cm from the wire will be:
A. 4×10^{-5} Wbm^{-2}
B. 9×10^{-5} Wbm^{-2}
C. 8×10^{-5} Wbm^{-2}
D. 6×10^{-5} Wbm^{-2}

26. An electron moves at right angle to magnetic field of 1.5×10^{-2} tesla with a speed of 6×10^{7} m/s. If the specific charge of the electron is 17 coulomb/kg, the radius of the circular path will be:
A. 2.9 cm
B. 3.9 cm
C. 2.35 cm
D. 2 cm

27. A beams of electrons and protons move parallel to each other in the same direction, then they:
A. Attract each other
B. Repel each other
C. No relation
D. Neither attract nor repel

28. A proton and an α-particle are projected normally into a magnetic field. What will be the ratio of the radii of the trajectories of the proton and α particle?
A. 2 : 1 **B. 1 : 2**
C. 4 : 1 D. 1 : 4

29. Liquid oxygen remains suspended between two pole faces of a magnet because it is
A. Diamagnetic
B. Paramagnetic
C. Ferromagnetic
D. Antiferromagnetic

30. A charge of 1 C is moving in a magnetic field of 0.5 tesla with velocity of 10 m/s. Force experienced is
A. 5 N B. 10 N
C. 0.5 N D. 0 N

31. The magnetic moment of a current (I) carrying circular coil of radius (r) and number of turns (n) varies as
A. $1/r^2$
B. 1/r
C. r
D. r^2

32. A bar magnet is equivalent to
A. Toroid carrying current
B. Straight conductor carrying current
C. Solenoid carrying current
D. Circular coil carrying current

A B C D

33. A short-circuited coil is placed in a time-varying magnetic field. Electrical power is dissipated due to the current induced in the coil. If the number of turns were to be quadrupled and the wire radius halved, the electrical power dissipated would be
A. Halved
B. the same
C. Doubled
D. quadrupled

34. An ionized gas contains both positive and negative ions. If it is subjected simultaneously to an electric field along the +x direction and a magnetic field along +z direction, then
A. positive ions deflect towards +y direction and negative ions towards -y direction

B. all ions deflect towards +y direction

C. all ions deflect towards -y direction

D. positive ions deflect towards -y direction and negative ions towards +y direction

35. A micrometre has a resistance of 100 Ω and full scale range of 50 ea. It can be used
As a voltmeter or as a higher range ammeter provided a resistance is added to it. Pick
The correct range and resistance combination (s).

A. 50 V range with 10 k Ω resistance in series

B. 10 V range with 200 k Ω resistance in series

C. 5 mA range with 1 Ω resistance in parallel

D. 10 mA range with 1 Ω resistance in parallel

36. A current I flows along the length of an infinitely long, straight, thin-walled pipe. Then

A. the magnetic field at all points inside the pipe is the same, but not zero

B. the magnetic Field at any point inside the pipe s zero

C. the magnetic field is zero only on the axis o the pipe

D. the magnetic field is different at different p nits inside the pipe

37. A long wire carries a steady current. It is bent into a circle of one turn and the Magnetic field at the centre of the coil is B. It is then bent into a circular loop of n Turns. The magnetic field at the centre of the coil will be

A. N B

B. n2B

C. 2nB

D. 2n2B

38. A charged particle is released from rest in a region of steady and uniform electric and magnetic fields which a e pa allele to each other. The particle will move in a

A. straight line

B. Circle

C. Helix

D. cycloid

39. The magnetic field due to a current carrying circular loop of radius 3 cm at a point on
The axis at a distance of 4 cm from the centre is 54 μT. What will be its value at the
Centre of the loop?

A. 250 μT

B. 150 μT

C. 125 μT

D. 75 μT

40. Two long conductors, separated by a distance d carry currents I1 and I2 in the same direction. They exert a force F on each other. Now the

current in one of them is increased to two times and its direction is reversed. The distance is also increased to3d. The new value of the force between them is

A. - 2F

B. F / 3

C. - 2F / 3

D. - F / 3

Achievement Key

Correct Answers	You Got
More than 32	
Below 28	

If you got thumb down, you must consider learning more about the optics.
If you got thumb up, go to the next exercise.

MCQ Set 2

MCQ Set 2 is consisted of the questions from the topic of Electromagnetism. The set takes you from very basic level (Sweet Candies) to the very tough level (Brain Buster).

Sweet Candies

Directions:

You are given following questions from the topics of this section, with four choices A through D. Select the choice that will answer the question best by filling the appropriate circle at the end of each question.

Answer of each question has been bolded for convenience.

1. A device which converts AC voltage of one magnitude into another AC voltage of required magnitude is called
   A. Alternating generator
   B. DC generator
   C. Electric motor
   D. Transformer

2. The phenomenon of electromagnetic induction produces
   A. Induced emf
   B. Induced current
   C. Work don
   D. All of them

3. Heating a magnet will
   A. Weaken it
   B. strength it
   C. reverse its polarity
   D. have no effect

   A B C D

4. The induced current in a conductor can be increase by
   A. Strong magnetic field
   B. Increasing number of turns
   C. Increasing speed of loop
   D. All of them

5. If a step-up transformer were 100% efficient, the primary and secondary windings would have the same
   A. current
   B. number of turns
   C. power
   D. voltage

6. Lenz's law always applies to
   A. Conductor
   B. conducting loop
   C. Semiconductor
   D. None of these

7. The condition for step-up transformer is
   A. $N_s > N_p$
   B. $N_s < N_p$
   C. $N_s = N_p$
   D. None of the above

8. Lenz's law is also statement of
   A. Law of conservation of mass
   B. Law of conservation of energy
   C. Law of conservation of momentum
   D. None of these

9. The mutual inductance of the two coils depends upon
   A. Number of turns
   B. Area of cross section of coil
   C. The distance between the two coils
   D. All of them

10. The self-inductance is more in case of
    A. Air cored coil
    B. Iron cored coil
    C. Tungsten cored coil
    D. Copper cored coil

11. The induced emf in the coil (self-induction) is given as
    A. $\varepsilon_L = -L\frac{\Delta t}{\Delta I}$
    B. $\varepsilon_L = -L\frac{\Delta v}{\Delta t}$
    C. $\varepsilon_L = -L\frac{\Delta I}{\Delta t}$
    D. None of these

12. The induced emf produced in the coil is sometimes called as
    A. Self-inductance
    B. Back emf
    C. Obey Lenz's law
    D. All of them

13. The energy stored in a inductor in terms of magnetic field B of a solenoid is given by
    A. $U_m = \frac{1}{2}\frac{B}{\mu_0}$
    B. $U_m = \frac{1}{2}\frac{B}{\mu_0^2}$
    C. $U_m = \frac{1}{2}\frac{B^2}{\mu_0}$
    D. None of these

14. The induced emf produced in an A.C. generator is equal to
    A. $\varepsilon_0 = N\omega AB$
    B. $\varepsilon_0 = NIAB$
    C. $N\omega IB$
    D. None of these

15. A d.c. motor converts
    A. Electrical energy into mechanical energy
    B. Mechanical energy to electrical energy
    C. Mechanical energy stored as potential energy
    D. None of these

16. The principle of d.c. motor based on
    A. Induced emf
    B. Force due to magnetic field
    C. Torque due to magnetic field

D. None of these

17. The torque produced in d.v. motor vanishes due to change of direction after each half revolution due to
A. Reversed torque
B. Creates jerk
C. Both
D. None of these

18. When the d.c. motor may overloaded beyond its limits the motor may be burnt due to
A. Low voltage
B. heavy current
C. High voltage
D. None of these

19. In transformer, if the resistance of the coil is negligible them
A. Back emf is equal to applied voltage
B. Back emf is equal and opposite to applied voltage
C. Back emf is less than applied voltage
D. None of these

20. Where the several secondary's the transformers are used for different voltages is required?
A. Television
B. Radio
C. Computer monitors
D. All of them

21. In order to improve the efficiency of the transformer
A. Core pieces should be laminated
B. Hysteresis loop is of small area
C. Wire should be of pure copper
D. All of them

22. The emf produce by motion of a coil across a magnetic field is called
A. Induced emf
B. Self -induced emf
C. Motional emf
D. emf

23. The induced emf primarily produced at the cost of
A. Internal energy
B. Chemical energy
C. Electrical energy
D. Mechanical energy

24. Energy can be stored in a magnetic field of
A. Capacitor B. Resistor
C. Conductor **D. Solenoid**

25. The Lenz's law hold in case of induced
A. Current
B. Voltage
C. Emf
D. All of them

26. Lamination of core of a transformer is to decrease its
A. Eddy current loss
B. conduction
C. Electrical resistance
D. Inductance

27. The purpose to place a soft Iron inside a coil is to
A. Increase current
B. Increase magnetic flux
C. Decrease in magnetic flux
D. None of these

28. Load is the device which consumes
A. Mechanical energy
B. Electrical energy
C. Frictional energy
D. None of these

29. The field coils on the armature coils are connected in
A. Series
B. Parallel
C. Series or parallel
D. None of these

30. To enhance the magnetic flux, the primary and secondary coils are wound on
A. Air core
B. Steel core
C. Wooden core
D. Soft iron core

31. When a metallic and glass pots are put over a heater the metallic pot heated up earlier due to the
A. Resistance
B. Voltage is generated
C. Current is generated
D. None of these

32. The direction of induced emf is such as to oppose the cause producing it. Comment on this statement
A. Faraday's law
B. Gauss's law
C. Lenz's law
D. None of these

33. A transformer is a device which
A. Steps up A.C. voltage
B. Steps down
C. Steps up energy
D. a and b

34. The power dissipation in the transformer is due to
A. Current
B. Voltage
C. Eddy currents
D. All of them

35. Which quantity is increased in step-down transformer?
A. Current B. Voltage
C. Power D. Frequency

36. The average power dissipation in a pure capacitor in AC circuit is
A. $\frac{1}{2}CV^2$ B. CV^2
C. $2CV^2$ **D. zero**

37. Quantity that remains unchanged in a transformer is
A. Voltage
B. Current
C. Frequency
D. None of these

38. The direction of induced current is such that it opposes the very cause that has produced it. This is the law of
A. Lenz
B. Faraday

C. Kirchhoff
D. Fleming

39. A particle is moving in a uniform magnetic field, then
A. its momentum changes but total energy remains the same
B. Both momentum and total energy remains the same
C. Both changes
D. Total energy change but momentum remains

40. A transformer works on the principle of
A. Convertor
B. Invertor
C. Mutual induction
D. Self-induction

Achievement Key

Correct Answers	You Got
More than 35	
Below 30	

If you got thumb down, you must consider learning more about the work and energy. If you got thumb up, be prepare to have a hard exercise based on work and energy.

Brain Busters

1. A 3-cm length of wire is moved at right angles across a uniform magnetic field with a speed of 2.0 m/s. If the flux density is 5.0 Tesla, what is the magnitude of the induced emf?
A. 0.03V
B. 0.3 V
C. 0.6 V
D. 10 V

2. When a conductor of 15 cm long at right angle to a uniform magnetic field of 1.5 web/m^2 and the force acting on its is 10 N. The current flowing through the conductor is
A. 40.23 A
B. 44.44 A
C. 45.29 A
D. 45.67 A

3. A coil of 24 mH carries a current of 2.5 Amp. The energy stored in its magnetic field is
A. 0.01 J
B. 0.075 J
C. 0.050 J
D. 0.025 J

4. If a current 24 flows through a coil, the fluxed link with the coil is 1 Weber. If the current through the coil changes at the $1As^{-1}$, the emf induced in the coils is
A. 0.25 V
B. 0.5 V
C. 0.75 V
D. 1.0 V

5. The energy stored in the magnetic field of an inductor of inductance 2H, when a steady current of 1.5 A flowing through it falls to zero is
A. 1.25 J
B. 2.25 J
C. 4.45 J
D. 9.0 J

6. When a current of 2A is passed in the primary of a transformer, the magnetic flux through the secondary is 8×10^{-5} Weber. The number of turns in the secondary is 25. The mutual inductance of the coils is
A. 1 mH
B. 2 mH
C. 3 mH
D. 4 z mH

7. A transfer is used to set up an alternating emf of 220 V to 4.4 kV in order to transmit 6.6 kW of power. If the primary coil has 100 turns, what is the number of turns in the secondary?
A. 20
B. 200
C. 2000
D. 20000

8. In an L-R circuit, time constant is that time in which current grows from zero to the value
A. 0.63 I_0
B. 0.50 I_0
C. 0.37 I_0
D. I_0

9. Two inductors each of inductance 'L' are joined in parallel. What is the equivalent inductance?
A. 2L
B. L
C. $\frac{L}{2}$
D. Zero

10. A step-up transformer has transformation ratio of 3 : 2. What is the voltage in secondary, if voltage in primary is 30V?
A. 45 V B. 15 V
C. 90 V D. 300 V

11. The current in a coil changes from 4 ampere to zero in 0.1 s. If the average e.m.f. induced is 100 volt,

what is the self-inductance of the coil?

A. 2.5 H B. 25 H
C. 400 H D. 40 H

12. The best material for the core of a transformer, is
A. Stainless steel
B. Mild steel
C. Hard steel
D. Soft iron

13. In an ideal transformer, the voltage and the current in the primary are 200 V, 2A and that in the secondary are 2000 V, IA. The value of I is (in A):
A. 20
B. 2
C. 0.2
D. 1

14. The effective value of A.C. in a circuit is 10A. The peak value of current is
A. 10A
B. 14.14A
C. 0.707A
D. 5A

15. The average power dissipation in a pure inductor of inductance L when A.C. current is passing through it is
B. $\frac{1}{4}LI^2$
C. Zero
D. LI^2

16. The inductance of the motor of a fan is 0.1 H. In order to provide maximum power at 50 Hz to it
A. 100 Ω resistance must be connected in series to it
B. 100 μF condenser must be connected in series to it
C. 15 Ω resistance must be connected in series to it
D. 50 μF condenser must be connected in series to it

17. A coil of R = 10 Ω and L = 5H is connected to a 100 V battery, then energy stored is
A. 100 J
B. 400 J
C. 250 J
D. 500 J

18. In a pure inductive circuit, current
A. Lags behind e.m.f by π/2
B. Leads the e.m.f by π/2
C. Lags behind by π
D. Leads the e.m.f by π
Lags behind the e.m.f by π/4

19. The time taken by AC of 50 Hz in reaching from zero to the maximum value is
A. 1×10^{-2}s
B. 2×10^{-2}s
C. 50×10^{-3}s
D. 5×10^{-3}s

20. The peak value of alternating current is $5\sqrt{2}$ ampere. The mean square value of current will be:
A. 5 A
B. 2.5 A
C. $5\sqrt{2}$ A
D. None of these

21. In an A.C. circuit, the current lags behind the voltage by π/3. The components in the circuit are
A. R and L B. L and C
C. R and C D. only R

22. Current in an inductance of 1 mH is reduced from 5 A to 0 in 1 ms. The e.m.f. induced in it is (in V):
A. $\frac{1}{5}$ **B. 10^{-6}**
C. 50 D. 5

23. When a magnet is moved with its north pole toward a coil placed in a closed circuit, then the nearest face of the coil
A. Shows south polarity
B. Shows north polarity
C. Shows no polarity
D. Shows sometimes north and sometimes south polarity

24. The average power dissipated in a pure inductor of inductance L is
A. $LI^2/2$
B. LI^2
C. $LI^2/4$
D. Zero

25. The peak value of AC voltage on a 220 V mains is:
A. $240\sqrt{2}$ V
B. $230\sqrt{2}$ V
C. $220\sqrt{2}$ V
D. $200\sqrt{2}$ V

26. Two coils are placed close to each other. The mutual inductance of the pair of coils depends upon:
A. The currents in the two coils
B. The rates at which currents are changing in the two coils
C. Relative position and orientation of the two coils
D. The materials of the wires of the coils

27. The phase difference between the current and voltage at resonance is
A. 0
B. $\frac{\pi}{2}$
C. π
D. -π

28. A current I ampere flows along an infinitely long straight thin walled tube, then the magnetic induction at any point inside the tube is
A. infinite
B. zero
C. $\frac{\mu 0}{2\pi}\frac{2i}{r}$ tesla
D. $\frac{2i}{2}$ tesla

29. A transformer used only for electrical isolation between two circuits has turns ratio which is
A. More than unity
B. Equal to unity
C. Less than unity
D. More than 0.5

30. An induced emf generated in a wire loop moving across the poles of a magnet, so that it cuts a flux of 0.1 weber in 0.1 sec, is
A. 0.01 Volt **B. 1.0 Volt**
C. zero D. 0.1 volt

31. A metal wire of length 1.0 meter moves with a uniform speed 5m/sec in a magnetic field of induction 0.1 Weber/metre^2 acting perpendicular to its motion. The emf developed between the ends of the wire is:
A. 0.05 volt
B. 0.2 volt
C. 0.5 volt
D. 10 volt

32. The current in a coil changes from 5 A to 3A in 10 milli-second and produces an induced emf of 200 volt. The inductance of the coil is:
A. 0.1 Henry
B. 1.0 Henry
C. 20 Henry
D. 100 Henry

33. A time varying magnetic field given by $B(t) = 2t^2 - 4t + 2$ exists in a region where a plane coil of area 0.2 m^2 having 20 turns is placed with its plane perpendicular to the field. The induced emf in the coil at t = 2 s is
A. zero
B. 0.8 V
C. 1.6 V
D. 16 V

34. A search coil (a small plane coil of a few turns of insulated copper wire) of area A and negligible resistance has N turns in it. It is kept between the poles of an electromagnet so that the plane of the coil is perpendicular to the magnetic field B produced by the electromagnet. This search coil is connected in series with a resistance R to form a closed circuit. When the current in the electromagnet is reversed, the charge flowing through R is
A. NAB/R
B. zero
C. NAB
D. 2NAB/R

35. A **bar magnet** is released into a copper ring which is directly below it. What about the acceleration of the magnet?
A. Greater than g
B. equal to g
C. less than g
D. Zero

36. A jet plane is flying horizontally at a speed of 1800 km/hour. What is the potential difference developed between the tips of its wings if the wing span is 25m? Earth's magnetic field at the location is 0.4 gauss and the angle of dip is 30°.
A. 25mV
B. 250mV
C. 500mV
D. 2.5V

37. A circular copper disc 10cm in diameter rotates 1800 times per minute about a central axis at right angles to the plane of the disc. A uniform magnetic **field of** 1 tesla is applied perpendicular to the plane of the disc. The voltage induced between the centre and the edge of the disc is
A. 0.235V
B. 0.47V
C. 2.35V
D. 4.7V

38. A copper rod 10cm long rotates 1800 times per minute about an axis passing through one end at right angles to the rod. A uniform magnetic field of 1 tesla is applied perpendicular to the plane of rotation. The voltage induced between the ends of the rod is
A. 0.235V
B. 0.942V
C. 2.35V
D. 4.7V

39. An aluminium rod 10 cm long rotates 1800 times per minute about an axis passing through its centre at right angles to it. A uniform magnetic field of 1 tesla is applied perpendicular to the plane of rotation. The voltage induced between the ends of the rod is
A. 0.235V
B. 0.47V
C. 2.35V

D. Zero

40. A varying magnetic flux linking a coil is given by $\Phi = Xt^2$. If at time t=3s, the emf induced is 9V, then the value of X is

A. 0.66 $Wb.s^{-2}$

B. 1.5 $Wb.s^{-2}$

C. -0.66 $Wb.s^{-2}$

D. -1.5 $Wb.s^{-2}$

Achievement Key

Correct Answers	You Got
More than 32	
Below 28	

If you got thumb down, you must consider learning more about the waves and oscillations.

If you got thumb up, go to the next exercise.

CHAPTER 13

ALTERNATING CURRENT

1 Inductive reactance

$$X_L = 2\pi fL$$

Where

X_L = Inductive reactance in ohms

F = Frequency in hertz

L = Inductance in henrys

2 Capacitive reactance

$$X_C = \frac{1}{2\pi fC}$$

Where

X_C = Inductive reactance in ohms

f = Frequency in hertz

L = Capacitance in farads

3 Impedance in relation to R and X

$Z_L = R + jX_L$

$Z_C = R - jX_C$

4 Ohm's Law for AC

$$E = IZ \quad I = \frac{E}{Z} \quad Z = \frac{E}{I}$$

Where

E = Voltage in volts

I = Current in amperes (amps)

Z = Impedance in ohms

5 Series and Parallel Impedances

$$Z_{series} = Z_1 + Z_2 + \ldots\ldots Z_n$$

$$Z_{parallel} = \frac{1}{\frac{1}{Z_1} + \frac{1}{Z_2} + \ldots\ldots \frac{1}{Z_n}}$$

Note: All impedances must be calculated in complex number form for these equations to work.

6 Resonance

$$f_{resonant} = \frac{1}{2\theta\sqrt{LC}}$$

7 AC power

P = True power

$$P = I^2R \qquad P = \frac{E^2}{R}$$

Measured in Units of **Watts**

Q = Reactive power

$$Q = I^2X \qquad Q = \frac{E^2}{X}$$

Measured in Units of **Volt-Amps-Reactive (VAR)**

S= apparent power

$$S = I^2Z \qquad S = \frac{E^2}{Z} \qquad S = IE$$

Measured in Units of Volt-Amps

P = (IE) (Power factor)

$$S = \sqrt{P^2 + Q^2}$$

Power factor = cos (Z phase angle)

MCQ Set 1

MCQ Set 1 is consisted of the questions from the topic of Alternating Current. The set takes you from very basic level (Sweet Candies) to the very tough level (Brain Buster).

Sweet Candies

Directions:

You are given following questions from the topics of this section, with four choices A through D. Select the choice that will answer the question best by filling the appropriate circle at the end of each question.

Answer of each question has been bolded for convenience.

1. The instantaneous value of A.C. voltage is given by
   A. $V = V_0 \sin 2\pi ft$
   B. $V = V_0 / \sin 2\pi ft$
   C. $V = \sin 2\pi ft / V_0$
   D. $V = V_0 \pi ft / \sin 2$

2. During each cycle, alternating voltage reaches a peak value
   A. One time
   B. Two times
   C. Four times
   D. A number of times depending on the frequency

3. In alternating current, the average power delivered during a cycle is
   A. Zero
   B. One
   C. I^2R
   D. $\frac{V}{R^2}$

4. A D.C. ammeter measures alternating current as
   A. Instantaneous value
   B. Root mean square value
   C. Peak to peak value
   D. Average value

5. The Angle θ in equation $V=V_0 \sin \theta$ specifies
   A. Average value
   B. Instantaneous value
   C. Root mean square value
   D. None of these

6. The basic circuit element in D.C circuit is a
   A. Capacitor
   B. Resistor
   C. Inductance
   D. None of these

7. The device which allows only the flow of an A.C. through a circuit is
   A. Capacitor B. Inductor
   C. D.C.motor D. Battery

8. In A.C. circuits the basic elements are
   A. Resistor
   B. Capacitor
   C. Inductor
   D. All of them

9. The r.m.s. value of alternating current is equal to its maximum value at angle of
   A. 60o
   B. 45o
   C. 30o
   D. 90o

10. The $P=VI=I^2R=\frac{V^2}{R}$ holds only when the
    A. Current lags voltage
    B. Current leads voltage
    C. Current and voltages are in phase
    D. None of these

11. A resonance curve for RLC series circuit is a plot of frequency versus
    A. Voltage
    B. Current
    C. Impendence
    D. Reactance

12. In A.C. through capacitor circuit the v and q are as
    A. v leads q
    B. v legs q
    C. v and q are in phase
    D. None of these

13. The power factor of resonance series circuit is
    A. 1
    B. 0
    C. -1
    D. 0.5

14. At high frequency the reactance of the capacitor is
    A. Low
    B. Large
    C. Very large
    D. None of these

15. At resonance, the phase angle for RLC series resonance circuit equals
    A. 0°
    B. 90°
    C. 180°
    D. 270°

16. At high frequency and low reactance the current will be
    A. Large
    B. Very large
    C. Extremely large
    D. None of these

17. At resonance, the impedance of RLC series circuit is
    A. Maximum
    B. Zero
    C. Minimum
    D. Determinate

18. An inductor is a solenoid having the resistance
A. Large
B. Small
C. Negligible
D. None of these

19. The impedance of RLC series resonance circuit at resonant frequency is
A. Greater than R
B. Equal to R
C. Less than R
D. None of these

20. The reactance of a coil depends upon the
A. Frequency of A.C
B. Frequency of D.C
C. Both a and b
D. None of these

21. As a function of frequency, the inductance and capacitance behaves
A. Similarly
B. Opposite
C. Always similar
D. None of these

22. SI unit of impedance is
A. Hertz
B. Henry
C. Ampere
D. Ohms

23. In pure inductor, the power dissipation is
A. Maximum
B. Minimum

24. The phase angle of a serried RLC circuit at resonance is
A. 180°
B. 90°
C. 0°
D. None of the above

25. An inductor coil when consume no energy is called
A. A coil
B. Choke
C. Toroid
D. None of these

26. If the value of C in a series RLC circuit is increased, the resonant frequency
A. Is not affected
B. Increase
C. Remains the same
D. Decreases

27. In an inductor the phase difference between the current and voltage is
A. Current lags voltage by 90°
B. Voltage lags current by 180°
C. Current leads voltage by 90°
D. None of these

28. Which one of the following waves belongs to electromagnetic spectrum
A. Radio and TV waves
B. Radar waves
C. Micro waves
D. All of them

29. Power dissipation is zero in a circuit
A. Inductive
B. Capacitive
C. Both
D. None of these

30. Which one of the following electro-magnetic wave have the highest frequency and shortest wave-length
A. X- rays
B. Ultraviolet rays
C. γ- rays, gamma rays
D. Cosmic rays

31. The impedance Z of the R-L series circuit is
A. $Z = \sqrt{R^2} + (\frac{1}{\omega C})^2$
B. $Z = \sqrt{R^2} + (\omega L)^2$
C. $Z = \sqrt{R^2} + (\frac{1}{\omega L})^2$
D. None of these

32. Transmitting antenna emits
A. Magnetic waves
B. Electric waves
C. Electromagnetic waves
D. Sound waves

33. When electrons in the transmitting antenna vibrate 94000 times per second, they produce radio waves having frequency
A. 9.4 kHz
B. 940 kHz
C. 94 kHz

34. In a three phase AC generator, three coils are connected and inclined at an angle
A. 60°
B. 120°
C. 180°
D. None of these

35. Chock consumes extremely small
A. Charger
B. Current
C. Power
D. Potential

36. Since there are three coils, the generator has the terminals
A. Two
B. Four
C. Six
D. Eight

37. In L.C.R series A.C. circuit, the phase angle between current and voltage is
A. Any angle between 0 and $\pm\frac{\pi}{2}$
B. $\frac{\pi}{2}$
C. π
D. Any angle between 0 and $\frac{\pi}{2}$

38. An ideal choke (used along with fluorescent tube) would be
A. A pure resistor
B. A pure capacitor
C. A pure inductor
D. A combination of an inductor and a capacitor

39. The peak voltage in a 220 volt A.C. supply is nearly
A. 220 volt
B. 253 volt
C. 311 volt
D. 440 volt

40. In a capacitive circuit
A. Current leads voltage by phase of π/2
B. Voltage leads current by phase of π/2
C. Current and voltage are in same phase
D. Sometime current and sometime voltage leads.

Achievement Key

Correct Answers	You Got
More than 35	
Below 30	

If you got thumb down, you must consider learning more about the optics.
If you got thumb up, be prepare to have a hard exercise based on optics.

Brain Busters

1. In an A.C. circuit with resistor only, the current and voltage have a phase angle of
A. 90°
B. 0°
C. 180°
D. None of these

2. In an A.C circuit with capacitor only, the current
A. Leads the voltage by 90° or $\frac{\pi}{2}$
B. Legs behind voltage by 90° or $\frac{\pi}{2}$
C. In phase with voltage
D. None of the above

3. In an inductive A.C. circuit, the current
A. Lags behind the voltage by 90o or $\frac{\pi}{2}$
B. Leads the voltage by 90°or $\frac{\pi}{2}$
C. Lags behind the voltage by 180°or π
D. Is in phase with the voltage

4. To design a resonant circuit of frequency 100 kHz with an inductor of inductance 5 mH, we need a capacitor of capacitance
A. 5.07 pF
B. 50 nF
C. 0.507 pF
D. 507 pF

5. When 10V are applied to an A.C. circuit, the current flowing in it is 100mA impedance
A. 50Ω
B. 75Ω
C. 90Ω
D. 100Ω

6. In an A.C. circuit, a resistance of R ohm is connected in series with an inductance L. If phase angle between voltage and current be 45°, the value of inductive reactance will be
A. $\frac{R}{4}$
B. $\frac{R}{2}$
C. R
D. Cannot be found with the given data.

7. A 220 V, 50 Hz. A.C. source is connected to an inductance of 0.2 H and a resistance of 20 ohm in series. What is the current in the circuit?
A. 10 A
B. 5 A
C. 33.3 A
D. 3.33 A

8. A capacitor acts as an infinite resistance for
A. AC
B. DC
D. Neither AC nor DC

9. The reactance of a coil when used in the domestic A.C. power supply (220 volts, 50 cycles per second) is 50 ohms. The inductance of the coil is nearly
A. 2.2 henry
B. 1.6 henry
C. 0.22 henry
D. 0.16 henry

10. In an A.C. circuit, the current lags behind the emf. The power factor is 50%. In order to make it 100%, what additional component is to be used?
A. Impedance
B. Inductance
C. Capacitance
D. Resistance

11. An L-R circuit has R = 10 Ω and L = 2 H. If 120 V, 60 Hz A.C. voltage is applied, then current in the circuit will be
A. 0.32 A
B. 0.16 A
C. 0.48 A
D. 0.80 A

12. A circuit has a resistance of 11 Ω, an inductive reactance of 25 Ω and a capacitance reactance of 18 Ω. It is connected to an a.c. source of 260 V and 50 Hz. The current through the circuit (in amperes) is
A. 11

C. 18
D. 20

13. Alternating current cannot be measured by D.C. ammeter because
A. A.C. cannot pass through D.C. Ammeter
B. A.C. changes direction
C. Average value of current for complete cycle is zero
D. D.C. Ammeter will get damaged

14. The current in LCR circuit will be maximum when ω is
A. As large as possible
B. Equal to natural frequency of LCR system
C. $\sqrt{LC}$
D. $\sqrt{\frac{1}{LC}}$

15. In a series LCR circuit the current in the circuit is plotted as a function of the frequency of the A.C source, the source voltage remaining constant to obtain the resonance curve. The resonance frequency is 100 kHz. The most appropriate statement is
A. the curve is symmetrical about the resonant frequency
B. the current at 99 kHz is not the same as that at 101 kHz.
C. the current at 50 kHz is larger than that at 150 kHz.
D. the current at 150 kHz is larger than that at 50 kHz.

550 W from a source of 220 volt, 50 Hz. The power factor for the circuit is 0.8 and current in the circuit lags behind the applied voltage in phase. To make the power factor of the circuit as 1.0
A. R should be doubled
B. L should be appropriately increased
C. a capacitor of appropriate value should be connected in series with C
D. a capacitor of appropriate value should be connected across C

16. An LR series A.C circuit of L=1/20 H and R = 12 ohm is connected to a 130 volt source of 50 Hz. The current in the circuit is
A. 100 mA
B. 10 mA
C. 10 A
D. 100 A

17. Three LCR circuits with same values of L and C and varying resistor values of R, 2R and 3R respectively have circuit quality factors Q_1, Q_2 and Q^3 respectively related by
A. $Q_1 = Q_2 = Q_3$
B. $Q_1 > Q_2 > Q_3$
C. $Q_1 < Q_2 < Q_3$
D. $Q_1 > Q_3$, $Q_1 = Q3$

18. An inductor L and a resistor R are connected in series to a battery of emf E volts .The final current in the exponential growth of current are, respectively
A. E/L and L/R
B. E/L and R/L
C. E/R and L/R
D. E/R and R/L

19. If the rams voltage drop across a 15 k resistor is 16 V, the peak current through the resistor is
A. 15 mA
B. 1.5 mA
C. 10 mA
D. 1 mA

20. Two series resistors are connected to an AC source. If there are 7.5 V rams across one resistor and 4.2 V rams across the other, the peak source voltage is
A. 5.93 V
B. 1.65 V
C. 16.54 V
D. 10.60 V

21. A saw-tooth wave has a period of 10 ms. Its frequency is
A. 50 Hz
B. 100 Hz
C. 10 Hz
D. 1,000 Hz

22. When a sine wave has a frequency of 100 Hz in 12 as it goes through
A. 1,200 cycles
B. 120 cycles
C. 1/100 cycle

23. A waveform has a baseline of 3 V, a duty cycle of 20%, and amplitude of 8 V. The average voltage value is
A. 5V
B. 1.6V
C. 11V
D. 4V

24. If the peak of a sine wave is 13 V, the peak-to-peak value is
A. 26 V
B. none of the above
C. 13 V
D. 6.5 V

25. A phasor represents
A. the width of a quantity
B. the magnitude of a quantity
C. the magnitude and a quantity direction
D. the phase angle

26. A sine wave with an rams value of 12 V is riding on a dc level of 18 V. The maximum value of the resulting waveform is
A. 35V
B. 6V
C. 4V
D. 0V

27. The average half-cycle value of sine wave with a 40 V peak is
A. 6.37 V
B. 14.14 V
C. 25.48 V

28. A short circuited coil is placed in a time varying magnetic field. Electric power is dissipated due to the current induced in the coil. If the number of turns were quadrupled and the wire radius halved, the electric power dissipated would be
A. halved
B. same
C. doubled
D. quadrupled

29. An electric heater consumes 1000 watts power when connected across a 100 volt D.C. supply. If this heater is to be used with 200V, 50 Hz A.C.supply, the value of the inductance to be connected in series with it is
A. 5.5 H
B. 0.55 H
C. 0.055 H
D. 1.1 H

30. The voltage V applied across an A.C. circuit and the current I flowing in it are given by $V = 12 \cos\omega t$ volt and $I = 20 \sin \omega t$milliamp ere respectively. The power dissipated in the circuit is
A. 120 watt
B. 120 mill watt
C. 240 watt
D. zero

31. If $e_1 = A \sin \omega t$ and $e_2 = B \sin (\omega t - \theta)$,
B. e_2 lags e_1 by θ
C. e_2 leads e_1 by θ
D. e_1 is in phase with e_2

32. From the two voltage equations $e_A = E_m \text{ Sin } 100\pi t$ and $e_B = E_m \text{ Sin } (100\pi t + \pi/6)$, it is obvious that
A. A leads B by 30°
B. B achieves its maximum value 1/600 second before A does
C. B lags behind A
D. A achieves its zero value 1/600 second before B.

33. The reactance offered by a capacitor to alternating current of frequency 50 Hz is 10Ω.If frequency is increased to 100 Hz reactance becomes
A. 20
B. 5
C. 2.5
D. 40

34. When alternating current passes through a conductor
A. it remains uniformly distributed throughout the section of conductor
B. portion of conductor near the surface carries more current as compared to the core
C. portion of conductor near the surface carries less current as compared to the core
D. entire current passes through the core of the conductor.

35. The effective resistance of a conductor will be the same as ohmic resistance when
A. current is in true sine wave form
B. voltage is low
C. power factor is unity
D. Current is uniformly distributed in the conductor cross-section.

36. One 200 V, 100 W bulb is connected in series with primary of a 200 V, 10 kVA transformer. If its secondary is left open circuited then the bulb would have
A. Full brightness
B. poor brightness
C. a little less than full brightness
D. more than full brightness

37. Eddy currents always tend
A. To flow in the direction of magnetic flux
B. To flow in planes perpendicular to magnetic flux
C. Can flow any direction
D. None of these

38. A choke is used as a resistance in
A. DC circuit
B. AC circuits
C. Both AC and DC circuit
D. Full wave rectifier circuit

39. An A.C series circuit containing 4 ohm resistance and 3 ohm inductive reactance. The impedance of the circuit is
A. 1 ohm
B. 5 ohm
C. 7 ohm
D. 10 ohm

Achievement Key

Correct Answers	You Get
More than 32	
Below 28	

If you got thumb down, you must consider learning more about the optics.
If you got thumb up, go to the next exercise.

14

PHYSICS OF SOLIDS

MCQ Set 1

MCQ Set 1 is consisted of the questions from the topic of Physics of Solids. The set takes you from very basic level (Sweet Candies) to the very tough level (Brain Buster).

Sweet Candies

Directions:

You are given following questions from the topics of this section, with four choices A through D. Select the choice that will answer the question best by filling the appropriate circle at the end of each question.

Answer of each question has been bolded for convenience.

1. Polythene, polystyrene and nylon are examples of
   - **A. polymeric solids**
   - B. crystalline solids
   - C. glassy solids
   - D. amorphous solids

2. Crystalline solids have the properties such as
   - **A. Regular arrangement**
   - B. Covalent bonding
   - C. Somewhat defective
   - D. All of them

3. The metals become electrically conducting due to their
   - A. Ductility
   - B. Hardness
   - **C. Structure**
   - D. All of them

4. The measure of deformation of a solid when stress is applied to it is called
   - **A. strain**
   - B. stress
   - C. force
   - D. none of these

5. The atoms molecules or ions in a crystalline solids at room temperature
   - A. Motionless
   - **B. Vibrate**
   - C. Fixed
   - D. Circulate

6. The ratio of applied stress to volumetric strain is called
   - A. shear modulus
   - B. Young's modulus
   - **C. Bulk modulus**
   - D. none of these

7. While vibrating the atoms are at their
   - A. Fixed positions
   - B. Extreme position
   - **C. Average positions**
   - D. None of them

8. In between two consecutive permissible energy bands, there is a range of energy states which cannot be occupied by electrons. These are called
   - A. hidden energy states
   - **B. forbidden energy states**
   - C. band levels
   - D. none of these

9. A substance which has empty conduction band is called
   - A. conductor
   - **B. insulator**
   - C. semiconductor
   - D. none of these

10. Amorphous materials have the properties of solid like
    - A. No structure
    - B. Like liquid
    - C. Glassy
    - **D. a and c**

11. Arsenic, antimony or phosphorus are impurities for
    - A. p-type
    - **B. n-type**
    - C. may be p-type or n-type
    - D. none of these

12. The amorphous material (solids) have
    - A. No structure
    - B. No melting points
    - C. Partially crystalline solids
    - **D. All of them**

13. Polymeric solids have the structure
    - A. One dimensional
    - B. Two dimensional
    - C. Zero dimensional
    - **D. Three dimensional**

14. Unit cell has a basic structure of
    - A. One dimensional
    - B. Tow dimensional
    - **C. Three dimensional**
    - D. None of these

15. In a semiconductor, the mobility of holes is
A. greater than electrons
B. less than electrons
C. equal to electrons
D. None

16. How many oxygen atoms are in Yttrium barium copper oxide
A. 3 B. 6
C. 5 D. 7

17. Examples of crystalline solids are
A. Copper
B. Zirconia
C. Iron
D. All of them

18. Polymers have chemically combinations with
A. Carbon
B. Nitrogen
C. Hydrogen
D. All of them

19. The deformation produced in the body by an applied force in their
A. Shape
B. Length
C. Volume
D. All of them

20. In forward bias, the width of potential barrier in a p-n junction

21. The ability of a body to return to its original shape when applied force is removed is called
A. Stress
B. Strain
C. Elasticity
D. All of them

22. Which of the following when added as an impurity into the silicon produces n-type semi-conductor?
A. P
B. Al
C. B
D. Mg

23. When a stress changes its length it is called,
A. Stress
B. Tensile stress
C. Shear stress
D. None of these

24. Two inputs of NAND gates are shorted. This gate is equivalent to
A. OR gate
B. AND gate
C. NOT gate
D. XOR gate

25. When a stress change its shape it is called
A. Tensile stress
B. Shear stress
C. Volume stress

26. Which logic gate is represented by following diagram?
A. AND
B. OR
C. NOR
D. EOR

27. The measure of the deformation of a solid is called
A. Stress
B. Strain
C. Elastic constant
D. None of these

28. How many types of strain is
A. 1
B. 2
C. 3
D. 4

29. Nm^{-2} or Pa are the units of
A. Stress
B. Strain
C. Modulus of Elasticity
D. A and C

30. The energy band gap is maximum in
A. Metals
B. Superconductors
C. Insulators
D. Semiconductors

31. For three dimensional deformation i.e. volume deformation the bulk modulus is given by
A. $K = \frac{F/A}{V/\triangle V}$
B. $K = \frac{A/F}{V/\triangle V}$
C. $K = \frac{F/A}{\triangle V/V}$
D. $K = \frac{A/F}{\triangle V/V}$

32. Young's modulus for aluminium is
A. 30
B. 70
C. 80
D. 100

33. When the output of OR gate is 1
A. If either or both inputs are 1
B. Only if both inputs are 1
C. If either input is zero
D. If both inputs are zero

34. Shear modulus for aluminium is
A. 30
B. 70
C. 80
D. 90

35. Young's modulus for bass is
A. 40
B. 60
C. 90
D. 91

36. At absolute zero, SI acts as
A. Non-metal
B. Metal
C. Insulator
D. None of these

37. In a junction diode, the holes are due to
A. Protons
B. Neutrons
C. Extra electrons
D. Missing of electrons

38. The dimensional formula for the modulus of elasticity is same as that for:
A. Stress
B. Strain
C. Velocity
D. Surface tension

39. Steel is preferred for making springs over copper. Why?
A. Steel is cheaper
B. Young's modulus of steel is more than that of copper
C. Young's modulus of copper is more than that of steel
D. Steel is less likely to be oxidized.

40. The modulus of elasticity of a liquid is
A. Zero
B. Unity
C. Infinity
D. greater than zero but less than one

Achievement Key

Correct Answers	You Got
More than 35	
Below 30	

If you got thumb down, you must consider learning more about the Physics of Solids. If you got thumb up, be prepare to have a hard exercise based on Physics of Solids.

Brain Busters

1. N-type crystal is
A. neutral
B. positively charged
C. negative charged
D. none of these

2. A half-wave rectifier is being used to rectify an alternating voltage of frequency 50 Hz. The number of pulses of rectified current obtained in one second is
A. 50 B. 25
C. 100 D. 200

3. A n-p-n transistor conducts when
A. Collector is positive and emitter is negative with respect to the base
B. Collector is positive and emitter is at negative potential as the base
C. Both collector and emitter are negative with respect to the base
D. Both collector and emitter are positive with respect to the base

4. Which of the modulus of elasticity is involved in compressing a rod to decrease its length?
A. Young's modulus
B. Bulk modulus
C. Modulus of rigidity
D. None of the above

5. When N-type semiconductor is heated?
A. number of electrons increases while that of holes decreases
B. number of holes increases while that of electrons decreases
C. number of electrons and holes remain same
D. number of electron and holes increases equally

6. Which one of the following physical quantities does not have the dimensions of force per unit area?
A. Stress
B. Strain
C. Young's modulus
D. Pressure

7. A rubber cord of cross-sectional area 2cm2 has a length of 1m. When a tensile force of 10N is applied the length of the cord increases by 1cm. What is the young's modulus of rubber?
A. $2x10^{8}$ Nm^{-2}
B. $5x10^{6}$ Nm^{-2}
C. $0.5x10^{-6}$ Nm^{-2}
D. $0.2x10^{-6}Nm^{-2}$

8. A wire suspended vertically from one end is stretched by attaching a weight of 20N to the lower end. Th weight stretches the wire by 1mm How much energy is gained by th wire?
A. 0.01J