F/h → 6

٣٫٥

6 ع م هـ

الفرقة الأولى

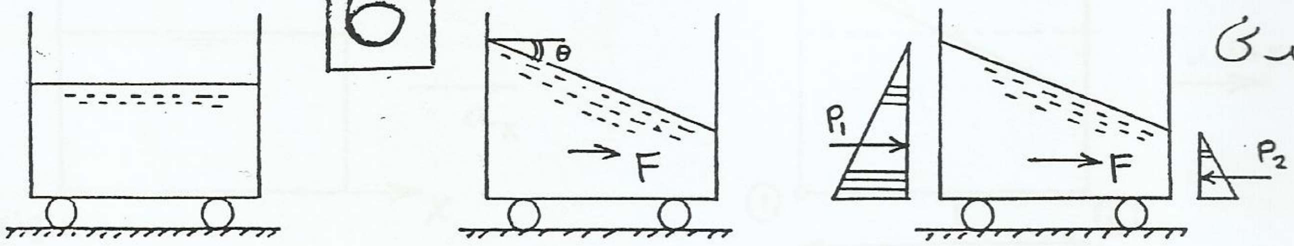
مدنى

فلويد

...id Masses Subjected to linear Acceleration

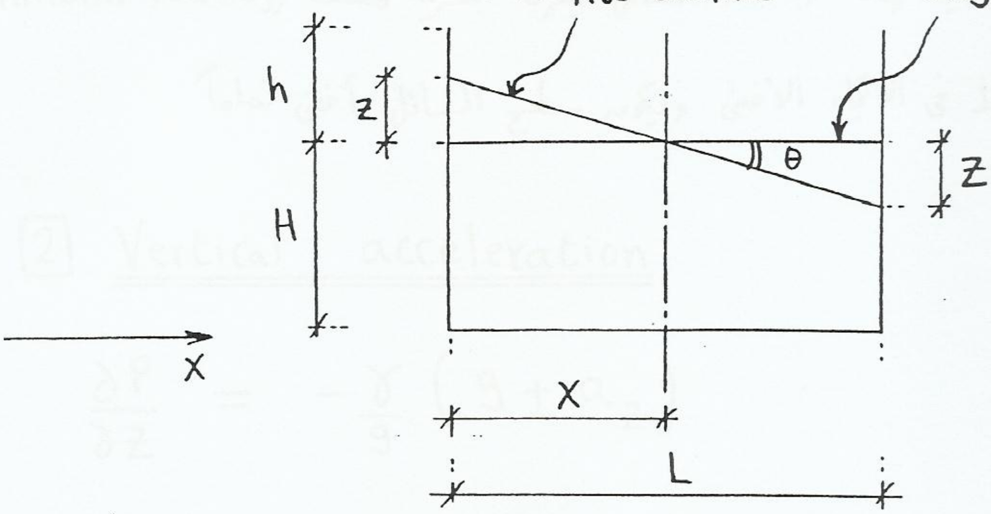
FLuid

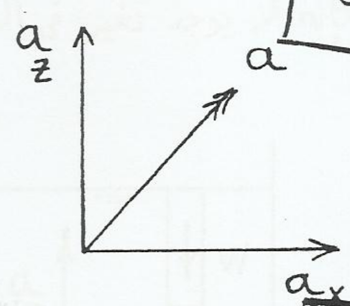
6



- إذا أعطى سائل فى إناء مفتوح عجلة منتظمه "a" uniform acceleration
- فإنه بعد زمن معين يتحرك الإناء كوحدة واحدة moves as a solid body
- وبالتالى لا توجد حركة نسبيه بين جزيئات السائل وبعضها أو بينه وبين الاناء الحاوى له shear stresses
- فى هذه الحاله يمكن تطبيق قوانين الـ static fluid لكن بإضافة تأثير العجلة

Assume the acceleration (a) in a given direction and its Components a_x , a_z





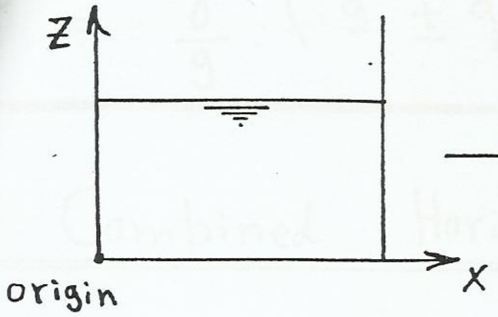
a_x : العجله فى الاتجاه الأفقى

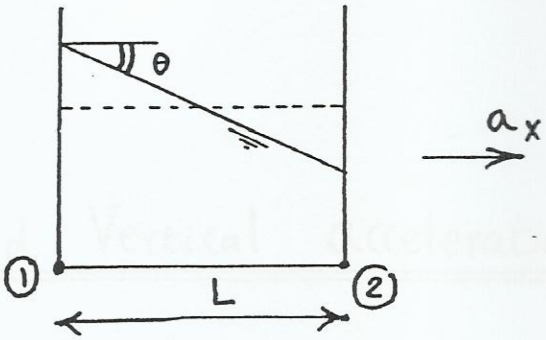
a_z : العجله فى الاتجاه الرأسى

$$\tan\theta = \frac{Z}{L/2}$$

θ : الزاويه بين الـ Free surface قبل الحركه والـ Free surface بعد الحركة

Horizontal acceleration





$$P_1 > P_2$$

$$\frac{\partial P}{\partial x} = -\frac{\gamma}{g}\, a_x$$

$$\boxed{P_2 = P_1 - \frac{\gamma}{g}\, a_x L}$$

- من هذه المعادلة نستنتج أن الضغط يتغير فى الاتجاه الأفقى وإشارة السالب تعنى

أن الضغط يقل كلما اتجهنا فى اتجاه العجلة (إلى اليمين)

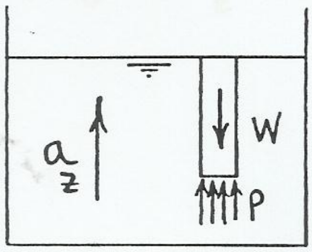
- أسطح تساوى الضغط ليست أفقية لكن تميل بزاوية θ

* If $a_x = 0 \Rightarrow \frac{\partial P}{\partial x} = 0$

فى حالة عدم وجود عجلة أفقية a_x أو كان السائل يتحرك بسرعة منتظمة (Uniform Velocity)

فإنه لا يوجد تغير فى الضغط فى الاتجاه الأفقى ويكون سطح السائل أفقى تماماً

2 Vertical acceleration



$$\frac{\partial P}{\partial z} = -\frac{\gamma}{g}\left(g \pm a_z\right)$$

- إذا تحرك tank محتوياً على سائل رأسياً إلى أعلى بعجلة منتظمة a_z

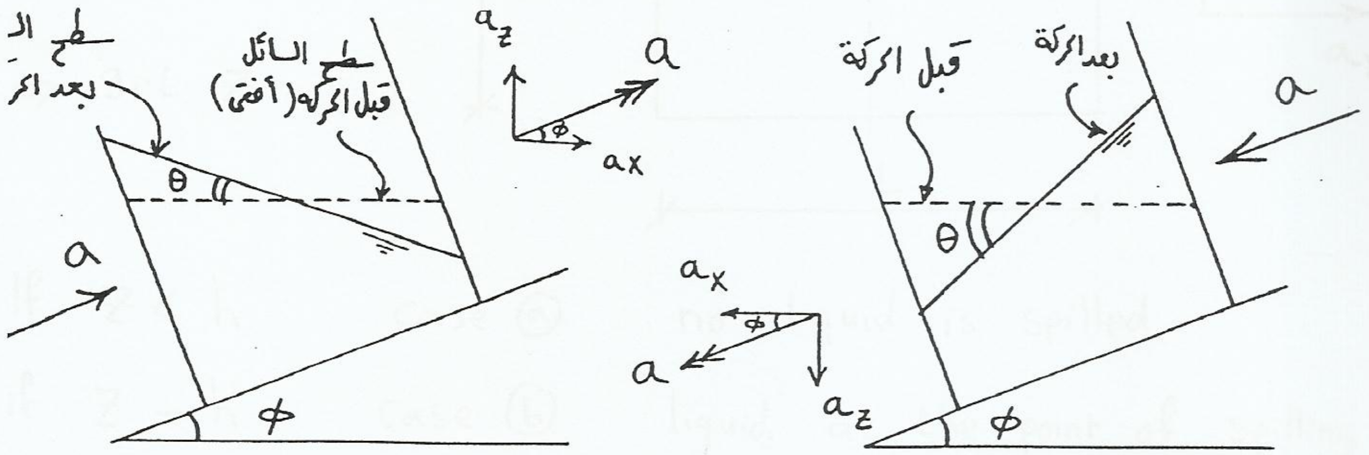
فإن الضغط يزداد طردياً مع زيادة العجلة الرأسية إلى أعلى ويظل سطح السائل

أفقياً ما لم يتعرض إلى عجلة أفقية a_x

* If $a_z = 0 \Rightarrow \frac{\partial P}{\partial z} = -\gamma$

$$\boxed{P = \frac{\gamma}{g}\left(g \pm a_z\right) h}$$

3 Combined Horizontal and Vertical acceleration



$$\boxed{\tan\theta = \frac{a_x}{g \pm a_z}}$$

$a_x = a\cos\phi$

$a_z = a\sin\phi$

لو كان a_z لأعلى ⇐ $a_z \to (+ve)$

لو كان a_z لأسفل ⇐ $a_z \to (-ve)$

If $a_x = 0 \Rightarrow \tan\theta = 0$

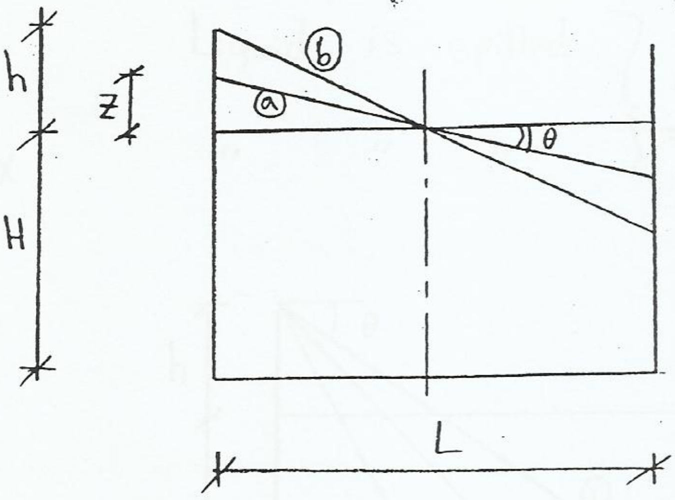
في حالة عدم وجود عجلة أفقية فإن سطح السائل يظل أفقياً

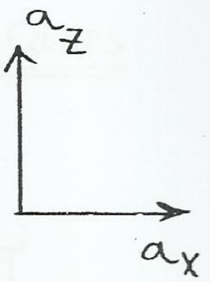
If $a_z = 0 \Rightarrow \tan\theta = \dfrac{a_x}{g}$

How to Know if liquid will be spilt?

$$\tan\theta = \frac{a_x}{g \pm a_z} = \frac{z}{L/2}$$

$\Rightarrow$ get z





If $z < h$ case (a) no liquid is spilled

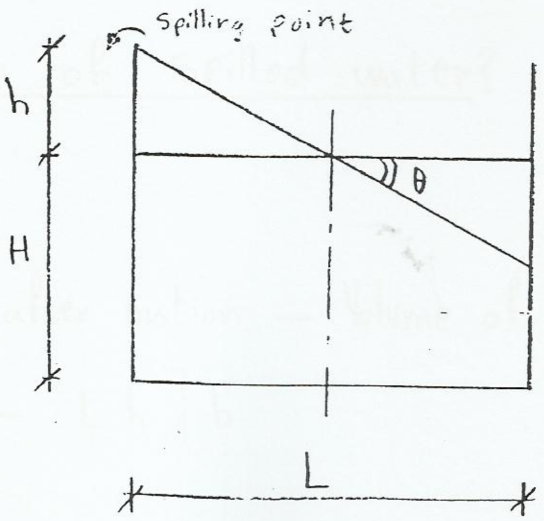
if $z = h$ case (b) liquid at the point of spilling

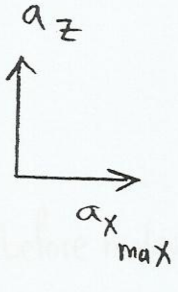
if $z > h$ water is spilled $\Rightarrow$ 3 cases

How to get $(a_x)_{max}$ or max height of the Container to make the liquid at the spilling point

$$\tan\theta = \frac{a_{x\,max}}{g \pm a_z} = \frac{h}{L/2}$$

$\Rightarrow$ get $a_{x\,max}$





$$\tan\theta = \frac{a_x}{g \pm a_z} = \frac{h_{max}}{L/2}$$

$\Rightarrow$ get h_{max}

hen is liquid spilled ?

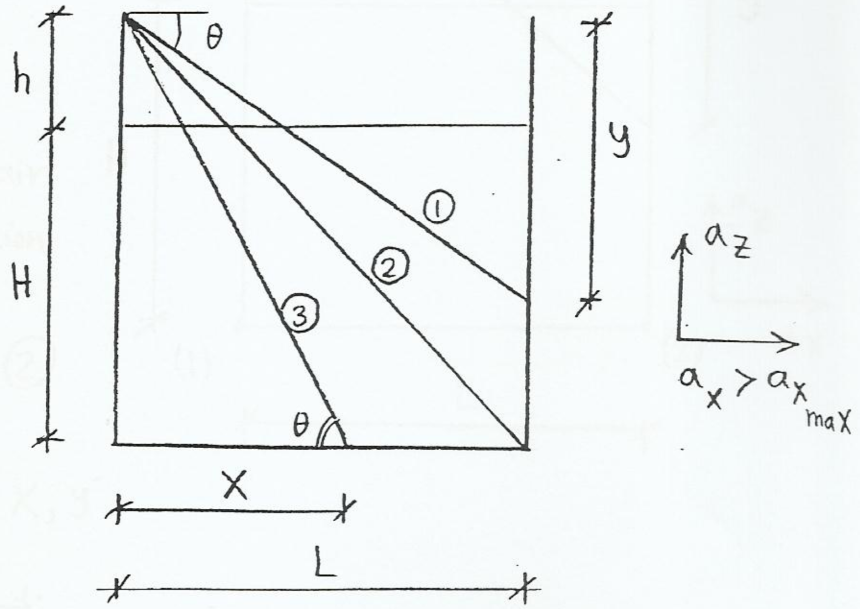
IF $z > h$ Liquid is spilled

IF $a_x > a_{x_{max}}$ " " "

3 Cases

$$\tan\theta = \frac{a_x}{g \pm a_z} = \frac{y}{L}$$

$\Rightarrow$ get y



f $y < H+h \Rightarrow$ Case 1

$y = H+h \Rightarrow$ Case 2

$y > H+h \Rightarrow$ Case 3

3 $\tan\theta = \frac{a_x}{g \pm a_z} = \frac{H+h}{X}$

$\Rightarrow$ get X

low to get the Volume of spilled water?

For case 1, 2

olume spilled = Volume of air after motion − Volume of air before motion

$$\forall_{spilled} = \left[\frac{1}{2} L y - L h\right] b$$

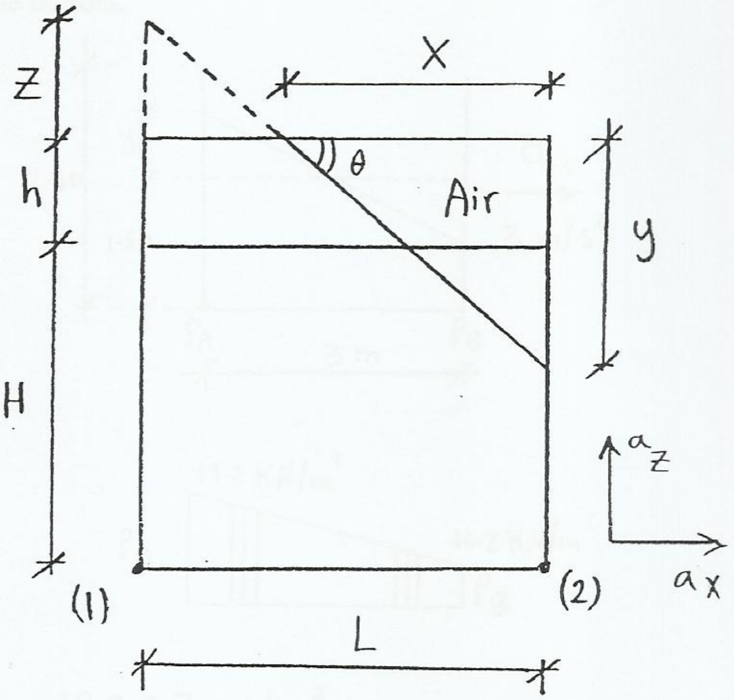
ase 3

olume spilled = Volume of water before motion − Volume of water after motion

$$\forall_{spilled} = \left[L H - \frac{1}{2} X (H+h)\right] b$$

Case of closed tank, find Pressure at (1) and (2)

$$\tan\theta = \frac{a_x}{g \pm a_z} = \checkmark$$



$$\tan\theta = \frac{y}{X} \rightarrow ①$$

$\because$ Area of air before motion = Area of air after motion

$$L h = \frac{1}{2} X y \rightarrow ②$$

from ①, ② $\Rightarrow$ get X, y

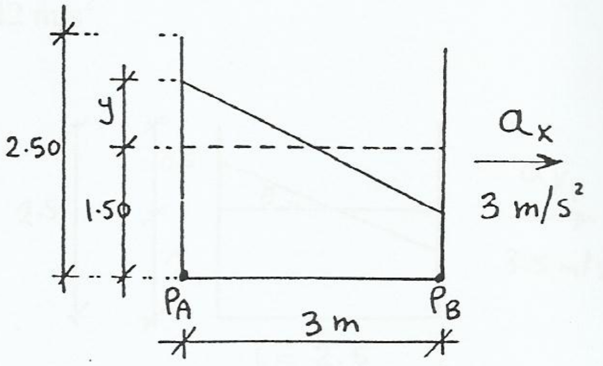
$\Rightarrow$ get Z تشابه مثلثات

$$P_1 = P_{air} + \frac{\gamma}{g}(g \pm a_z)\left[H + h + Z\right]$$

$$P_2 = P_{air} + \frac{\gamma}{g}(g \pm a_z)\left[H + h - y\right]$$

7

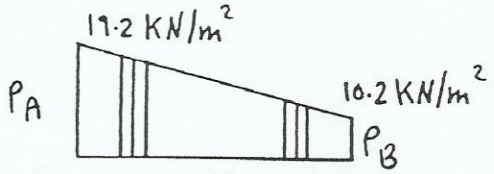
A tank containing water moves horizontally with a constant linear acceleration of 3 m/s².
The tank is 3 m long, 2.5 m high and the depth of water when the tank is at rest is 1.5 m.
calculate a) the angle of the water surface to the horizontal,
b) the maximum pressure intensity on the bottom.



$$\tan\theta = \frac{a_x}{g}$$

$$\tan\theta = \frac{3}{9.81} \Rightarrow \theta = 17^\circ$$

$$\tan\theta = \frac{3}{9.81} = \frac{y}{X} = \frac{y}{1.5}$$



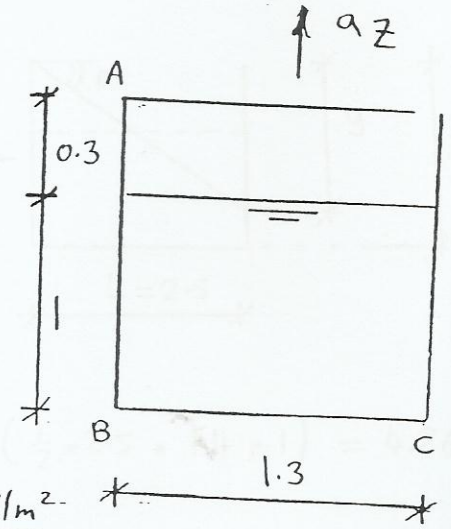
$$\therefore y = \frac{1.5 * 3}{9.81} = 0.46$$

$$P_A = \gamma h = 9810(1.5 + 0.46) = 19227 \ N/m^2$$

$$P_B = \gamma h = 9810(1.5 - 0.46) = 10202 \ N/m^2$$

(b) $a_z = 9.806$ $P_a, P_b, P_c = ?$

Sol



$$\tan\theta = 0$$

$$P_A = 0$$

$$P_B = P_C = \frac{\gamma}{g}(g \pm a_z) h$$

$$= \frac{9810}{9.81}(9.81 + 9.806)\,1 = \underline{\underline{19616 \ N/m^2}}$$

If acceleration ceases and the tank moves at Constant Velocity 6 m/s تابع الأول

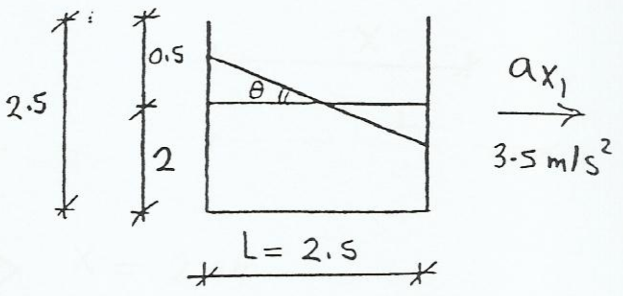
$$\Rightarrow a_z = 0 \Rightarrow P_B = P_C = \gamma h = 9810\,(1) = \underline{\underline{9810 \ N/m^2}}$$

A tank containing water moves horizontally with a constant linear acceleration of 3.5 m/s^2. The tank is 2.50 m long, 2.5 m high and the depth of water when the tank is a t rest is 2 m. Calculate a) the angle of the water surface to the horizontal.

b) the volume of spilled water when the acceleration is increased by 25%.

c) the force acting on each side if a = 12 m/s^2.

(a) $a_x = 3.5\ m/s^2$ $\quad \theta = ?$



$$\tan\theta = \frac{a_x}{g} = \frac{3.5}{9.81}$$

$$\therefore \theta = 19.63^\circ$$

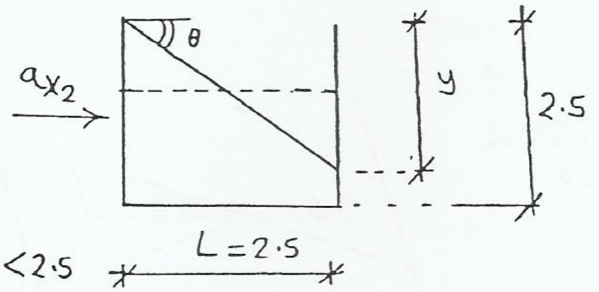
(b) If a_x is increased 25%

$$a_{x_2} = 1.25\, a_{x_1} = 1.25 * 3.5 = 4.375\ m/s^2$$

$$\tan\theta = \frac{a_x}{g} = \frac{Z}{L/2}$$

$$\frac{4.375}{9.81} = \frac{Z}{2.5/2} \Rightarrow Z = 0.557 > 0.5\,m$$

$\therefore$ water will spill



$$\tan\theta = \frac{a_x}{g} = \frac{y}{L}$$

$$\frac{4.375}{9.81} = \frac{y}{2.5} \Rightarrow y = 1.11 < 2.5$$

$$\forall_{\text{water after acceleration}} = (2.5 * 2.5 * 1) - (\tfrac{1}{2} * 2.5 * 1.11 * 1) = 4.86\,m^3$$

$$\forall_{\text{water before acceleration}} = (2.5 * 2 * 1) = 5\,m^3$$

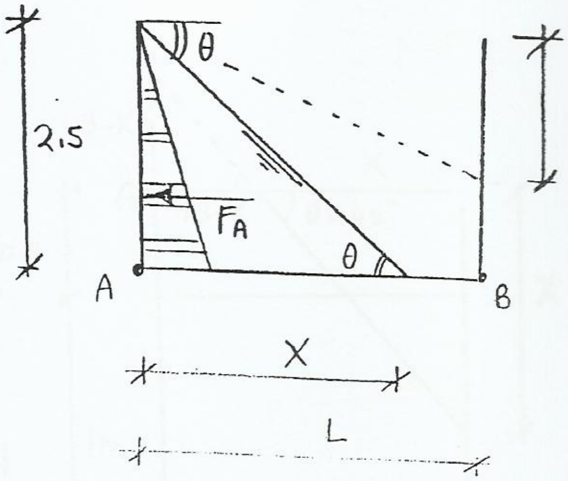
$$\forall_{\text{water spilt}} = \forall_{\text{water before acceleration}} - \forall_{\text{after acceleration}}$$

$$= 5 - 4.86 = 0.14\,m^3$$

$$\%\ \text{Volume Spilt} = \frac{0.14}{5} * 100 = 2.8\ \%$$

$$a_x = 12 \ m/s^2$$

$$\tan\theta = \frac{a_x}{g} = \frac{y}{L}$$



$$\frac{12}{9.81} = \frac{y}{2.5} \Rightarrow y = 3.06 > 2.5$$

$$\therefore \tan\theta = \frac{a_x}{g} = \frac{2.5}{X}$$

$$\frac{12}{9.81} = \frac{2.5}{X} \Rightarrow X = 2.04$$

$$F_A = \gamma A \bar{h} = 9810\,(2.5 \times 1)\,\frac{2.5}{2} = \underline{\underline{30656 \ N}}$$

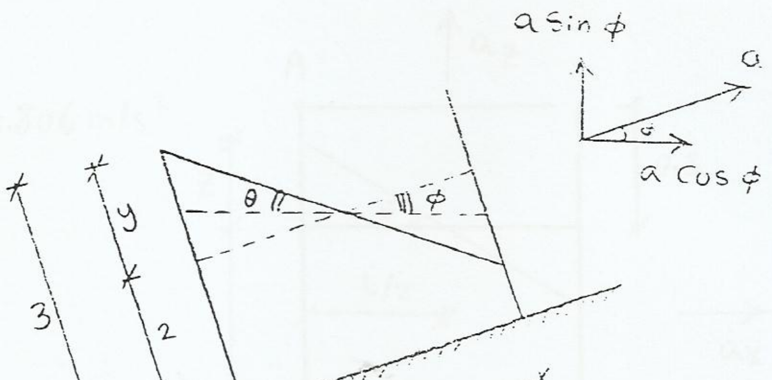
$$F_B = 0$$

An open rectangular tank is 5 m long, 4 m wide and 3 m high contains water up to a height of 2 m is accelerated up a 15° inclined plane. Determine the maximum acceleration that can be given without spilling the water along the larger side.

$$\tan(\phi + \theta) = \frac{y}{L/2}$$

$$\tan(15 + \theta) = \frac{1}{5/2}$$

$$\Rightarrow \theta = 6.8^\circ$$

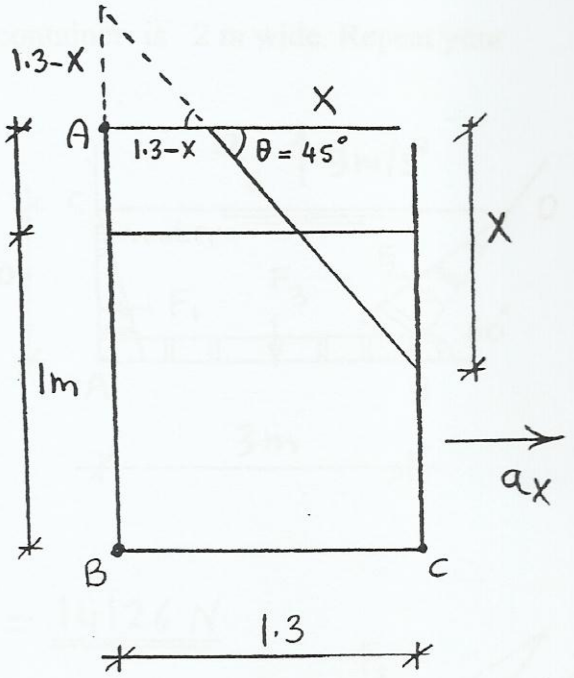


$$\tan\theta = \frac{a_x}{g + a_z} = \frac{a\cos\phi}{g + a\sin\phi}$$

$$\tan 6.8 = \frac{a\cos 15}{9.81 + a\sin 15} \Rightarrow a = \underline{\underline{1.25 \ m/s^2}}$$

Ⓐ

$a_x = 9.806\ m/s^2 \qquad P_{a,b,c} = ?$



Sol//

$$\tan\theta = \frac{a_x}{g} = \frac{9.806}{9.81} \simeq 1$$

$$\therefore \theta = 45^\circ$$

$$\because \forall_{air} \text{ before accel} = \forall_{air} \text{ after accel}$$

$$1.3 * 0.3 = \tfrac{1}{2} X^2$$

$$\therefore X = 0.883 \qquad , \ 1.3 - X = 0.417$$

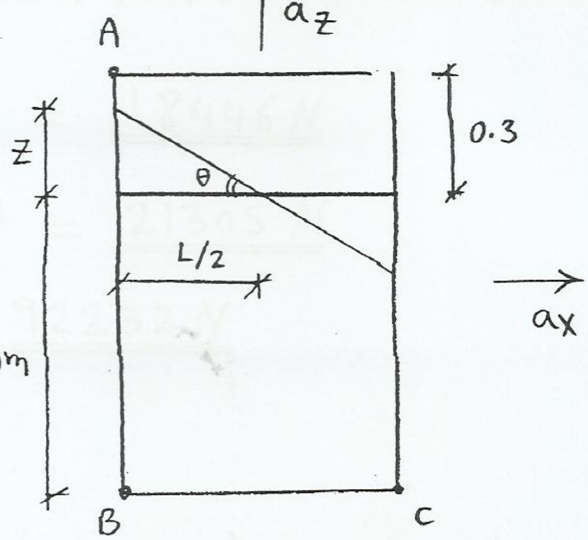
$$P_A = \gamma_w (0.417) = \underline{\underline{4090\ N/m^2}}$$

$$P_B = \gamma_w (0.417 + 1.3) = \underline{\underline{16843\ N/m^2}}$$

$$P_c = P_B - \frac{\gamma}{g} a_x L = 16843 - \frac{9810}{9.81}(9.806)\,1.3 = \underline{\underline{4096\ N/m^2}}$$

$\boxed{28}$ Ⓒ

$a_x = 4.903\ m/s^2 \qquad a_z = 9.806\ m/s^2$



Sol//

$$\tan\theta = \frac{a_x}{g \pm a_z} = \frac{Z}{L/2}$$

$$= \frac{4.903}{9.81 + 9.806} = \frac{Z}{1.3/2}$$

$$\Rightarrow Z = 0.1625 < 0.3 \qquad \Rightarrow \underline{\underline{P_A = 0}}$$

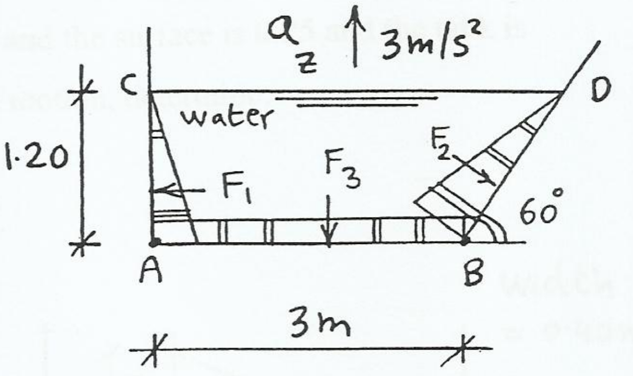
$$P_B = \frac{\gamma}{g}(g \pm a_z) h = \frac{9810}{9.81}(9.81 + 9.806)(1 + 0.1625) = \underline{\underline{22803\ N/m^2}}$$

$$P_c = \frac{9810}{9.81}(9.81 + 9.806)(1 - 0.1625) = \underline{\underline{16428\ N/m^2}}$$

or// $P_c = P_B - \frac{\gamma}{g} a_x L = 16428\ N/m^2$

Calculate the total forces on the ends and bottom of this container while at rest and when being accelerated vertically upward at 3 m/s^2. The container is 2 m wide. Repeat your calculations for a downward acceleration of 6 m/s^2.

Width = 2m

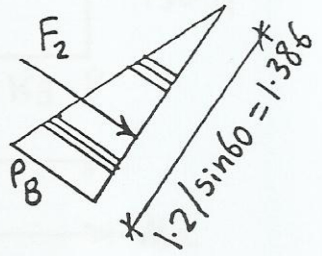


At rest

$P_A = P_B = \gamma h$

$= 9810 * 1.2 = 11772\ N/m^2$

$F_1 = \gamma A \bar{h} = 9810\,(1.2 \times 2) \times \frac{1.2}{2} = \underline{\underline{14126\ N}}$



$F_2 = \frac{1}{2} PA = \frac{1}{2}(11772)(1.386 \times 2) = \underline{\underline{16316\ N}}$

$F_3 = PA = 11772\,(3 \times 2) = \underline{\underline{70632\ N}}$

Upward $a_z = 3m/s^2$

$P_A = P_B = \frac{\gamma}{g}(a_z + g)h = 1000(3 + 9.81)(1.2) = 15372\ N/m^2$

$F_1 = \frac{1}{2} PA = \frac{1}{2}(15372)(1.2 * 2) = \underline{\underline{18446\ N}}$

$F_2 = \frac{1}{2} PA = \frac{1}{2}(15372)(1.386 \times 2) = \underline{\underline{21305\ N}}$

$F_3 = PA = 15372 * 3 * 2 = \underline{\underline{92232\ N}}$

Downward $a_z = 6 m/s^2$

$P_A = P_B = \frac{\gamma}{g}(g - a_z)h = 1000\,(9.81 - 6)\,1.2 = 4572\ N/m^2$

$F_1 = \frac{1}{2} PA = \frac{1}{2}(4572)(1.2 * 2) = \underline{\underline{5486\ N}}$

$F_2 = \frac{1}{2} PA = \frac{1}{2}(4572)(1.386 * 2) = \underline{\underline{6336\ N}}$

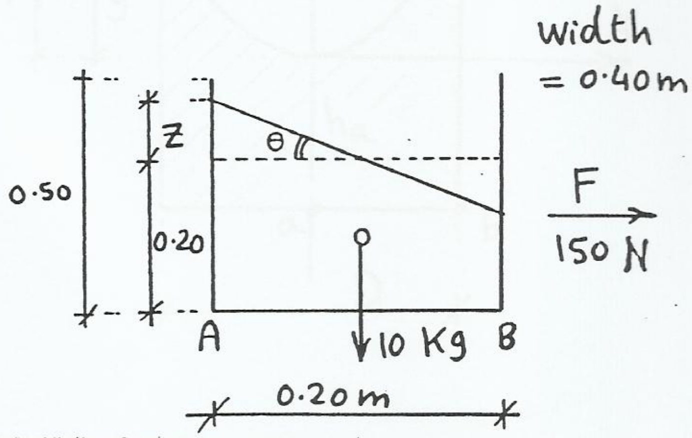
$F_3 = PA = (4572) * (3 * 2) = \underline{\underline{27432\ N}}$

A rectangular container of base dimensions 0.4 m x 0.2 m and height 0.5 m is filled with water to a depth of 0.2 m; the mass of the empty container is 10 kg. The container is placed on a horizontal surface and is subjected to a constant horizontal force of 150 N. If the coefficient of sliding friction between the container and the surface is 0.25 and the tank is aligned with the short dimension along the direction of motion, determine:

a. The force of the water on each end of the tank.

b. The force of the water on the bottom of the tank.

$\mu = 0.25$

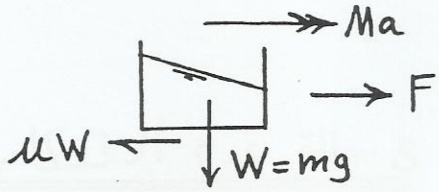


$M_{water} = 0.2 * 0.2 * 0.4 * 1000$

$= 16\ Kg$

$M_{full} = M_{empty} + M_{water}$

$= 10 + 16 = 26\ Kg$



$F - \mu M g = M a$

$150 - 0.25(26)9.81 = 26 a_x \Rightarrow a_x = 3.316\ m/s^2$

$\tan\theta = \frac{a_x}{g} = \frac{3.316}{9.81} = 0.338$

$Z = \frac{0.2}{2} \tan\theta = 0.1(0.338) = 0.0338\ m$

$F_A = \gamma A \bar{h} = 9810\,(0.4 * 0.2338)\,\frac{0.2338}{2} = \underline{\underline{107.24\ N}}$

$F_B = \gamma A \bar{h} = 9810\,(0.4 * 0.1662)\,\frac{0.1662}{2} = \underline{\underline{54.2\ N}}$

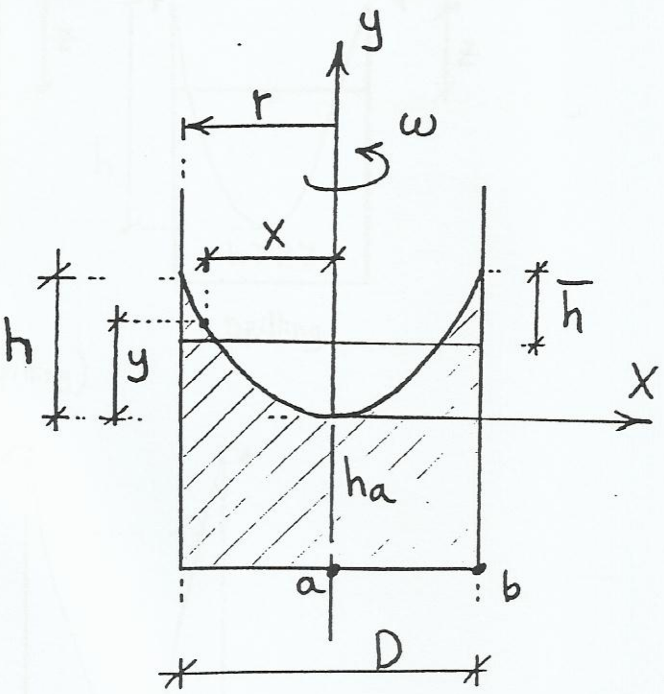
$P_A = \gamma h = 9810(0.2338) = 2293.5\ Pa$

$P_B = \gamma h = 9810(0.1662) = 1630.4\ Pa$

$F_{Bottom} = \frac{1}{2}(P_A + P_B) A = \frac{1}{2}(2293.5 + 1630.4)\, 0.2 * 0.4 = \underline{\underline{156.96\ N}}$

...niform Rotation about Vertical Axis (13)

$$\boxed{\omega = \frac{2\pi N}{60}}$$



N = number of revolutions Per minute (r.p.m.)

ω = Angular Velocity

$$y = \frac{\omega^2 x^2}{2g}$$

$$\boxed{h = \frac{\omega^2 r^2}{2g}}$$

فى حالة عدم الانسكاب

حجم السائل قبل الدوران = حجم السائل بعد الدوران

حجم الفراغ قبل الدوران = حجم الفراغ بعد الدوران

حجم الـ Paraboloid يساوى ½ حجم الاسطوانه المشتركه معه فى القاعدة و الارتفاع

$$\boxed{V_{parab} = \frac{1}{2}\pi r^2 h}$$

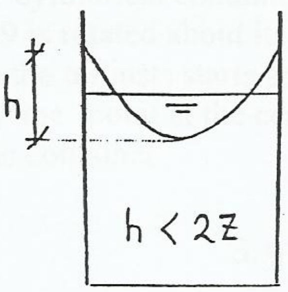
فى حالة عدم الانسكاب يقسم الـ Paraboloid الى ارتفاعين متساويين

If No liquid is Spilled

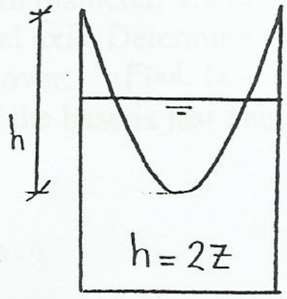
Volume of air before rotation = Volume of air after rotation

$$\pi r^2 \bar{h} = \frac{1}{2}\pi r^2 h \quad \Rightarrow \boxed{\bar{h} = \frac{h}{2}}$$

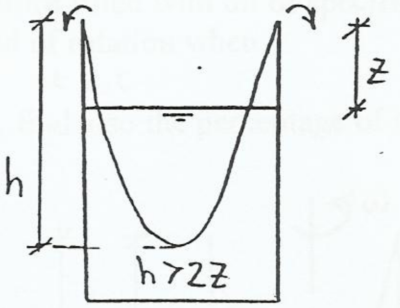
Open tank cases



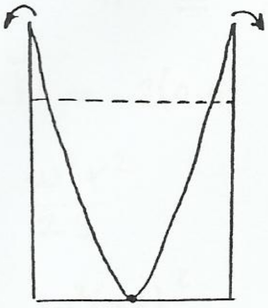
No spilling



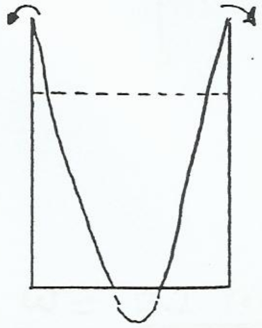
No spilling
(at the point of spilling)



spilling

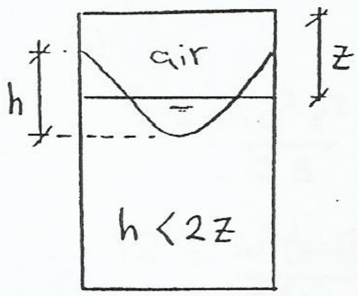


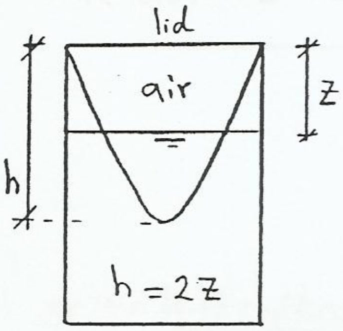
point at the center
is just uncovered



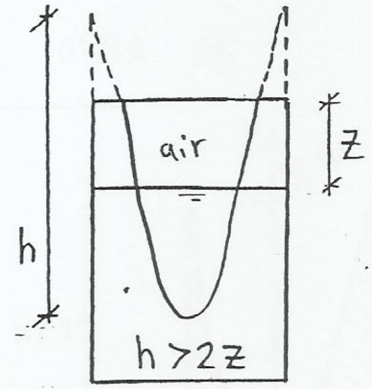
bottom of the tank
is uncovered

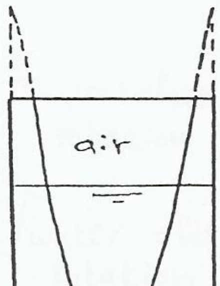
Closed tank cases



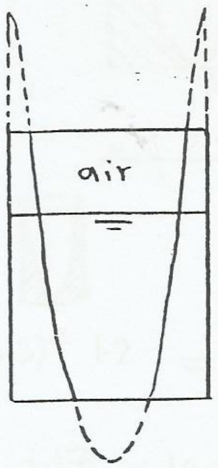


Water starts to
touch the lid





Point at the center
is just uncovered



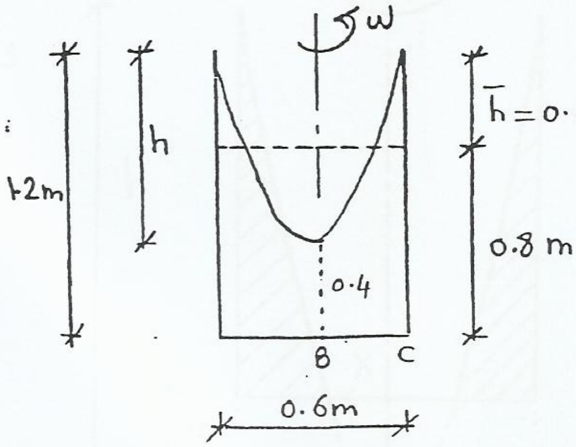
bottom of the tank
is unconvered

A cylindrical container, 0.6 m diameter, 1.2 high, two third filled with oil of specific gravity 0.9 is rotated about its vertical axis. Determine the speed of rotation when

a) the oil justs starts spilling over. Find the Pressure at B;C

b) the point at the center of the base is just uncovered, find also the percentage of oil left in the container.

$S.g. = 0.9$



$\forall_{air\ before\ rot} = \forall_{air\ after\ rot}$

$\bar{h} = \frac{h}{2}$

$h = 2\bar{h} = 2(0.4) = 0.8$

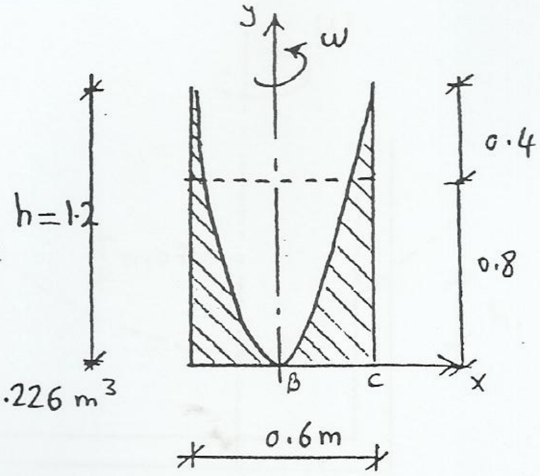
$h = \frac{w^2 r^2}{2g}$

$0.8 = \frac{w^2 (0.3)^2}{2 * 9.81} \Rightarrow \underline{\underline{w = 13.2\ rad/sec}}$

$P_B = \gamma h_B = 0.9(9810)\ 0.4 = 3531.6\ Pa$

$P_C = \gamma h_C = 0.9(9810)\ 1.2 = 10595\ Pa$

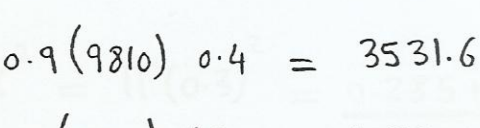
(b).



$h = \frac{w^2 r^2}{2g}$

$1.2 = \frac{w^2 (0.3)^2}{2(9.81)} \Rightarrow \underline{\underline{w = 16.17\ rad/sec}}$

$\forall_{water\ before\ rotation} = \pi r^2 H = \pi (0.3)^2\ 0.8 = 0.226\ m^3$

$\forall_{water\ after\ rotation} =$ 

$= \pi (0.3)^2\ 1.2 - \frac{1}{2}\pi (0.3)^2\ 1.2 = 0.17\ m^3$

$\%\ \forall\ left = \frac{\forall_{after}}{\forall_{before}} * 100 = \frac{0.17}{0.226} \times 100 = \underline{\underline{75.2\ \%}}$

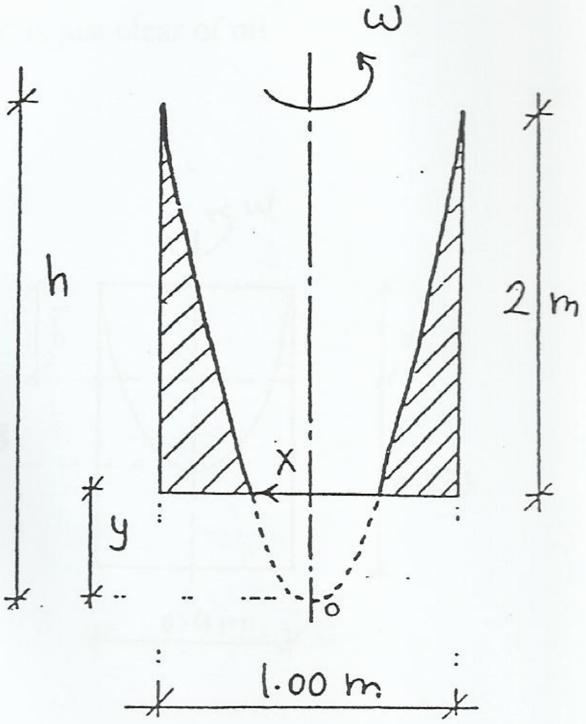
$P_B = 0$

$P_C = \gamma h_C = 0.9\ (9810)\ 1.2 = 10595\ Pa$

An open cylinderical tank 2 m high and 1 m in diameter is full of water. If the cylinder is rotated with an angular velocity of 2.5 rev/s.

How much of the bottom of the tank is uncovered?

16



$$\omega = 2\pi n = 2\pi(2.5) = 15.7 \text{ rad/s}$$

$$h = \frac{\omega^2 r^2}{2g}$$

$$= \frac{(15.7)^2 (0.5)^2}{2 * 9.81} = 3.14$$

$$y = h - 2 = 3.14 - 2 = 1.14 \text{ m}$$

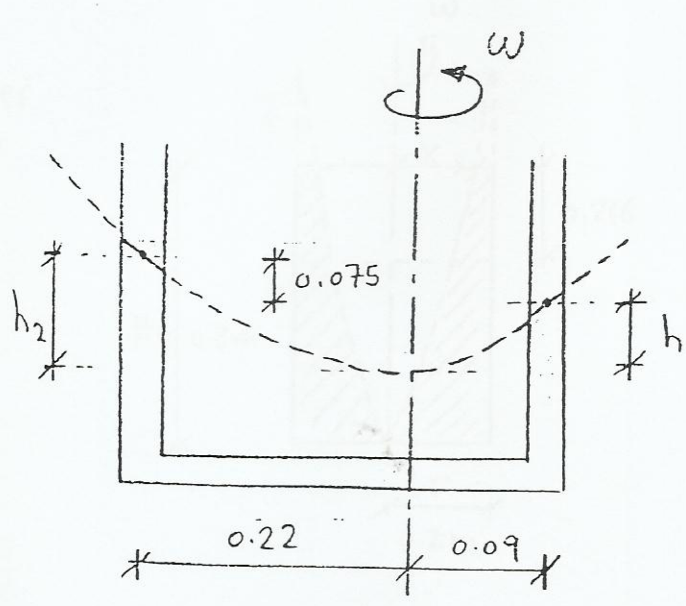
$$1.14 = \frac{(15.7)^2 x^2}{2 * 9.81} \Rightarrow x = 0.30 \text{ m}$$

$$\text{Uncovered Area} = \pi x^2 = \pi (0.3)^2 = \underline{0.285 \text{ m}^2}$$

29

$$h_2 - h_1 = 0.075$$

$$\omega = ?$$



$$h_1 = \frac{\omega^2 r^2}{2g} = \frac{\omega^2 (0.09)^2}{2(9.81)}$$

$$h_2 = \frac{\omega^2 (0.22)^2}{2(9.81)}$$

$$\frac{\omega^2 (0.22)^2}{2(9.81)} - \frac{\omega^2 (0.09)^2}{2(9.81)} = 0.075$$

$$\Rightarrow \omega = \underline{6.04 \text{ rad/s}}$$

A closed cylindrical container, 0.40 m diameter and 0.8 m high, two third of its height is filled with oil (S.G. = 0.85). The container is rotated about its vertical axis. Determine the speed of rotation when: a) the oil just start touching the lid.

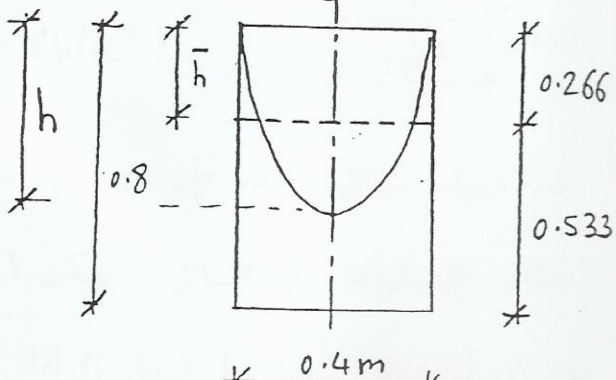
b) the point at the center of the base is just clear of oil.

$S.g. = 0.85$

$\forall_{\substack{\text{air before}\\ \text{rot}}} = \forall_{\substack{\text{air after}\\ \text{rot}}}$

$\bar{h} = \frac{h}{2}$

$h = 2\bar{h} = 2(0.266) = 0.533$



$h = \frac{w^2 r^2}{2g}$

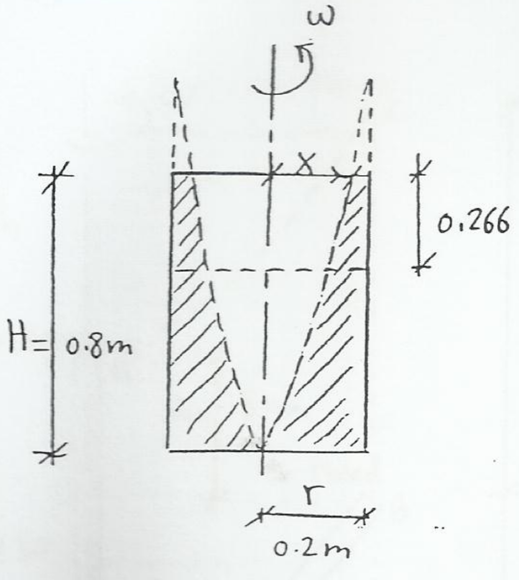
$0.533 = \frac{w^2 (0.2)^2}{2 * 9.81} \Rightarrow \underline{w = 16.17 \text{ rad/sec}}$

$\forall_{\substack{\text{air before}\\ \text{rotation}}} = \forall_{\substack{\text{air after}\\ \text{rotation}}}$

$\cancel{\pi} r^2 (0.266) = \frac{1}{2} \cancel{\pi} x^2 (0.8)$

$(0.2)^2 (0.266) = \frac{1}{2} x^2 \, 0.8$

$\therefore \; X = 0.163 \text{ m}$



$H = \frac{w^2 x^2}{2g}$

$0.8 = \frac{w^2 (0.163)^2}{2 * 9.81}$

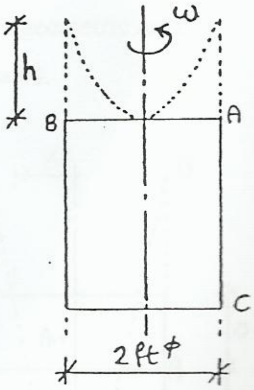
$\Rightarrow \; w = \underline{\underline{24.29 \text{ rad/sec}}}$

A closed vessel, 2 ft in diameter, is completely filled with water. If the vessel is rotated at 1200 rpm, what increase in pressure would occur at the top of the tank at the circumference? (18)

$$\omega = \frac{2\pi N}{60} = \frac{2\pi(1200)}{60} = 125.6 \text{ rad/s}$$

$$h = \frac{\omega^2 r^2}{2g} = \frac{(125.6)^2 (1)^2}{2 * 32.2} = 245.2 \text{ ft}$$

$$P = \gamma h = 62.4\,(245.2) = 15300 \text{ lb/ft}^2$$



عند دوران سائل مغلق فإن الأسطح العليا عند A,B تصبح تحت ضغط ، ونظراً لوجود غطاء للإسطوانة فإن السائل لا يمكن أن يأخذ شكل الـ Parabola لأن الغطاء يغلقه عليه الزوج من الاسطوانة ، لذا يؤول سطح السائل إلى اتخاذ شكل الـ Parabola وتصبح النقطة A تحت ضغط $= \gamma \frac{\omega^2 r^2}{2g}$

A tube AOB has the part OB, 300 mm long, bent upwards so that the angle OB is 45. AO is vertical and the end B is closed. The tube AOB is completely filled with water to a height of 230 mm above O. Find the number of revolutions per min of the tube about axis OA so that the pressure at B is the same as the pressure at O.

$$P_O = P_B$$

$$\gamma h_{AO} = \gamma h_{BC}$$

$$\therefore BC = AO = 230 \text{ mm}$$

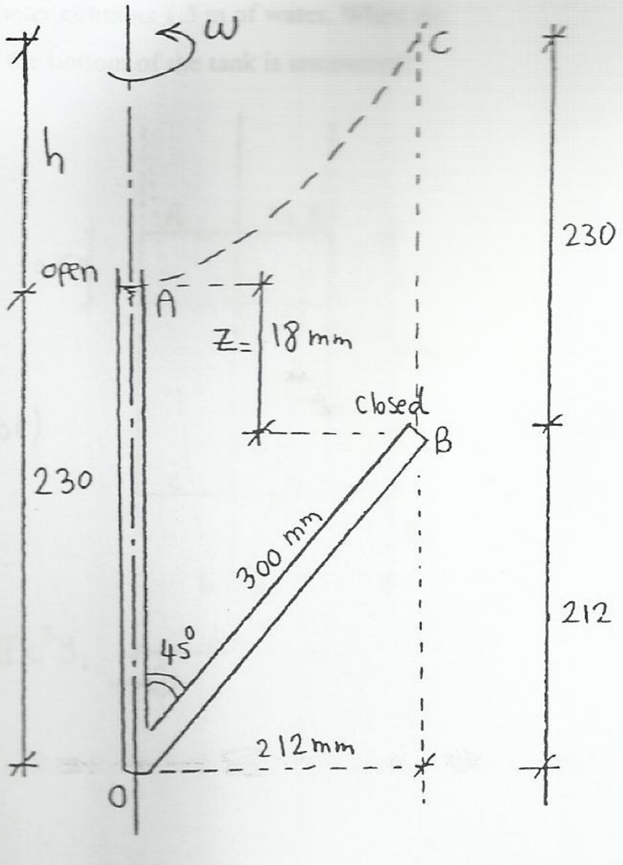
$$Z = 230 - 300 \cos 45 = 18 \text{ mm}$$

$$h = \frac{\omega^2 r^2}{2g}$$

$$(0.23 - 0.018) = \frac{\omega^2 (0.212)^2}{2 * 9.81}$$

$$\Rightarrow \omega = 9.62 \text{ rad/s} = \frac{2\pi N}{60}$$

$$\therefore N = \underline{91.86 \text{ rev/min}}$$



A closed cylindrical tank, 2 m high and 1 m in diameter, contains 1.5 m of water with air space subjected to a pressure of 1.07 bar. If the cylinder rotates about its geometric axis. What are the pressures at points C and D, when the angular velocity is 12 rad/s.

$$H = \frac{\omega^2 r^2}{2g} = \frac{(12)^2 (0.5)^2}{2 * 9.81} = 1.83\,m$$

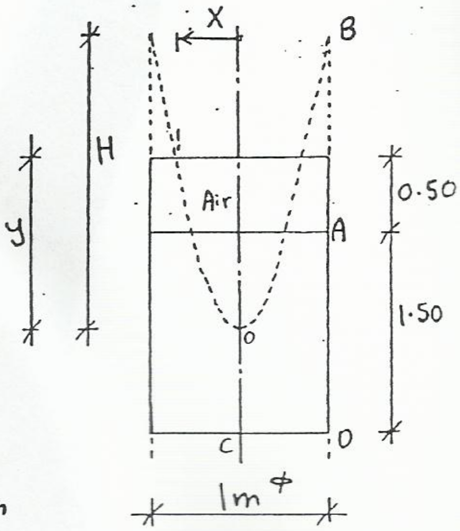
$$V_{air}\,(\text{before rot}) = V_{air}\,(\text{after rot})$$

$$\pi (0.5)^2\, 0.5 = \tfrac{1}{2}\pi x^2 y$$

$$x^2 y = 0.25 \rightarrow ①$$

$$y = \frac{(12)^2 x^2}{2 * 9.81} \rightarrow ②$$

$$y^2 = \frac{(12)^2\, 0.25}{2 * 9.81} = 1.83 \Rightarrow y = 1.36\,m$$



OC + H

$$C = 2 - 1.36 = 0.64\,m$$

$$BD = 0.64 + 1.83 = 2.47$$

$$= 1.07 \times 10^5 + 0.64 \times 9810 = \underline{1.13\ bar}$$

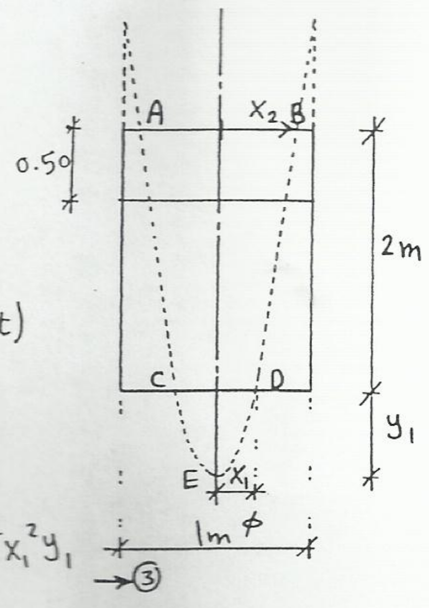
$$P_D = 9810\,(2.47) + 1.07 \times 10^5 = \underline{1.31\ bar}$$

---

closed cylindrical tank 2 m high and 1 m in diameter contains 1.5 m of water. When the gular velocity is constant at 20 rad/s, how much of the bottom of the tank is uncovered?

$$y_1 = \frac{(20)^2 X_1^2}{2 * 9.81} \rightarrow ①$$

$$y_1 = \frac{(20)^2 X_2^2}{2 * 9.81} \rightarrow ②$$



air (before rot) = V_{air} (after rot)

$$\frac{\pi (1)^2}{4} * 0.5 = \overset{A\ \ B}{\underset{E}{\bigcup}} - \overset{C\ \ D}{\underset{E}{\bigcup}}$$

$$0.3927 = \tfrac{1}{2}\pi X_2^2 (2 + y_1) - \tfrac{1}{2}\pi X_1^2 y_1 \rightarrow ③$$

rom ①, ②, ③ $\Rightarrow X_1 = 0.116$

rea $= \pi (0.116)^2 = \underline{0.0423\ m^2}$