(28) . (29)

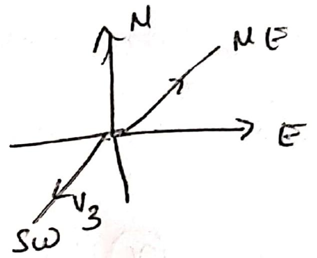
let $\cancel{m}$ M $= 5\ kg$:

$m_1 = m_2 = 2\ kg$; $m_3 = 1\ kg$

$V_1 = 5\hat{j}$ m/s [North) ; $V_2 = 5\hat{i}$ m/s (east)

According to law of conservation of linear momentum

$$P_3 = \sqrt{P_1^2 + P_2^2}$$



$$\Rightarrow m_3 V_3 = \sqrt{(m_1 V_1)^2 + (m_2 V_2)^2}$$

$$\Rightarrow V_3 = \sqrt{(2\times5)^2 + (2\times5)^2} = \sqrt{10^2 + 10^2} = 10\sqrt{2}\ m/s$$

SW

momentum of third part $P_3 = m_3 V_3$

$= 1 \times 10\sqrt{2}$

$= 10\sqrt{2}$ kg m/s.

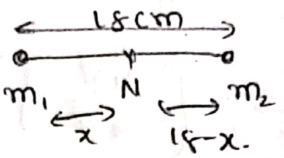
Scanned with OKEN Scanner

WS-10 · Gravitation 8th foundation

Task

①

let $m_1 = 8\,kg$: $m_2 = 2\,kg$



let N - be the Point where field is zero.

(ie) Gravitational field strength due to m_1 and m_2 are equal and opposite. $[r_1 = x ;\ r_2 = 18 - x]$

$$\therefore \frac{m_1}{r_1^2} = \frac{m_2}{r_2^2}$$

$$\Rightarrow \frac{\cancel{8}^{4}}{x^2} = \frac{\cancel{2}}{(18-x)^2} \Rightarrow 4 = \left(\frac{x}{18-x}\right)^2$$

$$\Rightarrow \frac{x}{18-x} = \sqrt{4} = 2$$

$$\Rightarrow x = 2(18-x)$$

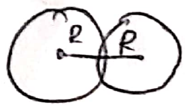
$$\Rightarrow x = 36 - 2x$$

$$\Rightarrow 3x = 36$$

$$\Rightarrow x = 12\,cm = 0.12\,m \text{ from } m_1 = 8\,kg$$

②

let 'R' be the radius of each sphere.. when two spheres are kept in contact distance between ~~two~~ the centres of two sphere's is $r_1 = 2R$



$F_1 = F$.

If Radius is doubled $r_2 = 4R$. then the force is

F_2

2nd continuation

According to newton's law of gravitation

$$F \propto \frac{1}{r^2}$$

$$\Rightarrow \frac{F_1}{F_2} = \left[\frac{r_2}{r_1}\right]^2$$

$$\Rightarrow \frac{F}{F_2} = \left(\frac{\cancel{4}^{2} \cancel{R}}{2 \cancel{R}}\right)^2 = 2^2 = 4$$

$$\Rightarrow F_2 = \frac{F}{4}. \rightarrow A$$

(3) Given weight of the body on surface of Earth is

$w = mg = 64$ N.

when the body is at a height $h = \frac{R}{3}$.

Acceleration due to gravity $g' = \frac{gR^2}{(R+h)^2}$

$$g' = \frac{gR^2}{(R+\frac{R}{3})^2} = \frac{9gR^2}{16R^2}$$

$$g' = \frac{9}{16}g$$

$\therefore$ weight of the body $w' = mg' = mg \times \frac{9}{16}$

$$= \cancel{64}^{4} \times \frac{9}{\cancel{16}}$$

$$= 36 \text{ N} \rightarrow D$$

(4) Given $T_{planet} = 8 T_{Earth}$

Distance of planet from sun is $R_p = r$, then $R_e = ?$

According to kepler's law of Planetary motion

$$T^2 \propto r^3$$

$$\left[\frac{T_p}{T_e}\right] = \left[\frac{r_p}{r_e}\right]^{3/2}$$

$$\Rightarrow \frac{8\cancel{T_e}}{\cancel{T_e}} = \left[\frac{r}{r_e}\right]^{3/2}$$

$$\Rightarrow 2^{3/2} = \left(\frac{r}{r_e}\right)^{3/2}$$

$$\Rightarrow 2^2 = \frac{r}{r_e} \Rightarrow r_e = \frac{r}{4} \rightarrow C.$$

(5)

let 'd' be the depth and $h = 64\,km$ is height

Given $g_{depth} = g_{height}$

$$\Rightarrow \cancel{g}\left[1-\frac{d}{R}\right] = \cancel{g}\left[1-\frac{2h}{R}\right]$$

$$\Rightarrow \cancel{1}-\frac{d}{R} = \cancel{1}-\frac{2h}{R}$$

$$\Rightarrow \frac{d}{\cancel{R}} = \frac{2h}{\cancel{R}} \Rightarrow d = 2h = d = 2\times 64 = 128\,km$$

(6)

Given

g at a height $= 64\%\, g$ [36% Reduced]

$$\Rightarrow \frac{\cancel{g}R^2}{(R+h)^2} = \frac{64}{100}\cancel{g}$$

$$\Rightarrow \frac{R}{R+h} = \sqrt{\frac{64}{100}} \Rightarrow \frac{R}{R+h} = \frac{8}{10} = \frac{4}{5}$$

$$\Rightarrow 5R = 4R + 4h \Rightarrow h = \frac{R}{4} = \frac{6400}{4} = 1600\,km$$

(7)

$H_{max} = 0.5m$

Given velocity of Projection is same on earth and moon, $g_{moon} = \frac{1}{6} g_{earth}$

Maximum height reached by vertically projected body $H_{max} = \frac{u^2}{2g} \Rightarrow H_{max} \propto \frac{1}{g}$

$\Rightarrow \frac{H_e}{H_m} = \frac{g_m}{g_e} \Rightarrow \frac{0.5}{H_m} = \frac{\frac{1}{6} \cancel{g_e}}{\cancel{g_e}}$

$\Rightarrow \frac{0.5}{H_m} = \frac{1}{6} \Rightarrow H_m = 3m \rightarrow D$

(8)

depth to which the body taken $d = 16km$

% change in $g = \frac{\Delta g}{g} \times 100 = \frac{d}{R} \times 100$

$\Rightarrow \frac{\cancel{16}}{\cancel{64}00} \times 100 = \frac{100}{400} = \frac{1}{4} = 0.25\%$
$\rightarrow B$

(9)

Given

$M_e : M_m = 3 : 2$. $R_e : R_m = \frac{6}{P} : 1$

we know weight $w = \underset{\text{mass of body}}{m} g$: $\left[g = \frac{G \overset{\text{mass of planet}}{M}}{R^2} \right]$

$\Rightarrow W = \frac{GM}{R^2} \Rightarrow \frac{W_e}{W_m} = \frac{M_e}{M_m} \times \left[\frac{R_m}{R_e}\right]^2$

$\Rightarrow \frac{W_e}{W_m} = \frac{3}{2} \times \left[\frac{1}{6}\right]^2 = \frac{\cancel{3}}{2} \times \frac{1}{\cancel{36}_{12}} = \frac{1}{24} \rightarrow B$

10

If Earth is shrinking to half of its radius means the body is now at a depth $d = \frac{R}{2}$ from centre of Earth.

$$w = mg = \frac{GMm}{R^2} \quad \left[g = \frac{GM}{R}\right]$$

At depth d' $w' = mg'$

$$= mg' = mg\left(1 - \frac{d}{R}\right) = mg\left(1 - \frac{R}{2R}\right) = \frac{mg}{2}$$

$$w = \frac{GMm}{d'^2} \qquad g = \frac{Gm}{R^2}$$

$$w = \frac{GMm}{\left(\frac{R}{2}\right)^2} = 4\frac{GMm}{R^2} = 4w$$

weight of the body changes by 4 times

11

Comet does not have elliptical orbit. Hence does not obey kepler's law of Planetary action. they move along the paths which are hyperbolic or almost Parabola

12

According to kepler's 2nd law, Angular momentum is conserved. This suggests that for the planet, radial and tangential acceleration is zero.

(14)

we know that According to kepler's 3^{rd} law

$$T^2 \propto r^3$$

As the distance of the planet from the sun increases, the length of the semi-major axis of it's orbit will also increase and therefore the period of revolution will also increase

(15)

The Gravitational acceleration on the earth's surface is $g = \frac{GM}{R_e^2}$; we know density $= \frac{Mass}{volume}$

$$\Rightarrow \rho = \frac{M}{V}$$

$$\Rightarrow M = \rho V = \rho \frac{4\pi}{3} R_e^3$$

$$\therefore g = \frac{G\rho \frac{4\pi}{3} R_e^{\cancel{3}}}{\cancel{R_e^2}} = \frac{4\pi}{3} G\rho R_e$$

$$\therefore G = \frac{3g}{4\pi\rho R_e} \quad (or) \quad G = \frac{g R_e^2}{M}$$

(16)

we know $g = \frac{GM}{r^2}$. $r \rightarrow$ distance of the body from centre of Earth

when $r > R$, - moving away from centre. $g \rightarrow$ decreases because r increases.

At the centre of Earth $r = 0$ and hence $g = \frac{GMr}{R^3}$

$$\therefore g = 0.$$

16th continuation

(4)

If Earth stops rotating, the gravitational force will increase since there will be no centrifugal force.

(18)

(i) If Earth shrinks to half of it's Present value then Radius $R' = \frac{R}{2}$.

we know that $g = \frac{GM}{R^2}$ [M = constant]

$\Rightarrow g \propto \frac{1}{R^2} \Rightarrow \frac{g'}{g} = \left[\frac{R}{R'}\right]^2$

$\Rightarrow \frac{g'}{g} = \left[\frac{R'}{\frac{R}{2}}\right]^2 = 4$

$\Rightarrow g' = 4g$

(ii)

If Earth shrinks to $\frac{1}{3}$rd of it's Present value

then $R' = \frac{R}{3}$.

We know $g \propto \frac{1}{R^2}$ (M = constant)

$\Rightarrow \frac{g'}{g} = \left[\frac{R}{R'}\right]^2$

$\Rightarrow \frac{g'}{g} = \left[\frac{R'}{\frac{R}{3}}\right]^2 = 3^2 = 9$

$\Rightarrow g' = 9g$

(19)

Given $r_1 = 10^{12}\,m$; $r_2 = 10^{10}\,m$

According to kepler's law of planetary motion

$T^2 \propto r^3$

$$\Rightarrow \left[\frac{T_1}{T_2}\right]^2 = \left[\frac{r_1}{r_2}\right]^3$$

$$\Rightarrow \frac{T_1}{T_2} = \left[\frac{10^{12}}{10^{10}}\right]^{3/2} = \left[10^{\cancel{2}}\right]^{3/\cancel{2}} = 10^3 = 1000.$$

(20)

Given

$g_m = \frac{1}{5} g_e$; $R_m = \frac{1}{4} R_e$. then $\frac{M_e}{M_m} = ?$

From $g = \frac{GM}{R^2}$

$$\Rightarrow \frac{g_m}{g_e} = \frac{M_m}{M_e} \times \left[\frac{R_e}{R_m}\right]^2$$

$$\Rightarrow \frac{1}{5} = \frac{M_m}{M_e}\left[4\right]^2$$

$$\Rightarrow \frac{1}{5} = \frac{M_m}{M_e}\,16$$

$$\Rightarrow \frac{M_e}{M_m} = 16 \times 5 = 80.$$

LTask

CUQs

1

when body is taken from equator to poles

r ~~in~~decreases since $g \propto \frac{1}{r^2}$

As r increases g decreases. vice versa

So $W = mg$ = ~~decreases~~ increases.

2

we know that $T^2 \propto r^3$

If the distance between earth and sun is

$R' = \frac{1}{4}$ (present distance R)

$\therefore \frac{T'}{T} = \left(\frac{R'}{R}\right)^{3/2} \Rightarrow \frac{T'}{T} = \left(\frac{1}{4}\right)^{3/2}$

$\Rightarrow \frac{T'}{T} = \left(\frac{1}{2}\right)^3 = \frac{1}{8}$

$\Rightarrow \boxed{T' = \frac{T}{8}}$

3

Since

$g_{height} = g\left[1 - \frac{2h}{R}\right]; \quad g_{depth} = g\left[1 - \frac{d}{R}\right]$

As height and depth are increasing

Acceleration due to gravity decreases

(4)

If Earth shrinks to half of it's radius

i.e. $R' = \frac{R}{2}$.

g becomes $g = \frac{GM}{R^2}$ $g \propto \frac{1}{R^2}$

$\Rightarrow \frac{g'}{g} = \left[\frac{R}{R'}\right]^2 = \left[\frac{R}{\frac{R}{2}}\right]^2 = 2^2 = 4$

$\Rightarrow g' = 4g$

$\therefore$ weight $w = mg' = 4mg$ = increases 4 times

(5)

If the earth stops rotating, the weight of a body at the equator will increase. However, there is no influence on the weight at the poles. The impact of the earth's rotating on gravity acceleration is to reduce its value. As a result, if the earth stops rotating, the value of 'g' will rise.

(10)

we know that Areal velocity $A = \frac{L}{2M}$.

$\Rightarrow L = 2MA$

$= 7.5 \times 10^5$ pascal

$\Rightarrow \frac{\Delta g}{g} =$

Jee main level

(1)

According to given question $\frac{\Delta g}{g} = 4\%$

$\Rightarrow$ we know $\frac{\Delta g}{g} = \frac{2h}{R}$

$\therefore \frac{2h}{R} = 4\% \Rightarrow \frac{\cancel{2}h}{R} = \frac{\cancel{4}2}{100}$

$\Rightarrow h = \frac{2}{\cancel{1}00} \times R = \frac{1}{50} \times 6400$

Scanned with OKEN Scanner

(2)

weight of the body on surface of Earth $w = 360N$

g ~~ad~~ at a depth 'd' : $g' = g(1 - \frac{d}{R})$

Given $R = 800$ km

$g' = g(1 - \frac{800}{\cancel{6400}_{8}})$

$g' = g(1 - \frac{1}{8}) = \frac{7g}{8}$

weight $= mg' = m\frac{7g}{8} = \frac{7}{8} \times mg = \frac{7}{8} \times 360$

$= 315N$

(3)

we know that $R_{max} = \frac{u^2}{2g} \Rightarrow R \propto \frac{1}{g}$

$\frac{R}{R'_p} = \frac{g_p}{g_e} \Rightarrow \frac{R}{\frac{5R}{4}} = \frac{g_p}{g_e} \Rightarrow \frac{g_p}{g_e} = \frac{4}{5}$

$\Rightarrow \frac{g_e}{g_p} = \frac{5}{4} \Rightarrow \frac{g_p}{g_e} = \frac{4}{5}$.

(4)

$M_e = 80 M_p \qquad D_e = 2 D_p$

we know $\quad g = \frac{GM}{R^2}$

$\Rightarrow \frac{g_p}{g_e} = \frac{M_p}{M_e}\left[\frac{R_e}{R_p}\right]^2$

$\Rightarrow \frac{g_p}{9.8} = \frac{\cancel{M_p}}{80\cancel{M_p}}\left[\frac{2\cancel{D_p}}{\cancel{D_p}}\right]^2$

$\Rightarrow \frac{g_p}{9.8} = \frac{1}{\cancel{80}_{20}} \times \cancel{4} \Rightarrow g_p = \frac{9.8}{20} = 0.49 m/s^2$

(5)

Given $\quad M_p = \frac{1}{9} M_e. \; : \; R_p = \frac{1}{2} R_e. \qquad w_e = mg_e = 9N.$

$\frac{w_e}{w_p} = \frac{g_e}{g_m} \qquad$ Since $\; g = \frac{GM}{R^2} \Rightarrow g \propto \frac{M}{R^2}$

$\Rightarrow \frac{w_e}{w_p} = \frac{M_e}{M_p} \times \left[\frac{R_p}{R_e}\right]^2 \qquad \Rightarrow \frac{1}{w_p} = \frac{1}{2^2}$

$\Rightarrow \frac{9}{w_p} = \cancel{9} \times \left[\frac{1}{2}\right]^2 \qquad \Rightarrow w_p = 4 N.$

(6)

Given $\quad w_{height} = \frac{1}{4} w_{surface}.$

$\Rightarrow mg_h = \frac{1}{4} mg$

$\Rightarrow \cancel{mg}\left[1 + \frac{2h}{R}\right]^2 = \frac{1}{4}\cancel{mg}$

$\Rightarrow \cancel{1 - \frac{1}{4} = \frac{2h}{R} \Rightarrow \frac{3}{4} = \frac{2h}{R}}$

$\left(1 + \frac{h}{R}\right)^2 = 4 \qquad \Rightarrow 1 + \frac{h}{R} = 2$

$\Rightarrow \frac{h}{R} = 2 - 1 = 1$

$\Rightarrow h = R$

(7)

let $m_1 = xm$; $m_2 = (1-x)m$

we know that Gravitational force

$$F = \frac{Gm_1m_2}{r^2} = \frac{G\, xM(1-x)M}{r^2}$$

$$F = \frac{GM^2}{r^2} x(1-x)$$

For maximum value of force $\frac{dF}{dx} = 0$

$$\Rightarrow \frac{d}{dx}\left[\frac{GM^2}{r^2}(x-x^2)\right] = 0$$

$$\Rightarrow \frac{d}{dx}(x-x^2) = 0 \qquad \left[\text{use } \frac{d}{dx}x^n = nx^{n-1}\right]$$

$$\Rightarrow 1-2x = 0 \Rightarrow x = \frac{1}{2}$$

(8)

let $m_A = m$; $r_A = r$

$m_B = 2m$; $r_B = 4r$

we know that $T^2 \propto r^3$

$$\Rightarrow T \propto r^{3/2}$$

$$\Rightarrow \frac{T_1}{T_2} = \left(\frac{r_A}{r_B}\right)^{3/2} = \left(\frac{r}{4r}\right)^{3/2}$$

$$= \left(\frac{1}{2^2}\right)^{3/2} = \left(\frac{1}{2}\right)^3 = \frac{1}{8}$$

(9)

let $r_1 = 10^{13}$; $r_2 = 10^{12}$ we know that $T \propto (r)^{3/2}$

$$\Rightarrow \frac{T_1}{T_2} = \left(\frac{r_1}{r_2}\right)^{3/2} = \left(\frac{10^{13}}{10^{12}}\right)^{3/2} = 10^{3/2} = 10\sqrt{10}$$

(8)

(11)

If $m_1' = 2m$; $m_2' = 2m$. $r' = 2r$

we know $F = \frac{G m_1 m_2}{r^2} = \frac{G m m}{r^2} = \frac{G m^2}{r^2}$

$\Rightarrow F' = \frac{G m_1' m_2'}{r'^2}$

$\Rightarrow F' = \frac{G (2m)(2m)}{(2r)^2} = \frac{4 G m^2}{4 r^2} = F$

(13)

As the depth increased the mass of the earth decreases. At the surface of earth this value will be maximum because radius will be maximum. when radius becomes less this value also decreases. Hence acceleration due to gravity decrease with increase in the depth.

(14)

Due to the equatorial bulge, i.e. the equator being more bulged towards the outside, the poles are near to the centre of the earth, as compared to the equitorial regeon. And as the acceleration due to gravity is inversely proportional to the distance from the centre of the earth, the distance is less on poles, g is more.

(15)

If G starts decreasing, then gravitational force and earth will start to decrease. therefore earth will try to follow a spiral path of decreasing radius. Hence, it's period of revolution around the sun will increase. ∴ Duration of the year will increase.

~~Since revolution of~~

But rotational motion of earth about its own axis will remain unchanged, hence period of rotation will remain unchanged or length of the day will remain unchanged.

Since, the radius of circular path of earth will increase or the earth will follow spirical path.

∴ therefore it's P.E will increase but P.E is always −ve so the magnitude of K.E decreases.

(16)

$g_m = \frac{1}{6} g_e$.

we know $g = \frac{GM}{R^2} \Rightarrow g \propto \frac{1}{R^2}$

$\Rightarrow \frac{g_m}{g_e} = \left(\frac{R_e}{R_m}\right)^2 \Rightarrow$

$\Rightarrow \frac{1}{6} = \left(\frac{R_e}{R_m}\right)^2 \Rightarrow \frac{R_e}{R_m} = \frac{1}{\sqrt{6}}$

If density same $g \propto R$. $\frac{R_e}{R_m} = \frac{g_e}{g_m} = \frac{6}{1} \Rightarrow \frac{g_m}{g_e} = \frac{1}{6}$

If $\frac{\rho_m}{\rho_e} = \frac{5}{3}$ $\quad \frac{R_e}{R_m} = \frac{\rho_e}{\rho_m} \times \frac{g_m}{g_e} = \frac{5}{3} \times \frac{1}{6} = \frac{5}{18}$

Scanned with OKEN Scanner

17

(i) $g_h = g$. Given $h = 2R$. $g_h = g_0$.

we know $g_h = \dfrac{g}{(1+\frac{h}{R})^2} = \dfrac{g}{(1+\frac{2\cancel{R}}{\cancel{R}})^2}$

$\Rightarrow g_0 = \dfrac{g}{(1+2)^2} = \dfrac{g}{9}$

$\Rightarrow g = 9g_0$

(ii)

$\dfrac{\Delta g}{g} = \dfrac{75}{100} = \dfrac{3}{4}$

$\Rightarrow \dfrac{d}{R} = \dfrac{3}{4} \Rightarrow d = \dfrac{3}{4}R$

18

Given $m_p = 2m$: $R_p = 2R$.

we know $W = mg$ and $g = \dfrac{GM}{R^2}$ $g \propto \dfrac{m}{R^2}$

$\dfrac{g_p}{g_e} = \dfrac{M_p}{m_e}\left(\dfrac{R_e}{R_p}\right)^2$

$= \dfrac{2\cancel{m}}{\cancel{m}}\left(\dfrac{\cancel{R}}{2\cancel{R}}\right)^2$

$\Rightarrow \dfrac{g_p}{g_e} = 2 \times \dfrac{1}{4} \Rightarrow g_p = \dfrac{g_e}{2}$

$W_p = mg_p = \dfrac{mg_e}{2} = \dfrac{W}{2}$

(19)

let masses are m_1 & m_2 distance $= r$.

$$F = \frac{G m_1 m_2}{r^2} \qquad m_1' = 2m_1 \; ; \; m_2' = 2m_2$$

$$r' = \frac{r}{2}$$

$$F' = \frac{G m_1' m_2'}{r'^2} = \frac{G (2m_1)(2m_2)}{\left(\frac{r}{2}\right)^2}$$

$$\Rightarrow F' = \frac{16\, G m_1 m_2}{r^2} = 16F$$

(20)

use $F = \frac{G m_1 m_2}{r^2}$

(a) $m_1 = 20kg$: $m_2 = 30kg$; $r = 1m$ $\rightarrow F = G \times 20 \times 30 = 600GN$

(b) $m_1 = 40kg$: $m_2 = 60kg$: $r = 0.5m \Rightarrow F = G \times \frac{40 \times 60}{\left(\frac{1}{2}\right)^2} = 9600GN$

(c) $m_1 = 30\,kg$; $m_2 = 50kg$; $r = 2m \Rightarrow F = G \times \frac{30 \times 50}{2^2} = 375GN$

(d) $m_1 = 10kg$: $m_2 = 40kg \rightarrow r = 2.5m \Rightarrow F = G\,\frac{10 \times 40}{(2.5)^2} = 64GN$.

fluid mechanics

T.Basle

①

h = 76 cm
$= 76 \times 10^{-2}$ m

Normal pressure = 76 cm of Hg

In SI system $P = \rho g h$

$= 1.36 \times 10^{3} \times 10 \times 76 \times 10^{-2}$ m

$= 103.36 \times 10^{2}$ N/m²

$= 103360$ N/m² → A.

②

$\rho_{liquid} = 12$ kg/m³ ; P = 600 Pa

pressure at a depth $P = \cancel{P_{atm}} + \rho g h$

$600 = \cancel{0} + 12 \times 10 \times h$

$h = \frac{600}{12 \times 10} = 5m$ → D

③

Pressure at ground floor $P_G = 120000$ Pa.

pressure at a height $P_h = 30000$ Pa

$P = P_a + \rho g h$

⇒ ~~300000 120,000 = 30~~ Pressure difference = $\rho g h$

⇒ $(120{,}000 - 30{,}000) = 10^{3} \times 10 \times h$

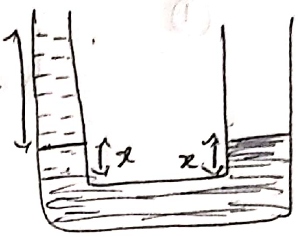
⇒ $90{,}000 = 10^{4} h$

$h = 9m$ → C.

(4)

$a_L = 3a_r$. $h_L = 30cm$

Mercury rises in right limb until the Pressure's are equal in both limb's.



$P_w = P_{Hg}$

$\Rightarrow \cancel{P_a} + \rho_w g h_w = \cancel{P_a} + \rho_{Hg}\, g\, h_{Hg}$.

h_w = height of water = $30 + 3x$

h_{Hg} = height of Hg = $4x$.

$\therefore \rho_w\, g\, h_w = \rho_{Hg}\, g\, h_{Hg}$

$\Rightarrow \cancel{10^3} \times (30+3x) = 13.6 \times \cancel{10^3} (4x)$

$\Rightarrow 30 + 3x = 13.6 \times 4x$

By solving it we get

$x = 0.58cm \rightarrow A$

Volume = constant

$A \times l$ = constant

$A \propto \frac{1}{l}$

$\Rightarrow \frac{A_L}{A_r} = \frac{L_r}{L_L}$

$\Rightarrow 3 = \frac{L_r}{L_L}$

$\Rightarrow L_r = 3L_L$

(5)

Given Area = $1.5\, m^2$; $h = 1m$.

Pressure exerted by the water = $\rho g h = 10^3 \times 10 \times 1 = 10^4$

Force exerted = $P \times A$

$= 10^4 \times 1.5 = 1.5 \times 10^4 N. \rightarrow B$

(6) Area of tube $a_1 = 1 cm^2$

Area of top of vessel $a_2 = 100\ cm^2$

height of vessel $h_2 = 1\ cm$

height of water in tube = 99cm

But from bottom of vessel = 100 cm = 100×10^{-2} m

weight of water in the system

= weight of water in (tube of Area $1cm^2$ + vessel of area $100\ cm^2$]

$\Rightarrow \rho g V_1 + \rho g V_2$

$\Rightarrow 10^3 \times 10 \times [V_1 + V_2] = 10^4 [a_1 h_1 + a_2 h_2]$

$= 10^4 [99 \times 1 \times 10^{-6} + 100 \times 10^{-6}]$

$\Rightarrow 1.99 N \rightarrow B, C.$

Force exerted by water against the bottom of the vessel $F_{base} = P_{base} \times Area$.

$P_{base} = P_{atm} + \rho_w g h_w = 10^5 + 10^3 \times 10 \times 100 \times 10^{-2}$

$= 1.1 \times 10^5\ N/m^2$

Area of base $a_2 = 100\ cm^2 = 100 \times 10^{-4} m^2 = 10^{-2} m^2$

F_{base} = Pressure × Area $= 1.1 \times 10^5 \times 10^{-2}$

$= 1100\ N$

(7)

we know

pressure difference = $\rho g h$

$\Rightarrow (40000 - 10000) = 10^3 \times 10 \times h$

$\Rightarrow 30,000 = 10^4 h$

$\Rightarrow h = 3m$ — A.

(8)

height of water $h_w = 10cm$

density of ~~water~~ kerosene $d_k = 0.8 \times 10^3$ kg/cc.

density of water $d_w = 10^3$ kg / kg.

kerosene rises until ~~water~~ pressure in two limbs are equal.

$P_w = P_k$

$\Rightarrow d_w g h_w = d_k g h_k$

$\Rightarrow \cancel{10^3} \times 10 = 0.8 \times \cancel{10^3} \times h_k$

$\Rightarrow h_k = \frac{10}{0.8} = \frac{100}{8} = 12.5$ cm $\rightarrow$ B

(9)

Given Pressure at a depth ~~d~~ $P = 4$ atmo

Atmospheric Pressure $P_{at} = 1$ atm

we know variation of pressure with depth $P = P_a + \rho g h$

$\Rightarrow 4at = 1atm + \rho g h$

$\Rightarrow 3atm = 10^3 \times 10 \times h$

$= 3 \times 10^5 = 10^4 h \Rightarrow h = \underline{30}$ m $\rightarrow$ A

1 atm = 10^5 (or) 1.05×10^5 pascals

Scanned with OKEN Scanner

(10)

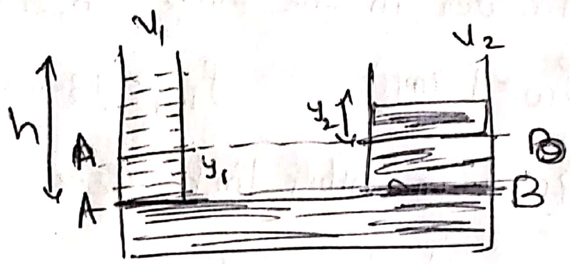
let D_1 and D_2 are the diameters of two vessels

S = Relative density of Hg = $\frac{d_{Hg}}{d_w}$.

$r_2 = n r_1$

If the level in the narrow tube goes down by y_1

Then in wider tube goes up to y_2.



$$V_1 = V_2$$

$$\Rightarrow A_1 y_1 = A_2 y_2. \Rightarrow \cancel{\pi} r_1^2 y_1 = \cancel{\pi} r_2^2 y_2$$

$$\Rightarrow r_1^2 y_1 = (n r_1)^2 y_2$$

$$\Rightarrow y_1 = n^2 y_2.$$

$$P_A = P_B$$

$$\Rightarrow \rho_w g h = \rho_m g [y_1 + y_2]$$

$$\Rightarrow h = \frac{\rho_m}{\rho_w} [n^2 y_2 + y_2)$$

$$\Rightarrow h = S\, y_2 (n^2 + 1] \Rightarrow y_2 = \frac{h}{S(n^2+1)}$$

(11)

$h_w = 10m$ $h_g = 20m$

$d_w = 10^3 kg/m^3$

$P = P_{atm} + \rho g h_w = 1 atm + 10^3 \times 10 \times 10 = 10^5 + 10^5$

$= 2 \times 10^5$ Pascal

$= 2 atm.$

(12)

Level of water in one limb $h_1 = 27.2 cm.$

$\rho_w = 1 gm/cc$; $\rho_{Hg} = 13.6$ units.

The liquid in other limb rises until pressures are same

$P_A' = P_C$

$\Rightarrow \rho_w g h_1 = \rho_{Hg} g h_2$

$\Rightarrow 1 \times 27.2 = 13.6 h_2 \Rightarrow h_2 = \underline{2 cm}.$

Difference in levels $= 27.2 - 2 = 25.2 cm$

(13)

Because the vessels base areas are different so Force exerted by water on the base of vessel is not same.

(14)

As the depth of a point in a liquid increases Pressure also changes from the relation

$P_{depth} = P_{atm} + \rho g h$

$\rho \rightarrow$ density of liquid; $h =$ depth of a point in a liquid.

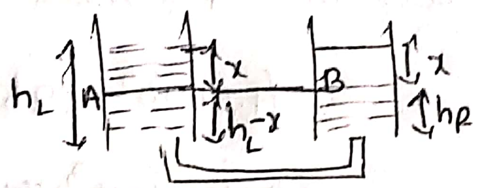
(15), (16)

left ; Right

$d_L = 800\ kg/m^3$; $d_R = 1600\ kg/m^3$

$h_L = 30\ cm$; $h_R = 20\ cm$

when two tanks are connected then liquid flows until two both have same level



let 'x' be the rise of liquid the level in Right vessel, so same level falls in left vessel

$$P_A = P_B$$

$$\Rightarrow \rho_L g (h_L - x) = \rho_R g (h_R + x)$$

$$\Rightarrow \cancel{800}(30 - x) = \overset{2}{\cancel{1600}}(20 - x)$$

$$\Rightarrow 30 - x = 40 - 2x \Rightarrow 2x - x = 40 - 30$$

$$\Rightarrow x = 10\ cm = 0.1\ m$$

If we connect the tube at a distance of 0.1 m from top of vessel No flow takes place.

(17), (18), (19)

height of water $h_w = 10cm = 0.1m$

Bottom Area = $10cm^2$; Top area = $30\ cm^2 = 30 \times 10^{-4} m^2$

vol = 1 lit $= 10^{-3} m^3$; $d_w = 10^3 kg/m^3$

$P_{atm} = 1.01 \times 10^5 N/m^2$

Force at bottom = $P \times Area$

$$= (1.01 \times 10^5 + \rho g h) A$$

$$= (1.01 \times 10^5 + 10^3 \times 10 \times 0.1) \times 10^{-3}$$

$$= (10.1 + 0.1) \times 10^4 \times 10^{-3}$$

$$= 10.2 \times 10 = 102 N \text{ downward}$$

(18). let F be the force exerted by side of wall on the water (upward), then from equilibrium

$$F + F_1 = F_2 + \omega$$

$$\Rightarrow F = F_2 + \omega - F_1 = 303 - 10 - 102 = 211 N (\text{upward})$$

(19) If air inside the Jar is completely Pumped out

$$F_1 = \rho g h A_1 = 10^3 \times 10 \times 0.01 \times 10^{-3} = 1 N \text{ downward}$$

Here F_2 = Force exerted by atmosphere on water

$$= P_0 A_2 = 1.01 \times 10^5 \times 3 \times 10^{-3} = \underline{303 N} (\text{downwards})$$

ω = weight of water = $mg = V d g =$

$$= 10^{-3} \times 10^3 \times 10$$

$$= 10 N (\text{downwards})$$

Scanned with OKEN Scanner

(20)

Given $d_L = 12\ kg/m^3$, Pressure $= 720\ Pa$.

Pressure at a point inside of liquid

$$P = \cancel{P_a +} \rho g h$$

$$\Rightarrow \cancel{720}^{6} = \cancel{12 \times 10} \times h$$

$$\Rightarrow h = 6\,m$$

(21)

Given depth of water $h = 20\,m$

change in Pressure $= \rho g h = 10^3 \times 10 \times 20$

$= 2 \times 10^5\ N/m^2$

$= 2\ atm$

LTank

CUQ's

(2)

We know variation of Pressure with depth

$$P = P_{atm} + \underbrace{\rho g h}_{\text{Pressure due to liquid column}}$$

(5)

Atmospheric Pressure decreases with increase of height Because density of air is heavier near the surface of earth and begins to lighten as we go to higher altitudes. and eventually leads to empty space, outside of the atmosphere of the earth.

(9)

Pressure is a scalar quantity because it is the ratio of the component of the force normal to the area and it is independent on the size of the area chosen.

(10)

According to Pascal's law, pressure is same if the point's are same depth from surface of liquid and is independent on base area.

(11)

we know $P = \underline{P_0} + \rho g h$

$\rho, g =$ constant $P \propto h$.

$\therefore$ c → correct option

(12)

Here pressure at a depth $P = \rho g h$ depends on depth (h), density (ρ) and acceleration due to gravity (g) only. so $P =$ same in all directions at a given point.

Jee mains level

(1)

Given $h = 10m$ $P = \rho g h = 10^3 \times 10 \times 10$

$= \underline{10^5 \text{ Pa}}$

$= 0.5 \times 10^4 + 10.$

(2)

Given
$h_{Hg} = 50cm$

$d_{Hg} = 13.6$ gm/cc ; $g = 1000$ cm/s^2

$P = \rho g h = 13.6 \times 50 \times 1000$

$\Rightarrow 680 \times 10^3 = 6.8 \times 10^5$ dy/cm^2 → A

(3)

$h_{w} = 27.2$ cm.

Mercury rises in other limbs until Pressure is same at certain level

$P_{Hg} = P_w$

$\Rightarrow \rho_{Hg}\, \cancel{g}\, h_{Hg} = \rho_w\, \cancel{g}\, h_w$

$\Rightarrow \cancel{13.6} \times h_{Hg} = 1 \times \cancel{27.2}^{\,2}$ cm

$h_{Hg} = 2$cm.

difference in levels $= h_w \sim H_{Hg}$

$= 27.2 - 2$

$= 25.2$ cm

(4)

Barometer reading $P = 70$ cm of Hg. $= 70\times10^{-2}\times g\times13600$

$P_w = \rho_w g h_w$

$\Rightarrow P_{Hg} = P_w$

$\Rightarrow 7\cancel{0}\times10^{-2}\times \cancel{g}\times 136\cancel{00} = 10^{\cancel{3}}\times \cancel{g}\times h_w$

$\Rightarrow 7\times136\times10^{-2} = h_w$

$\Rightarrow \underline{9.52 \text{ m}} = h_w \rightarrow A$

(5)

$P_w =$ atmospheric Pressure

$= 76$ cm of Hg

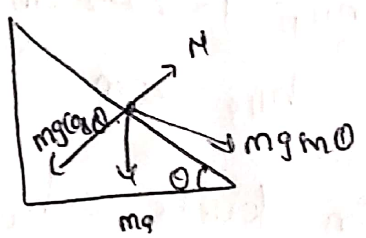
$\Rightarrow \rho_w g h_w = 76 \times d_{Hg} \times g$

$\Rightarrow 10^3 \times h_w = 76 \times 13600$

$\Rightarrow h_w = \frac{76\times13600}{10^3} = 13.6\times76 = 1033$ cm or

$= \underline{10.33} \text{ m} \rightarrow C$

(6)



$N = mg\cos\theta$

Here Pressure is exerted due to Normal Reaction force

$\therefore$ Force on small area $= P\,\Delta A$

$\Rightarrow \rho g h \cos\theta\, \Delta A$

$\Rightarrow \rho g h (\Delta A) \cos\theta$

Scanned with OKEN Scanner

10

$d_A = 1.6$ gm/cm³

$h_A = 26.6$ cm ; $h_B = 50$ cm

$$P_B = P_A$$

$$\Rightarrow \rho_B\, g\, h_B = \rho_A\, g\, h_A$$

$$\Rightarrow \rho_B \times 50 = 1.6 \times 26.6$$

$$\Rightarrow \rho_B = \frac{1.6 \times 26.6}{50} = 0.85 \text{ g/cm}^3.$$

11

$h_x = 8$ cm. $h_y = 10$ cm $\rho_{Hg} = 13.6$ gm/cc

$\rho_y = 3.36$ gm/cc

From fig it is clear that $h_{Hg} = 2$ cm

$$\therefore P_x + P_{Hg} = P_y$$

$$\Rightarrow \rho_x\, g\, h_x + \rho_{Hg}\, g\, h_{Hg} = \rho_y\, g\, h_y$$

$$\Rightarrow \rho_x\, 8 + 13.6\,(2) = 3.36\,(10)$$

$$\Rightarrow 8\rho_x + 27.2 = 33.6$$

$$\Rightarrow 8\rho_x = 33.6 - 27.2 = 6.4$$

$$\rho_x = \frac{6.4}{8} = 0.8 \text{ gm/cc}$$

12

$P_a = 16 \times 10^4$ Pa. ; $h = 15$ m.

Pressure difference $= \rho g h$

$$P_a - P_h = 10^3 \times 10 \times 15$$

$$\Rightarrow 16 \times 10^4 - P_h = 15 \times 10^4 \Rightarrow P_h = 1 \times 10^4 = 10{,}000 \text{ Pa}.$$

18, 19, 20

Given depth = 1000m ; $\rho_w = 1.03 \times 10^3$ kg/m^3; $g = 10$ m/s^2

Absolut Pressure = $P_a + \rho g h$

$= 1atm + 1.03 \times 10^3 \times 10 \times 1000$

$= 1atm + 103 \times 10^5$

$\Rightarrow 1am + 103$ atm

$= 104$ atm

Gauge pressure = $\rho g h$

$= 1.03 \times 10^3 \times 10 \times 1000$

$= 103$ atm

Force on window = $P_{abs} \times$ Area

$= 104$ atm $\times 400$ cm^2

$= 104 \times 10^5 \times 400 \times 10^{-4}$

$= 416 \times 10^3 = 4.16 \times 10^5$ N

$\simeq 4.12 \times 10^5$ N

(21)

~~$h_w = 15$cm.~~

(25)

$P_G = 40000$ Pa, $P_h = 10000$ Pa.

Pressure difference = $P_G - P_h = h \rho g$

$\Rightarrow 40000 - 10{,}000 = h \times 10^3 \times 10$

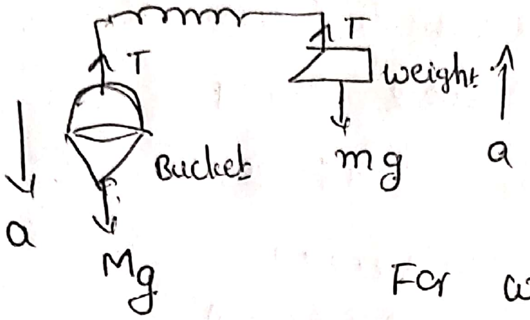
$\Rightarrow 30000 = h \times 10^4$

$\Rightarrow h = 3$m

(24)

Let T be the tension in the rope.

For the bucket $Mg - T = Ma \rightarrow (1)$



$Mg \rightarrow$ mass (or) weight of bucket

$mg =$ weight of suspended weight

$= \frac{Mg}{2}$.

For weight $T - mg = ma$

$\Rightarrow T - \frac{Mg}{2} = \frac{Ma}{2} \rightarrow (2)$

(1) + (2)

$$Mg - T + T - \frac{Mg}{2} = Ma + \frac{Ma}{2}$$

$$\Rightarrow \frac{\cancel{M}g}{\cancel{2}} = \frac{3\cancel{M}a}{\cancel{2}} \Rightarrow a = \frac{g}{3}$$

Thus the effective gravitational force acting on water filled in the bucket $a' = g - a = g - \frac{g}{3} = \frac{2g}{3}$

Pressure at bottom $= h\rho a' = h\rho\left(\frac{2g}{3}\right)$

$$= \cancel{15}^{5}\times10^{-2}\times10^{3}\times\frac{2}{\cancel{3}}\times10 \quad [h = 15\text{ cm}]$$

$$\Rightarrow 10\times10\times10 = 10^{3}\text{ Pa}$$

$$= 1\text{ kPa}$$