Task

①

Given $A = 10\ cm^2$: mass = 40 kg.

$= 10\times10^{-4}\ m^2$

∴ Pressure sustained by the femurs

$$= \frac{F}{2A} = \frac{mg}{2A} = \frac{\overset{20}{\cancel{40}}\times10}{\cancel{2}\times10^{-3}}$$

$$= 200\times10^{3} = 2\times10^{5}\ N/m^2 \rightarrow A$$

②

Given mass = 80 kg : $A = 0.6\ m^2$.

$$∴ \text{Pressure} = \frac{F}{A} = \frac{mg}{0.6} = \frac{80\times10}{6\times10^{-1}} = \frac{4}{3}\times10^{3}$$

$$= 1.3\times10^{3}\ N/m^2. \rightarrow C$$

③

Given mass = 80 kg : $A = 80\times10^{-4} = 8\times10^{-3}\ m^2$

$$\text{Pressure} = \frac{F}{2A} = \frac{mg}{2A} = \frac{80\times10}{2\times8\times10^{-3}} = 10^{5}\ N/m^2$$

$$= \frac{10}{2}\times10^{4}\ N/m^2 \rightarrow B$$

$$= 5\times10^{4}\ N/m^2$$

④

Given $P = 10^{5}$ Pa. : Area = $40\times80 = 3200\ cm^2 = 3200\times10^{-4}\ m$

$$∴ F = PA = 10^{5}\times3200\times10^{-4}$$

$$= 3200\times10 = \underline{3}.2\times10^{4}\ N \rightarrow B$$

⑤

density = $1.29\ kg/m^3$. ; $P_{at} = 10^5$ Pas

we know variation of Pressure with density

$$p = \rho g h$$

$$\Rightarrow p = 1.29 \times 10 \times h$$

$$\Rightarrow 10^5 = 1.29 \times 10 \times h$$

$$h = \frac{10^4}{1.29} = 8013\ m \rightarrow D$$

⑥

variation of Pressure with depth

$$P = P_a + \rho g h$$

$P_a = 10^5 = 1atm$; $\rho = 10^3\ kg/m^3$; Given $h = 10m$

$$\therefore P = 10^5 + 10^3 \times 10 \times 10$$

$$= 10^5 + 10^5 = 2 \times 10^5 = 2\ atm.$$

⑦

weight of the body in air $W_{air} = 25N$.

$W_{water} = 20N$.

upthrust acting on the body $= W_{air} - W_{water}$

$= 25 - 20$

$= 5N \rightarrow A$

⑧

Given $w_{water} = \frac{1}{3} w_{air} [w_1]$

The apparent loss of weight of the body after immersed in water $= W_{air} - W_{water}$

$\Rightarrow W_{air} - \frac{1}{3} W_{air}$

$\Rightarrow \frac{2}{3} W_{air} = \frac{2}{3} W_1 \rightarrow C$

⑨

Given $W_{air} = 100N$; $W_{kerosene} = 70N$.

Apparent loss of weight of the body $= W_{air} - W_{kerosene}$

$= 100 - 70$

$= 30\,N \rightarrow D$

⑩

Given that Pressure at ground floore = 270 kPa

$\Rightarrow P = 270 \times 10^3$ Pa

$\Rightarrow \rho g h = 270 \times 10^3$

$\Rightarrow \cancel{10^3} \times 1\cancel{0} \times h = 27\cancel{0} \times \cancel{10^3}$

$\Rightarrow h = 27\,m$ [where ρ = density of water $= 10^3\,kg/m^3$]

$\rightarrow A$

If we take $g = 9.8\,m/s^2$ we get $h = 27.55\,m$

⑪

ⓐ

on wearing skies, force due to the weight of the skier acts over a much larger area than the area of the soles of the shoes, this reduce the Pressure on the soft surface of the snow and allows the skier to slide over it without sinking.

ⓑ

In fluids, The atoms are free to move around in an enclosed fluids, they transmit Pressure to all parts of the fluid as well as the container's walls.

This what says Pascal's law.

⑫

ⓐ

weight of cork acts vertically downwards is balanced by upthrust due to the water.

∴ The apparent weight of the floating cork is zero.

ⓑ

we know Pressure at heights $P = \rho g h$

$\rho \rightarrow$ density of air

on the ground density of air > density at heights.

since $P \propto \rho$ $\Rightarrow P_{heights} < P_{ground}$

and also 'g' at height $= \frac{g}{(1+\frac{h}{R})^2}$ ∴ At higher altitudes g value decreases it also effects Pressure.

⑬

we know that Pressure $= \frac{F}{A} \Rightarrow P \propto \frac{1}{A}$

Because camels feet having large area compared with man feet they exert less pressure on sand as a result camels experience less reaction force on their feet. so they can walk easily on sand

⑭

A needle placed carefully on the surface of water may float due to surface tension, as upward forces due to surface tension balances the weight of the needle. But these upwards forces due to surface tension are very small as compared to weight of the ball, also the weight of liquid displaced by the ball immersed in liquid is less than weight of the ball, hence ball sinks into the liquid. so 'A' is correct

⑮

when rain drops are falling ~~from~~ at certain height

. Total upward force [Buoyant force + viscous force) is equal to weight of the drop.

$\Rightarrow$ Net force acting on the body $= 0$

$\therefore$ The ~~bod~~ drop moves with constant velocity

⑯ , ⑰

Given mass $m = 4kg$: Area $A = 2m^2$

weight of the body = $mg = 4 \times 10 = 40N$.

~~F~~ Pressure exerted by the body

$$P = \frac{F}{A} = \frac{40}{2} = 20 N/m^2.$$

LTask

CUQ's

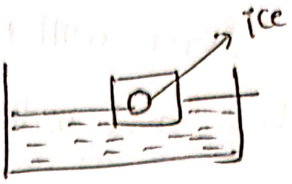
①

A freely falling body experiences zero apparent weight. Hence upthrust on it will be zero. Here when the system falls freely, the wooden block floating in the water is also in freefall and therefore feels zero upthrust.

②

when the balls are floating on the boat, they displace their own mass of water, but when they are thrown into the tank, they displace their own volume of water. Since steel is less denser than water, less water is displaced when the ball is only displacing it's volume instead of its greater mass. Hence the water level falls.

④ It will fall.



$\rho_{ice} \to$ density of ice

$\rho_{ball} \to$ density of ball

let $V \to$ volume of cube ; $V' \to$ volume of the ball.

Now when the cube floats

mass of water displaced $= m_{ice} + m_{ball}$.

$$= Vol_{ice}\, d_{ice} + V_{ball}\, d_{ball}$$

$$= [V-V']\,\rho_{ice} + V \rho_{Ball} \longrightarrow ①$$

volume of water displaced $= (V-V')\dfrac{\rho_{ice}}{\rho_w} + V'\dfrac{\rho_{Ball}}{\rho_w} \to ②$

After melting, mass of water melted = mass of ice

$$= (V-V')\,\rho_{ice}.$$

volume of water melted $= \dfrac{[V-V']\,\rho_{ice}}{\rho_w}$

But after the water has melted, rise in level of water will be equal to = volume of water melted + V_{Ball}

Rise in water $= [V-V']\dfrac{\rho_{ice}}{\rho_w} + V' \to ③$

As $\rho_{Ball} > \rho_{water}$.

From ② & ③ we can see that volume of water displaced is greater. water level falls

⑤

Buoyant force will ~~t~~ acts only on the body immersed in water and will not affect the total load on the scale pan

⑥

→ Since the box ~~is~~ air tight no air can pass through it. so if a bird is sitting then the total weight is equal to the sum of weight of box + bird

→ If the bird is flying, the reaction force applied on the floor of the box will be equal to its weight. So there is no change in the total weight of the box.

⑦

Because inter molecular forces are stronger in solids compared with liquids. and gases.

⑧

when the brick is on the boat. the weight of both brick and the boat pushes the water down and raises the water level.

when the brick is at bottom of the water it replaces it's volume in the water, not its weight ~~There~~ density of brick is higher than the density of water ~~er~~ volume, so the water level drops.

Jee main's level

①

Given $\text{Area} = 20\ cm^2 = 20\times10^{-4}\ m^2$

mass $m = 50\ kg$

$$\text{Pressure} = \frac{F}{2A} \quad [\text{two legs}]$$

$$= \frac{mg}{2A} = \frac{50\times\cancel{10}}{2\times\underset{2}{\cancel{20}}\times10^{-4}}$$

$$= \frac{50}{4}\times10^{4} = 12.5\times10^{4}\ N/m^2$$

$$= 1.25\times10^{5}\ N/m^2 \rightarrow A$$

②

Given $\text{Area} = 0.5\ m^2$; mass $m = 60\ kg$.

$$\text{pressure} = \frac{F}{A} = \frac{mg}{A} = \frac{60\times10}{0.5} = 1200\ N/m^2$$

$$= 12\times10^{2}\ N/m^2 \rightarrow C$$

③

Given mass $m = 90\ kg$; $\text{Area} = 90\ cm^2$
$= 90\times10^{-4}\ m^2$

$$\text{Pressure} = \frac{F}{A} = \frac{mg}{2A} \quad [\text{supported by two legs}]$$

$$= \frac{\cancel{90}\times10}{2\times\cancel{90}\times10^{-4}} = 5\times10^{4}\ N/m^2 \rightarrow B$$

④

Given $P = 10^5$ pa. ∴ Area of room $A = 10cm \times 20cm$

$= 200\ cm^2$

$= 200 \times 10^{-4}\ m^2$

From defination of Pressure $= \frac{Force}{A}$

$\Rightarrow Force = P \times A$

$= 10^5 \times 200 \times 10^{-4}$

$\Rightarrow 2000 = 0.2 \times 10^4$ N.

→ B

⑤

$d_{atm} = 1.29\ kg/m^3$

we know variation of pressure with altitude

$P = \rho g h$ where P = atmospheric pressure $= 1.05 \times 10^5\ N/m^2$

$\Rightarrow 1.05 \times 10^5 = 1.29 \times 10 \times h$

$\Rightarrow h = \frac{1.05 \times 10^5}{1.29 \times 10} \simeq 8013$ → D

⑥

Given depth $h = 5m$, $P_{atm} = 10^5\ N/m^2$.

Variation of pressure with depth $P = \rho g h + P_a$

$P \Rightarrow 10^5 + 10^3 \times 10 \times 5$

$\Rightarrow$ ~~below~~. $P = 10^5 + 0.5 \times 10^5$

$= 1.5 \times 10^5$

$= 1.5$ atm

⑦

Given $W_a = 50\,N$; $W_{wat} = 35\,M$

upthrust = $W_{air} - W_{wat}$

$= 50 - 35$

$\Rightarrow 15\,N \rightarrow A$

⑧

Given weight of body in water $(W_L) = \frac{1}{5} W_{air}(W_1)$

Apparent loss of weight of the body

$\Rightarrow W_{air} - W_{wa}$

$\Rightarrow W_1 - \frac{1}{5} W_1$

$\Rightarrow \frac{4}{5} W_L \rightarrow C$

⑨

Given weight of body in air $W_a = 75\,N$

weight of body in alcohol $W_{alc} = 50\,N$

Apparent loss of weight of the body $= W_a - W_{alc}$

$= 75 - 50$

$= 25\,N \rightarrow D$

⑩

Given Pressure at ground level $P_G = 100\,kp$

$\Rightarrow \rho g h = 100 \times 10^3$

$\Rightarrow \cancel{10^3} \times 10 \times h = \cancel{10^5}$

$h = 10\,m \rightarrow A$

Advanced

①

when a man is sitting in a boat which is floating in a Pond. If the man drinks some water from the pond, the boat sink slightly as the man's weight ~~de~~increases, displacing the same amount of water consumed by the man's ~~weight~~ As a result, the Pond's water level has risen to the same level as when the man drank the water. As a result, the water level will remain unchanged.

③

The density of concrete, of course, is more than that of water, and block of concrete will sink like a stone, if dropped into water

Concrete cargo were filled with air and as such,

$$\text{average density} = \frac{\text{mass of [concrete+air]}}{\text{volume of [concrete+air]}}$$

$\therefore$ <density> of cargo vessel < that of water. As a result the concrete cargo vessels did not sink.

②

Here the apparent weight of ice = to the weight of displaced water, when ice melt it will occupy the volume of water displaced so water remains at same level. as it was on before. It can be said that $d_{water} > d_{ice}$ (or) vice versa. So the level of water remains same

⑤ The pressure will be greater at bottom than at the top (e) from higher to lower pressure. Further in coming from bottom to top, the pressure decreases, since $P \propto \frac{1}{Area}$ Area there by volume increases. so radius increases

⑥

According to ~~Archi~~ Archimedes Principle

The apparent loss of weight of the body = weight of liquid displaced.

∴ Apparent weight = Real weight − Buoyance force

$$w' = Mg - \rho_L V_L g$$

$$= Mg - \frac{4\pi}{3} r^3 \rho_L g$$

∴ Both sphere's are same radius

∴ w'_{Solid} (Apparent weight) = w'_{Hallow}