

Task

(1)

Given

$$w_{\text{air}} = 0.2 \text{ kg}$$

$$w_{\text{water}} = 0.1 \text{ kg}$$

$$w_{\text{liquid}} = 0.12 \text{ kg}$$

$$\begin{aligned} \text{specific gravity} &= \frac{w_{\text{air}} - w_{\text{liquid}}}{w_{\text{air}} - w_{\text{water}}} = \frac{0.2 - 0.12}{0.2 - 0.1} \\ &= \frac{0.08}{0.1} = 0.8 \end{aligned}$$

(2)

$$w_{\text{air}} = 90 \text{ gm}$$

$$d_{\text{brass}} = 9 \text{ gm/cc} ; d_{\text{water}} = 1 \text{ gm/cc}$$

we know

$$S.G. = \frac{w_{\text{air}}}{w_{\text{air}} - w_{\text{water}}}$$

$$\text{also } S.G. = \frac{d_{\text{body}}}{d_{\text{water}}}$$

$$\Rightarrow \frac{9}{1} = \frac{90}{90 - w_{\text{water}}}$$

$$\Rightarrow 90 - w_{\text{water}} = 10 \Rightarrow w_{\text{water}} = 90 - 10 = 80 \text{ gm}$$

(3)

Given

$$w_{\text{air}} = 200 \text{ gm}$$

$$w_{\text{liquid}} = 180 \text{ gm}$$

$$w_{\text{water}} = 175 \text{ gm}$$

$$d_{\text{water}} = 1 \text{ gm/cc}$$

$$\text{we know } S.G. = \frac{w_{\text{air}} - w_{\text{liquid}}}{w_{\text{air}} - w_{\text{water}}} = \frac{200 - 180}{200 - 175}$$

$$\Rightarrow \frac{d_{\text{body}}}{d_{\text{water}}} = \frac{20}{25}$$

$$\begin{aligned} \Rightarrow d_{\text{body}} &= \frac{20}{25} \times d_{\text{water}} = \frac{4}{5} \times 1 = 0.8 \text{ gm/cc} \\ &= 800 \text{ kg/m}^3 \end{aligned}$$

(2)

Given $w_{air} = 200 \text{ gm}$

$w_{water} = 175 \text{ gm}$

(4)

Relative density =

$$\frac{w_{air}}{w_{air} - w_{water}}$$

$$R.D = \frac{200}{200 - 175} = \frac{200}{25} = \underline{8}$$

(5)

Given

$w_{air} = 24 \text{ gm}$

$w_{water} = 21 \text{ gm}$

specific gravity of liquid = 1.1

we know

$$\text{specific gravity} = \frac{w_{air} - w_{liquid}}{w_{air} - w_{water}}$$

$$\Rightarrow 1.1 = \frac{24 - w_{liquid}}{24 - 21}$$

$$\Rightarrow 1.1 = \frac{24 - w_{liquid}}{3}$$

$$\Rightarrow 3.3 = 24 - w_{liquid} \Rightarrow w_{liquid} = 24 - 3.3 = 20.7 \text{ gm}$$

(6)

Volume of liquid = 1 lit

specific gravity = 0.7

$$S.G = \frac{d_{body}}{d_{water}}$$

$$\Rightarrow m_{air} = 0.7 \times 1000$$

$$\Rightarrow 0.7 = \frac{d_{liquid}}{1 \text{ gm/cc}}$$

$$= 700$$

$$\text{weight} = mg = 0.7 \times 10$$

$$= 7 \text{ N}$$

$$\Rightarrow d_{liquid} = 0.7$$

$$\Rightarrow \frac{m_{air}}{V_{air}} = 0.7$$

$$\Rightarrow m_{air} = 0.7 \text{ lit}$$



⑦

$$W_{\text{air}} = 60 \text{ gm}$$

$$\text{Specific gravity} = S.G. = 0.6$$

$$\begin{aligned} \text{Tension in Thread} &= \text{loss of weight of the sphere} \\ &= W_{\text{air}} - W_{\text{liquid}} = 55 \text{ gm wt} \end{aligned}$$

$$\begin{aligned} \therefore \text{specific gravity of liquid} &= \frac{W_{\text{air}} - W_{\text{liquid}}}{W_{\text{air}} - W_{\text{water}}} \\ \Rightarrow 0.6 &= \frac{60 - 55}{60 - W_{\text{water}}} \Rightarrow 0.6 = \frac{5}{60 - W_{\text{water}}} \end{aligned}$$

$$\Rightarrow 60 - W_{\text{water}} = \frac{5}{0.6} = \frac{50}{6}$$

$$\Rightarrow W_{\text{water}} = 51.6$$

$$\begin{aligned} \therefore \text{Specific gravity of sphere} &= \frac{W_{\text{air}}}{W_{\text{air}} - W_{\text{water}}} \\ \Rightarrow \frac{60}{60 - 51.6} &= \frac{60}{8.4} = 7.2 \end{aligned}$$

⑧

Apparent weight = constant

$$mg - F_B = \text{constant}$$

$$\Rightarrow mg \left[1 - \frac{d_L}{d_b} \right] = \text{constant}$$

$$\Rightarrow m_{\text{lead}} g \left[1 - \frac{d_L}{d_{\text{lead}}} \right] = m_{\text{iron}} g \left[1 - \frac{d_L}{d_{\text{iron}}} \right]$$

$$\Rightarrow m_L \left(1 - \frac{1}{11} \right) = 8 \left(1 - \frac{1}{8} \right)$$

$$\Rightarrow m_L \left(\frac{10}{11} \right) = 8 \left(\frac{7}{8} \right)$$

$$\Rightarrow m_L = \frac{77}{10} = 7.7 \text{ gm}$$

(3)

$$W_{\text{cork}} = 10 \text{ N};$$

$$W_{\text{water}} = 6 \text{ N}.$$

$$W_{\text{liquid}} = 8 \text{ N}$$

(9)

$$\text{Specific gravity of liquid} = \frac{W_{\text{air}} - W_{\text{liquid}}}{W_{\text{air}} - W_{\text{water}}}$$

$$S.G. = \frac{10 - 8}{10 - 6} = \frac{2}{4} = \frac{1}{2} = 0.5$$

(10)

Here forces acting on cork

$$\rightarrow \text{buoyant force (thrust)} \uparrow \Rightarrow F_B = \rho V(g-a)$$

$$\rightarrow \text{weight} \downarrow \Rightarrow W = \rho Vg$$

'a' acceleration of elevator

$V \rightarrow$ volume of cork, $\rho \rightarrow$ density of water.

As elevator accelerates downwards, effective value of

g (ie) $(g-a)$ decreases (ie) F_B also decreases

This results there is a less upward force acting on the cork, so the spring will not need to exert as much force to keep the cork submerged.

As a result the length of the spring increases it will stretch more to accommodate the reduced buoyant force.

(11)

Given $w_{\text{air}} = 15 \text{ N}$ $w_{\text{water}} = 12 \text{ N}$

$$\text{Relative density of block} = \frac{w_{\text{air}}}{w_{\text{air}} - w_{\text{water}}} = \frac{15}{15 - 12}$$

$$= \frac{15}{3} = 5$$

$$\text{Relative density of liquid} = \frac{w_{\text{air}} - w_{\text{liquid}}}{w_{\text{air}} - w_{\text{water}}}$$

$$= \frac{15 - 13}{15 - 12} = \frac{2}{3}$$

(12)

Given

$$\text{Area } A = 4 \text{ cm}^2 = 4 \times 10^{-4} \text{ m}^2$$

$$\text{length } l = 60 \text{ cm} = 60 \times 10^{-2} \text{ m} ; d_{\text{solid}} = 1500 \text{ kg/m}^3$$

$$d_{\text{water}} = 10^3 \text{ kg/m}^3$$

$$\text{upthrust} = \rho_L V_{\text{in}} g = 10^3 \times A \times l \times g = 10^3 \times 4 \times 10^{-4} \times 60 \times 10^{-2} \times 10$$

$$= 2.4 \text{ N}$$

$$\text{weight of solid} = \rho_{\text{solid}} V g = 1500 \times 4 \times 10^{-4} \times 60 \times 10^{-2} \times 10$$

$$= 60 \times 10^{-2} \times 6$$

$$= 3.6 \text{ N}$$

(13)

According to Archimedes' Principle, the weight of the floating body is equal to weight of the liquid displaced.

The apparent weight = weight of the body - weight of liquid displaced

The body floats when both the weights are same. In this case, when the body is floating, the apparent weight is zero.

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(18)

Water = a
Liquid = b
Decrease in weight of body = $w_{air} - w_{liquid}$

Decrease in weight of body = $w_{air} - w_{liquid}$

= $w_{air} - w_{liquid}$

Reading of A in fig-III $\rightarrow w_{air} - w_{liquid} = a - b$

up $\angle a$

Reading of B in fig III $\rightarrow$ up thrust

fig IV $\rightarrow$ up thrust

$\frac{L_{total}}{c_{air}}$

(3)

No buoyancy force in vacuum.

(4)

clearly Buoyant force is more in case of seawater

because of its high density, and hence, the boat rises

when it goes from river to sea.

(8)

Since density of cotton $<$ density of iron, so

weight of cotton will occupy more space than 1 kg iron,

hence displace more volume of air. Since upthrust is

directly proportional to volume of fluid displaced,

cotton will experience more upthrust $\therefore R_1 > R_2$

$\therefore$ Apparent weight of iron $>$ cotton, hence it will fall



①

Given

$$w_{air} = 24 \text{ gm}$$

$$w_{water} = 21 \text{ gm}$$

$$\text{specific gravity of liquid} = \frac{3}{4}$$

we know that $S.G. = \frac{w_{air} - w_{liquid}}{w_{air} - w_{water}}$

$$\frac{3}{4} = \frac{24 - w_L}{24 - 21} = \frac{1}{3}$$

$$\Rightarrow w_L = 24 - 4 = 20 \text{ gm}$$

②

Given

$$w_{brass air} = 150 \text{ gm}$$

$$d_{br} = 9 \text{ gm/cc}$$

$$d_{water} = 1 \text{ gm/cc}$$

$$\text{specific gravity} = \frac{w_{air}}{w_{air} - w_{water}}$$

$$\frac{d_{br}}{d_{water}} = \frac{150}{150 - w_{water}}$$

$$\frac{9}{1} = \frac{150}{150 - w_{water}}$$

$$\Rightarrow 9 = \frac{150 - w_{water}}{150 - w_{water}}$$

$$\Rightarrow 150 - w_{water} = 20$$

$$\Rightarrow w_{water} = 150 - 20$$

$$= 160 \text{ gm}$$

$$w_{air} = 0.04 \text{ kg}; w_{water} = 0.2 \text{ kg}; w_{liquid} = 0.22$$

$$\text{specific gravity of liquid} = \frac{w_{air} - w_{liquid}}{w_{air} - w_{water}}$$

$$= \frac{0.04 - 0.22}{0.04 - 0.2} = \frac{0.18}{0.16}$$

$$= \frac{1.8}{1.6} = 1.125$$

(4)

$$d_{\text{alcohol}} = 0.8 \text{ gm/cc.}$$

$$V_{\text{raised}} = 20 \text{ cm}^3$$

$$F_B = \rho_{\text{liquid}} V_{\text{in}} g = 0.8 \times 20 \times 1000 = 16000$$

$$= 0.16 \text{ N}$$

(5)

$$V_{\text{ol}} = 400 \text{ m}^3$$

$$M_{\text{balloon}} = 34 \text{ kg}$$

$$d_{\text{H}_2} = 0.09 \text{ kg/m}^3, \quad d_{\text{air}} = 1.3 \text{ kg/m}^3$$

upward force = force weight of balloon without gas

$$d_{\text{air}} V g = m g + d_{\text{H}_2} V g + m' g$$

$$\Rightarrow 1.3 \times 400 = 34 + 0.09 \times 400 + m'$$

$$= 520 = 34 + 36 + m'$$

$$\Rightarrow m' = 450 \text{ kg}$$

(6)

$$V_{\text{in}} = \frac{4}{5} V. \quad \therefore \text{Relative density} = 0.8$$

where V = volume of block.

we know Relative density = $\frac{w_{\text{body}}}{w_{\text{liquid}}} = \frac{d_b}{d_w}$

$$\Rightarrow \frac{R \cdot d \cdot \frac{4}{5} g}{\rho_w V g} \Rightarrow d_b = R \cdot d \times \frac{4}{5}$$

when body floats

$$w_{\text{body}} = w_{\text{liquid displaced}}$$

$$\Rightarrow \rho_b \times V = \rho_L \times V_{\text{in}}$$

$$\Rightarrow R \cdot d \times d_w \times V = \rho_L \times \frac{4}{5} V$$

$$\Rightarrow 0.8 \times 10^3 = \rho_L \times \frac{4}{5} \Rightarrow \rho_L = 10^3 \text{ kg/m}^3$$



(6)

$$w = 2m, \text{ depth} = 1.5m, l = 4m$$

$$S.G. \text{ of block} = 0.7$$

$$\text{volume} = l \times b \times w = 2 \times 1.5 \times 4 = 12 m^3$$

when body floats

weight of body = weight of liquid displaced

$$\begin{aligned} R.d &= \frac{d_b}{d_w} = d_b = R.d \times d_w \\ &= 0.7 \times 10^3 \\ &= 700 \text{ kg/m}^3 \end{aligned}$$

9, 10

$$w_{air} = 49.05 \text{ N}, w_{water} = 19.62 \text{ N}$$

$$\text{Specific gravity of stone} = \frac{w_{air}}{w_{air} - w_{water}} = \frac{49.05}{49.05 - 19.62}$$

$$= \frac{49.05}{29.43} = 1.66$$

$$w_{air} \Rightarrow mg = 49.05$$

$$\Rightarrow m = \frac{49.05}{g} = \frac{49.05}{10} = 4.905 \text{ kg}$$

$$d_{stone} = S.G. \times d_{water} = 1.66 \times 10^3$$

$$\begin{aligned} \text{volume} &= \frac{\text{mass}}{d_{stone}} = \frac{4.905}{1.66 \times 10^3} = 2.95 \times 10^{-3} \\ &= 3 \times 10^{-3} = 0.003 m^3 \end{aligned}$$



Given

(14), (15), (16), (17)

$$\text{Area} = 4 \times 10^{-3} \text{ m}^2 ; l = 0.3 \text{ m}$$

$$\rho_{\text{alcohol}} = 780 \text{ kg/m}^3 ; \rho_{\text{solid}} = 1500 \text{ kg/m}^3$$

$$\begin{aligned} w = \text{weight of solid} &= \rho V g = \rho_{\text{solid}} A \times l \times g \\ &= 1500 \times 4 \times 10^{-3} \times 0.3 \times 10 \\ &= 1.8 \times 10^{-2} = 1.8 \text{ N} \end{aligned}$$

~~$$\begin{aligned} \text{upthrust} &= \text{weight of liquid displaced} \\ &= \rho_{\text{liq}} V_{\text{in}} g \\ &= 780 \times 4 \times 10^{-3} \times 0.3 \times 10 \\ &= 7.8 \times 10^{-2} \end{aligned}$$~~

$$\begin{aligned} \text{Apparent weight of the body in water} &= \rho_w V_{\text{in}} g \\ \text{upthrust} &= 10^3 \times 4 \times 10^{-3} \times 0.3 \times 10 \\ &= 1.2 \text{ N} \end{aligned}$$

$$\text{Apparent weight of the body in water} = 1.8 - 1.2 = 0.6 \text{ N}$$

$$\begin{aligned} \text{Apparent weight of the body in alcohol} &= w - \rho_{\text{alc}} V_{\text{in}} g \\ &= 1.8 - 780 \times 4 \times 10^{-3} \times 0.3 \times 10 \\ &= 1.8 - 7.8 \times 10^{-2} \\ &= 1.8 - 0.78 \\ &= 1.02 \text{ N} \end{aligned}$$

(7)

(18)

Given $w_{\text{air}} = 0.25 \text{ kg f}$; volume = $7.5 \times 10^{-5} \text{ m}^3$

$$\therefore \text{density} = \frac{m}{V} = \frac{0.25}{7.5 \times 10^{-5}} = 0.0333 \times 10^5 = 3333.3 \text{ kg.}$$

$$\text{weight} = mg = 0.25 \times 10 = 2.5 \text{ N.}$$

$$\text{loss of weight} = \rho_w V g = 10^3 \times 7.5 \times 10^{-5} \times 10 = 0.75 \text{ m}^3$$