Chapter 9 Exercise 9A

Q. 1. $0.83 \times 1{,}000 = 830$ kg/m^3

Q. 2. $\dfrac{375}{1{,}000} = 0.375$

Q. 3. (i) 1 m^3 has mass $13.6 \times 1{,}000{,}000$
$= 13{,}600{,}000$ grammes
$= 13{,}600$ kg
$\therefore$ Density $= 13{,}600$ kg/m^3

(ii) $\dfrac{13{,}600}{1{,}000} = 13.6$

Q. 4. Volume $= 0.1 \times 0.06 \times 0.02$
$= 0.00012$ m^3

Density $= \dfrac{\text{Mass}}{\text{Volume}}$
$= \dfrac{1.08}{0.00012} = 9{,}000$ kg/m^3

Relative density $= \dfrac{9{,}000}{1{,}000} = 9$

Q. 5. Volume $= \dfrac{\text{Mass}}{\text{Density}}$
$= \dfrac{70}{980} = \dfrac{1}{14}$ m^3

Mass $=$ Volume $\times$ Density
$= \dfrac{1}{14} \times 2{,}450 = 175$ kg

Q. 6.

s	v	sv
1	60	60
0.95	40	38
	100	98

$\bar{s} = \dfrac{98}{100} = 0.98$

Q. 7.

s	v	sv
7	10	70
9	1	9
	11	79

$\bar{s} = \dfrac{79}{11} = 7.182$

Q. 8.

s	v	sv
1	100	100
0.9	x	$0.9x$
	$100 + x$	$100 + 0.9x$

$\dfrac{100 + 0.9x}{100 + x} = 0.9625$
$\Rightarrow 100 + 0.9x = 96.25 + 0.9625x$
$\Rightarrow x = 60$ ml

Q. 9. Volume $= 0.4 \times 0.3 \times 0.2 = 0.024$ m^3
Weight $= V\rho g = (0.024)(1{,}000\ g) = 24g$ N

Q. 10. Volume $= \pi r^2 h = \pi(0.03)^2\ (0.1)$
$= 0.00009\pi$ m^3

Weight $= V\rho g = (0.00009\pi)(800)g$
$= 0.072\pi g$ N

Q. 11. (i) $V = \dfrac{1}{3}\pi h(R^2 + Rr + r^2)$
$= \dfrac{1}{3}\pi(18)(81 + 54 + 36)$
$= 1{,}026\pi$ cm^3 $= 0.001026\pi$ m^3

Weight $= V\rho g = (0.001026\pi)(1{,}000)g$
$= 1.026\pi g$ N

(ii) $V = \dfrac{1}{3}\pi h(R^2 + Rr + r^2)$
$= \dfrac{1}{3}\pi(6)(49 + 42 + 36)$
$= 254\pi$ cm^3 $= 0.000254\pi$ m^3

Weight $= V\rho g = (0.000254\pi)(950)(g)$
$= 0.2413\pi g$ N

(iii) Density $= \dfrac{\text{Mass}}{\text{Volume}}$
$= \dfrac{1.026\pi + 0.2413\pi}{0.001026\pi + 0.000254\pi}$
$= \dfrac{1.2673}{0.00128} = 990$

Specific gravity $= \dfrac{990}{1{,}000} = 0.99$

Exercise 9B

Q. 1. (i) Pressure $= h\rho g = (2)(1{,}000)g$
$= 2{,}000g$ N/m^2

(ii) Thrust $=$ Pressure $\times$ Area
$= 2{,}000g \times (2)^2 = 8{,}000g$ N

Weight $= V\rho g = (2)^3(1{,}000)g$
$= 8{,}000g$ N

Q. 2. (i) Pressure $= h\rho g = (0.11)(850)g$
$= 93.5g$ N/m^2

(ii) Thrust $=$ Pressure $\times$ Area
$= (93.5g)\pi\ (0.05)^2$
$= 0.23375\pi g$ N

(iii) Weight $= V\rho g = \pi r^2 h\rho g$
$= \pi(0.05)^2(0.11)(850)g$
$= 0.23375\pi g$ N

Q. 3. Thrust = Pressure × Area = $(h\rho g)(\pi r^2)$

$$= (0.1)\rho g(\pi(0.2)^2) = 0.00004\pi\rho g$$

Weight = $V\rho g$

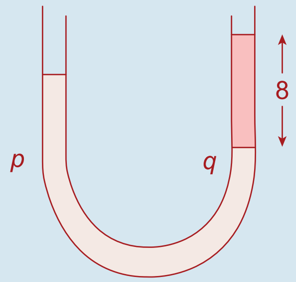
$$= \frac{1}{3}\pi h(R^2 + Rr + r^2)\rho g$$

$$= \frac{1}{3}\pi(0.1)\{(0.05)^2 + (0.05)(0.02) + (0.02)^2\}\rho g$$

$$= 0.00013\pi\rho g$$

The ratio is, therefore, 4 : 13

Q. 4. (a)



Pressure at p = Pressure at q

$\Rightarrow h(1{,}000)g = 8(850)g$

$\Rightarrow h = 6.8$ cm

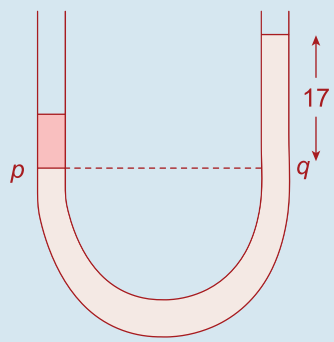
$\therefore$ Difference = 8 − 6.8 = 1.2 cm

(b) Pressure under mercury = Pressure under oil

$\Rightarrow h(950)g = 8(850)g$

$\Rightarrow h = 7.16$ cm

Q. 5. (a)



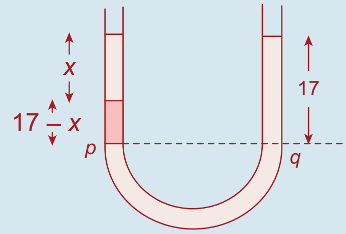
Pressure at p = Pressure at q

$\Rightarrow h(13{,}600)g = 17(1{,}000)g$

$\Rightarrow h = 1.25$ cm

$\therefore$ Difference = 17 − 1.25 = 15.75 cm

(b)



Pressure at p = Pressure at q

$\Rightarrow x(850)g + (17 - x)(13{,}600)g = 17(1{,}000)g$

$\Rightarrow x = 16.8$ cm

Q. 6. Pressure = $h\rho g = (3)(1{,}000)g = 3{,}000g$ N/m^2

Thrust = Pressure × Area

$= (3{,}000g)(2 \times 2) = 12{,}000g$ N

(i) $2 \times 2 \times h = 1 \times 1 \times 1 \Rightarrow h = \frac{1}{4}m$

(ii) $P = h\rho g = \left(\frac{1}{4}\right)(1{,}000)(g) \Rightarrow 250g$ N/m^2

(iii) $T = P \times A = (250g)(4) = 1{,}000g$ N

Q. 7. (i) $\pi R^2 h = \frac{4}{3}\pi r^3$

$\Rightarrow \pi(16)h = \frac{4}{3}\pi(27)$

$\Rightarrow h = 2\frac{1}{4}$ cm = 0.0225 m

(ii) $P = h\rho g = (0.0225)(1{,}000)g = 22.5g$ N/m^2

(iii) Thrust = $P \times A = (22.5g)(\pi(16)) = 360\pi$ N

Q. 8. (i) $\pi R^2 h = \frac{4}{3}\pi r^3$

$\pi(36)h = \frac{4}{3}\pi(27)$

$\Rightarrow h = 1$ cm = 0.01 m

(ii) $P = h\rho g = (0.01)(900)g = 9g$ N/m^2

(iii) $T = P \times A = (9g)(\pi(0.06)^2) = 0.0324\pi g$ N

Q. 9. $1\,\frac{\text{dyne}}{\text{cm}^2} = \frac{10^{-5}\text{ Newtons}}{10^{-4}\text{ m}^2} = 0.1$ N/m^2

Q. 10. (i) Thrust = Pressure × Area = $(h\rho g)(\pi r^2)$

$$= (2)(1{,}250)(9.8)\left(\frac{22}{7}\right)(1.4)^2$$

$= 150{,}920$ N = 150.92 kN

(ii) Volume = $\frac{M}{\rho} = \frac{750}{2{,}500} = 0.3$ m^3

at x = Increase in depth

$\Rightarrow \pi r^2 x = 0.3 \Rightarrow x = \frac{0.3}{\pi r^2}$

$\therefore$ Increase in pressure $= h\rho g = \dfrac{0.3}{\pi r^2}(1{,}250)g$

$\therefore$ Increase in thrust $= P \times A$

$= \dfrac{0.3}{\pi r^2}(1{,}250)g(\pi r^2)$

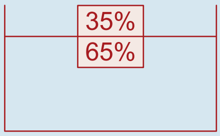
$= 3{,}675 \text{ N} = 3.675 \text{ kN}$

Exercise 9C

Q. 1. Bouyancy $= 12 - 8 = 4$

$B = \dfrac{W}{S} \Rightarrow 4 = \dfrac{12}{S} \Rightarrow S = 3$

Q. 2.



$W = V\rho g$

$B = \left(\dfrac{65}{100}V\right)(1{,}000)g = 650Vg$

But $B = W \Rightarrow \rho = 650 \Rightarrow S = 0.65$

Q. 3. 0.9, as in the last question

Q. 4. $B = 18 - 15 = 3$

$B = \dfrac{W}{S} \Rightarrow 3 = \dfrac{18}{S} \Rightarrow S = 6$

$B_L = 18 - 16 = 2$

$B_L = S_L\, B_w$

$\Rightarrow 2 = S_L(3) \Rightarrow S_L = \dfrac{2}{3}$

Q. 5. (i) $B = \dfrac{W}{S} = \dfrac{30}{6} = 5$

$\therefore$ Apparent weight $= 30 - 5 = 25$ N

(ii) $B_L = S_L B_W = (0.9)(5) = 4.5$

$\therefore$ Apparent weight $= 30 - 4.5 = 25.5$ N

Q. 6. $B_L = S_L B_W = S_L\left(\dfrac{W}{S}\right) = 13.6\left(\dfrac{200}{17}\right) = 160$

$\therefore$ Apparent weight $= 200 - 160 = 40$ N

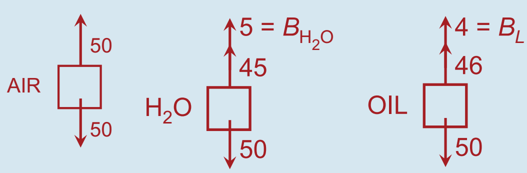
Q. 7. **Note:** B_{H_2O} = Bouyancy in water

B_L = Bouyancy in liquid

W_I = Immersed weight

S = Specific gravity of object

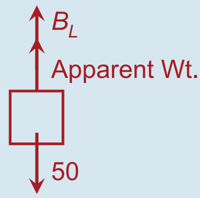
S_L = Specific gravity of liquid



(i) $B_{H_2O} = \dfrac{W_I}{S} \Rightarrow 5 = \dfrac{50}{S} \Rightarrow S = 10$

(ii) $B_L = S_L\dfrac{W_I}{S} \Rightarrow 4 = S_L\dfrac{(50)}{S} \Rightarrow S_L = 0.8$

(iii) In liquid, $S_L = 0.75$



Apparent Wt. $= 50 - B_L$

$\Rightarrow$ Apparent Wt. $= 50 - S_L\dfrac{W_I}{S}$

$\Rightarrow$ Apparent Wt. $= 50 - 0.75\dfrac{(50)}{S}$

$= 46.25$ N

Q. 8. Bouyancy in water, $B_W = 80 - 60 = 20$

Bouyancy in oil, $B_L = 80 - 64 = 16$

$B_L = S_L B_W \Rightarrow 16 = S_L(20) \Rightarrow S_L = 0.8$

Q. 9. (i) $V = \dfrac{4}{3}\pi r^3$

$= \dfrac{4}{3}\pi(0.3)^3$

$= 0.036\pi \text{ m}^3$ **OR** $\dfrac{9\pi}{250} \text{ m}^3$

(ii) $W = \rho V g$

$= 2{,}500\left(\dfrac{9\pi}{250}\right)g$

$= 90\pi g$ N

(iii) App. Wt. = Weight – Bouyancy,

$B = \dfrac{W_I}{S}$

$= 90\pi g - \dfrac{90\pi g}{2.5}$

$= 54\pi g$ N

Q. 10. $V = \dfrac{\pi r^2 h}{3}$

$r = 0.3,\ h = 0.7$

(i) $\Rightarrow V = \dfrac{22}{7}\dfrac{(0.3)^2}{3}(0.7)$

$\Rightarrow V = \dfrac{33}{500} \text{ m}^3$ **OR** $V = 0.066 \text{ m}^3$

(ii) $W = \rho V g$

$= 8{,}000\left(\dfrac{33}{500}\right)9.8$

$= 5{,}174.4$ N

(iii) $B_{H_2O} = \frac{W_l}{S} = \frac{5174.4}{8} = 646.6$

App. Wt. = Weight – Bouyancy

= 5174.4 – 646.6

= 4527.6 N

Q. 11. Let W = the weight of the body.
Let B = Bouyancy in water.

$\therefore W_1 = W - B$

$B_L = S_L B_W \Rightarrow$ Bouyancy in liquid 1 = $(0.8)B$

$\therefore W_2 = W - 0.8B$

Similarily, $W_3 = W - 0.75B$

$5W_2 - 4W_3 = 5(W - 0.8B) - 4(W - 0.75B)$
$= W - B = W_1$ **QED**

Exercise 9D

Q. 1. $\frac{3}{4}$ of volume under water $\Rightarrow S = \frac{3}{4}$

$\therefore \rho = \frac{3}{4} \times 1{,}000$

$= 750$

$W = V\rho g$

$= (0.1)(750)g$

$= 75g$

$B = \frac{W}{S} = \frac{75g}{\frac{3}{4}} = 100g$

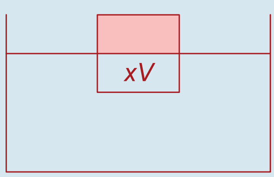
$B = W + T$

$\Rightarrow 100g = 75g + T$

$\Rightarrow T = 25g$

Q. 2. Its specific gravity is 0.8, as in question 1

Let V = its volume, xV = volume under the liquid



$W = V\rho g$

$= V(800)g$

$= 800Vg$

$B = xV(1{,}200)g$

$= 1{,}200xVg$

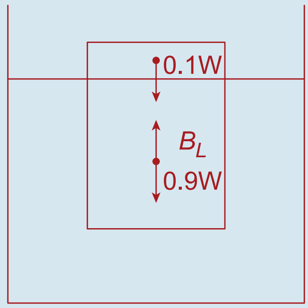
Since it is in equilibrium, $W = B$

$\Rightarrow 800Vg = 1{,}200xVg$

$\Rightarrow x = \frac{2}{3}$

$\therefore \frac{1}{3}$ of its mass, or $33\frac{1}{3}\%$, is above the surface.

Q. 3. (i)



$B_L = S_L B_W = S_L\left(\frac{W}{S}\right)$ where W = weight of the **immersed** part.

$\therefore B_L = (1.1)\left(\frac{0.9W}{S}\right) = \frac{0.99W}{S}$

Since it is in equilibrium

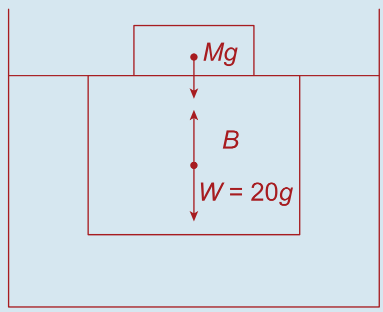
$0.1W + 0.9W = B_L$

$\Rightarrow W = \frac{0.99W}{S}$

$\Rightarrow S = 0.99$

(ii) 0.99 of its mass will be below, as in question 2.

Q. 4. Its specific gravity is $\frac{3}{4}$, as in question 1.



Let M = the mass of the glass

$B_L = S_L B_W$

$= s_L\left(\frac{W}{S}\right)$

$= (0.8)\left(\frac{20g}{0.75}\right)$

$= 21\frac{1}{3}g$

$B = Mg + 20g$

$\Rightarrow 21\frac{1}{3}g = Mg + 20g$

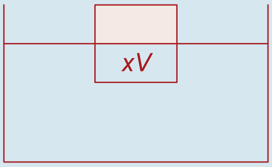
$\Rightarrow M = 1\frac{1}{3}$ kg

Q. 5. $B = 360 - 330 = 30$

$B = \frac{W}{S} \Rightarrow 30 = \frac{360}{S}$

$\Rightarrow S = 12$. It is lead

Q. 6.



Let V = its volume,
xV = volume under the sea.

B = weight of liquid displaced
$= (xV)(1{,}030)g$

W = weight of the object
$= V(900)g$

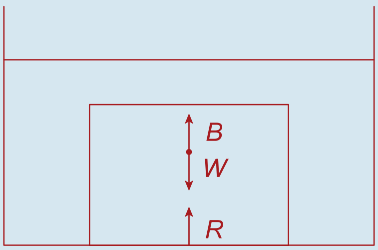
Since $B = W$,

$xV(1{,}030)g = V(900g)$

$\Rightarrow x = 0.87$

Answer: 87%

Q. 7. $V = (0.8)(0.6)(0.4) = 0.192 \text{ m}^3$



$W = V\rho g$

$= (0.192)(2{,}500)g = 480g$

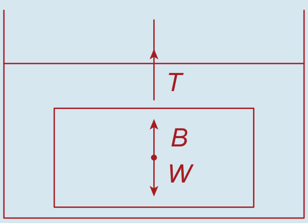
$B = (0.192)(1{,}000)g = 192g$

$B + R = W$

$\Rightarrow 192g + R = 480g$

$\Rightarrow R = 288g = 2{,}822.4 \text{ N}$

Q. 8.



(i) $V = \dfrac{M}{\rho}$

$= \dfrac{12.5}{2{,}500}$

$= 0.005 \text{ m}^3$

(ii) $M = V\rho$

$= 0.005(800)$

$= 4 \text{ kg}$

(iii) $W = 12.5g,\ B = 4g$

$W = T + B$

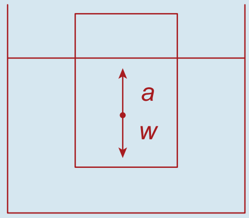
$\Rightarrow T = 12.5 - 4 = 8.5g$

$= 83.3 \text{ N}$

Q. 9. (i) $V = (0.1)(0.2)(0.08)$

$= 0.0016 \text{ m}^3$

(ii)



$M = V\rho$

$\Rightarrow 1 = 0.0016\rho$

$\Rightarrow \rho = 625$

$\therefore S = \dfrac{625}{1{,}000} = \dfrac{5}{8}$

$\dfrac{5}{8}$th of its length is submerged

$\therefore$ Depth $= \dfrac{5}{8} \times 20 = 12.5 \text{ cm}$

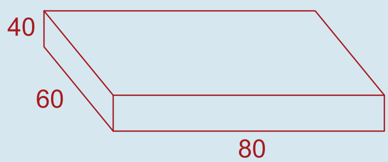
Q. 10. $B = 40 - 35 = 5$

$B = \dfrac{W}{S} \Rightarrow 5 = \dfrac{40}{S} \Rightarrow S = 8$

Q. 11. Total area $= (80 \times 60) + 2(80 \times 40) + 2(60 \times 40)$

$= 16{,}000 \text{ cm}^2$

$= 1.6 \text{ m}^2$



Volume $= 1.6 \times 0.0015$

$= 0.0024 \text{ m}^3$

Weight $= V\rho g$

$= (0.0024)(8{,}000)g = 19.2g$

Let X = the depth of the tank in the lake.

B = weight of liquid displaced

$= (0.6 \times 0.8 \times X)(1{,}000)g = 480Xg$

$B = W$

$\Rightarrow 480Xg = 19.2g$

$\Rightarrow X = 0.04 \text{ m}$

$= 4 \text{ cm}$

Q. 12. Pressure at 5 cm $= h\rho g$

$= (0.05)(900)g$

$= 45g$

Pressure at 9.5 cm $= (0.05)(900)g + (0.045)(1,000)g$

$= 90g$

$\therefore$ Pressure at 9.5 cm = Twice pressure at 5 cm

Pressure at 3 cm $= (0.03)(900)g$

$= 27g$

5 times pressure at 3 cm $= 135g$

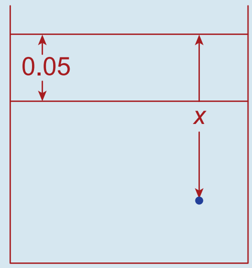
Let x = the depth (in metres)

Pressure $= (0.05)(900)g + (x - 0.05)(1,000)g = 135g$

$\Rightarrow 45g + 1,000g - 50g = 135g$

$\Rightarrow x = 0.14$ m

$= 14$ cm



Q. 13. Let A = Atmospheric pressure

Pressure at 14 m = 2 × Pressure at 2 m

$A + 14(1,000)g = 2(A + 2(1,000)g)$

$\Rightarrow A = 10,000g$

$= 98,000$ N/m^2

Q. 14. (i) Bouyancy = weight of liquid displaced

$= \left(\frac{2}{3}\pi(1)^3\right)(1,000)g$

$= \frac{2,000}{3}\pi g$ N

(ii) Pressure $= h\rho g$

$= (2)(1,000)g$

$= 2,000g$

Thrust $= P \times A$

$= (2,000g)(\pi(1)^2)$

$= 2,000\pi g$ N

(iii) $B = Fu - Fd$

$\Rightarrow \frac{2,000}{3}\pi g = 2,000\pi g - Fd$

$\Rightarrow Fd = \frac{4,000}{3}\pi g$ N

Q. 15. (i) Bouyancy = weight of displaced liquid

$= \left(\frac{1}{3}\pi(2)^2(6)\right)(900)g$

$= 7,200\pi g$ N

(ii) Pressure $= h\rho g$

$= (7)(900)g = 6,300g$ N

Thrust $= P \times A$

$= (6,300g)(\pi(2)^2)$

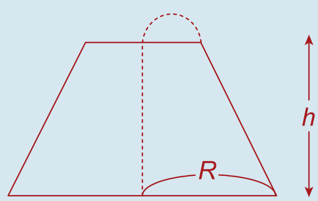
$= 25,200\pi g$ N

(iii) $B = Fu - Fd$

$\Rightarrow 7,200\pi g = 25,200\pi g - Fd$

$\Rightarrow Fd = 18,000\pi g$ N

Q. 16.



Since $\pi r^2 = \frac{1}{4}(\pi R^2)$, $R = 2r$

Volume $= \frac{1}{3}\pi h\{(2r)^2 + (2r)r + r^2\}$

$= \frac{7}{3}\pi h r^2$

Weight $= V\rho g = \frac{7}{3}\pi h r^2 \rho g$

Pressure at base $= h\rho g$

$\therefore$ Thrust $= P \times A = (h\rho g)(\pi(2r)^2)$

$= 4\pi h r^2 \rho g$

Ratio, Thrust : Weight

$= 4\pi h r^2 \rho g : \frac{7}{3}\pi h r^2 \rho g$

$= 12 : 7$

Q. 17. (i) $P = h\rho g = \left(\frac{1}{2}\right)(1{,}000)g = 500g \text{ N/m}^2$

(ii) $T = P \times A$

$= (500g)\left(\pi\left(\frac{1}{8}\right)^2\right)$

$= \frac{125}{16}\pi g \text{ N}$

(iii) $W = V\rho g$

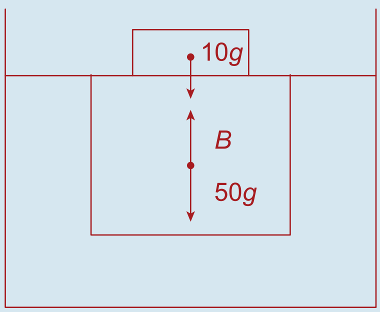
$= \frac{1}{3}\pi\left(\frac{1}{2}\right)\left\{\left(\frac{1}{2}\right)^2 + \left(\frac{1}{2}\right)\left(\frac{1}{8}\right) + \left(\frac{1}{8}\right)^2\right\}(1{,}000)g$

$= \frac{875}{16}\pi g$

$\therefore \frac{\text{Weight}}{T} = \frac{7}{1}$

Q. 18. Relative density of the wood $= \frac{3}{4} = 0.75$

$\therefore$ Volume $= \frac{M}{\rho} = \frac{50}{750} = \frac{1}{15} \text{ m}^3$



$B = 50g + 10g = 60g =$ Weight of liquid

$\Rightarrow 60g = \left(\frac{1}{15}\right)\rho g$

$\Rightarrow \rho = 60 \times 15 = 900$

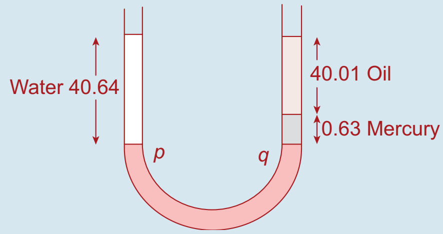
$\Rightarrow s = 0.9$

Q. 19. (i) $M = \rho V$

$= 13{,}600\left(\frac{1}{2}\right) = 6{,}800 \text{ kg}$

$= 6.8$ tonnes

(ii)



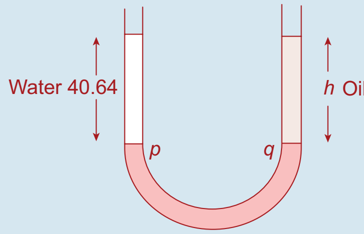
Pressure at $p =$ Pressure at q

$\therefore (40.64)(1{,}000)g = (40.01)\rho g$

$+ (0.63)(13{,}600)g$

$\Rightarrow \rho = 801.6 \text{ kg/m}^3$

(iii)

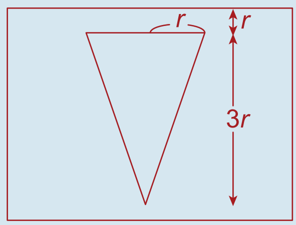


$(0.64)(1{,}000g) = h(801.6)g$

$\Rightarrow h = 50.7$ cm

$= 507$ mm

Q. 20.



(i) Pressure $= h\rho g = r\rho g$

Thrust $= P \times A = r\rho g(\pi r^2) = \pi r^3 \rho g$ N

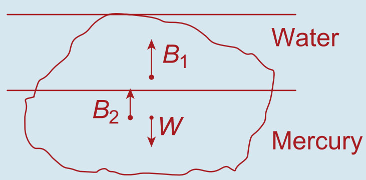
(ii) $B = V\rho g = (\frac{1}{3}\pi r^2(3r))\rho g = \pi r^3 \rho g$

$B = Fu - Fd$

$\pi r^3 \rho g = Fu - \pi r^3 \rho g$

$Fu = 2\pi r^3 \rho g$ N

Q. 21.



$W = V\rho g = (v_1 + v_2)(7{,}800)g$

$= 7{,}800(v_1 + v_2)g$

$B_1 = v_1(1{,}000)g = 1{,}000v_1 g$

$B_2 = v_2(13{,}600)g = 13{,}600v_2 g$

Since the body is in equilibrium

$B_1 + B_2 = W$

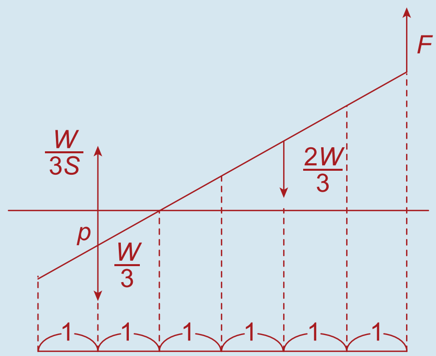
$\Rightarrow 1{,}000v_1g + 13{,}600v_2g = 7{,}800(v_1 + v_2)g$

$\Rightarrow 5{,}800v_2 = 6{,}800v_1$

$\Rightarrow \frac{v_1}{v_2} = \frac{58}{68} = \frac{29}{34}$

Exercise 9E

Q. 1. (i)



① $F + \frac{W}{3s} = W$

② Taking moments about p:

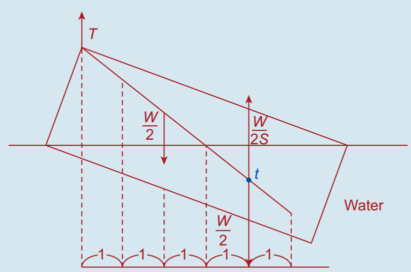
$\frac{2W}{3}(3) = F(5) \Rightarrow F = \frac{2}{5}W$

(ii) ① $\Rightarrow \frac{2}{5}W + \frac{W}{3S} = W$

$\Rightarrow \frac{W}{3S} = \frac{3}{5}W$

$\Rightarrow S = \frac{5}{9}$

Q. 2. (i)



(ii) ① $T + \frac{W}{2S} = W$

② (Taking moments about t)

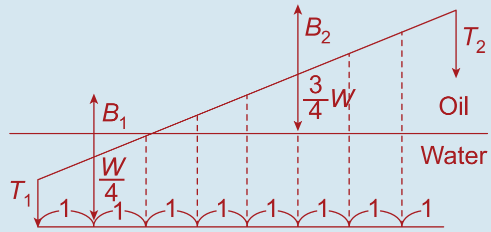
$\frac{W}{2}(2) = T(4) \Rightarrow T = \frac{1}{4}W \left(\therefore B = \frac{3}{4}W\right)$

(iii) ① $\Rightarrow \frac{1}{4}W + \frac{W}{2S} = W$

$\Rightarrow \frac{W}{2S} = \frac{3}{4}W$

$\Rightarrow S = \frac{2}{3}$

Q. 3.



$B_W = \frac{W}{S} \Rightarrow B_1 = \frac{\frac{W}{4}}{\frac{3}{4}} = \frac{W}{3}$

$B_L = S_LB_W = S_L\left(\frac{W}{S}\right) \Rightarrow B_2 = (0.9)\left(\frac{\frac{3}{4}W}{\frac{3}{4}}\right) = \frac{9W}{10}$

① $\frac{W}{3} + \frac{9W}{10} = T_1 + \frac{W}{4} + \frac{3}{4}W + T_2$

$\Rightarrow T_1 + T_2 = \frac{7W}{30}$

② (Taking moments about the lower end)

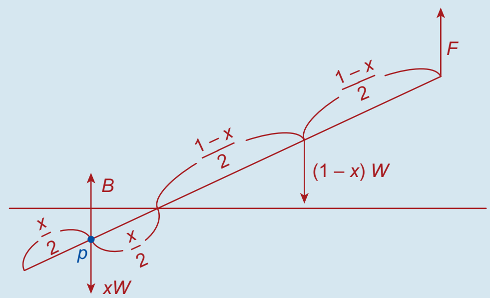
$\frac{W}{3}(1) + \frac{9W}{10}(5) = \frac{W}{4}(1) + \frac{3}{4}W(5) + T_2(8)$

$\Rightarrow T_2 = \frac{5W}{48}$

$\Rightarrow T_1 = \frac{7W}{30} - \frac{5W}{48}$

$= \frac{31W}{240}$

Q. 4.



Let W = the weight of the rod.

Let x = the length of the submerged part.

$B_W = \frac{W}{S} \Rightarrow B = \frac{xW}{0.36} = \frac{25xW}{9}$

① $\frac{25xW}{9} + F = W$

② (Taking moments about p).

$(1 - x)W\left(\frac{x}{2} + \frac{1 - x}{2}\right) = F\left(\frac{x}{2} + 1 - x\right)$

$\Rightarrow (1 - x)W\left(\frac{1}{2}\right) = F\left(1 - \frac{x}{2}\right)$

$\Rightarrow F = \frac{(1 - x)W}{2 - x}$

Putting this result into equation ① gives:

$$\frac{25xW}{9} + \frac{(1-x)W}{(2-x)} = W$$

... Multiply by $\frac{9(2-x)}{W}$

$$\Rightarrow 25x(2-x) + 9(1-x) = 9(2-x)$$

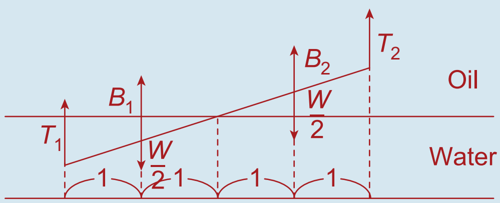
$$\Rightarrow 25x^2 - 50x + 9 = 0$$

$$\Rightarrow (5x-1)(5x-9) = 0$$

$\Rightarrow x = \frac{1}{5}$ m ($x = \frac{9}{5}$ m is too long)

Answer: 20 cm is submerged.

Q. 5.



$$B_W = \frac{W}{S} \Rightarrow B_1 = \frac{\frac{1}{2}W}{6} = \frac{W}{12}$$

$$B_L = S_L B_W = S_L\left(\frac{V}{s}\right) = 0.8\left(\frac{\frac{1}{2}W}{6}\right) = \frac{W}{15}$$

$$T_1 + \frac{W}{12} + \frac{W}{15} + T_2 = W$$

$$\Rightarrow T_1 + T_2 = \frac{51}{60}W$$

(Taking moments about the lower end).

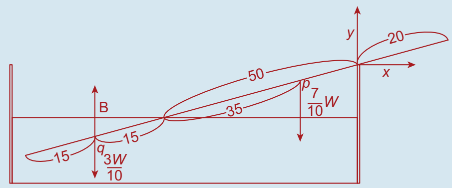
$$① \quad + \frac{W}{15}(3) + T_2(4) = \frac{W}{2}(1) + \frac{W}{2}(3)$$

$$\Rightarrow T_2 = \frac{103}{240}W$$

$$\Rightarrow T_1 = \frac{51}{60}W - \frac{103}{240}W$$

$$= \frac{101}{240}W$$

Q. 6. (i)



Let x and y be the horizontal and vertical components of the reaction at p, $x = 0$ since no other forces act along the vertical. Therefore, the reaction at p is vertical. We shall henceforth call it R.

(ii) $B_W = \frac{W}{S}$

$$\Rightarrow B = \frac{\frac{3}{10}W}{S} = \frac{3W}{10s}$$

$$① \quad \frac{3W}{10S} + R = W$$

② (Taking moments about q)

$$\frac{7}{10}W(50) = R(65)$$

$$\Rightarrow R = \frac{7}{13}W$$

Putting this into equation ① gives:

$$\frac{3W}{10S} + \frac{7}{13}W = W$$

$$\Rightarrow \frac{3W}{10S} = \frac{6W}{13}$$

$$\Rightarrow S = \frac{39}{60}$$

$$= \frac{13}{20}$$