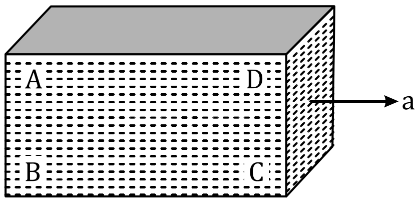
DPP 01

Solution

1. 

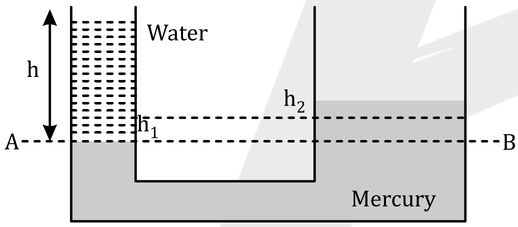
Due to acceleration towards right, there will be a pseudo force in a left direction. So, the pressure will be more on left side points A and B in comparison with front side points D and C.

Also due to height of liquid, pressure will be more at the bottom points B and C in comparison with top points A and D.

So overall maximum pressure will be at point B and minimum pressure will be at point D.

2. Thrust on lamina = pressure at centroid × Area

$$= \frac{h\rho g}{3} \times A = \frac{1}{3} A\rho g h$$

3. 

If the level in narrow tube goes down by h_1, then in wider tube goes up to h_2

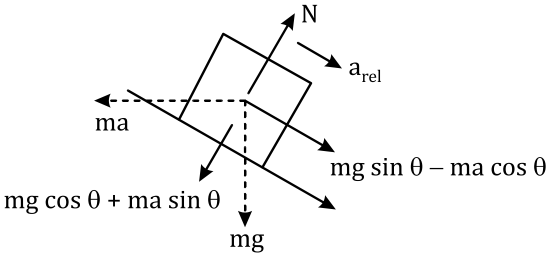
Now, $\pi r^2 h_1 = \pi (nr)^2 h_2 \Rightarrow h_1 = n^2 h_2$

pressure at point A = pressure at point B

$h\rho g = (h_1 + h_2)\rho' g$

$$\Rightarrow \; h = (n^2 h_2 + h_2) sg \left(\text{As } s = \frac{\rho'}{\rho} \right)$$

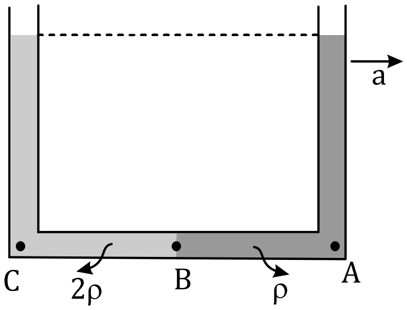
$$h_2 = \frac{h}{(n^2 + 1)s}$$

4. 

$ma_{rel} = mg \sin \theta - ma \cos \theta$

But for water surface $\tan \theta = a/g \Rightarrow a_{rel} = 0$

5. Liquid of density 2ρ should be behind that of ρ. From right limb:



$P_A = P_{atm} + \rho gh$

$P_B = P_A + \rho a \frac{l}{2} = P_{atm} + \rho\, gh + \rho_a \frac{l}{2}$

$P_C = P_B + (2\rho)a\frac{l}{2} = P_{atm} + \rho gh + \frac{3}{2}\rho al \qquad \dots(1)$

From left limb $P_c = P_{atm} + (2\rho)gh \qquad \dots(2)$

From (1) and (2);

$P_{atm} + \rho\, gh + \frac{3}{2}\rho al = P_{atm} + 2\rho gh$

$\Rightarrow\ h = \frac{3a}{2g} l$

6. Gauge pressure $= h\rho g$

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

$\therefore$ Gauge pressure is $\frac{H\rho g}{2}$

7. Force acting on the base

$F = P \times A = hdg\,A = 0.4 \times 900 \times 10 \times 2 \times 10^{-3} = 7.2\text{ N}$

8. $\tan\ \theta = \frac{3b-b}{4b} = \frac{a}{g} \Rightarrow a = \frac{g}{2}$

9. $F = PA = \rho ghA$

$= 10^3 \times 10 \times 10 \times 3 \times 10^{-4} = 30\text{ N}$

10. Increase in pressure at pistons is $\frac{F}{A}$.

Increase in pressure at every point will be $\frac{F}{A}$