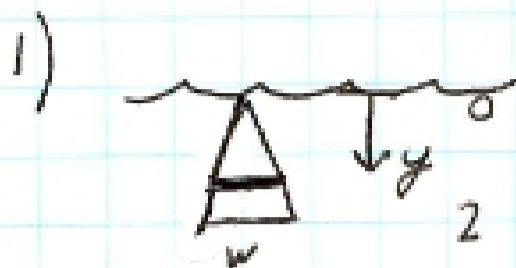


Homework 11 - Solutions



Fluid force on one strip:

$$F_i = P_i A_i$$

$$P_i = \rho g d_i \\ = \rho g y_i$$

$$A_i = w_i \Delta y$$

$$w_i = \frac{1}{2} y_i$$

$$A_i = \frac{1}{2} y_i \Delta y$$

$$F_i = \rho g y_i \left(\frac{1}{2} y_i \right) \Delta y$$

$$F = \int_0^2 \rho g y \left(\frac{1}{2} y \right) dy$$

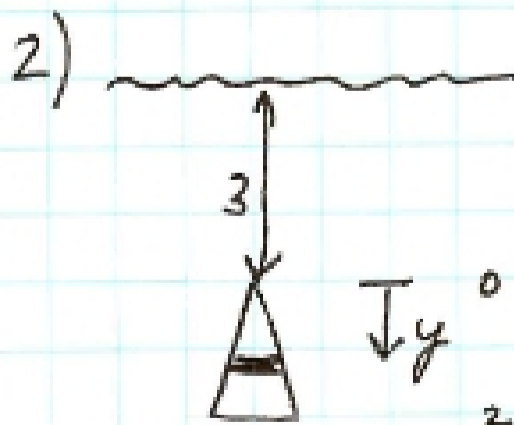
$$= \int_0^2 \frac{1}{2} \rho g y^2 dy$$

$$\frac{1}{2} \rho g \frac{y^3}{3} \Big|_0^2$$

$$= \frac{\rho g}{6} (2^3)$$

$$= \frac{4}{3} (9800)$$

$$= \boxed{1.307 \times 10^4 \text{ N}}$$



Same as above, except

$$d_i = y_i + 3$$

$$F = \int_0^2 \frac{1}{2} \rho g (y+3) y dy$$

$$= \int_0^2 \frac{1}{2} \rho g (y^2 + 3y) dy$$

$$= \frac{1}{2} \rho g \left(\frac{y^3}{3} + \frac{3y^2}{2} \right) \Big|_0^2$$

$$= \frac{1}{2} \rho g \left(\frac{8}{3} + \frac{12}{2} \right)$$

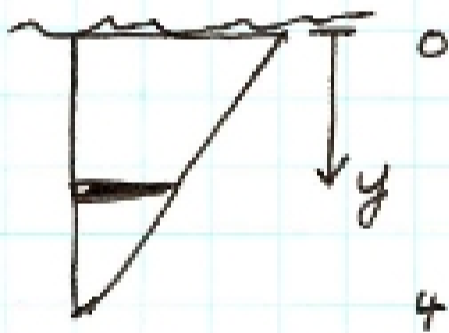
$$= \frac{1}{2} \rho g \left(\frac{16+36}{6} \right)$$

$$= \frac{1}{2} \rho g \left(\frac{52}{6} \right)$$

$$= \frac{52}{12} (9800)$$

$$= \boxed{4.247 \times 10^4 \text{ N}}$$

3a)



$$F_i = P_i A_i$$

$$P_i = \rho g d_i$$

$$= \rho g y_i$$

$$A_i = w_i \Delta y$$

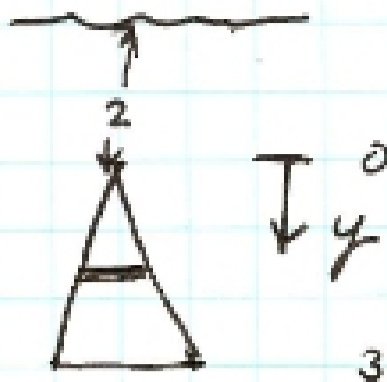
$$w_i = 3 - \frac{3}{4} y_i$$

$$A_i = \left(3 - \frac{3}{4} y_i \right) \Delta y$$

$$F_i = \rho g y_i \left(3 - \frac{3}{4} y_i \right) \Delta y$$

$$F = \int_0^4 \rho g y \left(3 - \frac{3}{4} y \right) dy$$

3 b)



$$P_i = \rho g d_i$$

$$w_i = \frac{2}{3} y_i$$

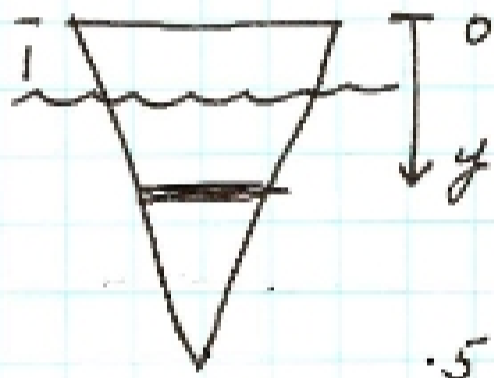
$$= \rho g (y_i + 2)$$

$$A_i = \frac{2}{3} y_i \Delta y$$

$$F_i = \rho g (y_i + 2) \left(\frac{2}{3} y_i \right) \Delta y$$

$$F = \int_0^3 \rho g (y + 2) \left(\frac{2}{3} y \right) dy$$

c)



$$P_i = \rho g d_i$$

$$w_i = \left(4 - \frac{4}{5} y_i \right)$$

$$= \rho g (y_i - 1)$$

$$A_i = \left(4 - \frac{4}{5} y_i \right) \Delta y$$

$$F_i = \rho g (y_i - 1) \left(4 - \frac{4}{5} y_i \right) \Delta y$$

$$F = \int_1^5 \rho g (y - 1) \left(4 - \frac{4}{5} y \right) dy$$

d)



$$P_i = \rho g d_i$$

$$w_i = 4 + \frac{1}{3} y_i$$

$$= \rho g (y_i + 1)$$

$$A_i = \left(4 + \frac{1}{3} y_i \right) \Delta y$$

$$F_i = \rho g (y_i + 1) \left(4 + \frac{1}{3} y_i \right) \Delta y$$

$$F = \int_0^3 \rho g (y + 1) \left(4 + \frac{1}{3} y \right) dy$$