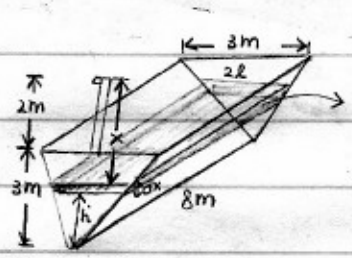
Section 6.5

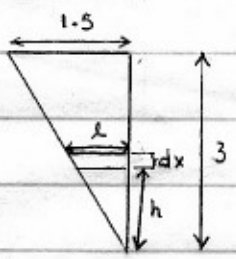
3. Work done = area under F-x curve

$= \frac{4(30)}{2} + 4(30)$

$= 60 + 120 = 180\ \text{J}$

17. a)





$h = 5 - x$

$\frac{5-x}{3} = \frac{\ell}{1.5} \Rightarrow \ell = \frac{1}{2}(5-x)$

$dm = \rho dV = \rho \cdot (2\ell \cdot 8 \cdot dx) = 8\rho(5-x)dx$

$dW = 8\rho g(5-x) \times dx = 8\rho g(5x - x^2)dx$

$\therefore W = \int_2^5 8\rho g(5x - x^2)dx$

$= 8\rho g\left(\frac{5x^2}{2} - \frac{x^3}{3}\right)\Big|_2^5$

$= 8\rho g\left(\frac{125}{2} - \frac{125}{3} - \frac{5(4)}{2} + \frac{8}{3}\right) = 8\rho g(13.5)$

$= 8(1000)(9.8)(13.5) \approx 1.06 \times 10^6\ \text{J}$ $\quad (\rho = 1000\ \text{kg/m}^3,\ g = 9.8\ \text{m/s}^2)$

b) $4.7 \times 10^5 = \int_2^{5-h} 8\rho g(5x - x^2)dx$

$\Rightarrow 4.7 \times 10^5 / (8000 \times 9.8) = \left(\frac{5x^2}{2} - \frac{x^3}{3}\right)\Big|_2^{5-h}$

$\Rightarrow 6 = \frac{5(5-h)^2}{2} - \frac{(5-h)^3}{3} - 10 + \frac{8}{3}$

$\Rightarrow \frac{40}{3} = \frac{5(5-h)^2}{2} - \frac{(5-h)^3}{3}$

$\Rightarrow 80 = 15(5-h)^2 - 2(5-h)^3$

$\Rightarrow 2(5-h)^3 - 15(5-h)^2 + 80 = 0$

$\Rightarrow h \approx 2\ \text{m}$