6.7
LSN 15
3, 4, 5, 9, 15, 17, 20, 30

3) $F = \frac{5}{x^2}$ (lb)

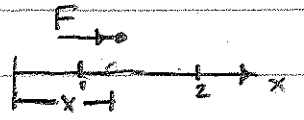
$W = Fd$ $\quad F = \frac{5}{x^2}$ (lb), $d = dx$ (ft)

$$W = \int_1^{10} \frac{5}{x^2}\,dx = 5\int_1^{10} x^{-2}\,dx = 5\left.\frac{x^{-1}}{-1}\right|_1^{10}$$

$$= 5\left(-\frac{1}{10} - -1\right) = \frac{45}{10}$$

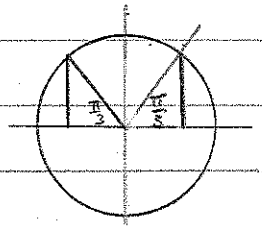
$$\boxed{W = 4.5 \text{ ft-lb}}$$

4)



$W = F \cdot d$, $\quad F = \cos\left(\frac{\pi x}{3}\right)$ (N)

$d = dx$, 1 to 2 m



$$= \int_1^2 \cos\left(\frac{\pi x}{3}\right) dx$$

$$= \frac{3}{\pi}\sin\left(\frac{\pi x}{3}\right)\Big|_1^2 = \frac{3}{\pi}\left(\sin\left(\frac{2\pi}{3}\right) - \sin\left(\frac{\pi}{3}\right)\right)$$

$$= \frac{3}{\pi}(\quad 0 \quad)(\text{N·m})$$

a) $\boxed{W = 0 \text{ Nm} = 0 \text{ J}}$

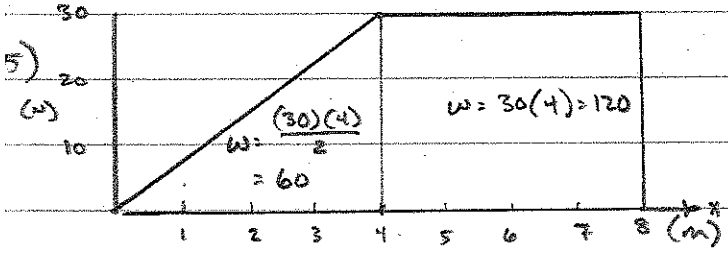
b) $\left.\frac{3}{\pi}\sin\left(\frac{\pi x}{3}\right)\right|_1^{1.5} = \frac{3}{\pi}\left(\sin\left(\frac{\pi}{2}\right) - \sin\left(\frac{\pi}{3}\right)\right)$

c) $\left.\phantom{\frac{3}{\pi}}\right|_{1.5}^{2} = \frac{3}{\pi}\left(\sin\left(\frac{2\pi}{3}\right) - \sin\left(\frac{\pi}{2}\right)\right)$

TOTAL: $\frac{3}{\pi}\left(\sin\left(\frac{2\pi}{3}\right) - \sin\left(\frac{\pi}{3}\right)\right) = 0$

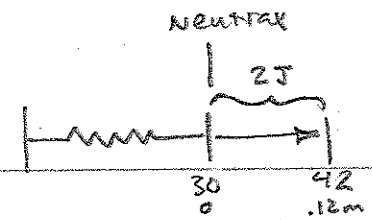
$$\boxed{W\Big|_1^{1.5} = -W\Big|_{1.5}^{2}}$$

5)



$W = (60 + 120)\text{N·m}$

$\boxed{W = 180 \text{ J}}$



9) Hooke's law $W = \int f(x)\,dx$

$f(x) = kx$

$W = k\int x\,dx = k\frac{x^2}{2}$

$W\Big|_0^{.12} = 2J = \frac{k}{2}(.12^2 - 0^2)$

$\frac{4}{.12^2} = k = k = 277.8\ \frac{J}{m^2}$

$J = Nm$

$k = 277.8\ \frac{N}{m}$

a)

b) $W\Big|_{.05}^{.10} = k\frac{x^2}{2}\Big|_{.05}^{.10} = \left(\frac{277.8\ N/m}{2}\right)\left((.1m)^2 - (.05m)^2\right)$

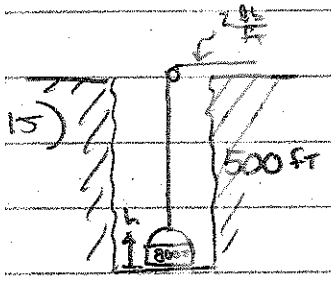
$= 1.04\ Nm$

$W\Big|_{35}^{40} = 1.04\ J$

c) $F = kx = 30N = \left(277.8\ \frac{N}{m}\right)x(m)$

$x = .108m = 10.8cm$ 30N will stretch the spring 10.8cm

15)



$W = FD,\ D = dh$

$F = 800 + (500 - h)\frac{2lb}{ft}$

$= (1800 - 2h)(lb)$

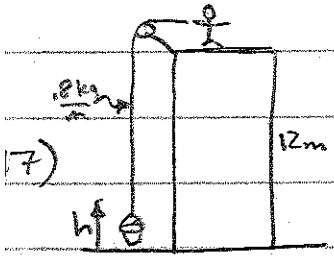
$W = \int_0^{500}(1800 - 2h)\,dh$

$= 1800h - h^2\Big|_0^{500}$

$W = 500(1800 - 500)$

$W = 650\,000\ ft\cdot lb$

17)



$W = FD \quad D = dh$

$F = ma,\ a = g = 9.8\ \frac{m}{s^2}$

$m = (12 - h)\left(.8\frac{kg}{m}\right) + (10 + (36 - 3h))$

$= 9.6 - .8h + 46 - 3h$

$= 55.6 - 3.8h$

$W = \int_0^{12} g(55.6 - 3.8h)\,dh$

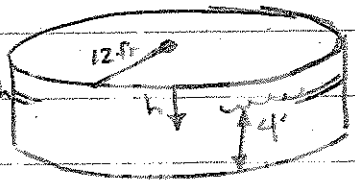
$= 55.6h - 1.9h^2\Big|_0^{12}$

$= 12(55.6 - 1.9(12)) = 393.6g\ (N\cdot m)$

$W = 3857.3\ J$

$= 10kg + (36 - 3h)$

20)



$W = Fd$, $d = h$

$F = ma$, $a = g$

$m = \rho \pi (12^2) dh$

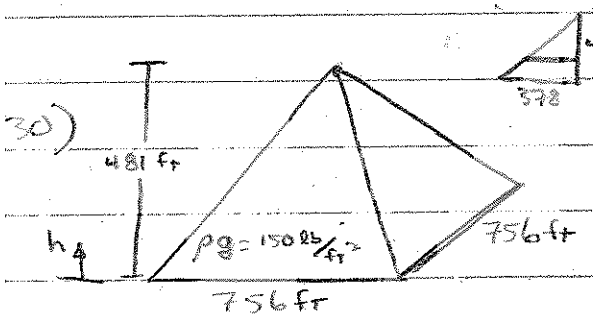
$= \rho g \pi (144) dh$

$W = \int_1^5 \pi \rho g (144) h \, dh$ $\quad \rho g = 62.5 \text{ lb/ft}^3$

$= 144\pi\rho g \frac{h^2}{2}\Big|_1^5 = 72\pi\rho g (25-1) = 1728\pi\rho g$ ft·lb

$W = 108000\pi$ ft·lb

30)

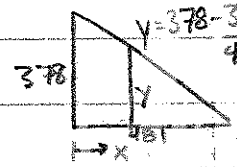


$W = FD$, $D = h$

$F = ma$ $\quad \rho g = 150$ lb/ft³

$a = g$

$m = \rho(A\,dh)$



$A = s^2$

$s = 2\left(378 - \frac{378}{481}h\right)$

$s = 2\left(\frac{378}{481}\right)(481 + h)$

$= 2\left(-\frac{378}{481}\right)(h - 481)$

$W = \int_0^{481} \rho (2)^2 \left(\frac{-378}{481}\right)^2 (h-481)^2 g h \, dh$

$\rho g = 150 \text{ lb/ft}^3$

$4(150)\left(\frac{378}{481}\right)^2 \int_0^{481} (h^2 - 962h + 481^2) h \, dh$

$\int_0^{481} (h^3 - 962h^2 + 481^2 h) dh$

$\left(600\left(\frac{378}{481}\right)^2\right)\left(\frac{h^4}{4} - 962\frac{h^3}{3} + 481^2\frac{h^2}{2}\right)\Big|_0^{481}$

$600\left(\frac{378}{481}\right)^2 (481^4)\left(\frac{1}{4} - \frac{2}{3} + \frac{1}{2}\right)$

$\frac{3}{12} - \frac{8}{12} + \frac{6}{12} = \frac{1}{12}$

$W = 1.653 \times 10^{12}$ ft·lb

$121{,}536$ laborers

$\times \frac{\text{hr}}{200 \text{ ft·lb}} \cdot \frac{\text{day}}{10 \text{ hr}} \cdot \frac{\text{yr}}{340 \text{ days}} \times \frac{1 \text{ man}}{20 \text{ yr}} = 121{,}536$