Chapter 7 Homework

7. Work-Energy theorem

$$\Delta K.E. = \text{Work done}$$
$$\tfrac{1}{2} m v_f^2 - \tfrac{1}{2} m v_i^2 = \text{Work}$$
$$\tfrac{1}{2}\, 2\, 6^2 - \tfrac{1}{2}\, 2\, 4^2 = \boxed{20 \text{ Joules}}$$

11. (a) To find the force use $\Sigma F = ma$

$$F_f = -ma \qquad a = -2 m/s^2 \text{ (deceleration)}$$
$$F_f = -85 \times 2 = -170 \text{ N}$$

(b) Work energy theorem

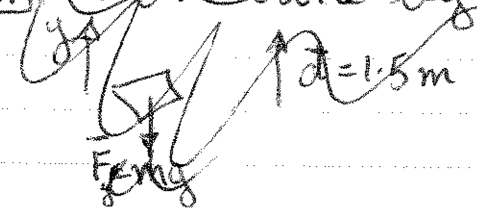
$$\tfrac{1}{2} m v_f^2 - \tfrac{1}{2} m v_i^2 = F \times d$$
$$0 - \tfrac{1}{2} m v_i^2 = -170 \times d$$
$$d = \frac{\tfrac{1}{2} m v_i^2}{170} = \frac{\tfrac{1}{2}\, 85 \times 37^2}{170} = 342 m$$

(c) Work done $= Fd = -170 \times 342 = 58000 J$.

(d) If $a = -4 m/s^2$ $F = -340 N$

(e) $d = \frac{\tfrac{1}{2}\, 85\, 37^2}{340} = 170 m$ (f) $= F.d = 58000 J$.

~~21. Work done by gravity $W = F.d$~~
~~$= -mgd$~~
~~$= -82 \times 0.15$~~
~~$= 123 J$.~~



21. $W = F.d$
$$\Delta W_g = mgd$$
$$= 3 \times 9.8 \times 0.15$$
$$= \underline{4.4} J$$

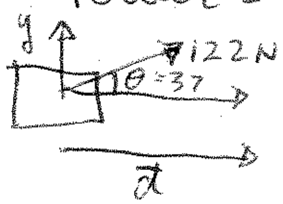
→ The change in energy of the box is the change in gravitational potential; there is no change in the kinetic energy.

38. $W = \int_{x=0.25}^{x=1.25} \bar{F} \cdot d\bar{x} = \int_{0.25}^{1.25} e^{-4x^2} dx$ let $u = 2x$, $du = 2dx$, limits $u = 0.5$ to $u = 2.5$

$$W = \int_{0.5}^{2.5} e^{-u^2} \frac{du}{2} = \frac{\sqrt{\pi}}{4}\left[\text{erf}(u)\right]_{0.5}^{2.5}$$

$$= \frac{\sqrt{\pi}}{4}\left[1 - 0.5205\right] = 0.21 \text{ J}$$

43. Power = Work done per second (J/s)

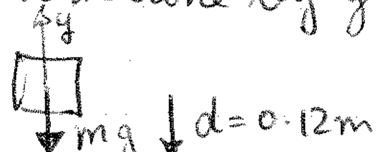


$W = F \cdot d = (122\text{N} \times 5\text{m}) \cos 37°$ each second

$= 490 \text{ J/s}$

$= 490 \text{ W}$.

54. (a) Work done by gravity in moving down 12cm



$W = mg\,d$

$= 0.25 \times 9.8 \times 0.12$

$= 0.3 \text{ J}$.

(b) Spring force $F_{sp} = +\frac{1}{2}ky^2\,\hat{y}$

$$W = \int_{0}^{0.12} -ky\,dy = -\frac{1}{2}k\left[y^2\right]_{0}^{0.12} = -1.8 \text{ J}$$

~~$= -12.5(0.12)$~~
~~$= -0.35$~~
~~$= -0.020$~~

(c) ΔKE = net work

$\frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 = W_g + W_{sp}$

$0 - \frac{1}{2}mv_i^2 = 0.3 - 1.8 \Rightarrow v_i = -\frac{2(0.3-1.8)}{m}$

$= 3.5$ m/s.

(d) $\Delta KE = 0 - \frac{1}{2}m(2v_i)^2 = mgx - \frac{1}{2}kx^2$

Solve for $x = 0.214$ m