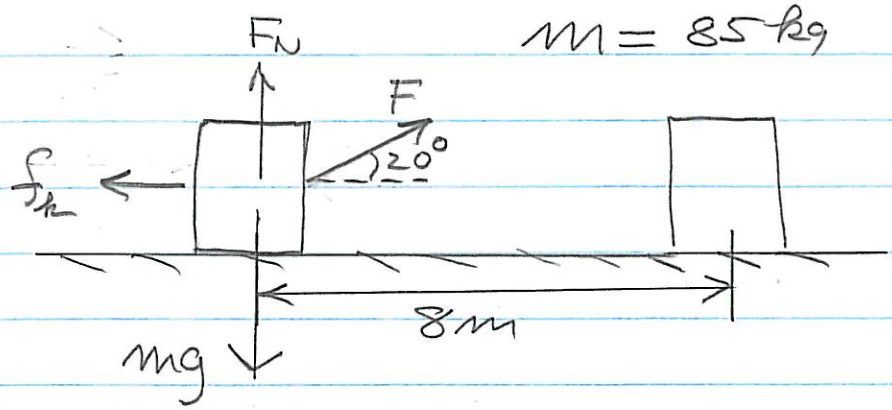
Chapter 6

$\boxed{6\text{-}9}$

$m = 85\,kg$

$F = 240N$



(a) $W_F = F\cos 20° \cdot S = 240\cos 20 \cdot 8$

$= \underline{1804\,J}$

(b) $W_{f_k} = -f_k S = -\mu_k F_N S$

$F_N + F\sin 20° - mg = 0$

$F_N = mg - F\sin 20$

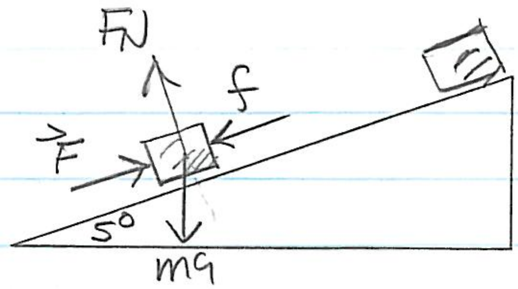
$= 751\ N$

$W_{f_k} = -0.2 \times 751 \cdot 8$

$= \underline{-1201\,J}$

Note: The net work done by all forces $= \Delta KE$

$\boxed{6\text{–}12}$



$s = 290\,m$

$f = 524\,N$
$m = 1200\,kg$

$$W_{NET} = W_F + W_f + W_{FN} + W_{mg}$$

FN does no work since it is ⊥ to displacement

$$W_{NET} = Fs - fs - mg\sin 5^\circ s$$

$$= s(F - f_s - mg\sin 5) \ *$$

$$150 \cdot 10^3\,J = 290(F - 524 - 1200 \cdot 9.8 \sin 5)$$

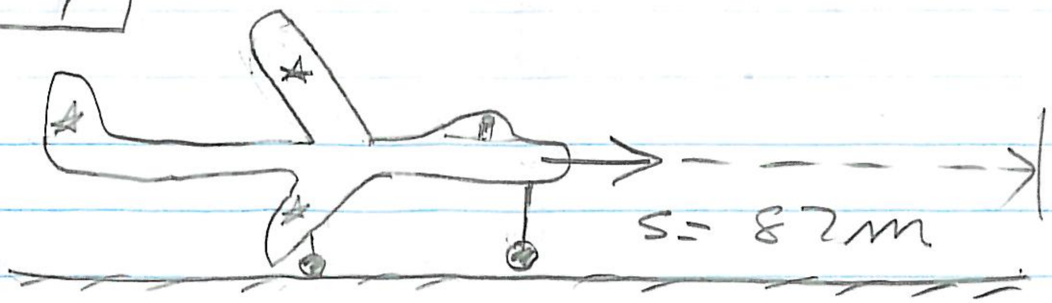
$$= 290(F - 1549)$$

$$517 = F - 1549$$

$$\underline{F = 2066\,N}$$

NOTE! No work is done by $mg\cos 5^\circ$

$\boxed{6-17}$



$F_{engines} = 2.3 \times 10^5\, N$

$KE_f = 4.5 \times 10^7\, J \quad , KE_0 = 0$

$W_{catapult} + W_{engines} = \Delta KE$

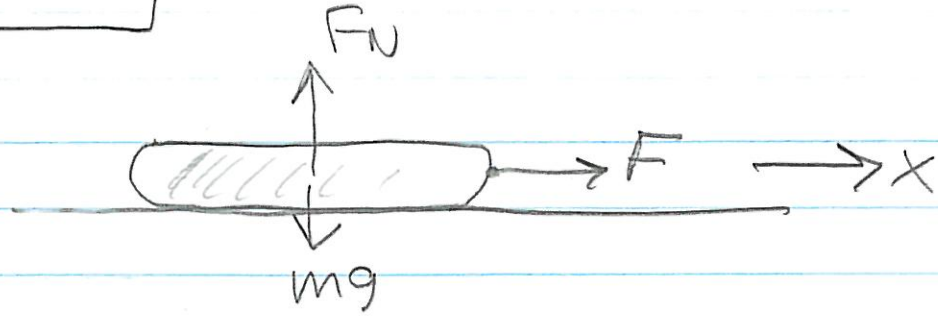
$W_{catapult} + F_{engines}\, s = KE_f - KE_0$

$W_{catapult} + 2.3 \times 10^5 \times 87m = KE_f$

$W_{catapult} = 4.5 \times 10^7 - 2.3 \times 10^5 \cdot 87$

$= \underline{2.5 \times 10^7\, J}$

$\boxed{6\text{-}23}$



$$\Delta KE = W_F = Fs$$

$$\frac{\Delta KE}{KE_0} = 0.38$$

$$\Delta KE' = F\cos 62\ s$$

$$\Delta KE' = Fs\cos 62 = \Delta KE \cdot 0.47$$

$$\frac{\Delta KE'}{KE_0} = \left(\frac{\Delta KE}{KE_0}\right)$$

$$= 0.38 \times 0.47$$

$$= \underline{0.18 \text{ or } 18\%}$$

$\boxed{6\text{-}25}$

$$\frac{GmM_E}{r^{\cancel{2}}} = \frac{mv^2}{\cancel{r}} \Rightarrow$$ to get into

a lower orbit (smaller r), the speed of the satellite must increase. The force which does this is gravity

$$W = \Delta KE = KE_f - KE_0$$

$$KE = \frac{1}{2} mv^2 = \frac{GmM_E}{2r} \left[\begin{array}{l}\text{using} \\ \text{1ST EQN}\end{array}\right]$$

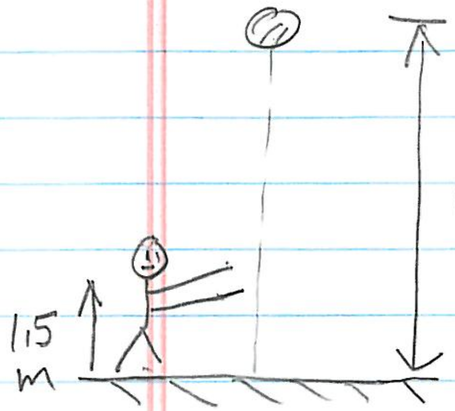
$$\Delta KE = \frac{GmM_E}{2}\left[\frac{1}{r_f} - \frac{1}{r_0}\right]$$

$$= \frac{6.67\times10^{-11} \times 6200 \times 6\times10^{24}}{2} \times \left[\frac{1}{7\times10^{6}} - \frac{1}{3.3\times10^{7}}\right]$$

$$= 1.24\times10^{18}\left[1.13\times10^{-7}\right]$$

$$W = 1.4\times10^{11}\ J$$

$\boxed{6-33}$



$m = 0.6\ kg$

(a) $W_w = mgh = 0.6\ kg \times 9.8 \times (6.1 - 1.5)$

$= 27J$

(b) $PE_{g,\ ground} = mgh$

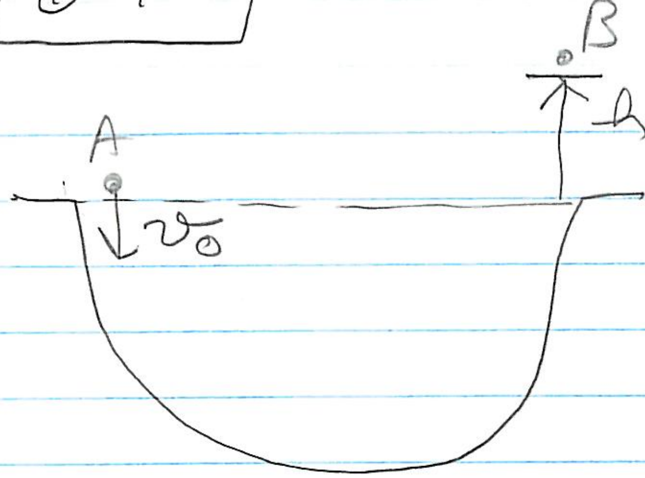
$= 0.6 \times 9.8 \times 6.1 = 36J$

(c) $PE_{g,\ caught} = mgh = 0.6 \times 9.8 \times 1.5$

$= 8.8J$

(d) $PE_f - PE_0 = 36 - 9 = 27J = W_w$

$\boxed{6\text{-}40}$



$v_0 = 5.4\,m/s$

TAKE initial position on left side where $PE_g = 0$

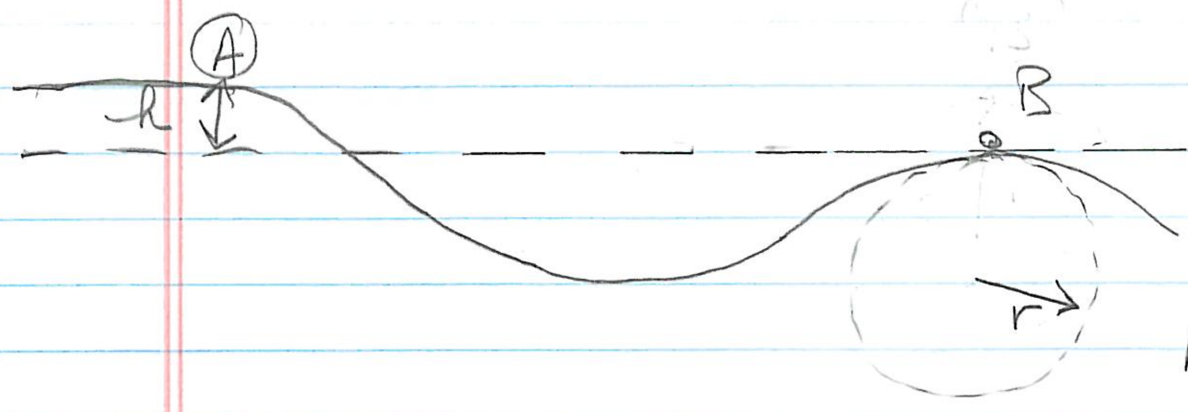
Then $E_A = E_B$

$$\frac{1}{2}\cancel{m}v_0^2 = \cancel{m}gh$$

$$h = \frac{v_0^2}{2g} = \frac{(5.4)^2}{2 \cdot 9.8}$$

$$= 1.5\,m$$

$\boxed{6\text{-}47}$



$r = 36m$

$E_A = E_B$

Take $PE_g = 0$ at dashed line

$\therefore \cancel{m} g h = \frac{1}{2} \cancel{m} v_B^2$

@B $\quad mg - F_N = \dfrac{m v_B^2}{r}$

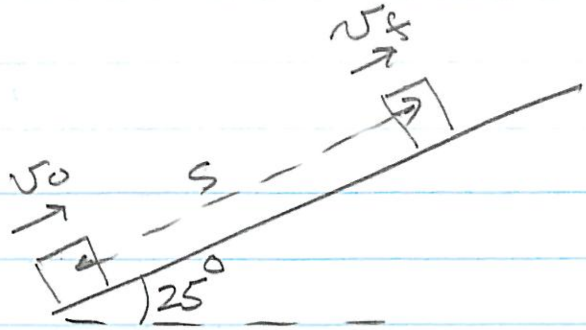
if skier "just" looses contact at B, $F_N = 0$

$\cancel{m} g = \dfrac{\cancel{m} v_B^2}{r} \implies v_B^2 = gr$

then $\cancel{g} h = \frac{1}{2} \cancel{g} r$

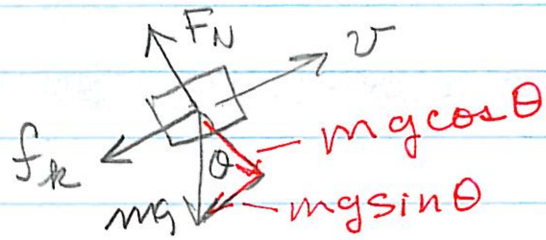
$\underline{h = 18m}$

$\boxed{6\text{-}57}$



$m = 63\text{ kg}$
$s = 1.9\text{ m}$
$v_o = 6.6\text{ m/s}$
$v_f = 4.4\text{ m/s}$

(a) $W_{\substack{NET\\FORCE}} = \Delta KE = KE_f - KE_o$



$$W_{\substack{net\\force}} = W_{F_N} + W_{mg} + W_{f_k}$$
$$= 0 - mg\sin 25\, s + W_{f_k}$$
$$= \tfrac{1}{2} m v_f^2 - \tfrac{1}{2} m v_o^2$$

$$-mg\sin 25\, s + W_{f_k} = \tfrac{1}{2} m (v_f^2 - v_o^2)$$

$$-63 \cdot 9.8 \cdot \sin 25 \cdot 1.9 + W_{f_k} = \tfrac{1}{2} \cdot 63 \cdot \left[(4.4)^2 - (6.6)^2\right]$$

$$-496 + W_{f_k} = -762$$

$$W_{f_k} = \underline{-266\text{ J}}$$

(b) $W_f = -f_k s$

$$f_k = \frac{266}{1.9} = \underline{140\text{ N}}$$

$\boxed{6\text{-}67}$

(a) $P = \frac{\Delta KE}{t}$

$= \frac{\frac{1}{2} m v^2}{t}$

$= \frac{\frac{1}{2}\ 110 \times (27)^2}{4.0}$

$\simeq 10{,}024\ W$

(b) $1\ hp = 745.7 W$

$P = 10{,}024 W \times \frac{1 hp}{745.7 W}$

$= 13.4\ hp$

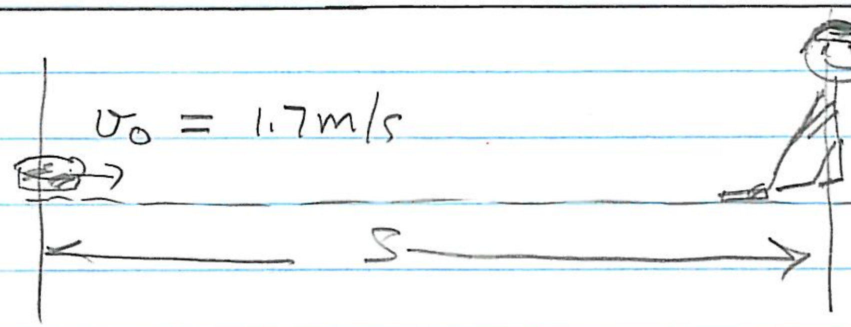
$\boxed{6\text{-}82}$

$$P = \frac{\Delta PE}{\Delta t} = \frac{M_{tot}\, g h}{\Delta t}$$

$$= \frac{4 \cdot 65\,kg \times 9.8 \times 140\,m}{120\,s}$$

$$= 3000\,W$$

$\boxed{6\text{-}84}$



$$W_{f_k} = \Delta K$$

$$-f_k \frac{s}{2} = 0 - \tfrac{1}{2} m v_0^2$$

$$\tfrac{1}{2} f_k s = \tfrac{1}{2} m v_0^2$$

DIVIDE

$$-f_k s = 0 - \tfrac{1}{2} m v_0'^2$$ (v_0' is NEW speed)

$$f_k s = \tfrac{1}{2} m v_0'^2$$

$$\tfrac{1}{2} = v_0^2 / v_0'^2 \Rightarrow v_0'^2 = 2 v_0^2$$

$$v_0' = \sqrt{2}\, v_0 = 2.4\ m/s$$