p 163 27, 31, (Potential Energy)

(27) $E_p = mgh = (7.0\,kg)(9.81\,ms^{-2})(1.2\,m) = 82\,J$

(31) (a) $\Delta E_p = mg\Delta h = (55\,kg)(9.81\,ms^{-2})(3300 - 1600\,m) = 9.2\times10^{5}\,J$

(b) $9.2\times10^{5}\,J$ (work = energy)

(c) yes, some work may be lost to friction or heat.

p 163 33, 35, 43 (Conservation of Mechanical Energy)

(33) $\Sigma E_b = \Sigma E_a$

$\frac{1}{2}mv^2 = mgh$

$h = \frac{v^2}{2g} = \frac{(5.3\,ms^{-1})^2}{2(9.81\,ms^{-2})} = \underline{1.4\,m}$

(35) $\Sigma E_b = \Sigma E_a$

$\frac{1}{2}mv^2 = mgh$

$v = \sqrt{2gh} = \sqrt{2(9.81\,ms^{-2})(1.35\,m)} = \underline{5.15\,ms^{-1}}$

(43) $1 \to 2$

$mgh = \frac{1}{2}mv^2$

$v = \sqrt{2gh} = \sqrt{2(9.81\,ms^{-2})(35\,m)} = \underline{26\,ms^{-1}}$

$1 \to 3$

$mg\Delta h = \frac{1}{2}mv^2$

$v = \sqrt{2g\Delta h} = \sqrt{2(9.81\,ms^{-2})(35 - 28\,m)} = \underline{12\,ms^{-1}}$

$1 \to 4$

$mg\Delta h = \frac{1}{2}mv^2$

$v = \sqrt{2g\Delta h} = \sqrt{2(9.81\,ms^{-2})(35 - 15\,m)} = \underline{20\,ms^{-1}}$

p 164 47, 51, 53 (Conservation of Energy)

(47) $\sum E_b = \sum E_a$

$95\ kmh^{-1} = 26.4\ ms^{-1}$

$\frac{1}{2} m_1 v_1^2 + \frac{1}{2} m_2 v_2^2 = E_{thermal}$

$E_{thermal} = 2\left(\frac{1}{2}(7650\ kg)(26.4\ ms^{-1})^2\right) = \underline{5.3 \times 10^6\ J}$

(51) (a) Energy Loss = Energy Before − Energy After

$= mgh_1 - mgh_2$

$= mg(h_1 - h_2)$

$= mg(2 - 1.5)$

$= .5\,mg$

Fraction $= \frac{\text{Energy Loss}}{\text{Energy before}} = \frac{.5\,mg}{mg(2)} = \underline{0.25} = \underline{25\%}$

(b) $\sum E_b = \sum E_a$

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

$v = \sqrt{2gh} = \sqrt{2(9.81\ ms^{-2})(1.5m)} = \underline{5.4\ ms^{-1}}$

(c) Transformed into thermal energy (and sound energy)

(53) $\sum E_b = \sum E_a$

$\frac{1}{2} m v_b^2 + mgh - E_{loss} = \frac{1}{2} m v_a^2$

$\frac{1}{2} m v_b^2 + mgh - \frac{mgs}{5} = \frac{1}{2} m v_a^2$

$v_a = \sqrt{v_b^2 + 2gh - \frac{2gs}{5}}$

$= \sqrt{(1.7\ ms^{-1})^2 + 2(9.81\ ms^{-2})(35m) - \frac{2(9.81\ ms^{-2})(45m)}{5}}$

$= \underline{23\ ms^{-1}}$

E_{loss} due to friction

energy = work

$E_{loss} = W = Fs$

friction is the force

$E_{loss} = F_f s$

we are told $F_f = \frac{mg}{5}$

so $E_{loss} = \frac{mgs}{5}$

p 164 58, 62, 65, 67 (Power)

(58) $Power = \frac{W}{t}$ $W = Fs$ $F = mg$

$t = \frac{Fs}{power} = \frac{(315\,kg)(9.81\,ms^{-2})(16.0\,m)}{1750\,W} = \underline{28.3\,s}$

(62) (a) $1\,kWh = (1000\,W)(3600\,sh^{-1}) = \underline{3.6 \times 10^6\,J}$

(b) $520\,W(3600\,s)(24\,h)(30\,d) = 1.347 \times 10^9\,J$

$\frac{1.347 \times 10^9\,J}{3.6 \times 10^6\,J} = \underline{370\,kWh}$

(c) $\underline{1.3 \times 10^9\,J}$

(d) $370\,kWh(0.12\,kwh^{-1}) = \underline{\$44.40}$

cost doesnot depend on rate only amount of energy used.

(65) $Power = \frac{W}{t} = \frac{Fs}{t}$ $F = ma$ ↑ need

Find a

$u = 0$
$v = 14\,ms^{-1}$
$t = 1.5\,s$
$a = ?$

$v = \cancel{u} + at$

$a = \frac{v}{t}$

$= \frac{14\,ms^{-1}}{1.5\,s}$

$= 9.33\,ms^{-2}$

Find s

$s = ?$

$s = \cancel{ut} + \frac{1}{2}at^2$

$= \frac{1}{2}(9.33\,ms^{-2})(1.5\,s)^2$

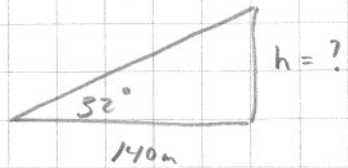
$= 10.496\,m$

$Power = \frac{mas}{t}$

$= \frac{(7.3\,kg)(9.33\,ms^{-2})(10.496\,m)}{1.5\,s}$

$= \underline{480\,W}$

(67) Power $= \frac{W}{t}$ $W = E$



$= \frac{mg\Delta h}{t}$

$= \frac{(95kg)(9.81\,ms^{-2})(87.48m)}{66s}$

$= \underline{1200\,J}$

$\tan 32 = \frac{h}{140}$

$h = 140 \tan 32 = 87.48\,m$

p165 74, 77, 78, 80, 83, 91 (General Problems)

(74) $\sum E_b = \sum E_a$

$\frac{1}{2}\not{m}v_1^2 = \not{m}gh + \frac{1}{2}mv_2^2$

$v_1 = \sqrt{2gh + v_2^2}$

$= \sqrt{2(9.81\,ms^{-2})(1.1m) + (6.5m/s)^2}$

$= \underline{8.0\,ms^{-1}}$

(77) (a) $\sum E_b = \sum E_a$

$\not{m}gh = \frac{1}{2}\not{m}v^2$

$v = \sqrt{2gh} = \sqrt{2gL}$

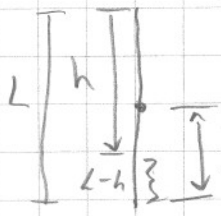
(b) $\sum E_b = \sum E_a$

$\frac{1}{2}\not{m}v_b^2 = \not{m}g\Delta h + \frac{1}{2}\not{m}v_a^2$

$v_a = \sqrt{V_b^2 - 2gh}$

$= \sqrt{2gL - 2g(.4L)}$

$= \sqrt{1.2gL}$



$? = (L-h)2$

$(L - .8L)2$

$.4L$

(78) (a) $W = Fs = mgs = (65\,kg)(9.81\,ms^{-2})(3700 - 2300\,m)$

$$= \underline{8.9 \times 10^5\,J}$$

(b) $Power = \frac{W}{t} = \frac{8.9 \times 10^5\,J}{5\,h\,(3600\,s)} = \underline{50.\,W} = \underline{0.066\,hp}$

$(1\,hp = 746\,W)$

(c) $efficiency = \frac{\text{Work Output}}{\text{Energy Input}}$

$\text{Energy input} = \frac{\text{Work output}}{\text{eff}} = \frac{50.\,W}{.15} = \underline{330\,W}$

(80) $Power = \frac{Work}{t} = \frac{Fs}{t}$ — on average the mass of 1 person is 70 kg.

$$= \frac{mgs}{t} = \frac{(47000)(70\,kg)(9.81\,ms^{-2})(200\,m)}{3600\,s}$$

$$= \underline{2 \times 10^6\,W}$$

(83) (a) $W = E$

$W = mgh$

$h = \frac{W}{mg} = \frac{1100 \times 10^3\,J}{(82\,kg)(9.81\,ms^{-2})} = \underline{1400\,m}$

(b) $\Sigma E_b = \Sigma E_a$

$mgh = \frac{1}{2} mv^2$

$v = \sqrt{2gh} = \sqrt{2(9.81\,ms^{-2})(1400\,m)} = \underline{170\,ms^{-1}}$

(91) $Power = \frac{W}{t}$ $W = E = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$

$35\ kmh^{-1} = 9.72\ ms^{-1}$

$55\ kmh^{-1} = 15.3\ ms^{-1}$

$W = \frac{1}{2}(1500kg)(15.3^2 - 9.72^2\ ms^{-1})$

$= 1.047 \times 10^5\ J$

$Power = \frac{1.047 \times 10^5\ J}{3.2s} = 3.27 \times 10^4\ W$

$Power = \frac{W}{t}$ $W = E = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$

$55\ kmh^{-1} = 15.3\ ms^{-1}$

$75\ kmh^{-1} = 20.8\ ms^{-1}$

$W = \frac{1}{2}(1500kg)(20.8^2 - 15.3^2\ ms^{-1})$

$= 1.489 \times 10^5\ J$

$Power = \frac{W}{t}$

$t = \frac{W}{power} = \frac{1.489 \times 10^5\ J}{3.27 \times 10^4\ W} = \underline{4.6s}$