Work Pg 223

1. $m = 0.50\,kg$ $\quad t = 2.0\,s$
$\vec{v}_1 = 3.0\,m/s\ [R]$ $\quad \vec{a} = 1.2\,m/s^2$

a) $\vec{F} = m\vec{a}$
$\vec{F} = (0.50)(1.2)$
$\vec{F} = \boxed{0.60\,N}$

b) $\Delta\vec{d} = \vec{v}_1\Delta t + \frac{1}{2}a\Delta t^2$
$\Delta\vec{d} = (3.0)(2.0) + \frac{1}{2}(1.2)(2.0)^2$
$\Delta\vec{d} = \boxed{8.4\,m\ [R]}$

c) $W = F\Delta d$
$W = (0.60)(8.4)$
$W = \boxed{5.0\,J}$

Pg 225

1. $F = 125\,N$
$\theta = 40.0°$
$\Delta\vec{d} = 12.0\,m$

$W = F\cos\theta\,\Delta d$
$W = (125)(\cos 40)(12.0)$
$W = 1149\,J$
$\boxed{W = 1.15\,kJ}$

2. $\theta = 35.0°$
$\Delta\vec{d} = 50.0\,m$
$W = 2410\,J$

$\boxed{F_{net} = 0.0}$ b/c not moving in vertical direction

Pg 227

1. $\Delta\vec{d} = 1.3\,m$
$\vec{F}_A = 4.5\,N$
$\vec{F}_S = 2.8\,N$

$W_A = (4.5)(1.3)$ $\quad W_F = (2.8)(1.3)$
$W_A = 5.85$ $\quad W_F = 3.64$

$\boxed{W_T = 5.85 - 3.64 = 2.2\,J}$

or

$\vec{F}_{net} = \vec{F}_A - \vec{F}_S$
$F_{net} = 4.5 - 2.8$
$= 1.7\,N$

$W = (1.7)(1.3)$
$\boxed{W = 2.2\,J}$

Pg 227

2. $m = 450\,kg$
$\Delta d = 12\,m$

① 

$F_{net} = F_A - F_g$
$0 = F_A - F_g$
$F_g = F_A$
$mg = F_A$
$(450)(9.8) = \vec{F}_g$
$4410\,N = F_A$

② $W = F\Delta d$
$W = (4410)(12) = 52920\,J$
$= 53\,kJ$

Pg 229

1. $\vec{F}_A = 25.0\,N$
$\Delta\vec{d} = 13.0\,m$

$W = (25.0)(13.0)$
$W = 325\,J$

2. $\vec{v}_i = 0.0\,m/s$
$\vec{F}_A = 1500\,N$
$\vec{F}_g = 810\,N$
$\Delta d = 12\,m$

a) $W = \vec{F}\Delta\vec{d}$
$W = (1500)(12)$
$W = 18000\,J$
$W = 18\,kJ$

$W = F\cos\theta\,\vec{d}$
$= (1500)\cos 0\,(12)$
$= 18\,kJ$

b) $W = \vec{F}\Delta\vec{d}$
$W = 810(12)$
$W = 9720\,J$
$= -9.7\,kJ$

use your brain to make it negative!

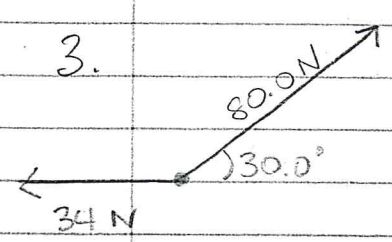
$W = F\cos\theta\,\vec{d}$
$= (810)\cos 180\,(12)$
$= -9.7\,kJ$

this will be neg. b/c $\cos 180 = -1$

c) 0.0 b/c no movement in vertical
or... $\cos 90^\circ = 0$ ∴ $W = F\cos\theta\,\Delta d$
$W = 0$

d) See c

3.



$\Delta d = 12\text{ m}$

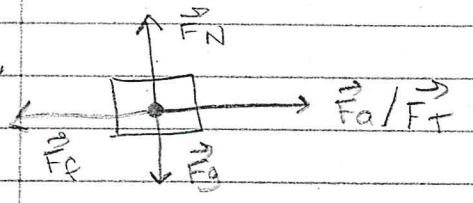
$\vec{F}_f = 34\text{ N}$

a) $W_A = \vec{F}\cos\theta\,\vec{\Delta d}$
$= (80.0)(\cos 30)(12)$
$= 831.4\text{ J}$

$W_f = (34)(\cos 180)(12)$
$= -408$
(or just make W_f −)

b) $W_T = 831.4 - 408$
$= 423\text{ J}$

4.



b)

$\vec{F}_T = \vec{F}_A$

$W = F\Delta d$

$250\text{ J} = F(12)$

$\vec{F} = 20.8$

$\vec{F} = 21\text{ N}$

c) $\vec{F}_{net} = \vec{F}_T - \vec{F}_f$

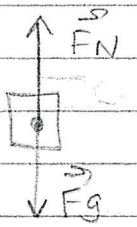
$m\vec{a} = \vec{F}_T - \vec{F}_f$

b/c $a = 0$ → $0 = 21 - F_f$

$F_f = 21\text{ N}$

5. $m = 62\,kg$
$v_c = 4.0\,m/s$
$t = 5.0$

a)



b) $W = \vec{F}\Delta\vec{d}$ ← $F_N = F_g$ (b/c $F_{net} = 0$)

$W = (607.6)(20)$ $F_N = (62)(9.8)$

$W = 12152\,J$ $F_N = 607.6\,N$

$\boxed{W = 12\,kJ}$

$\Delta d = v \times t$

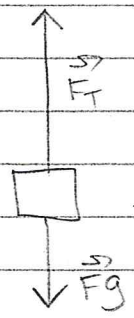
$= (4.0)(5.0)$

$= 20\,m$

c) same as b only $-12\,kJ$ b/c Force is down

d) Gravity would be + ∴ $W_g = 12\,kJ$
Normal would be − ∴ $W_N = -12\,kJ$
(b/c ⊖ would be reversed)

7. $v_i = 0.0$ $\vec{a} = 2.2\,m/s^2$ $t = 3.0$



a) $\Delta d = v_i \Delta t + \frac{1}{2} a \Delta t^2$

$\Delta d = (0)(3) + \frac{1}{2}(2.2)(3.0)^2$

$\boxed{\Delta d = 9.9\,m}$

b) $\vec{F}_g = (2.0)(9.8)$

$\vec{F}_g = -19.6\,N$

$F_{net} = F_T - F_g$

$(2.0)(2.2) = F_T - (19.6)$

$\boxed{\vec{F}_T = 24\,N}$

$W_g = (-19.6)(9.9)$

$W_g = -194$

$W_g = -190\,J$

$W_T = (24)(9.9)$

$W_T = 237.6$

$\boxed{W_T = 240\,J}$

c) $W_T = 240 - 190$
$= 50\,J$

d) $F_{net} = ma$
$= (2.0)(2.2)$
$= 4.4\,N$

$W_{net} = (4.4)(9.9)$
$= 43.56$
$= 44\,J$

8. a) box not moving $\therefore a = 0 \therefore F = 0 \therefore W = 0$

b) not enough F to overcome F_s $\therefore$ $d = 0 \therefore W = 0$

c) Δd has a value $\therefore \Delta d \neq 0$ so $W \neq 0$ for the first part, then once on rollers $\vec{a} = 0 \therefore F = 0 \therefore W = 0$

Energy

Pg 231

1. $m = 70.0\,kg$
$v = 12\,m/s$
$\Delta d = 100\,m$
$E_K = ?$

$E_K = \frac{mv^2}{2}$

$E_K = \frac{(70.0)(12)^2}{2} = 5040\,J = \boxed{5.0\,kJ}$

2. $4.2\,J = \frac{m(5.0)^2}{2}$

$\frac{8.4}{25} = \frac{25\,m}{25}$

$m = \boxed{0.336\,kg}$

3. $30.0\,J = \frac{(0.150)v^2}{2}$

$v = \boxed{20.0\,m/s}$

Or ① use $W = \frac{mv_2^2}{2} - \frac{mv_1^2}{2}$

② $W = F\Delta d$

Pg 232

1. $m = 1300\,kg$
$v_2 = 14\,m/s$
$\Delta d = 82\,m$
$v_1 = 0$

a) $W = F\Delta d$
↳ need F, $F = ma$
need $\vec{a}$!

① $v_2^2 = v_1^2 + 2a\Delta d$
$14^2 = 0 + 2(82)a$
$a = 1.195\,m/s^2$

② $\vec{F} = m\vec{a}$
$F = (1300)(1.195)$
$F = 1553.66\,N$

③ $W = F\Delta d$
$W = (1553.66)(82)$
$\boxed{W = 127.4\,kJ}$

b)

2. $m = 52\,kg$
$v_1 = 11\,m/s$
$v_2 = 0.0$
$\Delta d = 8.0\,m$

a) $v_2^2 = v_1^2 + 2a\Delta d$
$0^2 = 11^2 + 2a(8.0)$
$\vec{a} = -7.56\,m/s^2$
$\vec{F} = m\vec{a}$
$\vec{F} = (52)(-7.56)$
$\vec{F} = -393.3\,N$
$F = 393\,N$ [backward]

Pg 234

1. $m = 58\,kg$

a) $h = 6.0\,m$
$E = mgh$
$= (58)(9.8)(6.0)$
$= 3410\,J$

b) $h = 3.0\,m$
$E = (58)(9.8)(3.0)$
$E = 1705\,J$

c) $h = 0$
$E = 0.0\,J$

b) as you go ↓ E_p ↓
as you go ↑ E_p ↑

Pg 234

1. $m = 610\,kg$
$v = ?$
$E_K = 40.0\,kJ$

$E_K = \frac{mv^2}{2}$

$40\,000 = \frac{(610)v^2}{2}$

$v = 11.5\,m/s$

2. $m = 0.160\,kg$
$v_1 = 0.0\,m/s$
$v_2 = 22\,m/s$
$\Delta d = 1.2\,m$

$W = \Delta E_K$

$W = \frac{mv_2^2}{2} - \frac{mv_1^2}{2}$

$W = \frac{(0.160)(22)^2}{2} - \frac{(0.160)(0)}{2}$

$W = 38.72\,J$

$\Delta E = 39\,J$

3. $m = 42\,kg$

a) $h = 16.0\,m$

$E_g = mgh$
$= (42)(9.8)(16.0)$
$= 6585.6\,J$
$= 6.6\,kJ$

b) $4500 = (42)(9.8)h$
$h = 10.9\,m$

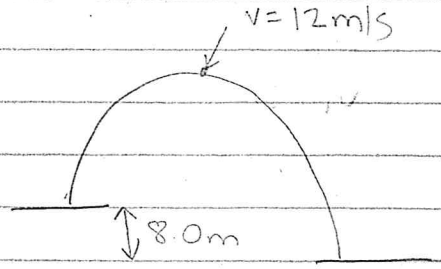
c) $E = 6585\,J - 4900\,J$
$= 1685\,J$
$1685 = (42)(9.8)h$
$h = 4.1\,m$

d) $E_g = 0$ b/c $h = 0$

Law of Conservation of Energy

Pg 241

2. $m = 0.0459\,kg$
$h_2 = 8.0\,m$
$v_1 = 20.0\,m/s$
$v_2 = 12\,m/s$
$h_1 = 0.0\,m/s$



a) $E_m = E_g + E_k$

$E_m = mgh + \frac{mv^2}{2}$

$E_m = (0.0459)(8)(9.8) + \frac{(0.0459)(20)^2}{2}$

$E_m = 3.599 + 9.18$

$E_m = 12.8\,J$

b) $12.8 = (0.0459)h(9.8) + \frac{(0.0459)(12)^2}{2}$

$12.8 = 0.45h + 3.3$

$9.5 = 0.45h$

$21\,m = h$

c) $12.8 = (0.0459)(0)(9.8) + \frac{(0.0459)v^2}{2}$

$12.8 = \frac{(0.0459)v^2}{2}$

$25.6 = 0.0459v^2$

$v = 23.6\,m/s$

Pg 241

@ top all E_g b/c $v = 0.0$
@ bottom all E_K b/c $h = 0.0$
@ loop $E = E_{g2} + E_{K2}$

3. $v_2 = 10.0\ m/s$
$h_2 = 16\ m$
$v_1 = 0.0\ m/s$
$h_1 = ?$

$$E_{m1} = E_{m2}$$

$$mgh_1 + \frac{mv_1^2}{2} = mgh_2 + \frac{mv_2^2}{2}$$

$$9.8h + \frac{(0)}{2} = 9.8(16) + \frac{(10)^2}{2}$$

$$9.8h = 156.8 + 50$$

$$9.8h = 206.8$$

$$h = 21\ m$$

Efficiency

Pg 243

1. $E = 5200\ J = E_{in}$
$m = 50.0\ kg$
$\Delta d = 4.0\ m$
$a = 0.0\ m/s^2$

$E_{out} = mgh$
$= (50.0)(9.8)(4.0)$
$= 1960\ J$

$$\% \ \frac{1960}{5200} \times 100 = 37.7\% = 38\%$$

2. $m = 1250\ kg$ $h = 1.8\ m$ $F = 5500\ N$ $\Delta d = 12.6\ m$

b) $W = F\Delta d$
$= (5500)(12.6)$
$= 69300\ J$

a) $E_{out} = mgh$
$= (1250)(9.8)(1.8)$
$= 22050\ J = 22\ kJ$

c) $$\frac{22050}{69300} \times 100 = 31.8\% = 32\%$$

Pg 249

1. $m = 54\,kg$ $v_1 = 0.0\,m/s$ $v_2 = 11\,m/s$ $\% = 85\%$.

$$E_{out} = E_K = \frac{mv^2}{2} = \frac{(54)(11)^2}{2} = 3267\,J$$

$$\text{efficiency} = \frac{E_{out}}{E_{in}} \times 100$$

$$E(E_{in}) = E_{out} \times 100$$

$$\therefore E_{in} = \frac{E_{out} \times 100}{E}$$

$$= \frac{(3267) \times 100}{85}$$

$$= 3843\,J$$

2. $v_1 = 0.0\,m/s$ $h = 65\,m$ $v_2 = 23\,m/s$

$$E_{out} = E_K = \frac{mv^2}{2} \qquad E_{in} = E_p = mgh$$

$$\% \text{ Eff} = \frac{E_{out}}{E_{in}} = \frac{\frac{1}{2}mv^2}{mgh}$$ ∴ mass not req'd

$$= \frac{\frac{1}{2}(23)^2}{(9.8)(65)} \times 100 = 41.5\%$$

3. $m = 0.046\,kg$ $E_{out} = \frac{(Eff)(E_i)}{100}$

$Eff = 20\%$ $= \frac{(20)(65)}{100} = 13\,J$

$E_K = 65\,J$

$v_1 = ?$

$$v = \sqrt{\frac{2E_K}{m}} = \sqrt{\frac{2(13)}{0.046}} = 24\,m/s$$

Power

Pg 251 #1-3

1. $\Delta t = ?$
$P = 0.50\ kW$
$E = 1200\ J$

$$P = \frac{\Delta E}{\Delta t}$$

$$\Delta t = \frac{\Delta E}{P} = \frac{1200\ J}{500\ W} = 2.4\ s$$

2. $m = 55\ kg$
$h_1 = 850\ m$
$h_2 = 2400\ m$
$t = 3.0\ h = 10800\ s$
$P = ?$

$\Delta E = E_{finish} - E_{start}$
$= mgh - mgh$
$= (55)(9.8)(2400) - (55)(9.8)(850)$
$= 835450\ J$

$$P = \frac{835450\ J}{10800\ s} = 77.4\ W$$

3. $m = 60\ kg$
$v_1 = 0.0\ m/s$
$v_2 = 12.0\ m/s$
$t = 6.0\ s$

$$W = \frac{mv_2^2}{2} - \frac{mv_1^2}{2}$$

$$W = \frac{(60)(12)^2}{2} = 4320\ J$$

$$P = \frac{4320\ J}{6.0\ s} = 720\ W$$

Pg 252

1. $P = 3100\ MW = 3.1 \times 10^9\ W$
$t = 24\ h \times 60\ \frac{min}{h} \times \frac{60\ s}{min} = 86400\ s$

$$P = \frac{E}{\Delta t}$$

$E = P\Delta t$
$= (3.1 \times 10^9)(86400)$
$= 2.7 \times 10^{14}\ J$

Pg 253

1. a) $20 \times 100 \times 12 \times 365$
$= 8760\ kWh$

b) $8760 \times 0.06 = \$525.60$

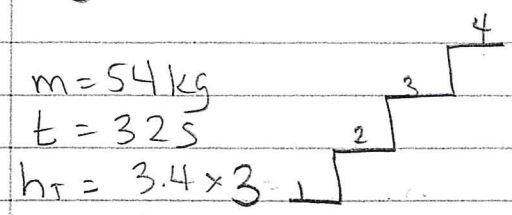
c) $20 \times 23 \times 12 \times 365$
$= 2014.8\ kWh$

$2014.8 \times 0.06 = \$120.89$

Saved: $525.60 - 120.89$
$= \$404.71$

Pg 254

1. $m = 54\,kg$
$t = 32\,s$
$h_T = 3.4 \times 3 = 10.2$



a) $E_p = mgh$
$= (54)(9.8)(10.2)$
$= 5397\,J$

b) $P = \frac{\Delta E}{\Delta t} = \frac{5397\,J}{32\,s} = 168.7\,W$

c) $\downarrow m = \downarrow E_p \therefore \downarrow P$

2. $m = 65\,kg$
$h = 5.0\,m$
$v = 1.4\,m/s$

$v = \frac{\Delta d}{t}$

$t = \frac{\Delta d}{v} = \frac{5.0}{1.4} = 3.57\,s$

a) $P = \frac{E}{\Delta t} = \frac{mgh}{\Delta t} = \frac{(65)(9.8)(5.0)}{3.57} = 892\,W$

b) $P = \frac{E}{t} \leftarrow mgh \rightarrow h = \Delta d \rightarrow \Delta d = v\Delta t \therefore mgv$

$mgv = (65)(9.8)(1.4) = 892\,W$

5. $1\,kWh = 3.6\,MJ$

$\frac{1\,kw}{h} \times \frac{1000\,W}{kw} \times \frac{3600\,s}{h} = 3.6 \times 10^6\,J$

$= 3.6\,MJ$