Work, Power and Energy - Key

Note Title 6/8/2015

1. $W = Fd = (25)(10) = \boxed{250\ J}$

2. $W = Fd = \underbrace{(15 \times 9.8)}_{F}(2.0) = 294\ J = \boxed{290\ J}$ (2 sig figs)

3. $P = \frac{W}{t} = \frac{\overbrace{(75 \times 9.8)}^{F}(3.0)}{4.2} = 525\ W = \boxed{530\ W}$

4. $P = \frac{W}{t} \qquad t = \frac{W}{P} = \frac{75}{100} = \boxed{0.75\ s}$

5. a) $W = \Delta E = mgh_f - mgh_i = mg(h_f - h_i)$
$= (50)(9.8)(50 - 0)$
$= \boxed{24,500\ J}$

b) $W = (50)(9.8)(50 - 30)$
$= \boxed{9800\ J}$

6. $E_k = \frac{1}{2}mv^2 \qquad m = 50g \overset{\div 1000}{=} 0.05\ kg$
$= \frac{1}{2}(0.05)(6.0)^2$
$= \boxed{0.9J}$

7. $E_{TOT} = E_k + E_p$
$= 0.9 + mgh$
$= 0.9 + (0.05)(9.8)(15)$
$= 0.9 + 7.35$
$= 8.25\ J = \boxed{8.3J}$

8. $E_{ki} + E_{pi} = E_{kf} + \cancel{E_{pf}}^{\,0}$
$8.25 = \frac{1}{2}mV_f^2$
$8.25 = \frac{1}{2}(0.05)V_f^2$

$$\frac{16.5}{0.05} = V_f^2$$

$$\sqrt{330} = \sqrt{V_f^2} \qquad V_f = 18.2 \, m/s = 18 \, m/s$$

9. $\cancel{E_{ki}}^{0} + E_{pi} = E_{kf} + \cancel{E_{pf}}^{0}$

($V_i = 0$ dropped) $\cancel{m}gh_i = \frac{1}{2}\cancel{m}v_f^2$ ($h_f = 0$)

$$(9.8)(15) = \frac{1}{2} V_f^2$$

$$\sqrt{294} = \sqrt{V_f^2} \qquad \vec{V_f} = 17.1 \, m/s = 17 \, m/s$$

10. $E_{ki} + E_{pi} = E_{kf} + E_{pf}$

$\frac{1}{2}\cancel{m}v_i^2 + \cancel{m}gh_i = \frac{1}{2}\cancel{m}\cancel{v_f^2}^{0} + \cancel{m}gh_f$

($V_f = 0$)

$$\frac{1}{2}(20)^2 + (9.8)(1.5) = (9.8)h_f$$

$$\frac{214.7}{9.8} = \frac{9.8\,h_f}{9.8} \qquad h_f = 21.9 \, m = 22m$$

11. $E_{ki} + E_{pi} = E_{kf} + E_{pf} + E_H$

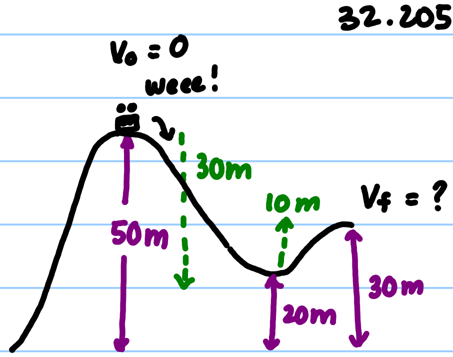
Some energy was converted to heat due to friction.

12. $$Eff = \frac{\text{useful output}}{\text{total input}} \times 100\%$$

$$\frac{1}{2}(0.150)(20)^2 + (0.150)(9.8)(1.5) = 0 + (0.150)(9.8)(17.34) + E_H$$

$$\underbrace{30 + 2.205}_{\text{Total input}} = \underbrace{25.4898}_{\text{useful output}} + E_H$$

$$Eff = \frac{25.4898}{32.205} \times 100\% = 79.15\% = 79\%$$

13. 

$E_{pi} + \cancel{E_{ki}}^{0} = E_{pf} + E_{kf}$

$\cancel{m}gh_i = \cancel{m}gh_f + \frac{1}{2}\cancel{m}v_f^2$

$$(9.8)(50) = (9.8)(30) + \frac{1}{2} V_f^2$$

$$490 = 294 + \frac{1}{2} V_f^2$$

$$\sqrt{392} = \sqrt{V_f^2} \qquad V_f = 19.799 = 20 \, m/s$$

14. $m = 500g \xrightarrow{\div 1000} = 0.5\ kg$

$$E_{pi} + \cancel{E_{ki}}^{0} = E_{pf} + \cancel{E_{kf}}^{0} + E_H$$

$$mgh_i = mgh_f + E_H$$

$$(0.5)(9.8)(5) = (0.5)(9.8)(4) + E_H$$

$$\underbrace{24.5}_{\text{Total Input Energy}} = \underbrace{19.6}_{\text{Useful Output Energy}} + E_H$$

$$Eff = \frac{\text{useful output}}{\text{total input}} \times 100\% = \frac{19.6}{24.5} \times 100\% = \boxed{80\%}$$

15. $V_i = 14\ m/s$

$h_i = 5.0m$

$h_f = ?$

$V_f = 0$

Assume 100% efficiency (no Energy "lost")

$$E_{pi} + E_{ki} = E_{pf} + \cancel{E_{kf}}^{0}$$

$$\cancel{m}gh_i + \frac{1}{2}\cancel{m}v_i^2 = \cancel{m}gh_f$$

$$(9.8)(5) + \frac{1}{2}(14)^2 = (9.8)h_f$$

$$49 + 98 = 9.8h_f$$

$$147 = 9.8\ h_f$$

$$\boxed{h_f = 15\ m}$$