Energy practice problems:

1. A brick is dropped from a height of 29 m. When it is moving 15 m/s, what is its altitude? $h_f = 17.5\,m$

2. A roller coaster is moving 20 m/s and goes up a 40° hill. How far up <u>along</u> the hill does it go? $d = 31.7\,m$

3. A block moving on a frictionless floor at 15 m/s hits an area where the coefficient of kinetic is 0.35 and slides to a stop. How far did it move while sliding? $d = 32.8m$

4. A block slides down a 35° hill whose coefficient of kinetic friction is 0.25. The hill is 10 m high. What is its final speed? $V_f = 11.2\,\frac{m}{s}$

5. A 0.35 kg block moving 2m across a frictionless floor at 4 m/s hits a spring with a spring constant of 275 N/m. How far is the spring compressed? $\Delta X = 0,143\,m$

6. A 5 kg mass sliding at $v_i = 12$ m/s on level ground goes up a hill. (a) What is its speed (v_1) when it is $h_1 = 3$ m above ground? (EC) It goes over the hill. What is its height (h_2) when it is going $v_2 = 10$ m/s? $V_1 = 9.23\,\frac{m}{s}$ $h_1 = 2.24\,m$

Energy practice – solutions

1) $h_i = 29\text{ m}$, $v_i = 0\ \frac{m}{s}$, $v_f = 15\ \frac{m}{s}$, $h_f = \_\_\_\_\ m$

$K_i + U_{gi} = K_f + U_{gf}$

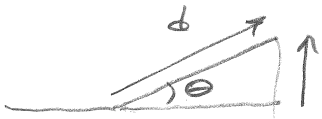
$\frac{1}{2}mv_i^2 + mgh_i = \frac{1}{2}mv_f^2 + mgh_f$

$h_f = \frac{2gh_i - v_f^2}{2g}$

$h_f = \frac{2(9.8\ \frac{m}{s^2})(29\text{ m}) - (15\ \frac{m}{s})^2}{2(9.8\ \frac{m}{s^2})}$

$\boxed{h_f = 17.5\text{ m}}$

2) $v_i = 20\ \frac{m}{s}$, $\theta = 40°$, $d = \_\_\_\_\ m$



$h = d\sin\theta$

$K_i + U_{gi} = K_f + U_{gf}$

$\frac{1}{2}mv_i^2 = mgh_f$

$v_i^2 = 2gd\sin\theta$

$d = \frac{v_i^2}{2g\sin\theta}$

$= \frac{(20\ \frac{m}{s})^2}{2(9.8\ \frac{m}{s^2})\sin 40°}$

$\boxed{d = 31.7\text{ m}}$

3) $v_i = 15\ \frac{m}{s}$, $\mu_k = 0.35$, $v_f = 0\ \frac{m}{s}$, $d = \_\_\_\_\ m$

$K_i + U_{gi} = K_f + U_{gf} + E_{cost}$

$\frac{1}{2}mv_i^2 = E_{cost}$

$mv_i^2 = 2f_k d$

$mv_i^2 = 2\mu_k mgd$

$d = \frac{v_i^2}{2\mu_k g}$

$= \frac{(15\ \frac{m}{s})^2}{2(0.35)9.8\ \frac{m}{s^2}}$

$\boxed{d = 32.8\text{ m}}$

4) $v_i = 0\ \frac{m}{s}$, $\theta = 35°$, $\mu_k = 0.25$, $h = 10\text{ m}$, $v_f = \_\_\_\_\ \frac{m}{s}$

$K_i + U_{gi} = K_f + U_{gf} + E_{cost}$

$2mgh = \frac{1}{2}mv_f^2 + 2f_k d$

$2mgh = mv_f^2 + 2\mu_k mg(\cos\theta)d$

$v_f = \sqrt{2g\left(h - \mu_k(\cos\theta)\frac{h}{\sin\theta}\right)}$

$= \sqrt{2(9.8\ \frac{m}{s^2})\left(10\text{ m} - 0.25(\cos 35°)\left(\frac{10\text{ m}}{\sin 35°}\right)\right)}$

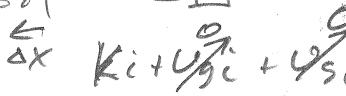
$\boxed{v_f = 11.2\ \frac{m}{s}}$

$h = d\sin\theta$

$d = \frac{h}{\sin\theta}$

$d = 17.4\text{ m}$

5) $v_i = 4\ \frac{m}{s}$, $k = 275\ \frac{N}{m}$, $m = 0.35\text{ kg}$, $\Delta x = \_\_\_\_\ m$



$K_i + U_{gi} + U_{si} = K_f + U_{gf} + U_{si}$

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

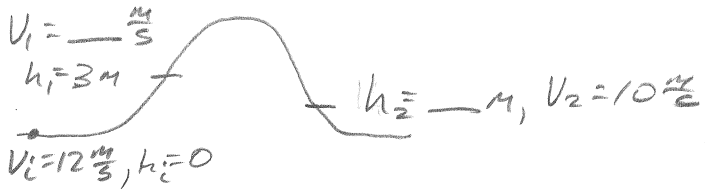
$x = \sqrt{\frac{mv^2}{k}}$

$= \sqrt{\frac{0.35\text{kg}\left(4\ \frac{m}{s}\right)^2}{275\ \frac{N}{m}}}$

$\boxed{x = 0.143\text{ m}}$

6) $M = 5\,kg$

$V_i = 12\,\frac{m}{s}$



a) $V_1 = \_\_\_\ \frac{m}{s}$ when $h_1 = 3m$

$h_2 = \_\_\_ m$

$V_2 = 10\,\frac{m}{s}$

$$K_i + \cancel{U_{gi}^{0}} = K_f + U_{gf}$$

$$\tfrac{1}{2} M V_i^2 = \tfrac{1}{2} M V_f^2 + M g h_1$$

$$V_1 = \sqrt{V_i^2 - 2 g h_1}$$

$$= \sqrt{(12\,\tfrac{m}{s})^2 - 2(9.8\,\tfrac{m}{s^2})\,3m}$$

a) $\boxed{V_1 = 9.23\,\frac{m}{s}}$

$$K_i + \cancel{U_{gi}^{0}} = K_f + U_{gf}$$

$$\tfrac{1}{2} M V_i^2 = \tfrac{1}{2} M V_f^2 + M g h_2$$

$$h_2 = \frac{V_i^2 - V_f^2}{2g}$$

$$= \frac{(12\,\frac{m}{s})^2 - (10\,\frac{m}{s})^2}{2(9.8\,\frac{m}{s^2})}$$

EC) $\boxed{h_2 = 2.24\,m}$