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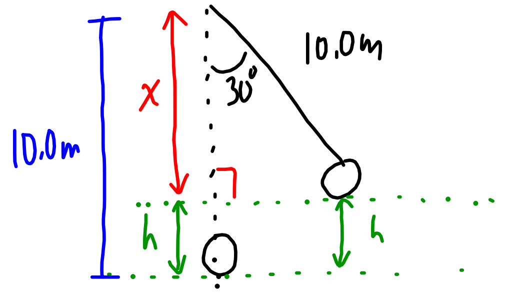
5.



To find x:

$$\cos\theta = \frac{adj}{hyp}$$

$$\cos 30^\circ = \frac{x}{10.0\,m}$$

$$x = (10.0\,m)\cos 30^\circ$$

$$x = 8.66\,m$$

$$h = 10.0\,m - 8.66\,m$$
$$h = 1.34\,m$$

a) $E_g = mgh$ (at top)

b) At the bottom: $E_K = E_g$ (at top)

$$E_{TOT} = E'_{TOT}$$
(top) (bottom)

$$E_g + \cancel{E_K}_{0} = \cancel{E'_g}_{0} + E'_K$$

c) $E_K = \frac{1}{2}mv^2$

6.

Lead Ball (2.5 kg)

(top) (bottom)

$E_{TOT} = E'_{TOT}$

$E_g + \cancel{E_k}_{0} = \cancel{E'_g}_{0} + E'_k$

$mgh = E'_k$

$(2.5\,kg)(9.81\,\frac{m}{s^2})(25\,m) = E'_k$

$E'_k = 6.1 \times 10^2\,J$

so $E_k = \frac{1}{2}mv^2$

$6.1 \times 10^2\,J = \frac{1}{2}(2.5\,kg)v^2$

$v = 22\,m/s$

Lead Shot (55g)

(top) (bottom)

$E_{TOT} = E'_{TOT}$

$E_g + \cancel{E_k}_{0} = \cancel{E'_g}_{0} + E'_k$

$mgh = E'_k$

$(0.055\,kg)(9.81\,m/s^2)(25\,m) = E'_k$

$E'_k = 13\,J$

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

$13\,J = \frac{1}{2}(0.055\,kg)v^2$

$v = 22\,m/s$

OR

$v_2^2 = v_1^2 + 2a\Delta d$

$v_2^2 = 0 + 2(-9.81\,m/s^2)(-25\,m)$

$v_2 = 22\,m/s$

Conservation of Energy ($E_e + E_k$)

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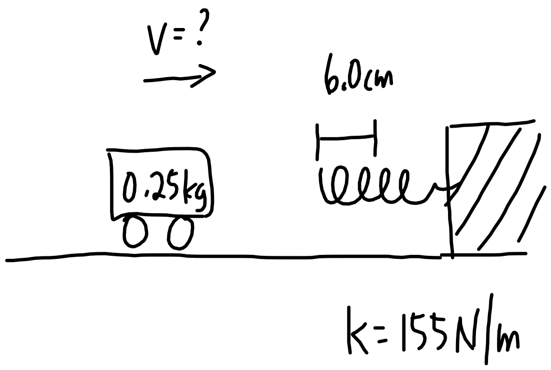

$$E_{TOT} = E_{TOT}'$$

(cart moving) (spring compressed)

$$\cancel{E_e}^{0} + E_k = E_e' + \cancel{E_k'}^{0}$$

$$\cancel{\tfrac{1}{2}}mv^2 = \cancel{\tfrac{1}{2}}kx^2$$

$$v^2 = \frac{kx^2}{m}$$

$$v^2 = \frac{\left(155\frac{N}{m}\right)(0.060\,m)^2}{0.25\,kg}$$

$$\boxed{v = 1.5}\ m/s$$

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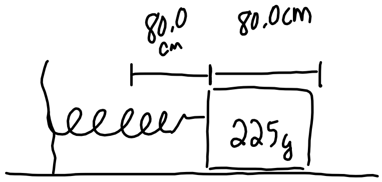

$k = 145\,N/m$

a) $v_{max} = ?$

b) $x = ?$ when $\frac{1}{2} v_{max}$

b) $E_{TOT} = E_{TOT}'$

(fully stretch) (partial stretch)

$$E_e + \cancel{E_k} = E_e' + E_k'$$
$$\quad\;\; 0$$

$$\cancel{\tfrac{1}{2}} k x_1^2 = \cancel{\tfrac{1}{2}} k x_2^2 + \cancel{\tfrac{1}{2}} m v^2$$

$$\left(145 \tfrac{N}{m}\right)(0.800 m)^2 = \left(145 \tfrac{N}{m}\right) x_2^2 + (0.225 kg)(10.15 m/s)^2$$

$$92.8 J = \left(145 \tfrac{N}{m}\right) x_2^2 + 23.2 J$$

$$69.6 J = \left(145 \tfrac{N}{m}\right) x_2^2$$

$$x_2^2 = 0.480 m^2$$

$x_2 = \pm 0.693 m$

($\pm$69.3 cm)

stretch (+)
compression (−)

a) The maximum velocity occurs when the kinetic energy is a maximum and the potential energy is a minimum (i.e. at the equilibrium position)

$E_{TOT} = E_{TOT}'$

(max stretch) (equilibrium)

$$E_e + \cancel{E_k} = \cancel{E_e'} + E_k'$$
$$\quad\;\; 0 \qquad\quad 0$$

$$\cancel{\tfrac{1}{2}} k x^2 = \cancel{\tfrac{1}{2}} m v^2$$

$$v^2 = \frac{k x^2}{m}$$

$$v^2 = \frac{(145 N/m)(0.800 m)^2}{0.225 kg}$$

$v = \pm 20.3 m/s$

The maximum velocity (+ away / − towards)

TODO

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