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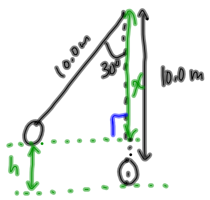
5.

$m = 315\,kg$

$l = 10.0\,m$

$\theta = 30.0°$



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

$\cos 30° = \frac{x}{10.0\,m}$

$x = (10.0\,m)(\cos 30.0°)$

$x \doteq 8.66\,m$

a) $E_g = ?$

b) $E_K = ?$ (at lowest point)

c) $V = ?$ (at lowest point)

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

$h \doteq 1.34\,m$

a) $E_g = mgh$

$E_g = (315\,kg)(9.81\,m/s^2)(1.34\,m)$

$E_g \doteq 4.14 \times 10^3\,J$

Since $E_k = 0$, the total energy is $4.14 \times 10^3\,J$ (at the highest point)

b) at the lowest point, $E_g = 0$, so all the energy is kinetic energy and $E_K = 4.14 \times 10^3\,J$

c) the speed at the lowest level:

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

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

$v^2 = \frac{2(4.14 \times 10^3\,J)}{315\,kg}$

$v \doteq 5.13\,m/s$

If you had only been asked to find the speed at the bottom:

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

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

$\cancel{m}gh = \frac{1}{2}\cancel{m}v^2$

$v^2 = 2gh$

$v^2 = 2(9.81\,m/s^2)(1.34\,m)$

$v \doteq 5.13\,m/s$

Elastic Potential Energy + Kinetic Energy

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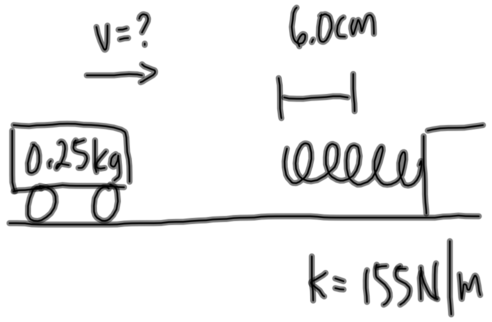

$$E_{total} = E'_{total}$$

(before the cart hits spring) (spring compressed to a maximum)

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

$$0 \qquad\qquad\qquad\qquad 0$$

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

$$mv^2 = kx^2$$

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

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

$$v \doteq 1.5\,m/s$$

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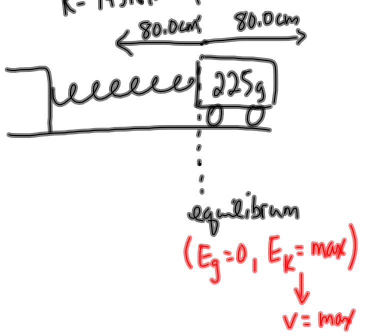
$k = 145\,N/m$



a) $v_{max} = ?$ (occurs at equilibrium)

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

a) $E_{total} = E'_{total}$

(full stretch) (equilibrium)

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

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

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

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

$$v = \pm 20.3\,m/s$$

b) What is x when $v = \frac{1}{2}(20.3\,m/s)$

$v = 10.2\,m/s$?

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

(fully stretched) (partial stretch)

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

$$\cancel{\tfrac{1}{2}}kx_1^2 = \cancel{\tfrac{1}{2}}kx_2^2 + \cancel{\tfrac{1}{2}}mv^2$$

$$kx_1^2 = kx_2^2 + mv^2$$

$$(145\,N/m)(0.800\,m)^2 = (145\,N/m)x_2^2 + (0.225\,kg)(10.2\,\tfrac{m}{s})^2$$

$$92.8\,J = (145\,N/m)x_2^2 + 23.409\,J$$

$$69.391\,J = (145\,N/m)x_2^2$$

$$x_2^2 = \frac{69.391\,J}{145\,N/m}$$

$$x_2 = \pm 0.692\,m \quad \text{or} \quad 69.2\,cm$$

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answer 9b 3.4 m/s (answer in back is wrong)