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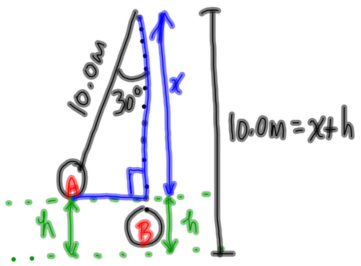
5.



$m = 315\,kg$

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

$\cos 30° = \frac{x}{10.0m}$

$x = (10.0m)\cos 30°$

$x = 8.66m$

$\therefore h = 10.0m - 8.66m$

$\boxed{h = 1.34m}$

According to the Law of Conservation of Energy:

$E_{total(A)} = E_{total(B)}$

$E_{g(A)} + \cancel{E_{k(A)}}^{0} = \cancel{E_{g(B)}}^{0} + E_{k(B)}$

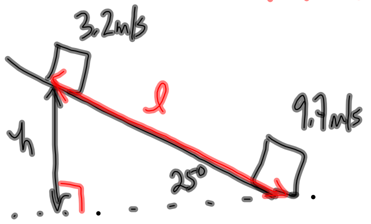
a) $E_g = mgh_A$

b) $E_{g(A)} = E_{k(B)}$

c) $E_{k(B)} = \frac{1}{2}mv_B^2$

↑ solve for v_B

7.



$E_{total(top)} = E_{total(bottom)}$

$E_{g(top)} + E_{k(top)} = \cancel{E_{g(bottom)}}^{0} + E_{k(bottom)}$

$\cancel{m}gh + \frac{1}{2}\cancel{m}v_1^2 = \frac{1}{2}\cancel{m}v_2^2$

↑ find h

↓

then find l (trig)

Elastic Potential Energy + Kinetic Energy

Recall: $E_k = \frac{1}{2}mv^2$ and $E_e = \frac{1}{2}kx^2$ $(F_a = kx)$

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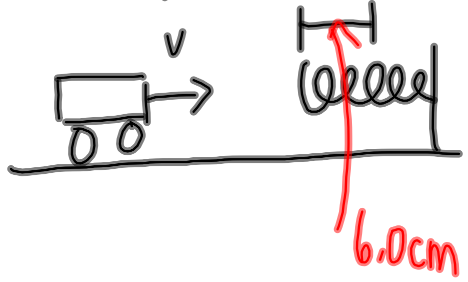
$m = 0.25\,kg$ $k = 155\,N/m$



* When the spring is fully compressed, the velocity of the cart is ZERO!

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

(before compression) (max compression)

$$E_k + \cancel{E_e}^{\,0} = \cancel{E'_k}^{\,0} + E'_e$$

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

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

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

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

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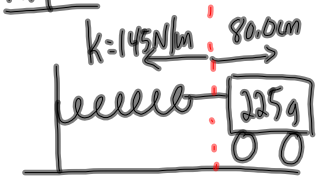

equilibrium position (spring is not stretched / compressed)

* The cart is going the fastest when it passes through the equilibrium position ($E_e=0$, E_k is maximum)

a) $V_{max}=?$

b) $x=?$, $\frac{1}{2}V_{max}$

a)
$$E_{total} = E'_{total}$$
(max stretch) (equilibrium)
$$E_e + \cancel{E_k}_0 = \cancel{E_e'}_0 + E_k'$$
$$\cancel{\tfrac{1}{2}}kx^2 = \cancel{\tfrac{1}{2}}mv^2$$
$$kx^2 = mv^2$$
$$v^2 = \frac{kx^2}{m}$$
$$v^2 = \frac{(145N/m)(0.800m)^2}{0.225kg}$$
$$\boxed{v = \pm 20.3m/s}$$

b) If $v = \frac{20.3m/s}{2} = 10.15436m/s$, $x=?$

$$E_{total} = E'_{total}$$
(fully stretched) (partially stretched)
$$E_e + \cancel{E_k}_0 = E_e' + E_k'$$
$$E_e = E_e' + E_k'$$
$$\cancel{\tfrac{1}{2}}kx_1^2 = \cancel{\tfrac{1}{2}}kx_2^2 + \cancel{\tfrac{1}{2}}mv^2$$
$$(145\tfrac{N}{m})(0.800m)^2 = (145\tfrac{N}{m})x_2^2 + (0.225kg)(10.15\ m/s)^2$$
$$92.8J = (145\tfrac{N}{m})x_2^2 + 23.18J$$
$$69.6J = (145\tfrac{N}{m})x_2^2$$
$$\boxed{x = \pm 0.693m}$$

TO DO

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