Conservation of Energy

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

$$E_g + E_e + E_k = E_g' + E_e' + E_k'$$

$E_g = mgh$

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

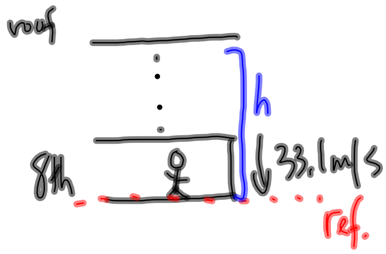
$E_k = \frac{1}{2}mv^2$

pp/287

8. $m = 0.125\,kg$

$V_2 = 33.1\,m/s$

$V_1 = 0\,m/s$



$E_g = ?$ $E_k = 0$

$E_g = 0$ $E_k = \frac{1}{2}mv^2$

1st floor = 12.0m

all others = 8.00m

a) x floors = ?

b) $V_{ground} = ?$

c) $E_K = ?$ (at ground)

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

(on the roof) (at the 8th floor)

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

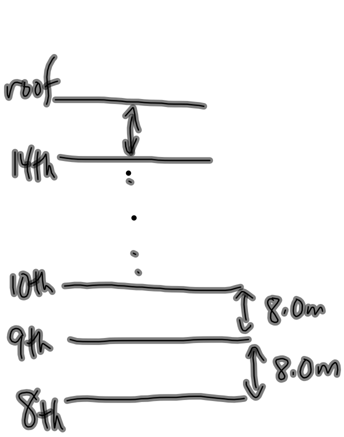
$\cancel{m}gh = \frac{1}{2}\cancel{m}v^2$

$h = \frac{v^2}{2g}$

$h = \frac{(33.1\,m/s)^2}{2(9.81\,m/s^2)}$

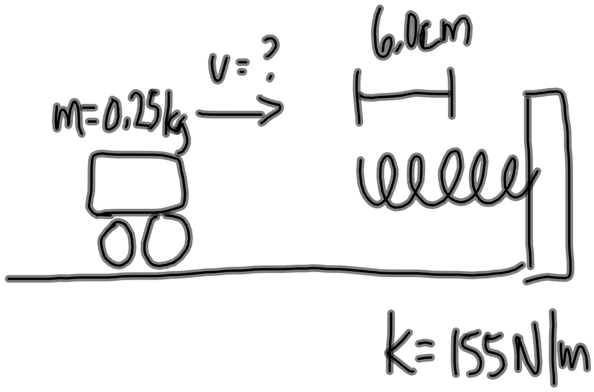
$h = 55.84\,m$

$\div 8 = 7$ floors (includes the 8th)



$\therefore$ **14 floors**

mp|292



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

(before) (compressed)

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

(0) (0)

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

$$mv^2 = kx^2$$

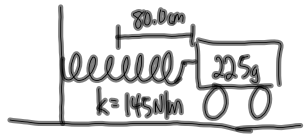
$$v^2 = \frac{kx^2}{m}$$

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

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

The cart was going $1.5\frac{m}{s}$ before hitting the spring bumper.

MP|294



a) $v_{max} = ?$ (occurs at the equilibrium position i.e. not stretched or compressed)

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

a)

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

(fully compressed) (equilibrium)

$$E_e + E_k = E'_e + E'_k$$

($E_k = 0$, $E'_e = 0$)

$$E_e = E'_k$$

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

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

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

max velocity occurs at equilibrium → $v = 20.3m/s$

b) where is the cart when going $\frac{1}{2}v_{max} = \frac{1}{2}(20.3m/s)$
$= 10.15m/s$

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

(fully compressed) (partially compressed)

$$E_e + E_k = E'_e + E'_k$$

($E_k = 0$)

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

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

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

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

$$69.6J = (145\frac{N}{m})x_2^2$$

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

$$x_2 = \pm 0.693\ m$$

PP|296