# Spring Energy Questions

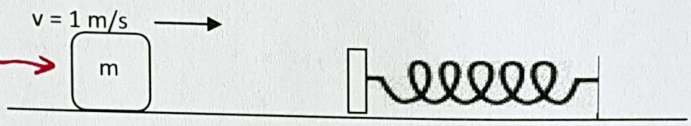
Show all work for your solutions.

$$F = k\Delta x \qquad E_s = \frac{1}{2}k\Delta x^2 \qquad E_T = E_g + E_k + E_s$$

$$W = \Delta E_k \qquad W = \Delta E_k \qquad W = \Delta E_s \qquad f_g = mg$$

1. A 3 kg mass, moving on a horizontal frictionless surface, collides with a spring bumper that has a spring constant of 100 N/m.

$E_K = \frac{mv^2}{2} = 1.5J$




a) $E_s = \frac{K\Delta x^2}{2} = 0.5J$

b) $E_K = 1.5J - 0.5J = 1J$

   a) Calculate the spring potential energy stored in the spring when it is compressed 0.10 m the mass?
   b) Calculate the kinetic energy of the mass at 0.10 m compression. Also, calculate its velocity at this point.
   c) Calculate the maximum compression of the spring

c) $E_K = E_s$

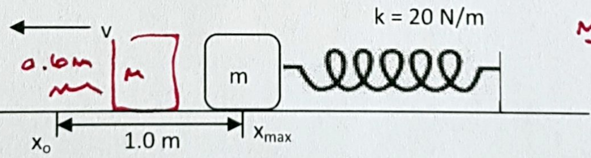
$1.5J = \frac{K\Delta x^2}{2} \rightarrow \Delta x = 0.17\,m = 17\,cm$

2. A spring having a force constant of 20 N/m is compressed 1.0 m. A 2.0 kg mass is then placed against the end and released. (frictionless).

a) $E_{S1} = E_K + E_S$

$\frac{K\Delta x_1^2}{2} = \frac{mv^2}{2} + \frac{K\Delta x_2^2}{2}$

$v = \sqrt{\frac{K(\Delta x_1^2 - \Delta x_2^2)}{m}} = 2.53\,m/s$



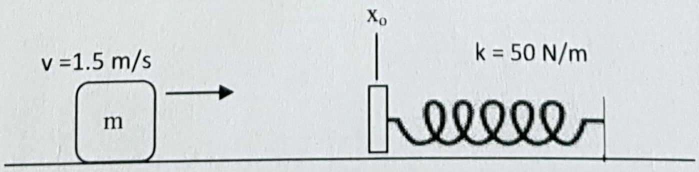

b) $E_K = E_S$ ← all energy released to $E_K$.

$\frac{mv^2}{2} = \frac{K\Delta x^2}{2}$

$v = \sqrt{\frac{K\Delta x^2}{m}} = 3.2\,m/s$

   a) Calculate the velocity of the mass at 0.6 m compression from $x_o$.
   b) Calculate the velocity that the mass will leave the spring?

3. The 2.0 kg mass shown collides with the horizontal spring. Using the data given in the diagram, calculate:




a) $E_K = E_S$

$\frac{mv^2}{2} = \frac{K\Delta x_{max}^2}{2}$

$\Delta x_{max} = \sqrt{\frac{mv^2}{K}} = 0.3\,m$ or $30\,cm$

   a) the maximum compression in the spring.
   b) the velocity of the mass at a compression of 0.20 m.

b) $E_{K1} = E_{K2} + E_s$

$\frac{mv_1^2}{2} = \frac{mv_2^2}{2} + \frac{K\Delta x^2}{2} \rightarrow v_2^2 = \frac{mv_1^2 - K\Delta x^2}{m}$

$v_2 = \sqrt{\frac{mv_1^2 - K\Delta x^2}{m}} = 1.1\,m/s$