A ball of mass 2.0 kg is released from rest at a height 60 cm above a light vertical spring of force constant k. the ball strikes the top of the spring and it compresses it a distance of 10 cm. Neglecting any energy loss during the collision, find the speed of the ball just as it touches the spring? The force constant k of the spring?

Solution:

Let:

$m = 2.0\ kg$

$h = 60\ cm = 0.6\ m$

$x = 10\ cm = 0.1\ m$

$v - ?, k - ?$

According to the low of conservation energy the changing of potential energy of the ball is equal to changing of potential energy of the string:

$\Delta E = \Delta W =>$

$mg\Delta H = \frac{1}{2}kx^2,$ were g is the acceleration due to gravity.

$mg(h + x) = \frac{1}{2}kx^2$

$k = \frac{2mg(h+x)}{x^2}$

$k = \frac{2*9.8*(0.6+0.1)}{0.1^2} = 1372\ N/m$

From: $h = \frac{1}{2}gt^2, v = gt$

$h = \frac{v^2}{2g} => v = \sqrt{2gh}$

$v = \sqrt{2 * 9.8 * 0.6} = 3.43\ m/s$

Answer: $v = 3.43\ m/s, k = 1372\ N/m$.