A ball sits on a spring that has a spring constant of 3500 N/m. the spring is compressed downward by 10 cm and at an angle that is 25° above the horizontal. At this time the ball is in a position that is 7.5 meters above the ground. The spring is released and the ball shoots upward. Find the speed of the ball just prior to hitting the ground. The ball has a mass of 0.125 kg. Ignore air resistance.

(It is asked to find the speed of the ball, not the velocity, this gives us a clue that the direction of motion is not required when the ball just to hit the ground. If they ask for velocity then only we have to solve using projectile motion and that enables us to find the angle at which the ball strikes the ground. Here the problem can be just solved simply by using the law of conservation of mechanical energy.)

Solution:

The spring constant of the ball is K = 3500 N/m,

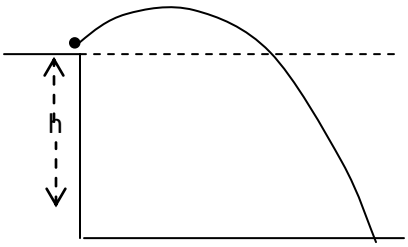
Compression in the spring Δl = 10 cm = 0.1 m,

Mass of the ball is m = 0.125 kg and

The height above ground is h = 7.5 m.

As the spring is released, loss is elastic potential energy of the spring is given by

$U_E = (1/2)\ K\ (\Delta l)^2$



The loss in the gravitational potential energy of the ball when the ball reaches the ground is given by

$U_G = m*g*(h_2 - h_1) = m*g*h$

Gain in the kinetic energy of the ball if its speed is v, just before reaching ground is

$E = (1/2)\ m*v^2$

Hence as the air resistance can be neglected applying law of conservation of energy we get

Gain in kinetic energy = loss in elastic potential energy

+ loss in gravitational potential energy

Or $(1/2)\ m*v^2 = (1/2)\ K\ (\Delta l)^2 + m*g*h$

or $v^2 = K(\Delta l)^2/m + 2gh$

or $$v^2 = \frac{3500*(0.1)^2}{0.125} + 2*9.8*7.5 = 280.0 + 147.0 = 427.0$$

gives v = 20.66 m/s.