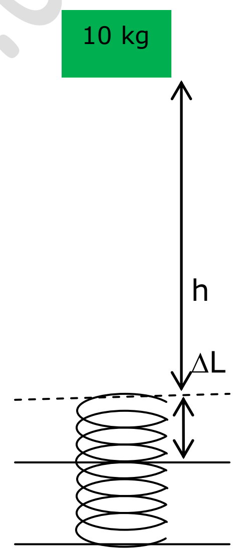
Q- Q- A particle with mass 10 kg falls from a height of 1.5 m on a vertically mounted spring. If the spring constant is 4000 N/m, calculate the maximum compression in the spring.

Mass of the particle	m = 10 kg
Height fallen before touching the spring	h = 1.5 m
Spring constant	K = 4000 N/m

Let the maximum compression in the spring is ΔL, which is at the moment when the particle will just come to rest before moving up again. In this situation the loss is height of the particle will be $h + \Delta L$.

According to law of conservation of energy as the initial and final kinetic energy of the particle is zero we can write

Gain in elastic potential energy of spring = loss in gravitation potential energy



Or $\frac{1}{2} K (\Delta L)^2 = mg(h + \Delta L)^2$

Substituting the values we get

$$\frac{1}{2} * 4000 * \Delta L^2 = 10 * 9.8(1.5 + \Delta L)$$

Or $2000\, \Delta L^2 = 147 + 98\, \Delta L$

Or $2000\, \Delta L^2 - 98\, \Delta L - 147 = 0$

Or $$\Delta L = \frac{-(-98) \pm \sqrt{(-98)^2 - 4*2000*(-147)}}{2*2000}$$

Or $$\Delta L = \frac{98 \pm \sqrt{9604+1176000)}}{2*2000} = \frac{98 \pm 1084.5}{2*2000}$$

Or $$\Delta L = \frac{98 \pm 1084.5}{2*2000} = 0.295\, m$$ (cannot be negative thus + sign is taken)

Hence the compression in the spring will be 0.30 m or 30 cm.