110.

A block of mass M, at rest on a horizontal frictionless table, is attached to a rigid support by a spring of constant k. A bullet of mass m and velocity v strikes the block as shown in the diagram. The bullet remains embedded in the block. We have to determine (a) *the velocity of the block immediately after the collision and* (b) *the amplitude of the resulting simple harmonic motion.*
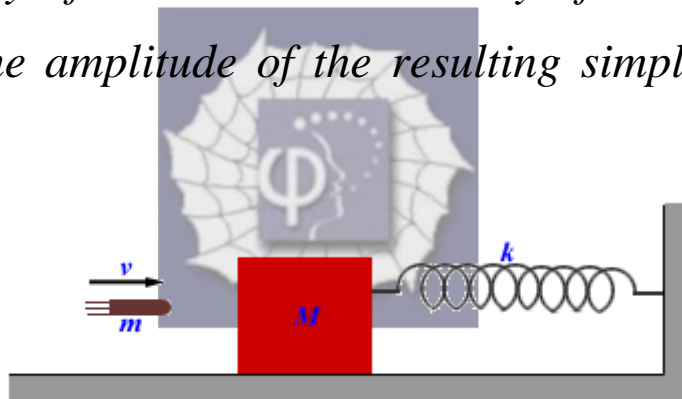
Solution:

(a)

A bullet of mass m moving with speed v strikes a block of mass M and gets embedded in it. It is an inelastic collision. In an inelastic collision although motion energy is not a constant of motion, momentum is conserved. Initial speed of the block of mass M with bullet of mass m embedded in it immediately after the collision will be

$$V = \frac{mv}{(m+M)} \; .$$

(b)

The block is attached to a spring having spring constant, k. Therefore, the block after being struck by the bullet will execute SHM. Amplitude, a, of the SHM can be calculated by requiring

$$\frac{1}{2}ka^2 = \frac{1}{2}(m+M)V^2 \; ,$$

$$= \frac{1}{2} \times \frac{m^2v^2}{(m+M)} \; ,$$

or

$$a = \frac{mv}{\sqrt{k(m+M)}} \; .$$