Question #82155, Physics / Mechanics | Relativity

A bullet of mass m and speed v is fired at an at rest pendulum bob. The bullet goes through the bob, and exits with a speed of v/3. The pendulum bob is attached to a rigid pole of length L and negligible mass. What is the minimum value of v such that the pendulum bob will barely swing through a complete vertical circle?

Solution

Conservation of momentum gives

$$mv = MV + \frac{mv}{3}$$

$$V = \frac{2mv}{3M}$$

From the conservation of energy:

$$\frac{1}{2}MV^2 = Mg(2L)$$

$$\frac{1}{2}V^2 = g(2L)$$

$$V^2 = 4gL$$

Thus,

$$\left(\frac{2mv}{3M}\right)^2 = 4gL$$

$$v = \left(\frac{3M}{m}\right)\sqrt{gL}$$