

### Answer on Question #77167 Physics / Other

A  $m = 38$  g bullet is fired horizontally with a speed of  $v = 180$  m/s at a  $M = 5$  kg sandbag suspended on a light rod  $l = 1.5$  m high forming a pendulum that is free to swing. To what maximum angle will the pendulum swing to?

#### Solution:

Using the law of conservation of momentum we get

$$mv = (M + m)u$$

The law of conservation of energy gives

$$\frac{(M + m)u^2}{2} = (M + m)gh$$

So

$$h = \frac{u^2}{2g} = \left(\frac{m}{M + m}\right)^2 \frac{v^2}{2g}$$

The maximum angle

$$\begin{aligned}\theta &= \arccos \frac{l - h}{l} = \arccos \left(1 - \left(\frac{m}{M + m}\right)^2 \frac{v^2}{2gl}\right) = \\ &= \arccos \left(1 - \left(\frac{0.038}{5 + 0.038}\right)^2 \frac{180^2}{2 \times 9.8 \times 1.5}\right) = 20^\circ\end{aligned}$$

**Answer:**  $20^\circ$

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