A bullet of mass 28 grams is fired into a block of mass 1.35 kg. The velocity of the bullet is 275 m/s and it stops inside the block. The block M is part of a pendulum of pendulum of length L = 2.00 m, as shown.

(a) Calculate the maximum value of the angle \( \theta \) that the pendulum achieves.

(b) Calculate the tension in the string when \( \theta = \theta_{\text{max}}/2 \).

\[ \Sigma F_y = T - M_Tg\cos\alpha = M_T\frac{v_c^2}{L} \]

\[ T = M_T \left( \frac{v_c^2}{L} + g\cos\alpha \right) \]

Use energy conservation to find \( v_c \):

\[ \frac{1}{2} M_T v_c^2 = \frac{1}{2} M_T v_a^2 + M_T g h_c \]

\[ v_c^2 = v_a^2 = 2gL(1 - \cos\alpha) \]

\[ T = M_T \left[ \left( \frac{v_c^2}{L} + g\cos\alpha \right) + \frac{3}{2} \right] \]

\[ T = (1.378) \left( \frac{1}{2} \frac{\text{m/s}^2}{\text{m}^2} \right) + 3.18\cos(37.8^\circ) \cos(25.9^\circ) \]

\[ T = 2.593 \text{ N} \Rightarrow T = 25.9 \text{ N} \]

**Part a**

- Tried to do problem without breaking up into parts. Must have a collision part and a pendulum swinging part. Why? Because without knowing how much energy was dissipated in collision (heat, noise, friction etc.), mechanical energy is not conserved. So must use collision approximation.

\[ \frac{1}{2} M_V v_a^2 \neq \frac{1}{2} M_T v_c^2 + M_T g h_{\text{max}} \]

Also, in a stickinelastic collision, only momentum is conserved, not kinetic energy too.

**Part b**

- Must realize that \( v \) points in direction of \( \vec{F}_N \) is not pointing in horizontal direction as this would mean the pendulum is swinging in a horizontal instead of a vertical circle. direction as this would mean the pendulum is swinging in a horizontal instead of a vertical circle. Also, \( v_a^2 \) was incorrectly solved for:

1. \( v_a^2 \neq v_a^2 \)
2. \( \frac{1}{2} M_T v_a^2 \neq M_T g h_c \)
3. \( h_c \neq h_{\text{max}} \)