FIRST MIDTERM

Name (print) #. = 239 Name (signed) Avg. 17.6

Discussion Instructor (circle one): Chen Emerson Iguchi Stoops

Discussion Section #__________ σ ~ 6.5

SHOW ALL WORK!!!
REPORT ALL NUMBERS TO THREE SIGNIFICANT FIGURES:
Use the conversion constants and data given on the front page.

Given a mass on a frictionless surface attached to the wall by a Hooke's Law spring of force constant \( k = 375 \text{ N/m} \). The mass \( m \) has a value of 1.25 kg. A bullet of mass 3.00 grams and velocity 250 m/s, strikes the mass \( m \) and sticks to it at \( t = 0 \). Initially, the spring is not compressed and the mass is at \( x = 0 \).

\[ \text{(a) Calculate the frequency, } f, \text{ of the resulting oscillation.} \]

\[ f = \frac{\omega}{2\pi} = \frac{1}{2\pi} \sqrt{\frac{k}{m+m_b}} = 2.75 \text{ (Hz)}; \text{ (m_b: Bullet mass.)} \]

\[ \text{(b) Frictionless } \Rightarrow \text{ Conservation of Momentum:} \]

\[ m_b v = (m_b + m) v_0 \]

\[ \Rightarrow v_0 = \frac{m_b v}{m_b + m} = \frac{3.00 \times 10^{-3} \times 250}{3.00 \times 10^{-3} + 1.25} \approx 0.599 \text{ (m/s)} \]

\[ \text{From } \frac{1}{2} k A^2 = \frac{1}{2} (m_b + m) v_0^2; \]

\[ \Rightarrow A = \frac{v_0}{\omega} \approx 3.46 \times 10^{-2} \text{ (cm)} \]

\[ \text{(c) } E = \frac{1}{2} k A^2 = \frac{1}{2} (m_b + m) v_0^2 \approx 0.224 \text{ (J)} \]