

PHYSICS 103, EXAM 1, SOLUTIONS

1. EACH BOUNCE: $E_{\text{AFTER}} = \left(\frac{2}{3}\right) E_{\text{BEFORE}}$
 $\Rightarrow E_{\text{FINAL}} = \left(\frac{2}{3}\right)^4 E_{\text{INITIAL}} = mg H_{\text{FINAL}}$
 $\Rightarrow H_{\text{FINAL}} = \frac{16}{81} \cdot 80 \approx 16 \text{ m.}$

2. BALL MOVES ALONG SAME TRAJECTORY
 \Rightarrow LANDS AT INITIAL LOCATION
 $v_{\text{FINAL}} = 60 \text{ m/s.}$

3. LINEAR MOMENTUM CONSERVED
 $\Rightarrow (8 \text{ kg}) \hat{E} (15 \text{ m/s.}) + (12 \text{ kg.}) (10 \frac{\text{m}}{\text{s.}}) \hat{N}$
 $= (m_1 + m_2) \vec{v}_F = 20 v_F$
 $\Rightarrow v_F = (6 \frac{\text{m}}{\text{s.}}) \hat{E} + (6 \frac{\text{m}}{\text{s.}}) \hat{N}$

4. FINAL SPEED: ENERGY CONSERVED \Rightarrow
 $\frac{1}{2} (800 \frac{\text{m}}{\text{s.}}) (1.8 \text{ m.})^2 + (15 \text{ kg}) (9.8 \frac{\text{m}}{\text{sec}^2}) (65 \text{ m.}) =$
 $\frac{1}{2} (15 \text{ kg.}) v_{\text{FINAL}}^2 \Rightarrow v_{\text{FINAL}} \approx 38 \text{ m/s.}$

TIME:

(1) IN 1.8 m., BALL GAINS 1296 joule, LOSES (15 kg.) $19.8 \frac{\text{m}}{\text{sec}^2}$
 $(1.8 \text{ m.}) = 270 \text{ joule} \Rightarrow v_{\text{RELEASE}} \approx 12 \text{ m/s.}$
 (2) AFTER 1.8 m., FREE FALL:
 $63.2 \text{ m.} = \frac{1}{2} g t^2 + v_R t = 5 t^2 + 12 t$
 $\Rightarrow t \approx 2.8 \text{ sec.}$

5. SPRING COMPRESSED BY (x). ENERGY CONSERVED
 $\Rightarrow \frac{1}{2} (4 \text{ kg.}) (22 \text{ m/s.})^2 + (4) (9.8) (70 + x) = \frac{1}{2} (1200) x^2$
 $\Rightarrow x \approx 2.4 \text{ METER}$