

Momentum & Impulse

- 1) A 400.0 g ball is dropped from 1.3 m off the ground.
(a) If the ball bounces off the ground at 4.0 m/s, what is the ball's change in momentum? (b) What impulse was applied to the ball? (c) What force did the ground exert on the ball if it took 0.2 s to bounce?

$$\begin{aligned} m &= .4 \text{ kg} \\ \Delta y &= -1.3 \text{ m} \\ v_f &= +4 \text{ m/s} \end{aligned}$$

(a) $v_{fy}^2 = v_{oy}^2 + 2g\Delta y$
 $v_{fy}^2 = 0^2 + 2(-16)(-1.3)$
 $v_{fy}^2 = 26$
 $v_{fy} = -5.099 \text{ m/s}$

(2) $v_{fy} = v_o$

$$\begin{aligned} \Delta p &= m\Delta v \\ \Delta p &= .4(4 - (-5.099)) \\ \Delta p &= +3.64 \text{ kg}\cdot\text{m/s} \end{aligned}$$

(b) $\Delta p = J = +3.64 \text{ N}\cdot\text{s}$

(c) $J = Ft$
 $+3.64 = F(.2)$
 $F_{\text{NET}} = +18.198 \text{ N}$



$$\Sigma F_y = F_N + w$$

$$+18.198 = F_N - 4$$

$$F_N = 22.20 \text{ N}$$

2) A 3.0g bullet is travelling at 200m/s the instant before it hits a block of wood. What force, horizontally, did the block of wood apply to the bullet if it travelled 0.15m into the wood?

$$m = .003 \text{ kg}$$

$$v_0 = 200 \text{ m/s}$$

$$F_{\text{block}} = ?$$

$$v_f = 0 \text{ m/s}$$

$$\Delta x = .15 \text{ m}$$

$$\textcircled{1} v_f^2 = v_0^2 + 2a\Delta x$$

$$0 = 200^2 + 2a(.15)$$

$$a = -133,333.33 \text{ m/s}^2$$

$$\textcircled{2} v_f = v_0 + at$$

$$0 = 200 - 133,333.33t$$

$$t = 0.0015 \text{ s}$$

$$\textcircled{1} v_{\text{avg}} = \frac{\Delta x}{t}$$

$$\left(\frac{200 + 0}{2} \right) = \frac{.15}{t}$$

$$100 = \frac{.15}{t}$$

$$t = 0.0015 \text{ s}$$



$$\textcircled{3} F t = m \Delta v$$

$$F(.0015) = .003(0 - 200)$$

$$F = -400 \text{ N}$$