

## Solutions to Ch 9

59) we want to find the initial momentum of our block.

We know it takes 5cm for friction to stop the block

$$v_f^2 = v_i^2 + 2ax \quad F = -0.2 \overset{\text{wood on wood}}{mg} \quad \text{see from an earlier chapter}$$

$$0 = v_i^2 - 0.4g(0.05m) \quad a = 0.2g$$

$$v_i = \sqrt{(0.4)(9.8 \text{ m/s}^2)(0.05m)} = 0.44 \text{ m/s}$$

$$p_{\text{block+bullet}} = (10.01 \text{ kg})(0.44 \text{ m/s}) = 4.43 \text{ kg m/s}$$

$$p_{\text{bullet}} + p_{\text{block}} = p_{\text{block+bullet}}$$

$\uparrow$   
 $v_i$  is zero

$$(0.01 \text{ kg})v_{\text{bullet}} = 4.43 \text{ kg m/s}$$

$$v_{\text{bullet}} = 443 \text{ m/s}$$

64) Speed relative to what? Laura? 1.5 m/s

Assuming the canoe was stationary when Laura jumps

$$p_i = 0 \quad - \quad 0 = p_{\text{canoe}} + p_{\text{Laura}}$$

$$v_{\text{Laura}} - v_{\text{canoe}} = 1.5 \text{ m/s}$$

$$m_{\text{canoe}}(v_{\text{Laura}} - 1.5 \text{ m/s}) + m_{\text{Laura}} v_{\text{Laura}} = 0$$

$$((55\text{kg}) + (35\text{kg})) v_{\text{launcher}} - 55\text{kg} (1.5\text{m/s}) = 0$$

$$v_{\text{launcher}} = 0.92\text{ m/s}$$

$$v_{\text{cannon}} = 0.92 - 1.5\text{m/s} = -0.58$$

$$9.66) \quad m_p v_{pi} = m_p v_{pf} + m_G v_G$$

$$m_p v_{pi} = -0.9 m_p v_{pi} + m_G v_G$$

$$1.9 m_p v_{pi} = m_G v_G$$

$$v_G = \frac{1.9 m_p v_{pi}}{197 m_p} = \frac{1.9}{197} (5 \times 10^7 \text{m/s}) = 4.8 \times 10^5 \text{m/s}$$

9.68) speed (no direction).

$p_i = 0$  so the nucleus' recoil momentum must exactly cancel the momenta of the two ejected particles.

$$p_x = (9.11 \times 10^{-31} \text{kg}) (5.00 \times 10^7 \text{m/s}) = 4.6 \times 10^{-23} \text{kg m/s}$$

$$p_x = m_{\text{nucleus}} v_x \quad v_x = \frac{4.6 \times 10^{-23} \text{kg m/s}}{2.34 \times 10^{-26} \text{kg}} = 1947 \text{m/s}$$

$$p_y = 8.00 \times 10^{-24} \text{kg m/s} = m_{\text{nucleus}} v_y$$

$$v_y = \frac{8.00 \times 10^{-24} \text{kg m/s}}{2.34 \times 10^{-26} \text{kg}} = 341.9 \text{m/s}$$

$$\text{speed} = |v| = \sqrt{v_x^2 + v_y^2} = \boxed{1980 \text{m/s}}$$

9.70)  $L = I\omega$  where  $I$  for an object swinging  
around a central object is  $mr^2$   
 $r$  mass of puck

$$L = mr^2\omega \quad \omega = \frac{3.0 \text{ kg m/s}}{(0.200 \text{ kg})(0.5 \text{ m})^2} = 60 \frac{\text{rad}}{\text{s}}$$

$$T = mr\omega^2 = (0.200 \text{ kg})(0.5 \text{ m})(60 \frac{\text{rad}}{\text{s}})^2 = \boxed{360 \text{ N}}$$

$T$  centripetal force