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

$v_f^2 = v_i^2 + 2ax$ $F = -0.2\,mg$ ← wood on wood μ_k from an earlier chapter

$ma = -0.2mg$ $a = 0.2g$

$0 = v_i^2 - 0.4g(0.05m)$

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

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

$p_{bullet} + p_{block} = p_{block+bullet}$ ($p_{block} = 0$ ↑ v is zero)

$(0.01 Kg) v_{bullet} = 4.43 Kg\,m/s$

$v_{bullet} = 443 m/s$

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

Assuming the canoe was stationary when Laura jumps

$p_i = 0$ $0 = p_{canoe} + p_{laura}$

$v_{laura} - v_{canoe} = 1.5 m/s$

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

$((55 kg) + (35 kg)) V_{laura} - 55 kg (1.5 m/s) = 0$

$V_{laura} = 0.92 \ m/s$

$V_{canoe} = 0.92 - 1.5 m/s = -0.58$

9.66) $m_p v_{pi} = m_p v_{pf} + M_G V_G$

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

$1.9 m_p v_{pi} = m_G V_G$

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

9.68) speed (no direction).

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

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

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

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

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

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

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

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

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