Homework 8
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Phys 216-510

Question 1

Given: 2 large balls rolling over a smooth surface

Ball 1: $m_1 = 5.00\ kg$, $v_1 = 2.55\ m/s$

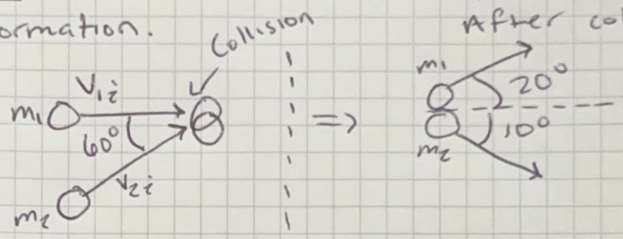
Ball 2: $m_2 = 3.61\ kg$, $v_2 = 1.55\ m/s$

Find: Velocity of ball 1 and 2 after collision.

Theory: Law of conservation, set up 2 systems of equations and solve from there for missing variables.

Assumptions: Balls are made of super hard material, no deformation.

Diagram



Solution: Using KE $= \frac{1}{2}mv^2$

$$x = \frac{1}{2}m_{1i}v^2 + \frac{1}{2}m_{2i}v^2 = \frac{1}{2}m_{1f}v^2 + \frac{1}{2}m_{2f}v^2$$

$$0 = -m_2 v_2 \cos(60°) = m_1 v_{f1} \sin(20) - m_2 v_{f} \sin(10)$$

v_{f1}: solve; v_f: solve

$$v_{f1} = \frac{-4.9 + 3.61\sin(10)}{1.71}$$

$$\boxed{v_{f1} = 2.98\ m/s}$$

$$x = -(3.61)(2.55) + (5)(2.55) = (5)(2.98) + (3.61)(x)$$? (solve)

$$\boxed{v_{2f} = 0.42\ m/s}$$

Question 2

Given - Villain = 65kg
Velocity = 9.26 m/s

Chuck Norris fist speed - 0.150 m/s

Villain v_2 = 8.52 m/s @ 20° from horizontal
v_4 = 0.0745 m/s @ 10°.0 from horizontal

Find - The mass of Chuck Norris fist in kg?
Kinetic Energy lost in collision

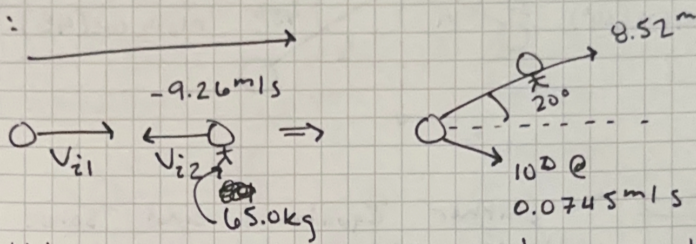
Theory - (a) momentum before event = momentum after event

(a) $m_1v_1 + m_2v_2 = m_1v_1\cos(10°) + m_2v_2\cos(20°)$

(b) Find change in Kinetic Energy

$$\Delta KE = \sum \frac{1}{2} m_i v_i^2 - \sum \frac{1}{2} m_f v_f^2$$

Diagram:



Hit at angle, causing collision to move object at a higher angle.

$\theta_1 = 20°, \theta_2 = 10.0°, m_2 = 65kg, v_2 = -9.26$

$m_1v_1 + m_2v_2 = m_1v_1\cos(\theta_1) + m_2v_2\cos(\theta_2)$

$= m_1(0.15) + (65)(-9.26) = m_1(0.0745)\cos 10 + ((65)(8.52)\cos(20))$

$m_1 = 14{,}645$ kg on Chuck's fist.

$\Delta KE = KE_i - KE_f$

$\Delta KE = \left(\frac{1}{2}m_1v^2 + \frac{1}{2}m_2v_2^2\right) - \left(\frac{1}{2}m_1v_1^2 + \frac{1}{2}m_4v_4^2\right)$

$= \frac{1}{2}(14{,}645)(0.150)^2 + \left(\frac{1}{2}(65)(9.26)^2\right) - \left(\frac{1}{2}(14{,}645)(0.0745)^2 + \frac{1}{2}(65)(8.52)^2\right)$

$\Delta KE = 552$ J Lost

Question 3

Givens: $V_1 = 9.660\ m/s$ – Vin

mass $_2 = 53.8\ kg$, $V_2 = 7.26\ m/s$ – Zane

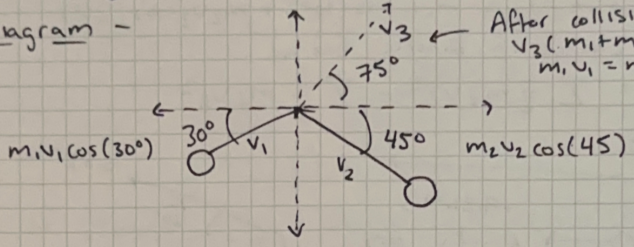
After collision:

$V_3 = 5.164\ m/s$

Find: Vin's mass in kg?

Theory – Apply law of conservation to the forces colliding in this example, this can be dirived by the diagram and derivation below

Diagram –



Solution – Gather Equations and solve for Vin's mass in kg.

$$m_1v_1\cos(30°) - m_2v_2\cos(45) = v_3(m_1+m_2)\cos(75)$$

$$= m_1(9.66)\cos(30°) - (53.8)(7.26)(0.707) = (5.164) \times (m_1+53.8) \times (0.259)$$

After solving for m_1:

Vin's mass in kg: 49.51 kg