

## Practice: Elastic Collisions

$$1) M_C = \frac{1}{2} M_{\text{MOON}} \quad M_C V_{Ci} + M_M V_{Mi} = M_C V_{Cf} + M_M V_{Mf}$$

$$V_{\text{MOON}i} = 3680 \text{ km/hr} = 1022.22 \text{ m/s}$$

$$V_{\text{MOON}f} = -440 \text{ km/hr} = 122.22 \text{ m/s}$$

$$V_{\text{COMET},f} = 5740 \text{ km/hr} = 1594.44 \text{ m/s}$$

$$.5 M_M (V_{Ci}) + M_M (1022.22) = .5 M_M (1594.44) + M_M (-122.22)$$

$$.5 V_{Ci} + 1022.22 = 797.22 - 122.22$$

$$675$$

$$V_{Ci} = -694.44 \text{ m/s}$$

$$\frac{1}{2} m_C V_{Ci}^2 + \frac{1}{2} m_M V_{Mi}^2 = \frac{1}{2} m_C V_{Cf}^2 + \frac{1}{2} m_M V_{Mf}^2$$

$$KE_i: .5 (.5 m) (694.44^2) + .5 m (1022.22^2) = 643,028.5926$$

$$KE_f: .5 (.5 m) (1594.44^2) + .5 m (122.22^2) = 643,028.5926$$

$$2) m_B = 18.40 \text{ kg} \quad m_B V_{Bi} + m_C V_{Ci} = m_B V_{Bf} + m_C V_{Cf}$$

$$m_C = 56.20 \text{ kg}$$

$$V_{Ci} = -5.0 \text{ m/s}$$

$$V_{Cf} = -.06 \text{ m/s}$$

$$V_{B,f} = 10.07 \text{ m/s}$$

$$m_B V_{Bi} + m_C V_{Ci} = m_B V_{Bf} + m_C V_{Cf}$$

$$18.4 V_i + 56.20(-5) = 18.4(-10.07) + 56.20(-.06)$$

$$18.4 V_i - 281 = -185.288 - 3.372$$

$$\boxed{V_i = 5.02 \text{ m/s, R}}$$

$$.5 (18.4) (5.02^2) + .5 (56.20) (-5^2) = 934.203$$

$$231.703 + 702.5 =$$

$$.5 (18.4) (-10.07^2) + .5 (56.20) (.06^2) = 933.026$$

$$932.925 + .1016$$

$$3) m_1 = m_2$$

$$v_{2i} = 2.0 \text{ m/s, L}$$

$$v_{1i} = 5 \text{ m/s, R}$$

$$v_{1F} =$$

$$m_1 v_{1i} + m_2 v_{2i} = m_1 v_{1F} + m_2 v_{2F}$$

$$v_{2i} = 2.0 \text{ m/s, R}$$

$$5 + v_{2i} = -2 + 5$$

$$v_{2F} = 5 \text{ m/s, R}$$

$$KE_i = KE_F$$

$$.5 \text{ m}(5^2) + .5 \text{ m}(-2^2) = .5 \text{ m}(5^2) + .5 \text{ m}(5^2)$$
$$14.5 = 14.5$$

$$4) m_1 = 0.045 \text{ kg}$$

$$m_1 v_{1i} + m_2 v_{2i} = m_1 v_{1F} + m_2 v_{2F}$$

$$v_{1i} = 273 \text{ km/hr} = 75.83 \text{ m/s}$$

$$.045(75.83) + 0 = .045(-25.28)$$

$$v_{2i} = 0 \text{ m/s}$$

$$+ m_2(50.56)$$

$$v_{1F} = -91 \text{ km/hr} = -25.28 \text{ m/s}$$

$$m_2 = .09 \text{ kg}$$

$$v_{2F} = 182 \text{ km/hr} = 50.56 \text{ m/s}$$

$$.5(.045)(75.83^2) + .5(.09)(0^2) = 129.379$$

=

$$.5(.045)(-25.28^2) + .5(.09)(50.56^2) = 129.413$$

$$14.379$$

$$115.034$$

$$5) v_{1i} = 185 \text{ km/hr} = 51.39 \text{ m/s}$$

$$v_{1f} = -80 \text{ km/hr} = -22.22 \text{ m/s}$$

$$m_1 = .057 \text{ kg}$$

$$v_{2i} = 0 \text{ m/s}$$

$$m_1 v_{1i} + m_2 v_{2i} = m_1 v_{1f} + m_2 v_{2f}$$

↓

0

$$m_1 v_{1i} = m_1 v_{1f} + m_2 v_{2f}$$

$$\frac{m_1}{m_2} (51.39) = \frac{m_1}{m_2} (-22.22) + v_{2f} \quad \div m_2$$

$$v_{2f} = 73.61 \frac{m_1}{m_2} \quad \leftarrow$$

$$KE_i = KE_f$$

$$.5 m_1 v_{1i}^2 + .5 m_2 v_{2i}^2 = .5 m_1 v_{1f}^2 + .5 m_2 v_{2f}^2$$

$$\div m_2 \quad .5 \frac{m_1}{m_2} (51.39)^2 = .5 \frac{m_1}{m_2} (-22.22)^2 + .5 v_{2f}^2$$

$$\frac{m_1}{m_2} (2640.93) = \frac{m_1}{m_2} (493.728) + v_{2f}^2 \quad \div .5$$

$$v_{2f} = \sqrt{2640.93 \frac{m_1}{m_2} - 493.728 \frac{m_1}{m_2}}$$

$$v_{2f} = \sqrt{2147.20 \frac{m_1}{m_2}} \Rightarrow 46.34 \sqrt{\frac{m_1}{m_2}}$$

$$73.61 \frac{m_1}{m_2} = 46.34 \sqrt{\frac{m_1}{m_2}} \Rightarrow \left( \frac{73.61}{46.34} \right)^2 = \left( \sqrt{\frac{m_2}{m_1}} \right)^2$$

$$2.52325 = \frac{m_2}{m_1}$$

$$m_1 = .057$$

$$m_2 = 0.14 \text{ kg}$$

$$b) m_1 = 400,000 \text{ kg}$$

$$m_2 = 160,000 \text{ kg}$$

$$v_{1i} = 32 = 8.89 \text{ m/s}$$

$$v_{2i} = 36 = 10 \text{ m/s}$$

$$v_{1f} = 35.5 \text{ km/hr} = 9.86 \text{ m/s}$$

$$m_1 v_{1i} + m_2 v_{2i} = m_1 v_{1f} + m_2 v_{2f}$$

$$400,000(8.89) + 160,000(10) = 400,000(9.86) + 160,000 v_f$$

$$v_f = 7.58 \text{ m/s, R}$$

$$KE_i = KE_f$$

$$.5(400,000)(8.89^2) + .5(160,000)(10^2) = 23,806,420$$
$$15806420 + 8000000$$

$$.5(400,000)(9.86^2) + .5(160,000)(7.58^2) = 24,034,370$$
$$19443920 \quad 4590450$$

$$7) m_1 = 550,000 \text{ kg} \quad m_1 v_{1i} + m_2 v_{2i} = m_1 v_{1f} + m_2 v_{2f}$$

$$m_2 = 230,000 \text{ kg}$$

$$v_{1i} = 5 \text{ m/s}$$

$$v_{2i} = -5 \text{ m/s}$$

$$v_{2f} = 9.10 \text{ m/s}$$

$$550,000(5) + 230,000(-5) = 550,000(v_{1f}) + \frac{230,000}{(9.10)}$$

$$2750000 + -1150000$$

$$1,600,000 = 2093000 + 550,000 v_{1f}$$

$$v_{1f} = -0.90 \text{ m/s, R}$$

$$.5(550,000)(5^2) + .5(230,000)(5^2) = 9,750,000$$

$$6875000 \quad + \quad 2875000$$

$$.5(550,000)(9^2) + .5(230,000)(9.1^2) = 9,745,900$$

$$222750 \quad + \quad 9523150$$