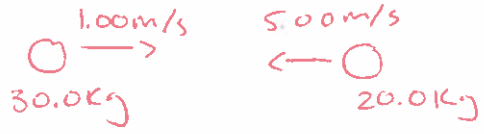
Worksheet 6.3 - Collisions

1) A 30.0 kg object moving to the right at a velocity of 1.00 m/s collides with a 20.0 kg object moving to the left with a velocity of 5.00 m/s. If the 20.0 kg object continues to move to the left at a velocity of 1.25 m/s, what is the velocity of the 30.0 kg object?



$m_1v_{1i} + m_2v_{2i} = m_1v_{1f} + m_2v_{2f}$

$(30)(1.00) + (20.0)(-5) = (30)(v_{1f}) + (20)(-1.25)$

$30 + (-100) = 30v_{1f} - 25$

$-70 = 30v_{1f} - 25$

$-45 = 30v_{1f}$

$-1.5 = $ **1.5 m/s left.**

2) A 4.50×10^3 kg railway car is moving east at a velocity of 5.0 m/s on a level frictionless track when it collides with a stationary 6.50×10^3 kg caboose. If the two cars lock together upon impact, how fast are they moving after collision?

$m_1v_{1i} + m_2v_{2i} = (m_1+m_2)v_f$

$4.5\times10^3\,kg(5.0\,m/s) + 0 = (4.5\times10^3 + 6.5\times10^3)v_f$

$\frac{22500\ kg\,m/s}{11000\ kg} = \frac{11000\ kg(v_f)}{11000\ kg}$

$2.045\ m/s = v_f$

East.

3) A 925 kg car moving at a velocity of 18.0 m/s right collides with a stationary truck of unknown mass. The two vehicles lock together and move off at a velocity of 6.50 m/s. What is the mass of the truck?

$m_1v_{1i} + m_2v_{2i} = (m_1+m_2)v_f$

$925(18) + 0 = (925+m_2)6.50$

$16650\ kg\,m/s = (925+m_2)6.5$

$2561\ kg = 925+m_2$

$1636.5 = m_2$

4) A 50.0 g bullet strikes a 7.00 kg wooden block. If the bullet becomes imbedded in the block and they both move off at a velocity of 5.00 m/s, what was the initial speed of the bullet?

$m_1v_{1i} + m_2v_{2i} = (m_1+m_2)v_f$

$(.050\ kg)(v_{1i}) + 0 = (.050 + 7\ kg)(5.00\ m/s)$

$(.050\ kg)v_{1i} = 35.25\ kg\,m/s$

$v_{1i} = 705\ m/s$ forward.

let right be positive.

5. A 40.0 g hot dog moving with a velocity of 9.00 m/s to the right collides with a 55.0 g hot dog bun with a velocity of 6.00 m/s to the left. If the two objects stick together upon collision, what is the velocity of the combined masses?

$m_1v_{1i} + m_2v_{2i} = (m_1+m_2)v_f$

$(.040)(9.00) + 0 = (0.040+.055)6.90$

$.36\ kgm/s =$

$m_1v_{1i} + m_2v_{2i} = (m_1+m_2)v_f$

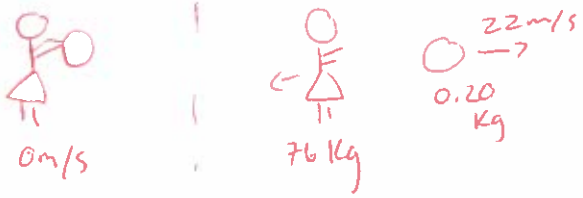
$(.040)(9.00) + (.055)(-6.00) = (.040+.055)v_f$

$(0.36) + (-.33) = .095(v_f)$

$.03 = .095\ v_f$

.316 m/s right

6. A 76 kg student, standing at rest on a frictionless surface throws a 0.20 kg cream pie horizontally at 22 m/s at Mr. Trask who is standing to the student's left. What was the velocity of the student after they throw the pie?



$0 = m_1v_{1f} + m_2v_{2f}$

$0 = 76kg(v_{1f}) + (0.20kg)(22m/s)$

$-4.4kgm/s = 76kg(v_{1f})$

$-0.058\ m/s = v_{1f}$

7. A 25 kg turkey is fired from a 1.1×10^3 kg turkey launcher. If the horizontal velocity of the turkey is 325 m/s east, what is the recoil of the launcher?

$0 = m_1v_{1f} + m_2v_{2f}$

$0 = 25(325m/s) + 1.1\times10^3(v_{2f})$

$-8125\ kgm/s = 1.1\times10^3 kg(v_{2f})$

$v_{2f} = -7.4\ m/s$

or

7.4 m/s west

8. A rail vehicle with a rocket engine is being tested on a smooth track. Starting from rest the engine is fired for a short period of time, releasing 4.5×10^2 kg of gases. It is estimated that the average velocity of the gases is 1.4×10^3 m/s to the right, and that the maximum velocity of the vehicle is 45 m/s left. What is the mass of the vehicle?

gas vehicle

$0 = m_1v_{1f} + m_2v_{2f}$

$0 = (4.5\times10^2 kg)(1.4\times10^3\ m/s) + m_2(45m/s)$

$-630\,000 = m_2(-45)$

$14000\ kg = m_2$

1) 1.50 m/s left or -1.50 m/s 2) 2.0 m/s east 3) 1640 kg 4) 705 m/s 5) 0.316 m/s right 6) 0.058 m/s right 7) 7.4 m/s west 8) 14000 kg