Physics 10
Ms. May
Momentum, Impulse, and Collisions WS

1. A little fly (5.0 g) is flying at a velocity of 2.0 m/s to the right. If a fly swatter approaches the fly and hits it in the same direction (to the right) giving the fly a velocity of 12 m/s and the time of impact on the hit is 0.0045 seconds, determine the force of the swatter on the fly.

Ft=Δmv
mvi=(0.005kg)(2.0m/s) = 0.010 kgm/s to the right
mvf=(0.005kg)(12.0m/s) = 0.060 kgm/s to the right
Δmv= + 0.050 kgm/s = Ft
F= (0.050 kgm/s)/(0.0045s) = *11.1 N*

2. Suppose you fell into a pile of marshmallows and your friend fell into a pile of Hershey bars. You both have the same mass (65 kg) had the same final velocity (right before hitting the marshmallows or Hershey bars) of 7.5 m/s. Assume the Smores treats brought both of you to a rest. A) Determine the change in momentum of both you and your friend B) Determine the net impulse acting on you and your friend C) If the time of impact for the marshmallow fall was 0.80 seconds, determine the net force on you D) If the net force acting on your friend (The Hershey bar faller) was 990 N, determine the time it took for the Hershey bars to bring your friend to a stop.

A. You: mvi=(65kg)(-7.5m/s)= -487.5 kgm/s. mvf=0 *Δmv= 487.5*
Friend: mvi=(65kg)(-7.5m/s)= -487.5 kgm/s. mvf=0 *Δmv= 487.5*

B. Ft=Δmv= 487.5 Ns
C. Ft= Δmv= 487.5 Ns F=(487.5 Ns)/(0.80s) *F=609 N*
D. Ft= Δmv= 487.5 Ns t= (487.5 Ns)/(990N) *t=0.492 s*

3. A 25.0 g marble sliding to the right at 20.0 cm/s overtakes and collides elastically with a 10.0 g marble moving in the same direction at 15.0 cm/s. After the collision, the 10 g marble moves to the right at 22.1 cm/s. Find the velocity of the 25.0 g marble after the collision.

Σmvi=(0.025kg)(0.20m/s) + (0.010kg)(0.15m/s) = 0.0065 kgm/s
Σmvf=0.0065 kgm/s (law of conservation of momentum)
Σmvf=(0.025kg)(vf) + (0.010kg)(0.221m/s) = 0.0065 kgm/s
0.025kg(vf) = 0.00429 kgm/s *vf=0.17 m/s*

4. A 5.0 kg fish swimming at 1.0 m/s swallows an absent minded 1.0 kg fish swimming toward it at a velocity that brings them both to a halt immediately after lunch. What is the velocity of the smaller fish before lunch?

Σmvi=(5.0 kg)(1.0m/s) + (1.0kg)(Vi) = ?
Σmvf= 0
Σmvi=0 (law of conservation of momentum)
0= Σmvi=(5.0 kg)(1.0m/s) + (1.0kg)(Vi)
-5.0 kgm/s = 1.0kg (Vi) *Vi= -5.0 m/s*

5. A railroad diesel engine weighs four times as much as a freight car. If the diesel engine coasts at 5 km/hr into the freight car that is initially at rest, how fast do the cars coast after they couple together?

$\Sigma mvi=(4X)(5.0\ km/hr) + (X)(0) = 20X$
$\Sigma mvf= 20X$ (law of conservation of momentum)
$\Sigma mvf=(5X)(Vf) = 20X$ $Vf= (20X)/(5X)$ ***Vf= 4 km/hr***

6. A tennis player places a 55 kg ball machine on a frictionless surface. The machine fires a 0.057 kg tennis ball horizontally with a velocity of 36 m/s toward the north. What is the final velocity of the machine?

$\Sigma mvi=0$ $\Sigma mvf=0$ (law of conservation of momentum)
$\Sigma mvf= (55kg)(Vf) + (0.057kg)(36m/s) =0$
$55(Vf) + 2.052\ kgm/s=0$
$55kg(Vf)= -2.052\ kgm/s$ $Vf= -0.037\ m/s$ or ***Vf= 0.037 m/s South***

7. Player A (78 kg) throws a football (0.80 kg) to his teammate, Player B (95 kg) at rest at a velocity of 24 m/s. If both players were standing on an ice patch (no friction) on the field with no friction, determine Player A's velocity after the throw and Player B's velocity after catching the ball?

Player A throwing the ball:
$\Sigma mvi= 0$ $\Sigma mvf=0$ (law of conservation of momentum)
$\Sigma mvi= (78kg)(VfA) + (0.80\ kg)(24m/s)$ $0=(78kg)(Vf) + (0.80\ kg)(24m/s)$
$78kg(Vf) = -19.2\ kgm/s$ ***Vf = -.25 m/s = Player A's final velocity***

Player B catching the ball:
$\Sigma mvi= (95kg)(0m/s) + (0.80kg)(24m/s)$ $\Sigma mvi=19.2\ kgm/s$
$\Sigma mvf= 19.2\ kgm/s$ (law of conservation of momentum)
$\Sigma mvf= (95.8\ kg)(Vf)$ $19.2 =(95.8kg)(Vf)$ ***Vf = 0.20 m/s = Player B's Vf***

8. A 62 kg child is sitting on a wagon full of bricks that has a mass of 150 kg (including the bricks). In order to move the wagon without touching the ground, the child throws two bricks each of a mass 3.0 kg in the direction opposite to the direction the wagon is to go. How fast will the wagon move if the bricks are thrown at 2.0 m/s?

$\Sigma mvi= 0$ $\Sigma mvf=0$ (law of conservation of momentum)
$\Sigma mvi= (206kg)(Vf) + (3.0\ kg)(-2.0\ m/s) + (3.0\ kg)(-2.0m/s)$
$0 = (206kg)(Vf) + (3.0\ kg)(-2.0\ m/s) + (3.0\ kg)(-2.0m/s)$

$206kg(Vf) = 12\ kgm/s$ ***Vf = 0.058 m/s***