Momentum Intro

We know that from Newton's 1st Law that as body's inertia increases it is more difficult to change its state of motion. This is true for both bodies at rest or at a constant velocity. This doesn't account for how much velocity a body may have. To account for this effect, Isaac Newton described what he called "the quantity of motion of a body" as its momentum. We can think of momentum as "Moving Inertia". Therefore a body with more momentum (moving inertia) would be harder to stop than a body with less momentum.

1 Momentum vs. mass:

a) Which has more momentum (moving inertia), a freight train moving at 55 mph or a car moving at 55 mph?

Train - because it has more mass

b) Who would have more momentum, "The Fridge" (big guy) running at 15 mph or Spud Web (small guy) running at 15 mph?

The Fridge

c) What would have more momentum, a butterfly moving at 5 m/s or a bird moving at 5 m/s?

The bird

d) In a~~-b~~ what is the only difference between the objects you were comparing? (Be careful because the momentum will be the same even if in outer space, the moon, or here on earth)

mass

e) What is the relationship between momentum and mass?

As mass increases so does momentum given equal velocities.

2. Momentum vs. velocity:

f) What would have more momentum, a car moving at 10 m/s or the same car moving at 30 m/s?

The car moving 30 m/s

g) What would have more momentum a bullet moving at 200 m/s or the same bullet moving at 250 m/s?

The 250 m/s bullet

h) What is the only thing that changed between cases f and g?

The mass is the same but velocities are different

i) What is the relationship between velocity and momentum?

As velocity increases so does momentum for equal mass object.

3. Try to write an equation for momentum (p) in terms of mass (m) and velocity (v).

p = mass x velocity. Note: momentum is a vector so direction is important

4. Describe a case where a train could have less momentum than a car.

   If a train is at rest or near zero velocity and a fast car

5. Describe a case where a bullet could have the same momentum as a person.

   Very slow person very fast bullet.

6. Which would have more momentum a beached whale (it's not moving) or a resting golf ball?

   They have the same momentum because both have a velocity of zero.
   p = mv = m(0) = 0

Momentum problems:

1. Which has greater momentum a heavy truck at rest or a rolling skateboard? Explain why!!!

   The rolling skateboard has more momentum. Although the skateboard has a small mass it is moving, and the truck is at rest so it doesn't have any momentum.

2. Whom would you rather have run into you: The Shaq (big guy) mass = 135 kg who is traveling at 2 m/s or Flo - Jo (little lady) mass = 60 kg who is running at 5 m/s? Do the calculation for momentum then explain your answer!

   Shaq:

   $p = m \cdot v$

   $p = 135 \cdot 2 = 270 \cdot kg \cdot \frac{m}{s}$

   Flo-Jo:

   $p = 60 \cdot 5 = 300 \cdot kg \cdot \frac{m}{s}$

   Shaq - Although Shaq is massive, Jlo-Jo's high velocity gives her more momentum.

4. a. Big moose has a momentum of 120 kg m/s and has a mass of 125 kg. What is his velocity? *0.96 m/s*

   $p = m \cdot v$

   $125 = 120 \cdot v$

   $v = \frac{125}{120} = 0.96 \cdot \frac{m}{s}$

   b. How could little Bo peep with a mass of 70 kg possibly have the same momentum as Big Moose? Do calculation and explain your answer.

   Find little Bo peeps velocity with Moose's momentum:

   $p = m \cdot v$

   $120 = 70 \cdot v \quad v = \frac{120}{70} = 1.71 \cdot \frac{m}{s}$

   Little Bo peeps could have the same momentum as big moose if her velocity is 1.71 m/s

5. Momentum essentially describes the inertia of a moving object. Why doesn't momentum describe the inertia of a resting object?

   Because an object at rest has no motion therefore the momentum is zero. Remember Newton described momentum as "the quantity of motion".