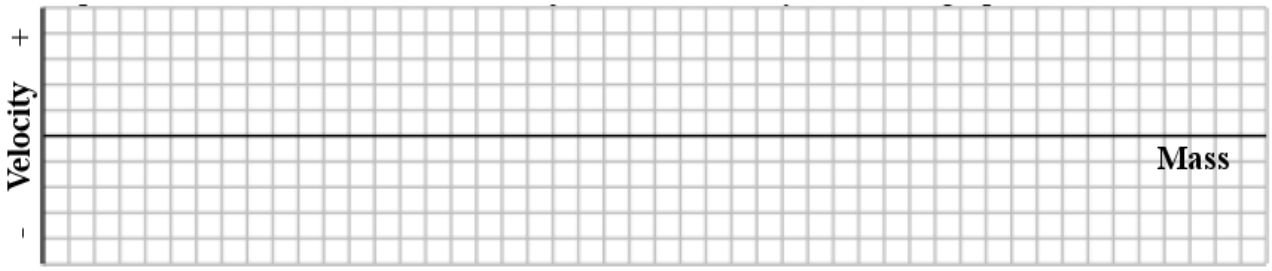
Name_____ Date _____ Pd____

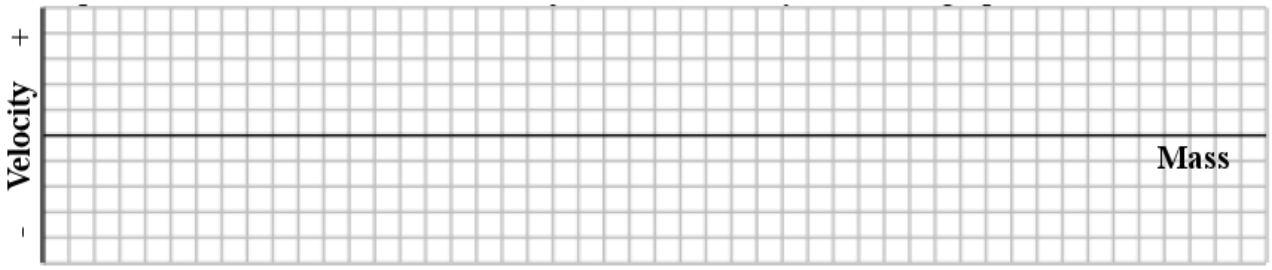
Worksheet 1: Momentum and Impulse

Variable, units, and abbreviations	Equations
Momentum (p) is measured in kg·m/s **Impulse** (I) is the force applied during a length of time, which is also the change in momentum, so it has the same units as momentum.	**Momentum**: $\boldsymbol{p = m \cdot v}$ **Impulse:** $\boldsymbol{I = F\Delta t}$ Reminder: Δ = (final – initial)

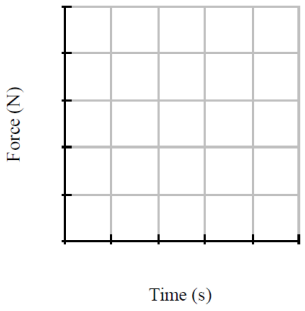
1. Two objects, A & B, have identical ***velocities***. Object A has 3 times the mass of object B. Represent the momentum of each on the velocity/mass bar graph.



2. Two other objects, C and D, have identical masses. Object C has twice the ***velocity*** of object D. Represent the momentum of each on the velocity/mass bar graph.

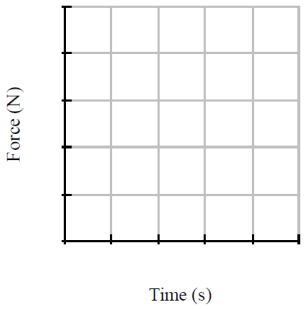


3. While being thrown, a net force of 132 N acts on a baseball (mass = 0.140 kg) for 0.045 s.
   a. Complete the force/time graph describing this situation. → → →
   b. Calculate the magnitude of the change in momentum of the ball.



   c. The initial speed of the baseball is 0.0 m/s. Calculate its speed when it leaves the pitcher's hand.

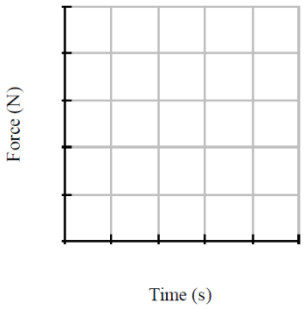
4. When the batter hits the ball, a net force of 1,320 N, opposite to the direction of the ball's initial motion, acts on the ball for 0.0090 s during the hit.
   a. Complete the force/time graph describing this situation. → → →
   b. Calculate the change in momentum of the ball.



   c. Calculate the final velocity of the ball.

5. How much is the force the ball exerts on the bat in the #4. Explain.

6. A rocket, weighing 43,600 N, has an engine that provides an upward force of 890,000 N. It reaches a maximum speed of 860 m/s.
   a. Make a force/time graph describing this situation. Label the unknown quantities on your graph with appropriate variables. → → →
   b. How long must the engine burn in order for the rocket to reach this speed?



7. A golf ball that weighs 0.45 N is dropped from a height of 1.0 m. Assume the bounciness factor (from the bouncy ball lab) is 1.0 (i.e. it bounces to the same height it is dropped from).
   a. Determine the time required for the ball to reach the floor.
   b. Calculate the ***instantaneous momentum*** of the golf ball be ***immediately before*** it strikes the floor.

   c. Calculate the ***change in momentum*** ($\Delta\mathbf{p}$) from the instant before the ball collides with the floor until the instant after it rebounds from the floor. (Illustrate with a diagram using vectors to show the direction.)

   d. Suppose that the golf ball was in contact with the floor for 0.0004 s. Calculate the average force on the ball while it was in contact with the floor.