Name _____ Date _____ Mods _____

Mr. Forrest/ AP Physics 1: 2018 Due on: _____

Momentum and Its Conservation

Remember - momentum is always, always, always (always?) - YES, ALWAYS conserved

PART A - In the space to the left, write the answer that best completes each statement.

Formulas to know:
$F\Delta t = \Delta mv$
$P = mv$

_____ 1. Momentum is the product of an object's _____ and velocity.

_____ 2. The standard unit of momentum is the _____.

_____ 3. The quantity ***Ft*** is called _____.

_____ 4. Complete the equation: ***Ft*** = _____.

_____ 5. A gain of momentum by an object occurs only by the _____ of a corresponding amount of momentum by another object.

_____ 6. The change of momentum of an object is equal to and caused by the _____ given to the object.

_____ 7. In a system consisting of objects upon which no external force is acting, the momentum of the system is _____.

_____ 8. Two objects of equal mass approach each other head-on with the same speed. The net momentum of the system before the collision takes place is _____.

_____ 9. A(n) _____ force cannot change the momentum of a system.

_____ 10. Because both direction and magnitude must be taken into account when adding momenta, momentum is a _____ quantity.

_____ 11. If the momentum of a cannon is considered positive after it fires a shell, the momentum of the shell is considered _____.

_____, _____ 12. A moving object containing a bomb explodes. If the object had a total of 20 units of momentum **west** just before the explosion, its pieces would have a total of _____ units of momentum _____ just after the explosion.

Part B - Some sample problems

1) A 10,000. kg freight car is rolling along a track at 3.0 m/s. Calculate the time needed for a braking force of 1000. N to stop the car.

2) A 15.0 g bullet is shot into a 5085 g wooden block. The block is standing on a frictionless surface. The block, with the bullet in it, acquires a velocity of 1.40 m/s. Calculate the velocity of the bullet before it struck the block.

3) A 0.25 kg soccer ball is rolling at 6.0 m/s toward a player. The player kicks the ball back in the opposite direction and gives it a – 14.0 m/s velocity. What is the average force during the interaction between the player's foot and the ball of the interaction lasts 0.018 seconds?

4) A 5.00 g bullet is fired with a velocity of 1.00 x 10^2 m/s toward a stationary solid block of mass 445 g is resting on a frictionless surface. Assume the bullet embeds in the block on a frictionless surface.

a) What is the momentum of the block and bullet *after* the collision?

~~b) What type of collision is this – elastic, perfectly inelastic, or just plain old inelastic?~~ Omit for 2018

c) What is the change in momentum of the bullet if it embeds in the block?

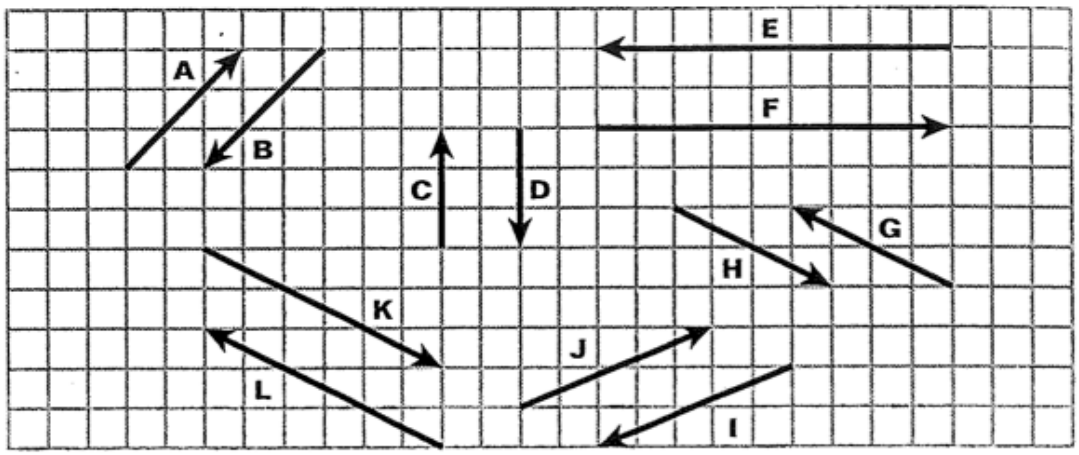
d) What is the change in momentum of the bullet if it ricochets in the opposite direction with a speed of 99 m/s (almost the same speed as it had originally)? Oh, and what type of collision is this?

e) In which case does the block achieve its highest velocity? WHY?

5) A 70.0 kg grandmother is riding on a 10.0 kg tricycle. The tricycle and woman are moving east at 6.0 m/s. Grandma leaps off the tricycle and hits the ground at 8.0 m/s eastward, relative to the ground. Calculate the velocity of the trike after she jumps. *Think about how you set this up!*

Graphing Momenta of Elastic and Inelastic Collisions [NOTE: the subscript '*i*' means initial condition and '*f*' means final condition.

Use the following vectors to answer items 1-5.



Consider a collision between two objects. Assume that the initial momentum of object 1 is represented by vector A ($p_{1,i}$= A) and the initial momentum of object 2 is represented by vector K ($p_{2,i}$ = K).

1. In the space to the right, construct a vector diagram showing the total initial momentum just before the collision.

2. Which vector in the graph represents the total initial momentum? _____

3. Which vector in the graph represents the total final momentum? _____

4. If the final momentum of object 1 is represented by vector H ($p_{1,f}$=H), construct a vector diagram in the space below to find the final momentum vector $p_{2,f}$ (Hint: Vectorally, $p_{1,f} + p_{2,f} = p_f$).

5. Which vector on the graph represents $p_{2,f}$?

* MOMENTUM IS A VECTOR QUANTITY *

Represent (+) for one direction; use (−) for the opposite!

These are the ones for your formula sheet

$$p = mv$$

$$Ft = m\Delta v \qquad \text{(Impulse)}$$

* MOMENTUM IS ALWAYS CONSERVED (OVERALL & VECTORALLY)

$$m_1v_1 + m_2v_2 = m_1v_1' + m_2v_2' \qquad \text{ELASTIC COLLISIONS}$$

$$m_1v_1 + m_2v_2 = (m_1 + m_2)v' \qquad \text{PERFECTLY INELASTIC COLLISIONS}$$

$$mv = \sum (m_1v_1' + m_2v_2' + m_3v_3' - \cdots) \qquad \text{EXPLOSIONS}$$

These 3 are just mathematical derivatives. You probably shouldn't need to write these down.

Why? These formulas only describe conservation of linear momentum!