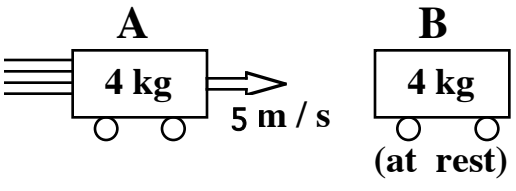
Name(s): _____ Date: _____ Period: ____

Physics Impulse & Momentum Worksheet II
Contributed by Jane Bray Nelson

1. Newton's _____ Law states that _____

   _____

   This implies that if I were to push with my hand against a wall with 5.0 newtons of force, then the _____ pushes against my hand with a force of _____ .
2. If I were to push harder against the wall, what would the wall do? _____

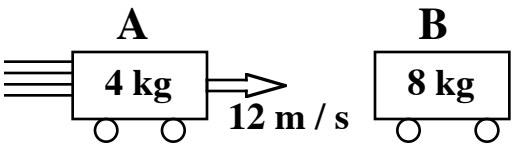
   _____
3. If body A pushes against body B, then body B will _____ against body ____ with a force which is _____ in magnitude but _____ in direction.
4. For every action force on B by A, there is a _____ force on _____ by _____. Forces always act in pairs.
5. Action and reaction forces act upon (different, the same) _____ body (bodies). Body A's motion is caused by the force (on, by) _____ body A exerted by _____ .
6. Fast moving trucks are hard to stop because of the _____ and _____ of the trucks. The product of mass and velocity is called the body's _____ . Units of momentum are _____ or _____ .
7. What is the momentum of a 3.0 kg object moving at 5.0 m/s ? _____
8. Scalar or vector? Mass _____ ; Velocity _____ ; Momentum _____
9. Forces cause masses to _____ according to Newton's 2nd Law, F = _____ . Acceleration, a, is defined as Δv / _____ . Substitute this into F = ma, and it becomes F = _____ . This can be rearranged into the version called the impulse equation, _____ . This equation sates that v is proportional to _____ _____ and _____ , but it is inversely proportional to _____ . Thus impulse is equal to _____ times _____ and is the cause of the change in the _____ that it produces.
10. 

Assume a frictionless surface. What is the initial momentum, p, of cart A? _____
According to Newton's 3rd Law an _____ force is applied by cart ___ on cart ___, and a _____ force which is _____ and _____ is applied upon cart _____ by cart _____ . What is true of the time during which each force is applied? _____

So each cart receives an i_____ that is _____ in magnitude but _____ in direction. This means that the momentum gained by one cart is _____ by the other. This is a form of the Law of Conservation of _____ . The total momentum of a system,

on which no outside _____ acts, remains _____ . If cart A comes to rest after the collision, then cart B's velocity must be _____ m/s .

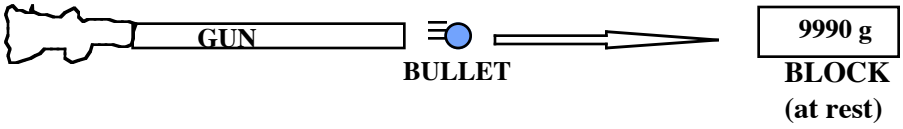
11.



Assume a frictionless surface. What is the momentum of cart A? _____ Cart B was at rest. What was its momentum? _____ What was the initial total momentum, p, of the system? _____

After the collision cart A is moving to the **left** at a speed of 2.0 m/s. Is it a + or - velocity after the collision? _____ Cart A's "p" is _____ after the collision. In order for "p" to be conserved, cart B's momentum must be equal to _____ Therefore, its velocity is _____

12.



Block A's velocity, after the 10.0 g bullet is stuck in it,

is 0.20 m/s along a frictionless surface.

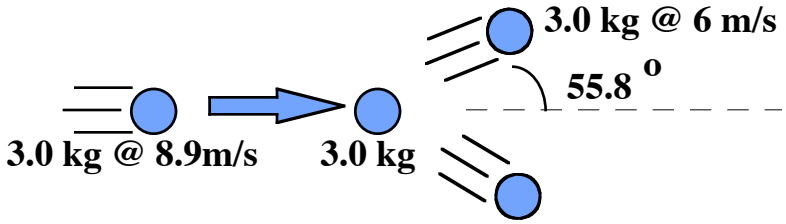
$$m_{bullet}v_{bullet} + m_{block}v_{block} = m_{bullet}v_{bullet} + m_{block}v_{block}$$

initially finally

Show work:

What was the bullet's initial velocity? _____

13.



Determine the speed of the "lower" ball after the collision. One of the balls is initially at rest. Assume a frictionless surface and a right angle between the balls after the collision. Attach a sheet with your diagram and work equations. _____

14. Momentum, p, is equal to _____ times _____ and is a _____ quantity. _____ is always conserved in a closed system.

Physics Momentum Worksheet II (Teacher Notes)

1. Newton's ___3rd___ Law states that ___For every action force on B by A, there is an equal and opposite reaction force on A by B.___

   This implies that if I were to push with my hand against a wall with 5.0 newtons of force, then the ___wall___ pushes against my hand with a force of ___5.0 newtons___ .

2. If I were to push harder against the wall, what would the wall do? ___Push harder back on me___

3. If body A pushes against body B, then body B will ___push___ against body ___A___ with a force which is ___equal___ in magnitude but ___opposite___ in direction.

4. For every action force on B by A, there is a ___reaction___ force on ___A___ by ___B___ . Forces always act in pairs.

5. Action and reaction forces act upon (different, the same) ___different___ body (bodies). Body A's motion is caused by the force (on, by) ___on___ body A exerted by ___B___ .

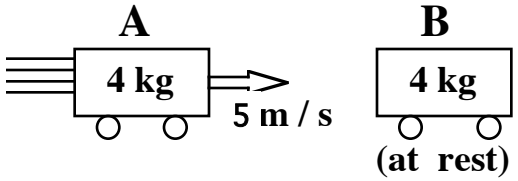
6. Fast moving trucks are hard to stop because of the ___mass___ and ___velocity___ of the trucks. The product of mass and velocity is called the body's ___momentum___ . Units of momentum are ___kg * m/s___ or ___N * s___ .

7. What is the momentum of a 3.0 kg object moving at 5.0 m/s ? ___15 kg*m/s___

8. Scalar or vector? Mass ___scalar___ ; Velocity ___vector___ ; Momentum ___vector___

9. Forces cause masses to ___accelerate___ according to Newton's 2nd Law, F = ___ma___ . Acceleration, a, is defined as $\Delta v / \Delta t$. Substitute this into F = ma, and it becomes F = ___$m * \Delta v / \Delta t$___ . This can be rearranged into the impulse equation, ___$F * \Delta t = m * \Delta v$___ . This equation sates that v is proportional to ___force___ and ___time___ , but it is inversely proportional to ___mass___ . Impulse is equal to ___force___ times ___time___ and is the cause of the change in the ___momentum___ that it produces.

10.

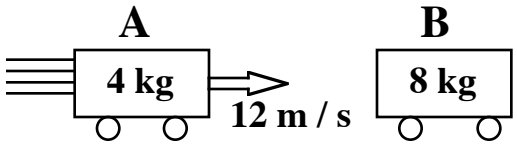


Assume a frictionless surface. What is the initial momentum, p, of cart A? ___20kg * m/s___

According to Newton's 3rd Law an ___action___ force is applied by cart ___A___ on cart ___B___ , and a ___reaction___ force which is ___equal___ and ___opposite___ is applied upon cart ___A___ by cart ___B___ . What is true of the time during which each force is applied? ___The time is the same.___

So each cart receives an i *impulse* that is *equal* in magnitude but *opposite* in direction. This means that the momentum gained by one cart is *given up* by the other. This is a form of the Law of Conservation of *Momentum* . The total momentum of a system, on which no outside *force* acts, remains *constant*. If cart A comes to rest after the collision, then cart B's velocity must be *0.50 m/s* .

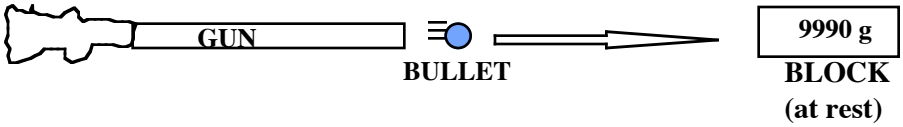
11.



Assume a frictionless surface. What is the momentum of cart A? *48 kg * m/s* Cart B was at rest. What was its momentum? 0 kg * m/s What was the initial total momentum, p, of the system? *48 kg * m/s*

After the collision cart A is moving to the **left** at a speed of 2.0 m/s. Is it a + or - velocity after the collision? *Negative* Cart A's "p" is *-8.0 kg *m/s* after the collision. In order for "p" to be conserved, cart B's momentum must be equal to *+56 kg * m/s* Therefore, its velocity is 7.0 m/s

12.



Block A's velocity, after the 10.0 g bullet is stuck in it, is 0.20 m/s along a frictionless surface.

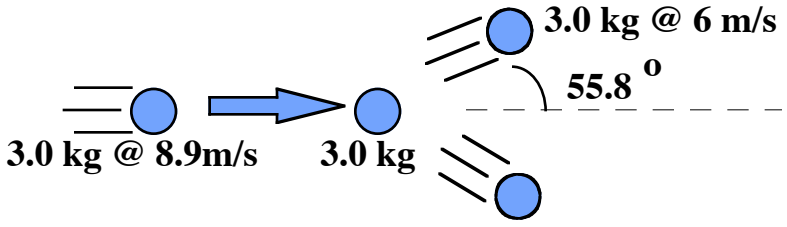
$$m_{bullet}v_{bullet} + m_{block}v_{block} = m_{bullet}v_{bullet} + m_{block}v_{block}$$

initially finally

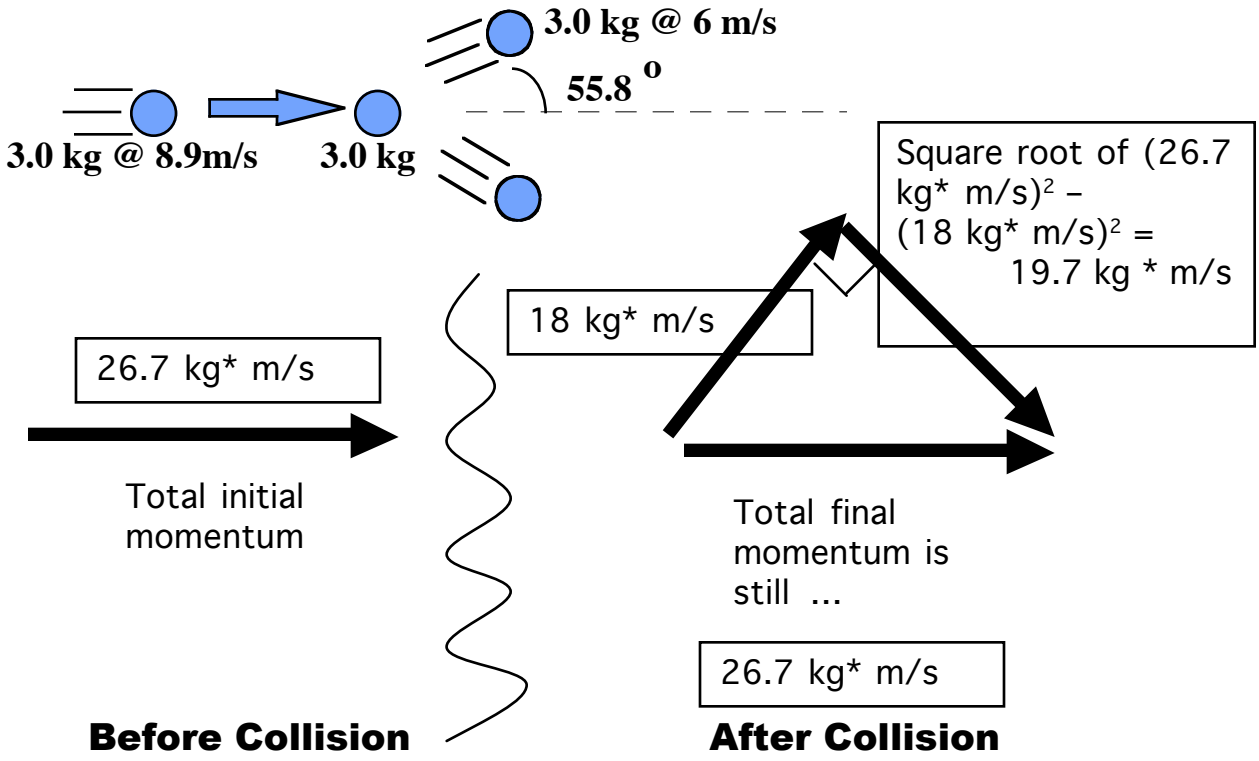
Show work: *0.010 kg * v + 9.99 kg * 0 m/s = 0.010 kg * 0.2 m/s + 9.99 kg * 0.2 m/s*

What was the bullet's initial velocity? *v = 200 m/s*

13.



Determine the speed of the "lower" ball after the collision. One of the balls is initially at rest. Assume a frictionless surface and a right angle between the balls after the collision. Attach a sheet with your diagram and work equations.



*The velocity of the ball traveling to the right and downward at 34 o is 19.7 kg * m/s divided by 3.0 kg = 6.6 m/s at 34 degrees.*

14. Momentum, p, is equal to ____*mass*__ times _*velocity*_ and is a _____*conserved*_____ quantity. ____*Momentum*_____ is always conserved in a closed system.