Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Momentum Notes

**Momentum-**

**Equation**

**Units**

When does an object have momentum?

* An object can have a large momentum either if its \_\_\_\_\_\_\_\_\_\_\_\_\_is large, its \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is large, or both.
* Object must be \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Is it possible to think that a child on roller skates and a large truck can have the same momentum? Explain.

Check Yourself

A 2 ton car, going 60 m.p.h. hits a 5 ton truck, going 20 m.p.h..

Which vehicle, the car or the truck, has greater momentum?

What would the car’s speed have to be for the momentums to match?

Aren’t you forgetting something?

How does that matter?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is important for momentum

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Momentum notes Continued-

In order to change the momentum of an object, either the \_\_\_\_\_\_\_\_\_\_\_\_\_\_ or

the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ must change

* + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_usually remains unchanged
  + Therefore, \_\_\_\_\_\_\_\_\_\_\_\_\_\_ changes and the object \_\_\_\_\_\_\_\_\_\_\_\_\_.
    - Forces cause \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_-therefore, force causes a

change in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

How \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ a force acts determines the amount of momentum change.

* + The \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ a force acts, the \_\_\_\_\_\_\_\_\_\_\_\_\_\_ the change in momentum.
  + The quantity of the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is called the \_\_\_\_\_\_\_\_\_\_

.

* + - The \_\_\_\_\_\_\_\_\_\_\_\_\_ the impulse, the \_\_\_\_\_\_\_\_\_\_\_\_\_ the change in momentum

Equation

* Using Newton’s Second Law F=MA and substituting that A=\_\_\_\_\_\_\_\_\_\_\_
* We conclude that

Equation

Where Ft is the Impulse and MV is the change in momentum

There are 2 ways to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ the momentum

* + Apply the greatest \_\_\_\_\_\_\_\_\_\_\_\_ possible
  + Apply the force for the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ possible

That is why golfers, baseball players etc., \_\_\_\_\_\_\_\_\_\_\_\_\_\_ when making an impact

Whenever a collision occurs, the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is the same, and

therefore, the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ acting on the person is the same. However,

the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is what is important. In order to \_\_\_\_\_\_\_\_\_\_\_\_\_ the

force of impact, the time is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. In all of the previous examples,

the time of impact is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, \_\_\_\_\_\_\_\_\_\_\_\_ the impact force.

Decreasing the impact \_\_\_\_\_\_\_\_\_ for a given change in \_\_\_\_\_\_\_\_\_\_\_ increases

the \_\_\_\_\_\_\_\_\_\_\_ imparted. For example, the car comes to an almost

\_\_\_\_\_\_\_\_\_\_\_\_ stop (very low time) so the \_\_\_\_\_\_\_\_ on the rider is very great for

a given change in \_\_\_\_\_\_\_\_\_\_\_\_\_.

Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Conservation of Momentum**:

* Only **\_\_\_\_\_\_\_\_\_\_\_\_** **\_\_\_\_\_\_\_\_\_\_\_\_\_\_** change the momentum of objects
* **­­­­­­­­­­­­­\_\_\_\_\_\_\_\_\_\_\_\_**  **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** do not change momentum
  + For example, if you are sitting inside a car and push the dashboard, the car will not move because it is an internal force. If a bulldozer pushed the outside of the car, it would move because it is an extrernal force.

**How about a rifle firing a bullet?**

* Force is \_\_\_\_\_\_\_\_\_\_\_\_\_
* Should be no change in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Before the gun is fired, momentum is \_\_\_\_\_\_\_\_\_\_\_\_\_\_
* After the gun is fired, the momentum should also be \_\_\_\_\_\_\_\_\_\_\_\_\_
* Momentum of gun is \_\_\_\_\_\_\_\_\_\_\_\_ and opposite the momentum of the bullet
  + This is an example of an \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Law of Conservation of Momentum:**

* In the absence of an ­\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_, the \_\_\_\_\_\_\_\_\_\_\_\_\_\_ of a system remains \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Explosions:**

* Explosion-any \_\_\_\_\_\_\_\_\_\_\_\_\_ where one object is broken into 2 objects because of an \_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + Total momentum before the explosion is \_\_\_\_\_\_\_(everything at rest)
  + Total momentum after must also equal \_\_\_\_\_\_\_\_\_\_\_\_
    - Equation:

**Collisions:**

* The Law of Conservation of Momentum can be neatly summarized by the following relationship

Total Momentum \_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_=

Total Momentum \_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

2 Types of Collisions:

* Elastic: An **Elastic Collision** is when objects \_\_\_\_\_\_\_\_\_ with no lasting \_\_\_\_\_\_\_\_\_\_\_\_\_\_ or the generation of \_\_\_\_\_\_\_\_\_\_\_\_.
  + Examples
    - Billiard balls
    - Air molecules

Nothing is 100 % perfectly elastic. Some things are pretty close.

Calculations will not be covered

Inelastic: An **inelastic collision** is 2 or more objects \_\_\_\_\_\_\_ and become \_\_\_\_\_\_\_\_\_\_ and generate \_\_\_\_\_\_. We will consider inelastic collisions where the 2 objects \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_ and move off as one.

* + Examples
    - Freight cars coupling together
    - Mashed potatos thrown at someone
* Equation: Using the law of Conservation of Momentum

p(before)=p(after)

becomes

MaVa + MbVb=(Ma+Mb)Vfinal

* Example-A freight car of mass 1000 kg is moving at 3 m/s when it collides and couples to a stationary freight car of mass 1200 kg. After the collision, what is the new velocity?

Solution:

* Example 2-

John has a mass of 40 kg and Emily a mass of 50 kg. John is skating towards Emily at 2 m/s, Emily is skating toward John at 3 m/s. They collide and move off together after the collision. What is their new speed?