Using formulas to guide your thinking

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

**Comparing Momentum shifts within a closed systems**

Conservation Laws in Science: *In a closed system, the \_\_\_\_\_\_\_\_ amount of a particular measureable quantity stays the \_\_\_\_\_\_\_ while shifting within the system.*

The Law of Conservation of Momentum states \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

Collisions & Explosions:

In an elastic collision, the objects will  *\_\_\_\_\_\_\_\_*  off one another.

In an inelastic collision, the objects will  *\_\_\_\_\_\_\_\_* together and move in the  *\_\_\_\_\_\_\_\_* direction after impact.

For a bomb that is ***at rest****,* the momentum before & after the explosion is  *\_\_\_\_\_\_\_\_*.

|  |  |  |  |
| --- | --- | --- | --- |
| Dimension | Variable | Standard  International  Unit | Definition |
| Mass |  |  |  |
| Velocity |  |  |  |
| Momentum |  |  |  |

Momentum Formula: *\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*

**Comparing separate systems using Momentum**

1. Two bullets have the same momentum. If their mass is the same, how do their velocities compare?
2. Objects X and Y are moving at the same velocity. If object’s X’s momentum is 3 times larger than Object Y’s, what information can you deduce about Object Y?
3. Two balls of the same mass and move in opposite directions at the same speed. If the first ball’s momentum is 18 kg m/s, what is the momentum of the other ball?
4. A red ball has twice the mass of a blue ball. The red ball is moving 3 times faster than the blue ball. Complete the sentence:

The red ball’s ***p*** is (more/less) than the blue ball’s p by a factor of \_\_\_\_\_\_\_\_\_\_.

1. The total momentum in a system changes from 30 kg m/s to 60 kg m/s. Is this a closed or open system?
2. Ball A & Ball B interact in a system. Ball A’s initial ***p*** is 16 kg m/s & Ball B’s initial ***p*** is -20 kg m/s. Later, the momentum has shifted due to an interaction and each ball’s momentum is 2 kg m/s. Is this an open or closed system?
3. By what factor will momentum change if velocity doubles and mass decreases by half?

|  |  |  |  |
| --- | --- | --- | --- |
| System A | System B | System C | System D |
| *p* = 72 kg m/s | *p* = -18 kg m/s | *p* = 36 kg m/s | *p* = 144 kg m/s |

1. For system C, what would be the velocity of the 4 kg object?
2. For system B, what is the object’s mass if its velocity is -72 m/s?
3. For system D, what is the object’s mass if its velocity is 12 m/s?
4. If the objects in system A and B each have a mass of 6 kg, find the velocities of each system.
5. If the mass of the object in system A is 9 kg, what is the mass of the object in system C if the velocity is the same for both systems?
6. Two carts, each with a mass of 8 kg, have different momentums. If cart A’s momentum is double Cart B’s momentum, how do their velocities compare?
7. A red ball has a momentum of + 5 kg m/s. A blue ball has a momentum of - 8 kg m/s. What can you conclude abou their velocities?

Impulse

|  |  |  |  |
| --- | --- | --- | --- |
| Dimension | Variable | Standard  International  Unit | Definition |
| Mass |  |  |  |
| Velocity |  |  |  |
| Momentum |  |  |  |
| Impulse |  |  |  |
| Force |  |  |  |
| Time |  |  |  |

Formulas:

Momentum: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Impulse \_\_\_\_\_\_\_\_\_\_\_\_ or \_\_\_\_\_\_\_\_\_\_\_\_

1. The momentum of a 2 kg object changes from 20 kg m/s to 12 kg m/s in 3 seconds.
   1. What is the impulse on the object?
   2. What Force caused the change in momentum?
2. A 12 kg cart moves at 3 m/s before a force of 3 N is applied to it. If the cart’s momentum after the force is applied is 72 kg m/s, how long was the force applied?
3. A system’s total momentum changes from 4 kg m/s to 12 kg m/s. Is the system open or closed?
4. A 7 kg cart’s momentum is – 56 kg m/s.
   1. What is the cart’s velocity?
   2. Next, the momentum changes to +2 kg m/s. What is the impulse?
   3. If the impulse ( momentum change) occurs over 3 seconds, how much force was applied?