



Keywords

Word	Definition
Force Pair	According to Newton's third law, for every action force there is an equal (in size) and opposite (in direction) reaction force. Forces always come in pairs - known as "action-reaction force pairs."
Inertia	The tendency of an object to remain stationary or continue travelling at a constant velocity
Inertial Mass	The ratio between the resultant force acting on an accelerating object and its acceleration
Momentum	A property of a moving object that is the product of its mass and velocity
Recoil	Recoil is the backward momentum of a object (like gun)when it is discharged.

Newton's Laws of Motion:

1st Law: the velocity, speed and/or direction of an object will only change if there is a resultant force acting on it.

2nd Law: the acceleration of an object is proportional to the resultant force on the object and inversely proportional to the mass of the object. **$F = m \times a$**

3rd Law: whenever two objects interact with each other, they exert equal and opposite forces on each other.

Newton's First law in detail:

The **inertia** of an object is its tendency to remain in an unchanging state eg: still, or moving at a constant speed in a straight line.

So: If the resultant force on a **stationary object** is zero, the object will **stay still**.

If the resultant force on a **moving object** is zero, it will continue to move at the **same speed** in a **straight line**.

If the resultant force is **not zero**, the **velocity** will change.

A change in **velocity** means an object could:

Start to move

Stop Moving

Speed Up

Slow Down

Change Direction

If any of these things happen it is because a resultant force is acting on the object.

Key Skills

Recall and use the equation for Newton's second Law and for momentum.

Understand and apply the conservation of momentum.



Newton's Second Law in detail

$$\mathbf{F} = \mathbf{m} \times \mathbf{a}$$

Resultant Force (N) = Mass (kg) x Acceleration (m/s^2)

The inertial mass of an object is a measure of how difficult it is to change the velocity of an object. It can be found using:

$$\text{Inertial mass (kg)} = \frac{\text{force (N)}}{\text{acceleration (m/s}^2\text{)}}$$

Momentum is a property of all moving objects. It is a vector quantity.

It depends on the mass and velocity of an object. Here is the equation:

$$\text{Momentum (kg m/s)} = \text{Mass (kg)} \times \text{Velocity (m/s)}$$

$$\mathbf{p} = \mathbf{m} \times \mathbf{v}$$

Law of Conservation of Momentum:

"In a closed system the total momentum before an event (a collision or explosion) is **equal** to the total momentum after the event".

If 2 moving object collide this law can be written as:

$$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$$

Where-

m_1 = mass of object 1

u_1 = initial velocity of object 1

m_2 = mass of object 2

u_2 = initial velocity of object 2

v_1 = final velocity of object 1

v_2 = final velocity of object 2

Newton's Third Law in detail

Forces always act in pairs.

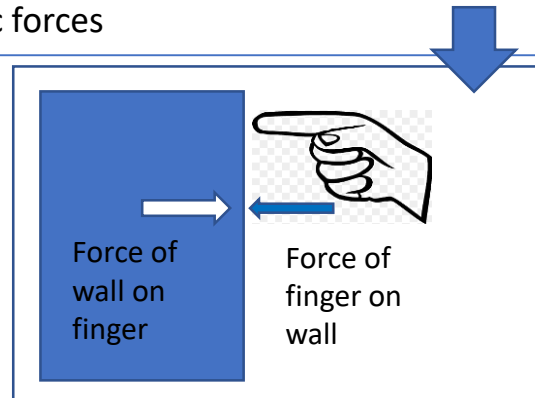
Each pair of forces:

Act on separate objects

Are the same size as each other

Act in opposite directions along the same line

Are of the same type eg: two gravitational forces or two electrostatic forces



Momentum is conserved in an explosion because:

Total mv before is zero;

Total mv after is also zero because different parts of the object travel in different directions and so the mv of each part will cancel out with the mv of another.

If 2 moving objects **recoil** from each other, they start off with a total mv of zero and end up moving away from each other with velocities v_1 and v_2 .

$$\text{So } m_1v_1 + m_2v_2 = 0$$