Objective 5 Newton's laws

Investigate and describe applications of Newton's laws such as in vehicle restraints, sports activities, geological processes and satellite orbits

What is a Force?

Force can be defined as a push or a pull. (Technically, force is something that can accelerate objects.) For example, when you throw a baseball, you apply a force to the ball. Force is measured by N (**Newton**). A force that causes an object with a mass of 1 kg to accelerate at 1 m/s is equivalent to 1 Newton.

Newton's First Law of Motion

You will have to learn a new terminology here: **net force**. Net force is the sum of all forces acting on an object. For example, in a tag of war, when one team is pulling the tag with a force of 100 N and the other with 80 N, the net force would be 20 N at the direction of the first team (100 N - 80 N = 20 N).

When you slide your book on floor it will stop soon. When you slide it on icy surface, it will travel further and then stop. Galileo believed that when you slide a perfectly smooth object on a frictionless floor the object would travel forever.

Isaac Newton developed the idea of Galileo further. He concluded that **an object will remain at rest or move with constant velocity when there is no net force acting on it.** This is called Newton's First Law of Motion, or Law of Inertia

Newton's Second Law of Motion

Newton's First Law deals with an object with *no* net force. Newton's Second Law talks about an object that has net force. It states that **when the net force acting on an object is not zero, the object will accelerate at the direction of the exerted force. The acceleration is directly proportional to the net force and inversely proportional to the mass.** It can be expressed in formula

$F = ma$

where:

- F is the net force in N,
- m is the mass of an object in kg and
- a is its acceleration in m/s^2.

From this formula, we can say that force is something that accelerates an object.

Newton's Third Law of Motion

When you kick the wall in your room, you will probably end up hurting your foot. Newton's Third Law of Motion can explain why: **when one object applies a force on a second object, the second object applies a force on the first that has an equal magnitude but opposite direction**. In other words, when you kick the wall, the wall kicks you back with equal force. As a result you will get hurt. These forces are called **action-reaction forces**.

Remember when you kick the wall, you exerts force on the wall. When the wall kicks you back, it exerts force on you. Therefore, the net force on the wall is not zero and the net force on your foot is not zero neither.

Mass and **weight** are different in physics. For example, your mass doesn't change when you go to the Moon, but your weight does. Mass shows the quantity, and weight shows the size of gravity.

If you know your mass, you can easily find your weight because
$W = mg$
where:

- W is weight in Newton (N), $=kg/ms^2 =$
- m is mass in kg, and
- g is the acceleration of gravity in m/s^2.

If your mass is 70 kg on Earth, your weight is
$W=(70\ kg)(9.8\ m/s^2) = 686$ N.
Weight is measured by Newton (N).

IN CONCLUSION

Newton's Laws of Motion

1. **Inertia** is the tendency of matter to resist a change in motion.
2. **Newton's first law** of motion states that an object at rest will remain at rest and an object in motion will remain in motion at constant velocity unless acted upon by an unbalanced force.
3. **Newton's second law** of motion describes how force, acceleration, and mass are related. Force equals mass times acceleration.
4. **Newton's third law** of motion states that forces always occur in pairs. Every action has an equal an opposite reaction.