Force a Push or a Pull

Understanding Force

Force is a push or a pull upon an object resulting from the object's interaction with another object. It can cause an object to start moving, stop moving, change its speed, or change its direction. Everyday actions like kicking a ball, opening a door, or pulling a bucket of water involve forces.

Types of Forces: Push and Pull

Forces can be broadly classified as pushes or pulls. A push moves an object away from the source of force, while a pull draws it closer. Many actions involve either pushing or pulling, or sometimes both.

Forces Arise from Interactions

For a force to act, there must be an interaction between two objects. For example, a man pushing a car applies a force on the car, and the car applies an equal and opposite force on the man. This mutual interaction is fundamental to the concept of force.

Contact and Non-contact Forces

Forces can be contact forces, where objects physically touch each other (like muscular force or friction), or non-contact forces, where forces act at a distance without physical contact (like magnetic force, electrostatic force, and gravitational force).

Solved Examples

Practice Set

- **Conceptual Question (Level 1):** Define force and explain the difference between push and pull.
- **Conceptual Question (Level 2):** Explain why forces always come in pairs with an example.
- **Application Question (Level 3):** A man pushes a stationary car with a force of 200 N, but the car does not move. Explain why the car remains stationary.

Answer Key

- **Q1:** Force is a push or pull on an object resulting from interaction with another object. A push moves an object away, while a pull draws it closer.
- **Q2:** Forces come in pairs due to interaction; when one object exerts a force on another, the second exerts an equal and opposite force on the first. Example: When a man pushes a car, the car pushes back with equal force.
- **Q3:** The car remains stationary because the applied force is balanced by friction and the car's inertia. The net force is zero, so no movement occurs.

Force Can Change Motion

Effect of Force on Speed and Direction

A force applied in the direction of motion increases the speed of an object, while a force applied opposite to the motion decreases its speed. A force applied at an angle can change the direction of motion.

State of Motion

The state of motion of an object is described by its speed and direction. An object at rest has zero speed. A force can change the state of motion by altering speed, direction, or both.

Examples in Sports

In games like football, hockey, and cricket, players apply forces to balls to change their speed and direction, demonstrating how forces affect motion.

Solved Examples

Practice Set

- **Conceptual Question (Level 1):** What happens to the speed of a ball when a force is applied in the direction of its motion?
- **Conceptual Question (Level 2):** How does a force applied perpendicular to the direction of motion affect an object?
- **Application Question (Level 3):** A ball rolling on the ground slows down and stops. Explain the role of force in this observation.

Answer Key

- **Q1:** The speed of the ball increases when a force is applied in the direction of its motion.
- **Q2:** A force applied perpendicular to the motion changes the direction of the object without changing its speed.
- **Q3:** Frictional force acts opposite to the motion, slowing the ball down until it stops.

Force Can Change Shape

Deformation Due to Force

When a force is applied to an object that is not free to move, it may change shape. For example, pressing dough flattens it, stretching a rubber band elongates it, and bending a plastic scale changes its shape.

Observations from Everyday Life

Objects like balloons, dough, and rubber balls change shape when forces are applied. The extent of shape change depends on the material properties and the magnitude of the force.

Solved Examples

Practice Set

- **Conceptual Question (Level 1):** What happens to a rubber band when a force is applied by pulling it?
- **Conceptual Question (Level 2):** Why does a dough change shape when pressed but does not move?

- **Application Question (Level 3):** Explain why a spring compresses when a person sits on a bicycle seat.

Answer Key

- **Q1:** The rubber band stretches and changes shape when pulled due to the applied force.
- **Q2:** Dough changes shape because it is soft and deformable; the force causes deformation but not motion.
- **Q3:** The person's weight applies a force on the spring, compressing it due to the force acting downward.

Contact Forces

Muscular Force

Muscular force is the force exerted by muscles in our body to perform actions like pushing, pulling, lifting, and moving objects. It is a contact force because it requires physical contact with the object.

Friction

Friction is a force that opposes motion between two surfaces in contact. It acts opposite to the direction of motion and causes moving objects to slow down and eventually stop.

Solved Examples

Practice Set

- **Conceptual Question (Level 1):** What is muscular force and why is it called a contact force?
- **Conceptual Question (Level 2):** How does friction affect the motion of a rolling ball?
- **Application Question (Level 3):** Explain why a heavy box may not move even when pushed with a large force.

Answer Key

- **Q1:** Muscular force is the force exerted by muscles; it is a contact force because it requires touching the object.
- **Q2:** Friction opposes the motion of the ball, causing it to slow down and stop.
- **Q3:** The force applied may be balanced by friction and the box's inertia, resulting in no movement.

Non-contact Forces

Magnetic Force

Magnetic force is the force exerted by magnets. Like poles repel each other, and unlike poles attract. This force acts without physical contact between the magnets.

Electrostatic Force

Electrostatic force arises from electric charges. Charged objects can attract or repel each other without contact, depending on the nature of their charges.

Gravitational Force

Gravitational force is the attractive force exerted by the Earth and other objects due to their mass. It pulls objects towards each other, such as objects falling towards the Earth.

Solved Examples

Practice Set

- **Conceptual Question (Level 1):** What happens when like poles of two magnets are brought close?
- **Conceptual Question (Level 2):** Describe the electrostatic force between two charged straws rubbed with paper.
- **Application Question (Level 3):** Why do objects fall towards the Earth when dropped?

Answer Key

- **Q1:** Like poles repel each other, so the magnets push away.
- **Q2:** Two straws rubbed with paper acquire similar charges and repel each other; if one is uncharged, they attract.
- **Q3:** Objects fall due to Earth's gravitational force pulling them downwards.

Pressure

Definition of Pressure

Pressure is defined as the force applied per unit area on a surface. It is given by the formula:

pressure = force / area

Pressure depends on both the magnitude of the force and the area over which it acts.

Pressure in Daily Life

Sharp tools exert more pressure due to smaller area, making cutting easier. Broad straps on bags reduce pressure on shoulders, making carrying easier. Liquids and gases also exert pressure on the walls of their containers.

Pressure Exerted by Liquids and Gases

Pressure in a liquid increases with depth and acts equally in all directions. Gases exert pressure on the walls of their containers due to the motion of gas particles.

Atmospheric Pressure

Atmospheric pressure is the pressure exerted by the weight of the air in the atmosphere on the Earth's surface. It acts in all directions and is significant in many natural phenomena.

Solved Examples

Practice Set

- **Conceptual Question (Level 1):** What is pressure and how is it related to force and area?
- **Conceptual Question (Level 2):** Why does a sharp knife cut better than a blunt knife?
- **Application Question (Level 3):** Explain why water jets out of holes near the bottom of a water-filled bottle with equal force.

Answer Key

- **Q1:** Pressure is force divided by area; increasing force or decreasing area increases pressure.

- **Q2:** A sharp knife has a smaller area at the edge, increasing pressure and making cutting easier.
- **Q3:** Pressure at the same depth in a liquid is equal in all directions, so water jets out with equal force from holes at the same level.

Quick Reference Table

Common Mistakes and Misconceptions

Glossary