🔹 What is Force?

🟦 **Definition:**
Force is a push or pull that changes or tends to change the state of motion or shape of an object.

✅ Effects of force:

- Can change speed
- Can change direction
- Can change shape (📷 Fig. 8.2)

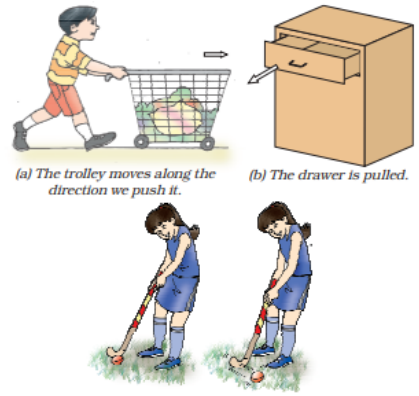
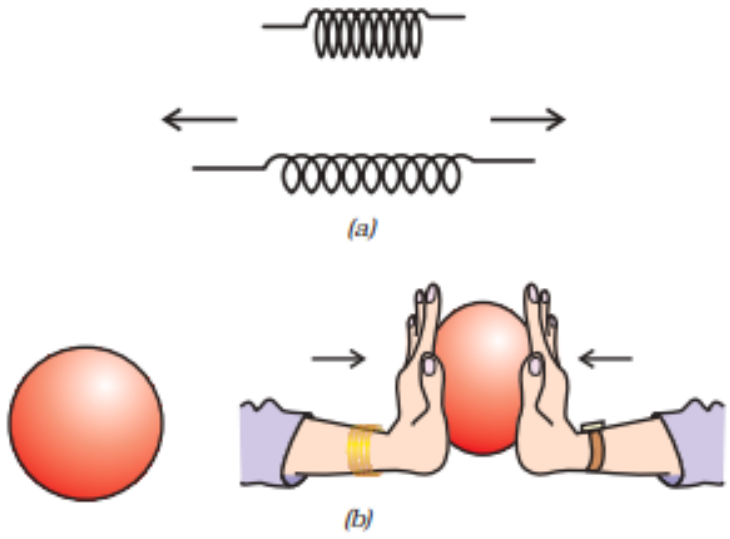


Fig. 8.1: Pushing, pulling, or hitting objects change their state of motion.

📷 *Fig. 8.1 – Pushing, pulling, or hitting changes motion*



📷 *Fig. 8.2 – Spring expands, ball deforms*

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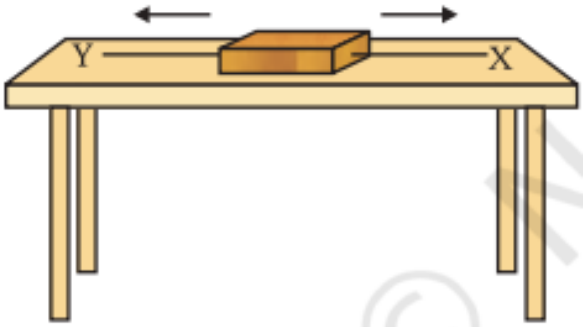
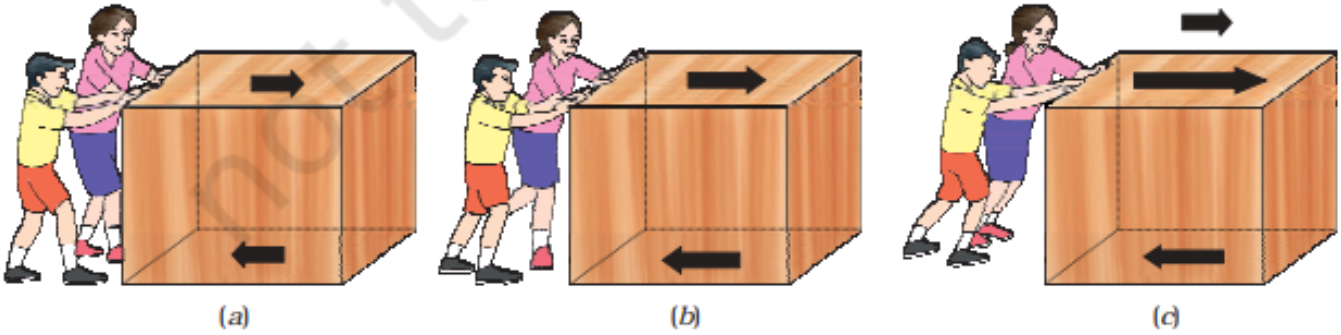
🔹 8.1 Balanced and Unbalanced Forces

- If two opposite forces cancel each other → balanced → no motion
- If one force is stronger → unbalanced → motion happens



📷 *Fig. 8.3 – Wooden block pulled equally = no movement (balanced)*



📷 *Fig. 8.4 – Push box harder → overcome friction → motion begins*

✅ Unbalanced force causes acceleration or deceleration

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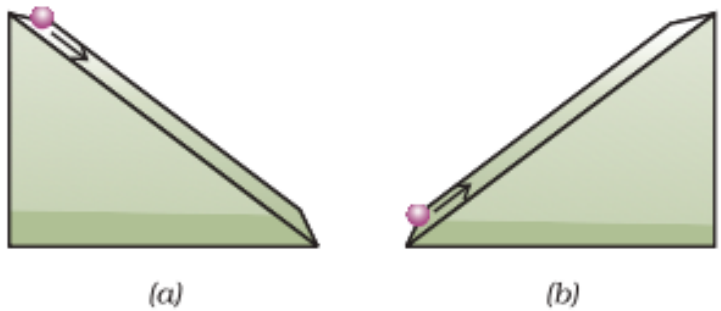
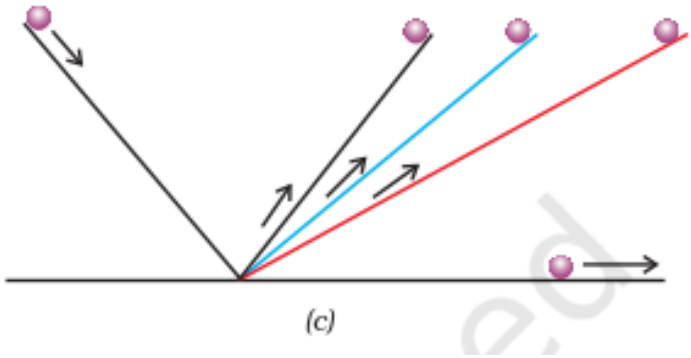
🔹 8.2 Newton's First Law of Motion (Law of Inertia)

🟦 Law:
An object remains at rest or in uniform motion unless an unbalanced force acts on it.

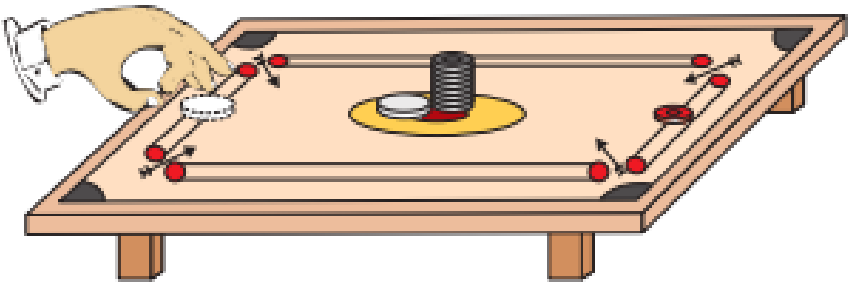
🟦 **Inertia:**
Tendency of an object to resist change in motion.

- Mass measures inertia — more mass = more inertia





📷 *Fig. 8.5 – Galileo's inclined plane experiment*



📷 *Fig. 8.6 – Carom coin at bottom moves → others stay (due to inertia)*

🔬 **Activity 8.1** – Hit bottom coin of carom stack → others fall down vertically

🔬 **Activity 8.2** – Flick card → coin falls in glass → due to inertia

🔬 **Activity 8.3** – Tray with water tumbler → turn tray fast → water spills due to inertia

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🔹 8.3 Inertia and Mass

🟦 Heavy objects offer more resistance to motion → more inertia

Examples:

- Train vs Cart
- Stone vs Ball
- 5-rupee coin vs 1-rupee coin

🟦 **Conclusion:**
Mass is a measure of inertia.

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🔹 8.4 Newton's Second Law of Motion

🟦 Law:
Rate of change of momentum of an object is directly proportional to the applied force and takes place in the direction of force.

🧮 **Momentum:**
$p = mv$
(SI unit: kg m/s)

🧮 Formula:
$F = ma$

🟦 More force = more acceleration (if mass is constant)
🟦 More mass = more force needed (if acceleration same)

📷 *Fig. 8.8 – Fielder pulls hands back while catching → reduces force*

🧮 Example 1:
Mass = 5 kg, u = 3 m/s, v = 7 m/s, t = 2 s
$F = m(v - u)/t = 10$ N

🧮 Example 2:
Compare 2 kg @ 5 m/s² vs 4 kg @ 2 m/s² → 2 kg mass needs more force (10 N vs 8 N)

🧮 Example 3:
Car slows from 30 m/s to 0 in 4 s → F = –7500 N (opposite to motion)

🧮 Example 4:
Find acceleration if two masses tied → m = 0.75 kg, F = 5 N → a = 6.67 m/s²

🧮 Example 5:
Ball slows from 20 cm/s to 0 in 10 s
a = −0.02 m/s², F = −0.0004 N

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🔹 8.5 Newton's Third Law of Motion

📘 Law:
To every action, there is an equal and opposite reaction.

- Action & reaction forces act on different objects
- Happen simultaneously

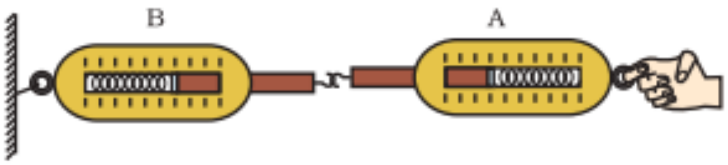

Fig. 8.10: Action and reaction forces are equal and opposite.

📷 *Fig. 8.10 – Two spring balances pulling equally → same reading*

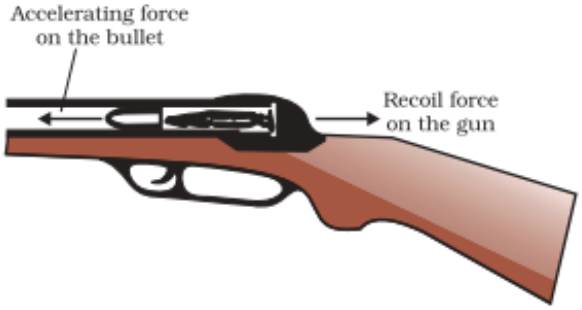

Fig. 8.11: A forward force on the bullet and recoil of the gun.

📷 *Fig. 8.11 – Bullet forward, gun recoils backward*

Fig. 8.12: As the sailor jumps in forward direction, the boat moves backwards.

📷 *Fig. 8.12 – Sailor jumps forward, boat moves backward*

🔬 **Activity 8.4** – Two kids on carts throw sand bag → both move due to reaction

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📚 **Summary: What You Have Learnt**

- Force is a push or pull
- Balanced force → no motion; Unbalanced → motion
- First Law = Inertia (mass resists change)
- Second Law = F = ma (force = mass × acceleration)
- Third Law = Action = –Reaction
- Momentum = mass × velocity (p = mv)