

CLASS 9 SCIENCE — CHAPTER 6

NCERT SOLUTIONS

How Forces Affect Motion

New NCERT *Exploration* Textbook | 2026–27

The chapter-end “Revise, Reflect, Refine” section contains **16 questions**.

PAUSE AND PONDER

Q1. Weightlifter and Barbell

Question:

A weightlifter lifts a barbell. List two forces acting on the barbell. Are these forces balanced if the weightlifter keeps the barbell steady?

Answer:

Two forces act on the barbell:

1.  **Gravitational force (weight)** — downward
2.  **Force applied by the weightlifter** — upward

If the barbell is steady:

Upward force = Downward force

Therefore:

 **The forces are balanced.**

Net force = **0 N**

Q2. Arm-Wrestling

Question:

Two players R and S are arm-wrestling. When their arms tilt towards the front, are the forces balanced? If not, which player exerted the larger force?

Answer:

 The forces are **not balanced** because the arms are moving.

The figure shows that:

 **Player S exerted the larger force.**

Therefore, there is a net force in the direction of S's greater force.

Q3. Constant Velocity

Question:

An object is moving with a constant velocity. Is there a net force acting upon it?

Answer:

No.

If an object moves with constant velocity, its acceleration is zero.

Using:

$$F = ma$$

$$a = 0$$

Therefore:

 **Net force = 0 N**

Q4. No Net Force

Which situations are possible?

- (i) Object remains at rest if at rest.
- (ii) Object keeps moving with constant velocity if already moving.
- (iii) Object moves with constant acceleration.

 **Answer:**

(i) and (ii)

If net force = 0:

- An object at rest remains at rest.
- A moving object continues with constant velocity.

It cannot have non-zero acceleration when net force is zero.

Q5. Net Force Zero in Real Life

Answer:

Consider a book lying on a table.

Two forces act on it:

 Weight of the book

 Normal force from the table

These forces are equal and opposite.

Therefore:

Net force = 0

So, although forces are acting on the book, the net force is zero.

Q6. Toy Car

Question:

A toy car of mass 100 g moves with a constant velocity of 0.5 m/s. What is the net force acting on it?

Answer:

The car moves with **constant velocity**.

Therefore:

$$\text{Acceleration} = 0$$

Using:

$$F = ma$$

$$F = m \times 0$$

$$\checkmark F = 0 \text{ N}$$

The official answer key also gives **0 N**.



REVISE, REFLECT, REFINE

Q1. Table Moving at Constant Velocity

Question:

A horizontal force F moves a table across the floor at constant velocity. How much is the frictional force exerted by the floor on the table?

Answer:

The table moves with **constant velocity**.

Therefore:

$$\text{Net force} = 0$$

So, friction must balance the applied force.

✓ **Frictional force = F**

Its direction is:

Opposite to the applied force.

The textbook answer key confirms this.



Q2. Ball on a Smooth Surface

Choose the correct option.

(i)

If no net force is applied, velocity will:

remain the same / increase / decrease

(ii)

If a net force acts in the direction of motion, velocity will:

remain the same / increase / decrease

(iii)

If a net force acts opposite to motion, velocity will:

remain the same / increase / decrease

✓ **Answers:**

(i) Same

(ii) Increase

(iii) Decrease



Explanation:

No net force:

- No acceleration
- Velocity remains constant.

Force in direction of motion:

- Positive acceleration
- Speed increases.

Force opposite to motion:

- Negative acceleration
 - Speed decreases.
-



Q3. Blocks P and Q

Two blocks are on a smooth horizontal surface.

For block P:

- Force = 5 N in one direction
- Force = 4 N in opposite direction

Block Q is moving with constant velocity.

Block P:

Net force:

$$5 - 4 = 1 \text{ N}$$

Therefore, P has a net force.

Block Q:

It moves with constant velocity.

Therefore:

$$\text{Net force} = 0$$

Answer:

(i) P experiences a net force and Q does not experience a net force.



Q4. Snake Boat

Question:

100 oarsmen are rowing a boat.

- 95 oarsmen row backward to propel the boat forward.
- 5 oarsmen accidentally row in the opposite direction.
- Each oarsman applies 200 N force.

Find the net force.

Step 1: Force of 95 oarsmen

$$95 \times 200$$

$$= 19,000 \text{ N}$$

Forward

Step 2: Force of 5 oarsmen

$$5 \times 200$$

$$= 1,000 \text{ N}$$

Backward

Step 3: Net force

$$19,000 - 1,000$$

$$= 18,000 \text{ N}$$



Answer:

18,000 N in the forward direction



Q5. Newton's Second Law

Question:

When a net force acts on an object, the object accelerates:

- (i) opposite to force...
- (ii) opposite to force...
- (iii) in direction of force, acceleration inversely proportional to force.
- (iv) in direction of force, acceleration proportional to force.

✓ Answer:

(iv)



Why?

Newton's second law:

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

Therefore, for a fixed mass:

$$\mathbf{a} \propto \mathbf{F}$$

Acceleration is in the **direction of net force**.



Q6. Position-Time Graph

Question:

The position-time graphs of four objects A, B, C and D are shown. On which object does a net force act?

✓ Answer:

(iii) Object C

Explanation:

The slope of a position-time graph gives velocity.

If the graph is curved:

→ Velocity changes

→ Acceleration occurs

→ Net force acts.

The graph for **C** represents changing velocity.

Therefore:

Net force acts on Object C.

Q7. Sailor Jumps from Boat

Question:

A sailor jumps forward from a small boat. Will the boat move? If yes, in which direction and why?

Answer:

Yes, the boat will move.

When the sailor jumps forward:

 Sailor pushes the boat backward.

According to Newton's third law:

The boat exerts an equal and opposite force on the sailor.

Therefore:

Sailor → Forward

Boat → Backward



Q8. Landing Mat in High Jump

Question:

Why is a landing mat or sand bed placed for a high-jump athlete?

Answer:

When an athlete lands, their momentum must change quickly.

A soft landing mat increases the **time taken to stop**.

According to:

$$F = \Delta p / \Delta t$$

If the stopping time increases:

Force decreases.

Therefore, the mat reduces the force experienced by the athlete and helps prevent injury.



★ Answer:

A landing mat increases stopping time and reduces the impact force.



Q9. Two Hand Carts

Question:

A loaded hand cart collides with an identical empty hand cart. During the collision, which statement is correct?

(i) Loaded cart exerts larger force.

(ii) Empty cart exerts larger force.

(iii) Neither exerts force.

(iv) Both exert equal forces on each other.

✓ **Answer:**

(iv)

🧠 **Explanation:**

Newton's third law states:

For every action, there is an equal and opposite reaction.

Therefore, during the collision:

Force by loaded cart = Force by empty cart

The masses being different do not change the equality of the action-reaction forces.



Q10. Acceleration-Mass Graph

Question:

The acceleration-mass graph is given. Plot the force-mass graph.

From the graph:

At:

$$\mathbf{m = 1\ kg}$$

$$\mathbf{a = 10\ m/s^2}$$

Using:

$$\mathbf{F = ma}$$

$$\mathbf{F = 1 \times 10}$$

$$\mathbf{F = 10\ N}$$

Check another point:

$$m = 2 \text{ kg}$$

$$a = 5 \text{ m/s}^2$$

$$F = 2 \times 5$$

$$\mathbf{F = 10 \text{ N}}$$

Again:

$$m = 5 \text{ kg}$$

$$a = 2 \text{ m/s}^2$$

$$F = 5 \times 2$$

$$\mathbf{F = 10 \text{ N}}$$

Therefore, the force remains constant.



Force-Mass Graph:

It will be a **horizontal straight line at $F = 10 \text{ N}$.**



Answer:

Force = 10 N for all masses.



Q11. Velocity-Time Graph

Question:

An object of mass 10 kg has the velocity-time graph shown. Calculate the force acting on it.

From the graph:

Initial velocity:

$$\mathbf{u = 10 \text{ m/s}}$$

Final velocity:

$$v = 30 \text{ m/s}$$

Time:

$$t = 8 \text{ s}$$

Step 1: Find acceleration

Formula:

$$a = (v - u) / t$$

$$a = (30 - 10) / 8$$

$$a = 20 / 8$$

$$a = 2.5 \text{ m/s}^2$$

Step 2: Find force

Formula:

$$F = ma$$

$$F = 10 \times 2.5$$

$$F = 25 \text{ N}$$

✓ **Answer:**

Force = 25 N

The official answer key confirms **25 N**.

Q12. Bullet Stopping in Wooden Block

Question:

A bullet of mass 50 g moves at 100 m/s and stops after penetrating 50 cm into a wooden block. Find the stopping force.

Given:

Mass = 50 g

= **0.05 kg**

u = 100 m/s

v = 0 m/s

s = 50 cm

= **0.5 m**

Step 1: Find acceleration

Formula:

$$v^2 = u^2 + 2as$$

$$0^2 = 100^2 + 2 \times a \times 0.5$$

$$0 = 10000 + a$$

Therefore:

$$a = -10000 \text{ m/s}^2$$

Negative sign means acceleration is opposite to the motion.

Step 2: Find force

$$F = ma$$

$$F = 0.05 \times (-10000)$$

$$F = -500 \text{ N}$$

✓ **Answer:**

Stopping force = 500 N opposite to the direction of motion.



Q13. Footballer Kicking the Ball

Question:

A footballer kicks a football with a speed of 108 km/h. The force applied is 800 N and the mass of the football is 0.4 kg. Find the time of contact.

Given:

Speed = 108 km/h

Convert to m/s:

$$108 \times 5/18$$

$$= 30 \text{ m/s}$$

Mass = 0.4 kg

Force = 800 N

Assume initial velocity = 0.

Formula:

$$F = \Delta p / \Delta t$$

Therefore:

$$F \times t = m(v - u)$$

$$800 \times t = 0.4 \times (30 - 0)$$

$$800t = 12$$

$$t = 12/800$$

$$t = 0.015 \text{ s}$$

✓ **Answer:**

Time of contact = 0.015 s



Q14. Object on a Rough Patch

Question:

An object of mass 2 kg moves at 10 m/s. It encounters a rough patch where friction is 7 N. An additional force of 3 N also opposes the motion. Find the distance travelled before it stops.

Given:

$$m = 2 \text{ kg}$$

$$u = 10 \text{ m/s}$$

$$v = 0$$

$$\text{Friction} = 7 \text{ N}$$

$$\text{Additional opposing force} = 3 \text{ N}$$

Step 1: Net opposing force

$$7 + 3$$

$$= 10 \text{ N}$$

Step 2: Acceleration

Since the force opposes motion:

$$F = -10 \text{ N}$$

Using:

$$F = ma$$

$$-10 = 2a$$

$$a = -5 \text{ m/s}^2$$

Step 3: Distance

Use:

$$v^2 = u^2 + 2as$$

$$0^2 = 10^2 + 2 \times (-5) \times s$$

$$0 = 100 - 10s$$

$$10s = 100$$

$$s = 10 \text{ m}$$

✓ Answer:

$$\text{Distance} = 10 \text{ m}$$



Q15. Tractor, Harrow and Trolley

Question:

A tractor pulls a harrow of mass m_1 with force F , producing acceleration a_1 .

The same tractor pulls a trolley of mass m_2 with the same force F , producing acceleration a_2 .

If the tractor pulls the trolley with the harrow placed on it, find the resulting acceleration in terms of a_1 and a_2 .

For the harrow:

Using:

$$F = m_1 a_1$$

Therefore:

$$m_1 = F/a_1$$

For the trolley:

$$F = m_2 a_2$$

Therefore:

$$m_2 = F/a_2$$

Combined mass:

$$m = m_1 + m_2$$

So:

$$m = F/a_1 + F/a_2$$

Combined acceleration:

$$a = F / (m_1 + m_2)$$

Substitute:

$$a = F / (F/a_1 + F/a_2)$$

Cancel F:

$$a = 1 / (1/a_1 + 1/a_2)$$

Therefore:

✓ **Answer:**

$$a = (a_1 a_2) / (a_1 + a_2)$$

Q16. Bar Magnet and Compass

Question:

A bar magnet and a compass needle exert equal and opposite forces on each other. The compass needle moves, but the bar magnet does not appear to move. Explain why.

Answer:

According to Newton's third law:

The two forces are equal and opposite.

However, the masses of the two objects are very different.

Compass needle:

Small mass → larger acceleration

Bar magnet:

Much larger mass → very small acceleration

Using:

$$a = F/m$$

For the same force:

Smaller mass → Greater acceleration

Larger mass → Smaller acceleration

Therefore, the compass needle moves noticeably, while the motion of the bar magnet is too small to notice.

The textbook explains the same principle for interacting objects with very different masses.

CHAPTER 6 — COMPLETE ANSWER KEY

Q	Answer
1	Friction = F , opposite to applied force
2	(i) Same, (ii) Increase, (iii) Decrease
3	(i)
4	18,000 N forward
5	(iv)
6	(iii) Object C
7	Boat moves backward
8	Landing mat increases stopping time and reduces force
9	(iv)
10	Force = 10 N ; horizontal F-m graph
11	25 N
12	500 N opposite to motion

13 0.015 s

14 10 m

15 $a = a_1 a_2 / (a_1 + a_2)$

16 Compass moves more because its mass is much smaller

These answers match the **new textbook's official Chapter 6 answer key**, including Q1, Q2, Q3, Q4, Q5, Q6, Q9, Q11–Q15.



CHAPTER 6 — FORMULAS TO REMEMBER



Newton's Second Law

$$F = ma$$



Acceleration

$$a = F/m$$



Momentum

$$p = mv$$



Force in terms of momentum

$$F = \Delta p / \Delta t$$



Impulse

$$\text{Impulse} = F \times \Delta t$$



Weight

$$W = mg$$



Key idea:

Net force = 0 → No acceleration

Net force ≠ 0 → Acceleration occurs

More force → More acceleration

More mass → Less acceleration for the same force

Action and reaction forces are equal and opposite but act on different objects.