

Laws of Motion

Class 11 Physics · 24 NEET MCQs with answers & explanations

Laws of Motion covers Newton's three laws, free-body diagrams, friction (static and kinetic), circular motion dynamics and connected bodies. NEET tests FBD-based problems, friction calculations, motion on inclined planes and problems involving pulleys and strings. Drawing correct FBDs is the key skill.

Key Laws & Concepts

Concept	Key Fact
Newton's 2nd law	$F = ma$; net force determines acceleration, not velocity
Newton's 3rd law	Action = -Reaction; forces act on different bodies
Static friction	$f_s \leq \mu_s N$; self-adjusting up to maximum value
Kinetic friction	$f_k = \mu_k N$; constant; $\mu_k < \mu_s$ always
Inclined plane	Component along plane = $mg \sin\theta$; normal = $mg \cos\theta$; friction = $\mu mg \cos\theta$
Circular motion	Net inward force = mv^2/r ; banking: $\tan\theta = v^2/rg$ (frictionless)

Questions

Q1. A book rests on a table. A horizontal force of 5 N is applied but the book does not move. The friction force acting on the book is:

- (A) Static friction
- (B) Kinetic friction
- (C) Limiting friction
- (D) No friction

Q2. The maximum value of static friction is called:

- (A) Kinetic friction
- (B) Rolling friction
- (C) Limiting friction
- (D) Dynamic friction

Q3. Two blocks connected by a light inextensible string are pulled on a smooth horizontal surface by an external force. Which quantity is the same for both blocks at every instant?

- (A) Mass
- (B) Net force acting on each block
- (C) Acceleration
- (D) Kinetic energy

Q4. Two blocks of masses 5 kg and 3 kg are connected by a light string on a smooth horizontal surface. A force of 40 N is applied to the 5 kg block. The tension in the string pulling the 3 kg block is:

- (A) 10 N
- (B) 15 N
- (C) 20 N
- (D) 24 N

Q5. According to Newton's First Law, a body continues in its state of rest or uniform straight-line motion unless acted upon by:

- (A) A non-zero net external force
- (B) A balanced force
- (C) Its own inertia
- (D) A gravitational force only

Q6. A body of mass 4 kg experiences a net force of 20 N. Its acceleration is:

- (A) 2 m/s^2
- (B) 5 m/s^2
- (C) 10 m/s^2
- (D) 80 m/s^2

Q7. Which one of the following is a non-contact force?

- (A) Friction
- (B) Tension
- (C) Normal reaction
- (D) Gravitational force

Q8. Tension in a light inextensible string arises primarily due to which of the following?

- (A) Gravitational interaction between the load and Earth
- (B) Intermolecular cohesive forces resisting elongation within the string
- (C) Electrostatic interaction between the load and the string
- (D) Magnetic interaction between string molecules

Q9. A pseudo force is experienced only in:

- (A) Inertial frames
- (B) Non-inertial frames
- (C) Both inertial and non-inertial frames
- (D) Frames moving with constant velocity

Q10. A bus accelerates forward. As observed from inside the bus (non-inertial frame), a standing passenger appears to be pushed backward because:

- (A) The bus exerts a backward contact force on the passenger
- (B) The passenger has a net backward velocity
- (C) A backward pseudo force acts on the passenger in the bus frame
- (D) Gravity acts in the backward direction inside the bus

Q11. A Free Body Diagram (FBD) of an object is drawn to represent:

- (A) All external forces acting on the isolated object
- (B) Only the balanced forces on the object
- (C) Only contact forces acting on the object
- (D) Only non-contact forces acting on the object

Q12. A block rests on a smooth horizontal surface. Which forces must appear in its FBD?

- (A) Weight only
- (B) Normal reaction only
- (C) Weight, normal reaction and friction
- (D) Weight and normal reaction

Q13. A monkey of mass m climbs a light rope with constant speed. The tension in the rope is:

- (A) Zero
- (B) mg
- (C) $2mg$
- (D) $mg/2$

Q14. A block rests on a rough horizontal surface. A horizontal force is gradually increased from zero. Which quantity begins to change as soon as the force is applied?

- (A) Kinetic friction
- (B) Normal reaction
- (C) Static friction
- (D) Weight

Q15. A 4 kg block is pulled on a rough horizontal surface ($\mu = 0.25$) by a force of 40 N at 37° above the horizontal. Take $g = 10 \text{ m/s}^2$, $\sin 37^\circ = 0.6$, $\cos 37^\circ = 0.8$. The acceleration of the block is:

- (A) 4 m/s^2
- (B) 6 m/s^2
- (C) 7 m/s^2
- (D) 8 m/s^2

Q16. A 6 kg block rests on a rough inclined surface ($\mu_s = 0.5$, $\theta = 30^\circ$). Take $g = 10 \text{ m/s}^2$, $\sin 30^\circ = 0.5$, $\cos 30^\circ = 0.87$. The block will:

- (A) Move up the incline spontaneously
- (B) Slide down the incline
- (C) Remain stationary on the incline
- (D) Cannot be determined without kinetic friction

Q17. Which of the following best defines force according to classical mechanics?

- (A) A push or pull that changes or tends to change the state of motion of a body
- (B) A property possessed only by moving bodies
- (C) A scalar quantity measured in joules
- (D) A quantity that always produces acceleration

Q18. A particle is acted upon by two forces of 15 N east and 20 N west. The net force on the particle is:

- (A) 35 N east
- (B) 5 N west
- (C) 5 N east
- (D) 20 N west

Q19. A car moves with uniform speed along a circular track. Which force is responsible for continuously changing its direction of motion?

- (A) Centrifugal force acting outward
- (B) Weight acting downward
- (C) Centripetal force acting toward the centre
- (D) Normal reaction acting upward

Q20. The direction of centripetal acceleration of a body moving in a horizontal circle is:

- (A) Along the tangent to the circle at that point
- (B) Along the radius directed toward the centre
- (C) Vertically downward
- (D) Perpendicular to the plane of the circle

Q21. All of the following are vector quantities EXCEPT:

- (A) Force
- (B) Acceleration
- (C) Work
- (D) Velocity

Q22. A body is in translational equilibrium under multiple concurrent forces. Which of the following is necessarily true?

- (A) The vector sum of all external forces acting on the body is zero
- (B) All forces acting on the body are equal in magnitude
- (C) The body must be at rest
- (D) No force acts on the body

Q23. Which of the following statements about balanced forces is CORRECT?

- (A) Balanced forces always stop a moving object
- (B) Balanced forces always act in pairs on the same body
- (C) Balanced forces produce equal and opposite accelerations
- (D) Balanced forces produce zero net force on a body

Q24. Consider the following statements: I. Force is a vector quantity. II. Force can change the shape of a body. III. A non-zero net force is necessary for acceleration. IV. Every force always changes the speed of a body. How many of the above statements are correct?

- (A) Only 1
- (B) Only 3
- (C) Only 2
- (D) All 4

Answer key

1-A	2-C	3-C	4-B	5-A	6-B	7-D	8-B
9-B	10-C	11-A	12-D	13-B	14-C	15-C	16-B
17-A	18-B	19-C	20-B	21-C	22-A	23-D	24-B

Answers with explanations

Q1 — Answer: (A) Static friction

Static friction acts since the book remains at rest. It self-adjusts to exactly balance 5 N, confirming the applied force is below the limiting value. Kinetic friction acts only after sliding begins.

Q2 — Answer: (C) Limiting friction

Limiting friction is the maximum value static friction can attain, occurring just at the verge of motion. Beyond this value, the body begins to slide and kinetic friction takes over.

Q3 — Answer: (C) Acceleration

The inextensible string constraint forces identical displacement at all times, so both blocks share the same acceleration. Net force differs because $F=ma$ and masses differ. Kinetic energy also differs since KE depends on mass.

Q4 — Answer: (B) 15 N

System acceleration = $40/8 = 5 \text{ m/s}^2$. Tension acts only on the 3 kg block: $T = 3 \times 5 = 15 \text{ N}$. Option C (20 N) arises from incorrectly using total mass ratio instead of only the pulled block's mass.

Q5 — Answer: (A) A non-zero net external force

Newton's First Law requires a non-zero net (unbalanced) external force to change the state of motion. Balanced forces produce zero resultant and cause no change. Gravity alone does not always produce motion change if balanced by normal force.

Q6 — Answer: (B) 5 m/s^2

By Newton's Second Law, $a = F/m = 20/4 = 5 \text{ m/s}^2$. Option A (2 m/s^2) arises from dividing force by 10; Option D (80 m/s^2) from multiplying force and mass instead of dividing.

Q7 — Answer: (D) Gravitational force

Gravitational force acts at a distance without physical contact. Friction, tension, and normal reaction arise only when objects are in physical contact.

Q8 — Answer: (B) Intermolecular cohesive forces resisting elongation within the string

Tension arises from intermolecular cohesive forces resisting elongation. It is not an external gravitational, magnetic, or electrostatic interaction.

Q9 — Answer: (B) Non-inertial frames

Pseudo force appears only in accelerating (non-inertial) frames to preserve the form of Newton's second law. Inertial frames and constant-velocity frames need no such correction — Newton's laws hold directly.

Q10 — Answer: (C) A backward pseudo force acts on the passenger in the bus frame

In the non-inertial bus frame, a pseudo force of magnitude ma acts on every object opposite to the frame's acceleration — here, backward. No real backward force exists; this is purely a fictitious correction for the accelerating frame.

Q11 — Answer: (A) All external forces acting on the isolated object

An FBD shows every external force on the isolated body. Internal forces between parts of the body are excluded. Option B is wrong — unbalanced forces must also be shown.

Q12 — Answer: (D) Weight and normal reaction

On a smooth surface friction is absent. Weight acts vertically downward and normal reaction acts vertically upward. These two forces balance each other for a block at rest.

Q13 — Answer: (B) mg

Constant speed means zero acceleration. Applying Newton's Second Law: $T - mg = 0$, so $T = mg$. Zero tension is wrong — that occurs only in free fall.

Q14 — Answer: (C) Static friction

Static friction is self-adjusting and immediately matches the applied force (up to $\mu_s N$). Normal reaction, kinetic friction, and weight are unaffected until the block begins to move.

Q15 — Answer: (C) 7 m/s²

Horizontal pull = $40 \times 0.8 = 32$ N. $N = mg - F \sin \theta = 40 - 24 = 16$ N. Friction = $0.25 \times 16 = 4$ N. Net force = $32 - 4 = 28$ N. $a = 28/4 = 7$ m/s² exactly. Trap: using $N = mg = 40$ N gives friction = 10 N, net = 22 N, $a = 5.5$ m/s².

Q16 — Answer: (B) Slide down the incline

Down-slope force = $mg \sin \theta = 6 \times 10 \times 0.5 = 30$ N. Normal reaction $N = mg \cos \theta = 6 \times 10 \times 0.87 = 52.2$ N, so maximum static friction = $\mu_s N = 0.5 \times 52.2 = 26.1$ N. Since $30 \text{ N} > 26.1 \text{ N}$, friction cannot hold the block and it slides down. Shortcut: the block slides whenever $\tan \theta > \mu_s$ (here $0.577 > 0.5$). Trap: using $N = mg = 60$ N gives friction 30 N and wrongly suggests the block stays at rest.

Q17 — Answer: (A) A push or pull that changes or tends to change the state of motion of a body

Force is an interaction that changes or tends to change a body's state of rest or uniform motion. It is a vector, not a scalar, measured in newtons, not joules.

Q18 — Answer: (B) 5 N west

Taking east as positive: $+15 + (-20) = -5$ N, meaning 5 N west. Adding magnitudes (35 N) is wrong — forces are vectors and opposite directions require subtraction.

Q19 — Answer: (C) Centripetal force acting toward the centre

Circular motion requires a net inward force directed toward the centre — centripetal force. It changes direction of velocity without changing speed. Centrifugal force is a pseudo-force in non-inertial frames only.

Q20 — Answer: (B) Along the radius directed toward the centre

Centripetal acceleration is always directed radially inward toward the centre. Option A is wrong — tangential direction is perpendicular to centripetal. Options C and D confuse geometry of circular motion.

Q21 — Answer: (C) Work

Work is the dot product of force and displacement, yielding a scalar. Force, acceleration, and velocity all have direction and are vectors.

Q22 — Answer: (A) The vector sum of all external forces acting on the body is zero

Translational equilibrium requires zero net external force — not zero forces. The body may move with constant velocity. Equal magnitudes only apply to pairs, not all forces.

Q23 — Answer: (D) Balanced forces produce zero net force on a body

Balanced forces cancel to give zero resultant — no acceleration results. A moving body under balanced forces continues at constant velocity; it does not stop. Balanced forces act on the same body, unlike Newton's third law pairs.

Q24 — Answer: (B) Only 3

Statements I, II, and III are correct. Statement IV is false — centripetal force changes direction, not speed, in uniform circular motion. Three statements are correct.

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