



Chapter 4 : Laws of Motion (50 Important MCQs)

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Notes

50 important MCQs from GSEB, CBSE, NEET and JEE exams · Answer key at the end

Section A — Multiple Choice Questions

Each question carries 1 mark. Choose the correct option.

Q.1 A circular racetrack of radius 300 m is banked at an angle of 20° . If the coefficient of friction between the wheels of the race car and the road is 0.2, what is the approximate maximum permissible speed of the race car? ($g = 9.8 \text{ m/s}^2$, $\tan 20^\circ = 0.3640$)

- (A) 88.2 m/s (B) 86.4 m/s (C) 42.3 m/s (D) none of these

Q.2 6 bullets are fired in a second from a machine gun with a velocity of 400 m s^{-1} . The mass of each bullet is 30 g. What force must be exerted on the machine gun to keep it stationary?

- (A) 72 N (B) 7200 N (C) 2 N (D) 12 N

Q.3 A block of mass 15 kg is lying on an inclined plane of angle 30° . To make it move upward along the slope with an acceleration of 25 cm s^{-2} , a horizontal force of 200 N is required. Then the frictional force on the block is ($g = 9.8 \text{ m s}^{-2}$)

- (A) 95.95 N (B) 134 N (C) 99.70 N (D) 90 N

Q.4 If p , v and E denote the momentum, velocity and kinetic energy of a particle, then

- (A) $p = \frac{dE}{dv}$ (B) $p = \frac{dv}{dt}$ (C) $p = \frac{dE}{dt}$ (D) $p = \frac{d^2 E}{dt^2}$

Q.5 A horizontal force $F = 100 \text{ N}$ presses a block of mass 4 kg against a vertical wall so that it does not fall. The coefficient of friction between the block and the wall is ($g = 10 \text{ m s}^{-2}$)

- (A) 0.8 (B) 0.5 (C) 0.4 (D) 0.3

Q.6 If the linear momentum of a body is increased by 0.5%, its kinetic energy increases by

- (A) 10% (B) 1% (C) 2% (D) 0%

Q.7 The F - t graph for a body shows a constant force of 20 N from $t = 0$ to $t = 0.06 \text{ s}$. The change in momentum of the body in the interval 0.02 s to 0.06 s is

- (A) 1.2 kg m s^{-1} (B) 0.3 kg m s^{-1} (C) 0.8 kg m s^{-1} (D) 0.4 kg m s^{-1}

Q.8 When a force acts on a body of mass 200 g, the change in its velocity is 15 cm s^{-1} per second. The magnitude of this force is N.

- (A) 0.3 (B) 0.003 (C) 0.03 (D) 3.0

Q.9 A car of mass 1000 kg is moving with a velocity of 20 m/s on a horizontal straight road. If the driver applies brakes to produce a constant braking force of 5000 N, the acceleration of the car is m/s^2 .

- (A) -5 (B) 50 (C) 5 (D) none

Q.10 A person of mass 60 kg is standing on a raft of mass 40 kg in a lake. The distance of the person from the bank is 30 m. If the person starts running towards the bank with a velocity of 15 m/s relative to the raft, what will his distance from the bank be after 2 seconds?

- (A) 26 m (B) 18 m (C) 21 m (D) 12 m

Q.11 A block of 50 kg on a smooth plane inclined at 60° and another block of 30 kg on a smooth plane inclined at 30° are connected by a light string passing over a frictionless pulley at the top. Take $g = 10 \text{ m s}^{-2}$, $\sqrt{3} = 1.7$. The acceleration of the blocks and the tension in the string are

- (A) 3.437 m s^{-2} and 25.311 N (B) 34.37 m s^{-2} and 253.11 N
(C) 3.437 cm s^{-2} and 25.311 dyne (D) 3.437 m s^{-2} and 253.11 N

Q.12 Bodies of 20 kg and 60 kg hang at the two ends of a string passing over a frictionless pulley. The acceleration of the system is m/s^2 ($g = 10 \text{ m/s}^2$).

- (A) 4.44 (B) 2.5 (C) 3 (D) 5

Q.13 Ramesh, of mass 65 kg, stands on a spring balance in a lift. If the lift moves upward with an acceleration of 3 m/s^2 , his apparent weight will become ($g = 10 \text{ m/s}^2$)

- (A) 195 N (B) 845 N (C) 480 N (D) 720 N

Q.14 A block of mass 5 kg rests on a rough plane inclined at 35° , on the point of sliding. The coefficient of static friction between the block and the surface is

- (A) 0.7 (B) 0.27 (C) 0.35 (D) 0.47

Q.15 A body of mass 10 kg at rest is acted on by perpendicular forces of 4 N and 3 N at the same time. At the end of 10 seconds its kinetic energy is

- (A) 25 J (B) 250 J (C) 125 J (D) 400 J

Q.16 When a force acts on a body of mass 0.1 kg, the change in its velocity is 20 cm s^{-1} per second. The magnitude of this force is N.

- (A) 0.02 (B) 0.002 (C) 20 (D) 0.2

Q.17 A force of 8 N acts on an object of mass 2 kg in the X-direction and another force of 6 N acts on it in the Y-direction. The magnitude of acceleration of the object will be

- (A) 2.5 m s^{-2} (B) 7.0 m s^{-2} (C) 5 m s^{-2} (D) 1 m s^{-2}

Q.18 Three blocks of masses m, 2m and 3m hang one below another, connected by strings. An upward force F is applied on block m, and the masses move upward at constant speed v. What is the net force on the block of mass 2m?

- (A) 6mg (B) zero (C) 2mg (D) 3mg

Q.19 Three blocks A, B and C of masses 4 kg, 2 kg and 1 kg respectively are in contact on a frictionless surface, in that order. If a force of 14 N is applied on the 4 kg block, the contact force between A and B is

- (A) 2 N (B) 6 N (C) 8 N (D) 18 N

Q.20 An explosion breaks a rock into three parts in a horizontal plane. Two of them go off at right angles to each other. The first part, of mass 1 kg, moves with a speed of 12 m s^{-1} and the second part, of mass 2 kg, moves with 8 m s^{-1} . If the third part flies off with a speed of 4 m s^{-1} , its mass is

- (A) 17 kg (B) 3 kg (C) 5 kg (D) 7 kg

Q.21 A block A of mass m_1 rests on a horizontal table. A light string connected to it passes over a frictionless pulley at the edge of the table, and another block B of mass m_2 hangs from its other end. The coefficient of kinetic friction between the block and the table is μ_k . When block A is sliding on the table, the tension in the string is

- (A) $\frac{(m_2 + \mu_k m_1)g}{m_1 + m_2}$ (B) $\frac{(m_2 - \mu_k m_1)g}{m_1 + m_2}$ (C) $\frac{m_1 m_2 (1 + \mu_k)g}{m_1 + m_2}$ (D) $\frac{m_1 m_2 (1 - \mu_k)g}{m_1 + m_2}$

Q.22 A plank with a box on it at one end is gradually raised about the other end. As the angle of inclination with the horizontal reaches 30° , the box starts to slip and slides 4.0 m down the plank in 4.0 s. The coefficients of static and kinetic friction between the box and the plank will be, respectively,

- (A) 0.4 and 0.3 (B) 0.6 and 0.6 (C) 0.6 and 0.5 (D) 0.5 and 0.6

Q.23 A rigid ball of mass m strikes a rigid wall with speed v , at 60° to the normal, and gets reflected at 60° without loss of speed. The impulse imparted by the wall on the ball is

- (A) $\frac{mv}{2}$ (B) $\frac{mv}{3}$ (C) mv (D) $2mv$

Q.24 A bullet of mass 10 g moving horizontally with a velocity of 400 m s^{-1} strikes a wooden block of mass 2 kg suspended by a light inextensible string of length 5 m. As a result, the centre of gravity of the block rises by 10 cm. The speed of the bullet after it emerges horizontally from the block will be ($g = 10 \text{ m s}^{-2}$)

- (A) 120 m s^{-1} (B) 160 m s^{-1} (C) 100 m s^{-1} (D) 80 m s^{-1}

Q.25 A stationary object splits into two fragments of masses $2M$ and $3M$. The total kinetic energy of both fragments is E . Find the energy of the fragment of mass $2M$.

- (A) $\frac{2E}{5}$ (B) $\frac{E}{2}$ (C) $\frac{E}{5}$ (D) $\frac{3E}{5}$

Q.26 A block of mass 10 kg is in contact with the inner wall of a hollow vertical cylindrical drum of radius 1 m. The coefficient of friction between the block and the wall is 0.1. The minimum angular velocity needed for the cylinder to keep the block stationary while it rotates about its axis is ($g = 10 \text{ m/s}^2$)

- (A) $10\pi \text{ rad/s}$ (B) $\sqrt{10} \text{ rad/s}$ (C) $\frac{10}{2\pi} \text{ rad/s}$ (D) 10 rad/s

Q.27 A particle moving with velocity $\vec{v}$ is acted on by three forces represented by the three sides of a triangle PQR taken in order. The velocity of the particle will

- (A) change according to the smallest force (B) increase
(C) decrease (D) remain constant

Q.28 Two bodies of mass 4 kg and 6 kg are tied to the ends of a massless string that passes over a frictionless pulley. The acceleration of the system in terms of g is

- (A) $\frac{g}{2}$ (B) $\frac{g}{5}$ (C) $\frac{g}{10}$ (D) g

Q.29 A shell of mass m is at rest initially. It explodes into three fragments having masses in the ratio 2 : 2 : 1. If the fragments having equal mass fly off along mutually perpendicular directions with speed v , the speed of the third (lighter) fragment is

- (A) $2\sqrt{2} v$ (B) $3\sqrt{2} v$ (C) v (D) $\sqrt{2} v$

Q.30 A football player is moving southward and suddenly turns eastward with the same speed to avoid an opponent. The force that acts on the player while turning is

- (A) along south-west (B) along eastward (C) along northward (D) along north-east

Q.31 Calculate the maximum acceleration of a moving car so that a body lying on the floor of the car remains stationary. The coefficient of static friction between the body and the floor is 0.15 ($g = 10 \text{ m s}^{-2}$).

- (A) 50 m s^{-2} (B) 1.2 m s^{-2} (C) 150 m s^{-2} (D) 1.5 m s^{-2}

Q.32 A horizontal force of 10 N is applied to block A (2 kg), which pushes block B (3 kg). The blocks slide over a frictionless surface. The force exerted by block A on block B is

- (A) 6 N (B) 10 N (C) zero (D) 4 N

Q.33 Forces F_1 , F_2 and F_3 act on a particle of mass m such that F_2 and F_3 are mutually perpendicular, and the particle remains stationary. If the force F_1 is now removed, the acceleration of the particle is

- (A) $\frac{F_1}{m}$ (B) $\frac{F_2 F_3}{m F_1}$ (C) $\frac{F_2 - F_3}{m}$ (D) $\frac{F_2}{m}$

Q.34 A person fires bullets of 40 g with a speed of 1200 m/s from his rifle. If the rifle can withstand a maximum recoil force of 144 N, how many bullets can he fire every second?

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

Q.35 Two blocks A and B of weight 20 N and 100 N respectively are pressed against a wall by a horizontal force F (F acts on A, which presses B against the wall). The coefficient of friction between the blocks is 0.1 and between block B and the wall is 0.15. The frictional force applied by the wall on block B is

- (A) 100 N (B) 80 N (C) 120 N (D) 150 N

Q.36 Two forces P and Q of magnitude $2F$ and $3F$ respectively act at an angle θ with each other. If the force Q is doubled, then their resultant also gets doubled. Then the angle θ is

- (A) 120° (B) 60° (C) 90° (D) 30°

Q.37 A mass of 10 kg is suspended by a rope of length 4 m from the ceiling. A force F is applied horizontally at the midpoint of the rope such that the top half of the rope makes an angle of 45° with the vertical. Then F equals ($g = 10 \text{ m/s}^2$, rope massless)

- (A) 100 N (B) 90 N (C) 75 N (D) 70 N

Q.38 A constant force F is applied on a block of mass m at an angle θ above the horizontal. The coefficient of kinetic friction is μ_k . Find the acceleration of the block.

- (A) $\frac{F}{m} (\cos \theta + \mu_k \sin \theta) - \mu_k g$ (B) $\frac{F}{m} (\cos \theta + \mu_k \sin \theta) + \mu_k g$
 (C) $\frac{F}{m} (\cos \theta - \mu_k \sin \theta) - \mu_k g$ (D) $\frac{F}{m} (\cos \theta - \mu_k \sin \theta) + \mu_k g$

Q.39 A particle of mass 5 g is thrown from the ground with a speed of $5\sqrt{2} \text{ m/s}$ at an angle of 45° with the ground. Find the change in momentum from the instant of throwing until it falls back to the ground.

- (A) 0.5 N s (B) 0.025 N s (C) 0.05 N s (D) 0.25 N s

Q.40 Four forces act on a body: 7 N along $+y$, 8 N along $-y$, 5 N along $+x$ and 6 N along $-x$. What additional force must be applied, and at what angle with the positive x -axis, so that the net acceleration of the body is zero?

- (A) $\sqrt{2} \text{ N}$, 45° (B) $\sqrt{2} \text{ N}$, 135° (C) $\frac{2}{\sqrt{3}} \text{ N}$, 30° (D) 2 N, 45°

Q.41 A block is sliding down a rough inclined plane of inclination 30° with an acceleration of $\frac{g}{4}$. Find the coefficient of friction between the block and the incline.

- (A) $\frac{1}{\sqrt{3}}$ (B) $\frac{1}{2\sqrt{3}}$ (C) $\frac{1}{3}$ (D) $\frac{1}{2}$

Q.42 Two masses $m_1 = 4 \text{ g}$ and $m_2 = 25 \text{ g}$ have the same kinetic energy. Find the ratio of the magnitudes of their linear momenta.

- (A) 1 : 5 (B) 2 : 5 (C) 1 : 1 (D) 1 : 6

Q.43 A block M of mass 10 kg on a smooth incline of 53° is connected by a string over a pulley at the apex to a block m on a smooth incline of 37° (fixed double incline). Block M has an acceleration of 2 m/s^2 down its incline. Find the mass m of the other block. ($g = 10 \text{ m/s}^2$, $\sin 53^\circ = 0.8$, $\sin 37^\circ = 0.6$)

- (A) 2.5 kg (B) 7.5 kg (C) 12.5 kg (D) 5 kg

Q.44 A car of mass m moves on a banked road of radius r and banking angle θ . To avoid slipping, the maximum permissible speed of the car is v_0 . The coefficient of friction μ between the wheels of the car and the banked road is

- (A) $\mu = \frac{v_0^2 + rg \tan \theta}{rg - v_0^2 \tan \theta}$ (B) $\mu = \frac{v_0^2 + rg \tan \theta}{rg + v_0^2 \tan \theta}$
 (C) $\mu = \frac{v_0^2 - rg \tan \theta}{rg + v_0^2 \tan \theta}$ (D) $\mu = \frac{v_0^2 - rg \tan \theta}{rg - v_0^2 \tan \theta}$

Q.45 A train is moving with a speed of 12 m/s on rails which are 1.5 m apart. To negotiate a curve of radius 400 m, by how much should the outer rail be raised with respect to the inner rail? ($g = 10 \text{ m/s}^2$)

- (A) 6.0 cm (B) 5.4 cm (C) 4.8 cm (D) 4.2 cm

Q.46 What should be the elevation of the outer track for a train to move in a circular path of radius R, if the width of the track is W ($\ll R$) and the speed of the train is v? (Neglect friction.)

- (A) $\frac{v^2 W}{Rg}$ (B) $\frac{v^2 W}{2Rg}$ (C) $\frac{gWv^2}{R}$ (D) $\frac{R}{gWv^2}$

Q.47 A bullet of mass m moving horizontally with velocity v hits and gets embedded in a wooden block of mass M resting on a horizontal frictionless surface. What will be the velocity of the composite system?

- (A) $\frac{mv}{M - m}$ (B) $\frac{Mv}{M - m}$ (C) $\frac{Mv}{M + m}$ (D) $\frac{mv}{M + m}$

Q.48 The accelerated motion of a vehicle on a horizontal road is due to

- (A) the engine of the vehicle (B) the driver
 (C) the earth's gravitational force (D) friction between the road and the vehicle

Q.49 An object of mass 8 kg is suspended through two light spring balances connected one below the other. Then

- (A) both spring balances will read 8 kg.
 (B) both spring balances will read 4 kg.
 (C) the upper balance will read 8 kg and the lower balance will read zero.
 (D) both balances will read any value, but their sum will be 8 kg.

Q.50 In an arrangement, two masses m hang from strings passing over two smooth fixed pulleys. The other ends of the strings are tied to a mass $\sqrt{2} m$ hanging symmetrically between the pulleys, each string making an angle θ with the vertical. For the system to remain in equilibrium, θ should be

- (A) 30° (B) 45° (C) 0° (D) 60°

Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	C	11	D	21	C	31	D	41	B
2	A	12	D	22	C	32	A	42	B
3	A	13	B	23	C	33	A	43	B
4	A	14	A	24	A	34	C	44	C
5	C	15	C	25	D	35	C	45	B
6	B	16	A	26	D	36	A	46	A
7	C	17	C	27	D	37	A	47	D
8	C	18	B	28	B	38	A	48	D
9	A	19	B	29	A	39	C	49	A
10	B	20	C	30	D	40	A	50	B

