4 Laws of Motion

Conceptual MCQs

1. A man getting down a running bus falls forward
(a) due to inertia of rest, road is left behind and man reaches forward
(b) due to inertia of motion upper part of body continues to be in motion in forward direction while feet come to rest as soon as they touch the road
(c) as he leans forward as a matter of habit
(d) due to the combined effect of all the three factors stated in (a), (b) and (c)

2. Which of the following is not an illustration of Newton's third law ?
(a) Flight of a jet plane
(b) A cricket player lowering his hands while catching a cricket ball
(c) Walking on floor
(d) Rebounding of a rubber ball

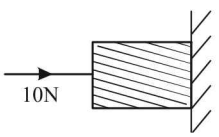
3. A force of 100 dynes acts on a mass of 5 gram for 10 sec. The velocity of body is
(a) 2000 cm/sec (b) 200 cm/sec
(c) 20 cm/sec (d) 2 cm/sec

4. A man weighing 80 kg, stands on a weighing scale in a lift which is moving upwards with a uniform acceleration of $5 m/s^2$. What would be the reading on the scale? ($g = 10 m/s^2$)
(a) 1200 N (b) Zero (c) 400 N (d) 800 N

5. A ball of mass 150 g, moving with an acceleration $20 m/s^2$, is hit by a force which acts on it for 0.1 sec. The impulsive force is
(a) 0.5 N (b) 0.1 N (c) 0.3 N (d) 1.2 N

6. When a body is placed on a rough plane inclined at an angle θ to the horizontal, its acceleration is
(a) $g(\sin\theta - \cos\theta)$ (b) $g(\sin\theta - \mu\cos\theta)$
(c) $g(\mu\sin\theta - \cos\theta)$ (d) $g\mu(\sin\theta - \cos\theta)$

7. A horizontal force of 10 N is necessary to just hold a block stationary against a wall. The coefficient of friction between the block and the wall is 0.2. The weight of the block is
(a) 20 N
(b) 50 N
(c) 100 N
(d) 2 N



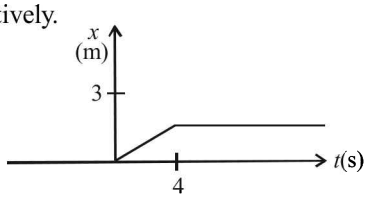
8. The maximum speed of a car on a road having turn of radius 30 m if the coefficient of friction between the tyres and the road is 0.4 will be
(a) 9.84 m/s (b) 10.84 m/s (c) 7.84 m/s (d) 5.84 m/s

9. Which of the following groups of forces could be in equilibrium?
(a) 3 N, 4 N, 5 N (b) 4 N, 5 N, 10 N
(c) 30 N, 40 N, 80 N (d) 1 N, 3 N, 5 N

10. If the force on a rocket moving with a velocity of 300 m/sec is 345 N, then the rate of combustion of the fuel, is
(a) 0.55 kg/sec (b) 0.75 kg/sec
(c) 1.15 kg/sec (d) 2.25 kg/sec

11. A shell of mass 10 kg is moving with a velocity of 10 ms^{-1} when it blasts and forms two parts of mass 9 kg and 1 kg respectively. If the 1st mass is stationary, the velocity of the 2nd is
(a) 1 m/s (b) 10 m/s
(c) 100 m/s (d) 1000 m/s

12. Figure shows the position-time graph of particle of mass 4 kg. Let the force on the particle for $t < 0$, $0 < t < 4$ s, $t > 4$ s be F_1, F_2 and F_3 respectively. Then
(a) $F_1 = F_2 = F_3 = 0$
(b) $F_1 > F_2 = F_3$
(c) $F_1 > F_2 > F_3$
(d) $F_1 < F_2 < F_3$



13. The linear momentum p of a body moving in one dimension varies with time according to the equation $p = a + bt^2$, where a and b are positive constants. The net force acting on the body is
(a) proportional to t^2 (b) a constant
(c) proportional to t (d) inversely proportional to t

14. A block has been placed on an inclined plane with the slope angle θ, block slides down the plane at constant speed. The coefficient of kinetic friction is equal to
(a) $\sin\theta$ (b) $\cos\theta$ (c) g (d) $\tan\theta$

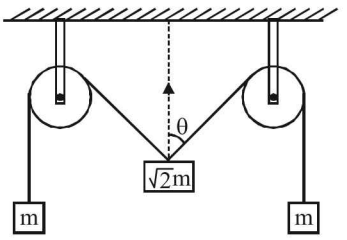
15. Ten one-rupee coins are put on top of each other on a table. Each coin has mass *m*. The reaction of the 6^{th} coin (counted from the bottom) on the 7^{th} coin is
(a) 4 *mg* (b) 6 *mg* (c) 7 *mg* (d) 3 *mg*

Application Based MCQs

16. The ratio of the weight of a man in a stationary lift and when it is moving downward with uniform acceleration 'a' is 3 : 2, then the value of 'a' is (g = acceleration due to gravity of the earth)

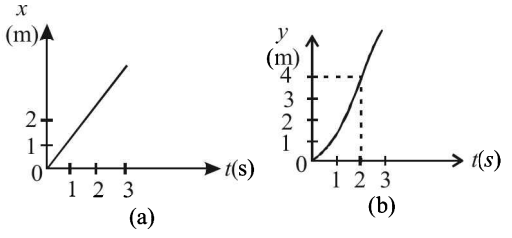
(a) $\frac{3}{2}g$ (b) $\frac{g}{3}$ (c) $\frac{2}{3}g$ (d) g

17. The pulleys and strings shown in the figure are smooth and of negligible mass. For the system to remain in equilibrium. The angle θ should be



(a) 0° (b) 30° (c) 45° (d) 60°

18. Figure shows (x, t), (y, t) diagram of a particle moving in 2-dimensions. If the particle has a mass of 500g, the force acting on the particle is



(a) 1 N along y-axis (b) 1 N along x-axis
(c) 0.5 N along x-axis (d) 0.5 N along y-axis

19. A body of mass 10 kg is acted upon by two perpendicular forces, 6 N and 8 N. The resultant acceleration of the body is

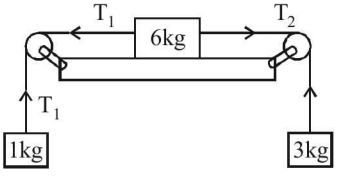
(a) 1 m s^{-2} at an angle of $\tan^{-1}\left(\frac{3}{4}\right)$ w.r.t. 8 N force.

(b) 0.2 m s^{-2} at an angle of $\tan^{-1}\left(\frac{3}{4}\right)$ w.r.t. 8 N force.

(c) 1 m s^{-2} at an angle of $\tan^{-1}\left(\frac{4}{3}\right)$ w.r.t. 8 N force.

(d) 0.2 m s^{-2} at an angle of $\tan^{-1}\left(\frac{4}{3}\right)$ w.r.t. 8 N force.

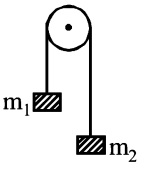
20. Three masses of 1 kg, 6 kg and 3 kg are connected to each other with threads and are placed on a table as shown in figure. What is the acceleration with which the system is moving ? Take g = 10 ms^{-2}:



(a) Zero (b) 2 ms^{-2} (c) 4 ms^{-2} (d) 3 ms^{-2}

21. Two blocks m_1 = 5 gm and m_2 = 10 gm are hung vertically over a light frictionless pulley as shown here. What is the acceleration of the masses when they are left free?

(a) g / 3
(b) g / 2
(c) g
(d) g / 5

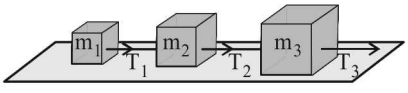


(where g is acceleration due to gravity)

22. A 100 g iron ball having velocity 10 m/s collides with a wall at an angle 30° and rebounds with the same angle. If the period of contact between the ball and wall is 0.1 second, then the force experienced by the wall is

(a) 10 N (b) 100 N (c) 1.0 N (d) 0.1 N

23. Three blocks of masses m_1, m_2 and m_3 are connected by massless strings as shown on a frictionless table. They are pulled with a force T_3 = 40 N. If m_1 = 10 kg, m_2 = 6 kg and m_3 = 4 kg, the tension T_2 will be



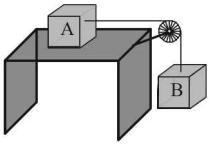
(a) 20 N (b) 40 N (c) 10 N (d) 32 N

24. An explosion blows a rock into three parts. Two parts go off at right angles to each other. These two are, 1 kg first part moving with a velocity of 12 ms^{-1} and 2 kg second part moving with a velocity of 8 ms^{-1}. If the third part flies off with a velocity of 4 ms^{-1}, its mass would be

(a) 5 kg (b) 7 kg (c) 17 kg (d) 3 kg

25. A block A of mass 7 kg is placed on a frictionless table. A thread tied to it passes over a frictionless pulley and carries a body B of mass 3 kg at the other end. The acceleration of the system is (given g = 10 ms^{-2})

(a) 100 ms^{-2}
(b) 3 ms^{-2}
(c) 10 ms^{-2}
(d) 30 ms^{-2}

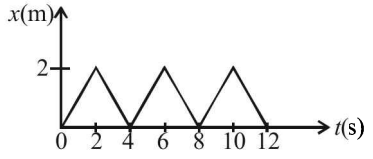


26. A block weighs W is held against a vertical wall by applying a horizontal force F. The minimum value of F needed to hold the block is

(a) Less than W (b) Equal to W

(c) Greater than W (d) Data is insufficient

27. Figure shows the positions-time (x-t) graph of one dimensional motion of a body of mass 500g. What is the time interval between two consecutive impulses received by the body?



(a) 2 s (b) 4 s (c) 6 s (d) 8 s

28. A block moving on a surface with velocity 20 m/s comes to rest because of surface friction over a distance of 40 m. Taking g = 10 m/s^2, the coefficient of dynamic friction is

(a) 0.5 (b) 0.3 (c) 0.2 (d) 0.1

29. A person with his hands in his pockets is skating on ice at the velocity of 10 m/s and describes a circle of radius 50 m. What is his inclination with vertical

(a) $\tan^{-1}\left(\frac{1}{10}\right)$ (b) $\tan^{-1}\left(\frac{3}{5}\right)$

(c) $\tan^{-1}(1)$ (d) $\tan^{-1}\left(\frac{1}{5}\right)$

30. A block of mass M is pulled along a horizontal frictionless surface by a rope of mass m. If a force P is applied at the free end of the rope, the force exerted by the rope on the block is

(a) $\frac{Pm}{M+m}$ (b) $\frac{Pm}{M-m}$ (c) P (d) $\frac{PM}{M+m}$

31. A monkey is decending from the branch of a tree with constant acceleration. If the breaking strength is 75% of the weight of the monkey, the minimum acceleration with which monkey can slide down without breaking the branch is

(a) g (b) $\frac{3g}{4}$ (c) $\frac{g}{4}$ (d) $\frac{g}{2}$

32. A heavy uniform chain lies on horizontal table top. If the coefficient of friction between the chain and the table surface is 0.25, then the maximum fraction of the length of the chain that can hang over one edge of the table is

(a) 20% (b) 25%

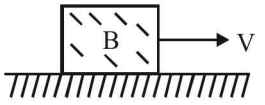
(c) 35% (d) 15%

33. A bullet is fired from a gun. The force on the bullet is given by F = 600 – 2 × 10^5 t

Where, F is in newton and t in second. The force on the bullet becomes zero as soon as it leaves the barrel. What is the average impulse imparted to the bullet?

(a) 1.8 N-s (b) Zero (c) 9 N-s (d) 0.9 N-s

34. A block B is pushed momentarily along a horizontal surface with an initial velocity V. If μ is the coefficient of sliding friction between B and the surface, block B will come to rest after a time



(a) $g\mu/V$ (b) g/V (c) V/g (d) $V/(g\mu)$.

35. A player caught a cricket ball of mass 150 gm moving at the rate of 20 m/sec. If the catching process be completed in 0.1 sec then, the force exerted by the ball on the hands of player is

(a) 0.3 N (b) 30 N (c) 300 N (d) 3000 N

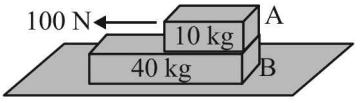
36. A person in an elevator accelerating upwards with an acceleration of 2 m s^{-2}, tosses a coin vertically upwards with a speed of 20 m s^{-1}. After how much time will the coin fall back into his hand? (Take g = 10 m s^{-2})

(a) $\frac{5}{3}$s (b) $\frac{3}{10}$s (c) $\frac{10}{3}$s (d) $\frac{3}{5}$s

37. A body takes time t to reach the bottom of an inclined plane of angle θ with the horizontal. If the plane is made rough, time taken now is $2t$. The coefficient of friction of the rough surface is

(a) $\frac{3}{4}\tan\theta$ (b) $\frac{2}{3}\tan\theta$ (c) $\frac{1}{4}\tan\theta$ (d) $\frac{1}{2}\tan\theta$

38. A 40 kg slab rests on a frictionless floor as shown in the figure. A 10 kg block rests on the top of the slab. The static coefficient of friction between the block and slab is 0.60 while the coefficient of kinetic friction is 0.40. The 10 kg block is acted upon by a horizontal force 100 N. If g = 9.8 m/s^2, the resultaing acceleration of the slab will be



(a) 0.98 m/s^2 (b) 1.47 m/s^2

(c) 1.52 m/s^2 (d) 6.1 m/s^2

39. A body takes n times to slide down a 45° rough incline as it takes to slide down a smooth 45° incline. The coefficient of friction is

(a) $1-\frac{1}{n^2}$ (b) $\frac{1}{1-n^2}$ (c) $\sqrt{\frac{1}{1-n^2}}$ (d) $\frac{1}{\sqrt{1-n^2}}$

40. In a rocket of mass 1000 kg fuel is consumed at a rate of 40 kg/s. The velocity of the gases ejected from the rocket is 5×10^4 m/s. The thrust on the rocket is

(a) 2×10^3 N (b) 5×10^4 N

(c) 2×10^6 N (d) 2×10^9 N

41. The mass of a lift is 2000 kg. When the tension in the supporting cable is 28000 N, then its acceleration is:

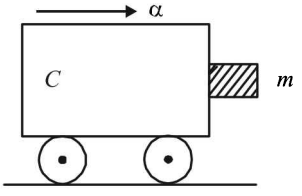
(a) 4 ms^{-2} upwards (b) 4 ms^{-2} downwards

(c) 14 ms^{-2} upwards (d) 30 ms^{-2} downwards

42. A block of mass m is placed on a surface with a vertical cross section given by $y = \frac{x^3}{6}$. If the coefficient of friction is 0.5, the maximum height above the ground at which the block can be placed without slipping is:

(a) $\frac{1}{6}$m (b) $\frac{2}{3}$m (c) $\frac{1}{3}$m (d) $\frac{1}{2}$m

43. A block of mass m is in contact with the cart C as shown in the **Figure**.



The coefficient of static friction between the block and the cart is μ. The acceleration α of the cart that will prevent the block from falling satisfies:

(a) $\alpha > \frac{mg}{\mu}$ (b) $\alpha > \frac{g}{\mu m}$ (c) $\alpha \geq \frac{g}{\mu}$ (d) $\alpha < \frac{g}{\mu}$

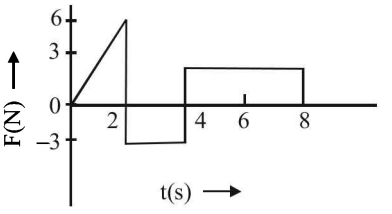
44. A car of mass 1000 kg negotiates a banked curve of radius 90 m on a frictionless road. If the banking angle is 45°, the speed of the car is :

(a) 20 ms^{-1} (b) 30 ms^{-1} (c) 5 ms^{-1} (d) 10 ms^{-1}

45. A light string passing over a smooth light pulley connects two blocks of masses m_1 and m_2 (Vertically). If the acceleration of the system is g/8 then ratio of the masses is

(a) 8 : 1 (b) 9 : 7 (c) 4 : 3 (d) 5 : 3

46. The force 'F' acting on a particle of mass 'm' is indicated by the force-time graph shown below. The change in momentum of the particle over the time interval from zero to 8 s is :



(a) 24 Ns (b) 20 Ns (c) 12 Ns (d) 6 Ns

47. A conveyor belt is moving at a constant speed of 2m/s. A box is gently dropped on it. The coefficient of friction between them is $\mu = 0.5$. The distance that the box will move relative to belt before coming to rest on it taking g = 10 ms^{-2}, is

(a) 1.2m (b) 0.6m (c) zero (d) 0.4m

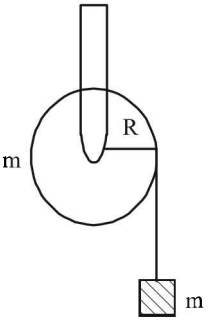
48. A mass 'm' is supported by a massless string wound around a uniform hollow cylinder of mass m and radius R. If the string does not slip on the cylinder, with what acceleration will the mass fall or release?

(a) $\frac{2g}{3}$

(b) $\frac{g}{2}$

(c) $\frac{5g}{6}$

(d) g



49. A Man fires a bullet of mass 200 g at a speed of 5 m/s. The gun is of one kg mass.

By what velocity the gun rebounds backwards

(a) 0.1 m/s (b) 10 m/s

(c) 1 m/s (d) 0.01 m/s

50. A force F_1 of 500 newton is required to push a car of mass 1000 kg slowly at constant speed on a levelled road. If a force F_2 of 1000 newton is applied, the acceleration of the car will be

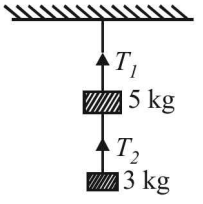
(a) zero (b) 1.5 m/s^2 (c) 1.0 m/s^2 (d) 0.5 m/s^2

Skill Based MCQs

51. A body of mass 5 kg starts from the origin with an initial velocity $\vec{u} = (30\hat{i} + 40\hat{j})\text{ms}^{-1}$. If a constant force $(-6\hat{i} - 5\hat{j})$ N acts on the body, the time in which the y-component of the velocity becomes zero is

(a) 5 s (b) 20 s (c) 40 s (d) 80 s

52. Two masses of 5 kg and 3 kg are suspended with the help of massless inextensible strings as shown in figure. The whole system is going upwards with an acceleration of 2 m s^{-2}. The tensions T_1 and T_2 are respectively (Take $g = 10$ m s^{-2})



(a) 96 N, 36 N

(b) 36 N, 96 N

(c) 96 N, 96 N

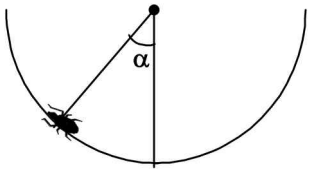
(d) 36 N, 36 N

53. A motorcyclist moving with a velocity of 72 km/hr on a flat road takes a turn on the road at a point where the radius of curvature of the road is 20 m. The acceleration due to gravity is 10m/s^2. In order to avoid sliding, he must not bend with respect to the vertical plane by an angle greater than

(a) $\theta = \tan^{-1}6$ (b) $\theta = \tan^{-1}2$

(c) $\theta = \tan^{-1}25.92$ (d) $\theta = \tan^{-1}4$

54. An insect crawls up a hemispherical surface very slowly (see fig.). The coefficient of friction between the insect and the surface is 1/3. If the line joining the center of the hemispherical surface to the insect makes an angle α with the vertical, the maximum possible value of α is given by



(a) $\cot\alpha = 3$ (b) $\tan\alpha = 3$

(c) $\sec\alpha = 3$ (d) $\text{cosec}\,\alpha = 3$

55. A block of mass m is placed on a smooth wedge of inclination θ. The whole system is accelerated horizontally so that the block does not slip on the wedge. The force exerted by the wedge on the block (g is acceleration due to gravity) will be

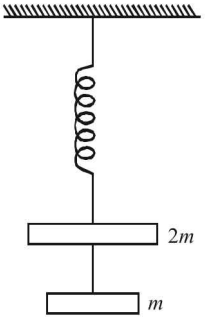
(a) mg/cos θ (b) mg cos θ

(c) mg sin θ (d) mg

56. If a man throws up a ball and catches it after some time. This time is called time of flight. Time of flight in these types of motion depend on whether the man is stationary or he is accelerated. If the man is in a moving lift throws a ball and catches it after time t_1 when lift is moving up with acceleration a and catches the ball in time t_2 if the lift is moving down with same acceleration a. The speed with which ball is thrown w.r.t. man is

(a) $\frac{gt_1t_2}{t_1 - t_2}$ (b) $\frac{gt_1t_2}{t_1 + t_2}$ (c) $\frac{2gt_1t_2}{t_1 - t_2}$ (d) $\frac{2gt_1t_2}{t_1 + t_2}$

57. The string between blocks of mass m and 2m is massless and inextensible. The system is suspended by a massless spring as shown. If the string is cut find the magnitudes of accelerations of mass $2m$ and m (immediately after cutting)



(a) g, g

(b) $g, \frac{g}{2}$

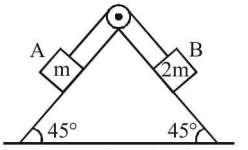
(c) $\frac{g}{2}, g$

(d) $\frac{g}{2}, \frac{g}{2}$

58. An iron block of mass 5 kg is kept on a trolley. If the trolley is being pushed with an acceleration of 5 m/s^2, what will be the force of friction between the block and the trolley surface (Take the coefficient of static friction between the block and the surface to be 0.8)

(a) Zero (b) 5N (c) 4N (d) 25N

59. Block A of mass m and block B of mass 2m are placed on a fixed triangular wedge by means of a massless, inextensible string and a frictionless pulley as shown in figure. The wedge is inclined at 45° to the horizontal on both the sides. If the coefficient of friction between the block A and the wedge is 2/3 and that between the block B and the wedge is 1/3 and both the blocks A and B are released from rest, the acceleration of A will be



(a) -1 ms^{-2} (b) 1.2 ms^{-2}

(c) 0.2 ms^{-2} (d) zero

60. A block of mass m is connected to another block of mass M by a spring (massless) of spring constant k. The block are kept on a smooth horizontal plane. Initially the blocks are at rest and the spring is unstretched. Then a constant force F starts acting on the block of mass M to pull it. Find the force of the block of mass m.

(a) $\frac{MF}{(m+M)}$ (b) $\frac{mF}{M}$

(c) $\frac{(M+m)F}{m}$ (d) $\frac{mF}{(m+M)}$

ANSWER KEY																			
Conceptual MCQs																			
1	(b)	**3**	(b)	**5**	(c)	**7**	(d)	**9**	(a)	**11**	(c)	**13**	(c)	**15**	(a)				
2	(b)	**4**	(a)	**6**	(b)	**8**	(b)	**10**	(c)	**12**	(a)	**14**	(d)						
Application Based MCQs																			
16	(b)	**20**	(b)	**24**	(a)	**28**	(a)	**32**	(a)	**36**	(c)	**40**	(c)	**44**	(b)	**48**	(b)		
17	(c)	**21**	(a)	**25**	(b)	**29**	(d)	**33**	(d)	**37**	(a)	**41**	(a)	**45**	(b)	**49**	(c)		
18	(a)	**22**	(a)	**26**	(c)	**30**	(d)	**34**	(d)	**38**	(a)	**42**	(a)	**46**	(c)	**50**	(d)		
19	(a)	**23**	(d)	**27**	(a)	**31**	(c)	**35**	(b)	**39**	(a)	**43**	(c)	**47**	(d)				
Skill Based MCQs																			
51	(c)	**52**	(a)	**53**	(b)	**54**	(a)	**55**	(a)	**56**	(b)	**57**	(c)	**58**	(d)	**59**	(d)	**60**	(d)