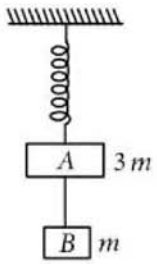
4 Laws of Motion

1. Two blocks A and B of masses $3m$ and m respectively are connected by a massless and inextensible string. The whole system is suspended by a massless spring as shown in figure. The magnitudes of acceleration of A and B immediately after the string is cut, are respectively



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

(NEET 2017)

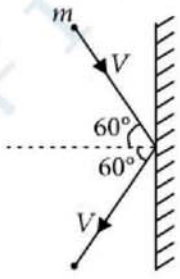
2. One end of string of length l is connected to a particle of mass 'm' and the other end is connected to a small peg on a smooth horizontal table. If the particle moves in circle with speed 'v', the net force on the particle (directed towards centre) will be (T represents the tension in the string)

(a) $T + \frac{mv^2}{l}$ (b) $T - \frac{mv^2}{l}$

(c) zero (d) T

(NEET 2017)

3. A rigid ball of mass m strikes a rigid wall at 60° and gets reflected without loss of speed as shown in the figure. The value of impulse imparted by the wall on the ball will be



(a) mV (b) $2mV$

(c) $\frac{mV}{2}$ (d) $\frac{mV}{3}$

(NEET-II 2016)

4. A car is negotiating a curved road of radius R. The road is banked at an angle θ. The coefficient of friction between the tyres of the car and the road is μ_s. The maximum safe velocity on this road is

(a) $\sqrt{\frac{g}{R}\frac{\mu_s + \tan\theta}{1 - \mu_s \tan\theta}}$ (b) $\sqrt{\frac{g}{R^2}\frac{\mu_s + \tan\theta}{1 - \mu_s \tan\theta}}$

(c) $\sqrt{gR^2\frac{\mu_s + \tan\theta}{1 - \mu_s \tan\theta}}$ (d) $\sqrt{gR\frac{\mu_s + \tan\theta}{1 - \mu_s \tan\theta}}$

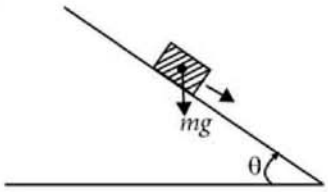
(NEET-I 2016)

5. Two stones of masses m and $2m$ are whirled in horizontal circles, the heavier one in a radius $\frac{r}{2}$ and the lighter one in radius r. The tangential speed of lighter stone is n times that of the value of heavier stone when they experience same centripetal forces. The value of n is

(a) 4 (b) 1 (c) 2 (d) 3

(2015)

6. 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) 0.5 and 0.6 (b) 0.4 and 0.3

(c) 0.6 and 0.6 (d) 0.6 and 0.5

(2015)

7. Three blocks A, B and C, of masses 4 kg, 2 kg and 1 kg respectively, are in contact on a frictionless surface, as shown. If a force of 14 N is applied on the 4 kg block, then the contact force between A and B is

(a) 8 N (b) 18 N

(c) 2 N (d) 6 N

(2015 Cancelled)

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

(a) $\frac{m_1 m_2(1+\mu_k)g}{(m_1+m_2)}$ (b) $\frac{m_1 m_2(1-\mu_k)g}{(m_1+m_2)}$

(c) $\frac{(m_2+\mu_k m_1)g}{(m_1+m_2)}$ (d) $\frac{(m_2-\mu_k m_1)g}{(m_1+m_2)}$

(2015 Cancelled)

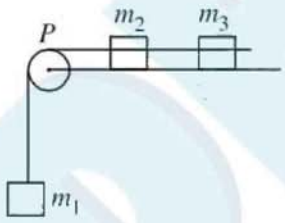
9. A system consists of three masses m_1, m_2 and m_3 connected by a string passing over a pulley P. The mass m_1 hangs freely and m_2 and m_3 are on a rough horizontal table (the coefficient of friction = μ). The pulley is frictionless and of negligible mass. The downward acceleration of mass m_1 is (Assume $m_1 = m_2 = m_3 = m$)

(a) $\frac{g(1-g\mu)}{9}$

(b) $\frac{2g\mu}{3}$

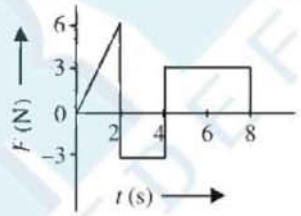
(c) $\frac{g(1-2\mu)}{3}$

(d) $\frac{g(1-2\mu)}{2}$



(2014)

10. 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 N s (b) 20 N s

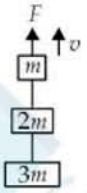
(c) 12 N s (d) 6 N s *(2014)*

11. A balloon with mass m is descending down with an acceleration a (where $a < g$). How much mass should be removed from it so that it starts moving up with an acceleration a?

(a) $\frac{2ma}{g+a}$ (b) $\frac{2ma}{g-a}$

(c) $\frac{ma}{g+a}$ (d) $\frac{ma}{g-a}$ *(2014)*

12. Three blocks with masses m, $2m$ and $3m$ are connected by strings, as shown in the figure. After an upward force F is applied on block m, the masses move upward at constant speed v. What is the net force on the block of mass $2m$? (g is the acceleration due to gravity)



(a) $3mg$

(b) $6mg$

(c) zero

(d) $2mg$ *(NEET 2013)*

13. 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} speed. If the third part flies off with 4 m s^{-1} speed, then its mass is

(a) 7 kg (b) 17 kg

(c) 3 kg (d) 5 kg *(NEET 2013)*

14. The upper half of an inclined plane of inclination θ is perfectly smooth while lower half is rough. A block starting from rest at the top of the plane will again come to rest at the bottom, if the coefficient of friction between the block and lower half of the plane is given by

(a) $\mu = 2\tan\theta$ (b) $\mu = \tan\theta$

(c) $\mu = \frac{1}{\tan\theta}$ (d) $\mu = \frac{2}{\tan\theta}$

(NEET 2013)

15. A car is moving in a circular horizontal track of radius 10 m with a constant speed of 10 m/s. A bob is suspended from the roof of the car by a light wire of length 1.0 m. The angle made by the wire with the vertical is

(a) $\frac{\pi}{3}$ (b) $\frac{\pi}{6}$ (c) $\frac{\pi}{4}$ (d) 0°

(Karnataka NEET 2013)

16. A person holding a rifle (mass of person and rifle together is 100 kg) stands on a smooth surface and fires 10 shots horizontally, in 5 s. Each bullet has a mass of 10 g with a muzzle velocity of 800 m s^{-1}. The final velocity acquired by the person and the average force exerted on the person are

(a) $-0.08\ ms^{-1}$, 16 N (b) $-0.8\ ms^{-1}$, 8 N
(c) $-1.6\ ms^{-1}$, 16 N (d) $-1.6\ ms^{-1}$, 8 N
(Karnataka NEET 2013)

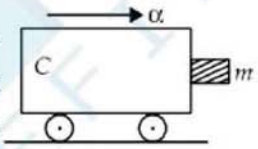
17. A stone is dropped from a height h. It hits the ground with a certain momentum P. If the same stone is dropped from a height 100% more than the previous height, the momentum when it hits the ground will change by
(a) 68% (b) 41%
(c) 200% (d) 100% *(Mains 2012)*

18. A person of mass 60 kg is inside a lift of mass 940 kg and presses the button on control panel. The lift starts moving upwards with an acceleration 1.0 m/s². If $g = 10\ m\ s^{-2}$, the tension in the supporting cable is
(a) 8600 N (b) 9680 N
(c) 11000 N (d) 1200 N *(2011)*

19. A body of mass M hits normally a rigid wall with velocity V and bounces back with the same velocity. The impulse experienced by the body is
(a) MV (b) $1.5MV$
(c) $2MV$ (d) zero *(2011)*

20. A conveyor belt is moving at a constant speed of 2 m s⁻¹. 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 $g = 10\ m\ s^{-2}$, is
(a) 0.4 m (b) 1.2 m
(c) 0.6 m (d) zero *(Mains 2011)*

21. A block of mass m is in contact with the cart C as shown in the figure.



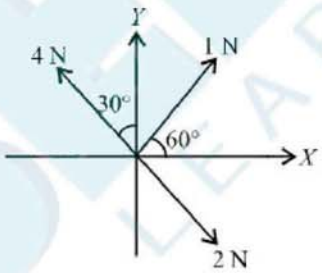
The coefficient of static friction between the block and the cart is μ. The acceleration α of the cart that will prevent the block from falling satisfies
(a) $\alpha > \frac{mg}{\mu}$ (b) $\alpha > \frac{g}{\mu m}$
(c) $\alpha \geq \frac{g}{\mu}$ (d) $\alpha < \frac{g}{\mu}$ *(2010)*

22. The mass of a lift is 2000 kg. When the tension in the supporting cable is 28000 N, then its acceleration is
(a) 4 m s⁻² upwards (b) 4 m s⁻² downwards
(c) 14 m s⁻² upwards (d) 30 m s⁻² downwards
(2009)

23. A body, under the action of a force $\vec{F} = 6\hat{i} - 8\hat{j} + 10\hat{k}$, acquires an acceleration of 1 m/s². The mass of this body must be
(a) 10 kg (b) 20 kg
(c) $10\sqrt{2}$ kg (d) $2\sqrt{10}$ kg *(2009)*

24. A roller coaster is designed such that riders experience "weightlessness" as they go round the top of a hill whose radius of curvature is 20 m. The speed of the car at the top of the hill is between
(a) 16 m/s and 17 m/s
(b) 13 m/s and 14 m/s
(c) 14 m/s and 15 m/s
(d) 15 m/s and 16 m/s *(2008)*

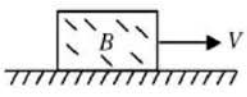
25.



Three forces acting on a body are shown in the figure. To have the resultant force only along the y-direction, the magnitude of the minimum additional force needed is
(a) $\frac{\sqrt{3}}{4}$ N (b) $\sqrt{3}$ N
(c) 0.5 N (d) 1.5 N *(2008)*

26. Sand is being dropped on a conveyer belt at the rate of M kg/s. The force necessary to keep the belt moving with a constant velocity of v m/s will be
(a) $\frac{Mv}{2}$ newton (b) zero
(c) Mv newton (d) $2\ Mv$ newton
(2008)

27. 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) $V/(g\mu)$. *(2007)*



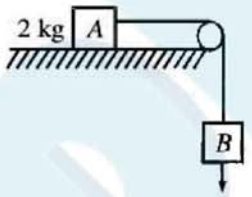
28. A 0.5 kg ball moving with a speed of 12 m/s strikes a hard wall at an angle of 30° with the wall. It is reflected with the same speed at the same angle. If the ball is in contact with the wall for 0.25 seconds, the average force acting on the wall is

(a) 96 N (b) 48 N
(c) 24 N (d) 12 N. *(2006)*

29. 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 will be (g is acceleration due to gravity)

(a) $mg\cos\theta$ (b) $mg\sin\theta$
(c) mg (d) $mg/\cos\theta$ *(2004)*

30. The coefficient of static friction, μ_s, between block A of mass 2 kg and the table as shown in the figure is 0.2. What would be the maximum mass value of block B so that the two blocks do not move? The string and the pulley are assumed to be smooth and massless. ($g = 10\ m/s^2$)



(a) 2.0 kg
(b) 4.0 kg
(c) 0.2 kg
(d) 0.4 kg *(2004)*

31. A man weighs 80 kg. He stands on a weighing scale in a lift which is moving upwards with a uniform acceleration of 5 m/s². What would be the reading on the scale ? ($g = 10\ m/s^2$)

(a) zero (b) 400 N
(c) 800 N (d) 1200 N *(2003)*

32. A monkey of mass 20 kg is holding a vertical rope. The rope will not break when a mass of 25 kg is suspended from it but will break if the mass exceeds 25 kg. What is the maximum acceleration with which the monkey can climb up along the rope ?($g = 10\ m/s^2$)

(a) 5 m/s² (b) 10 m/s²
(c) 25 m/s² (d) 2.5 m/s² *(2003)*

33. A lift of mass 1000 kg which is moving with acceleration of 1 m/s² in upward direction, then the tension developed in string which is connected to lift is

(a) 9800 N (b) 10,800 N
(c) 11,000 N (d) 10,000 N. *(2002)*

34. A block of mass 10 kg placed on rough horizontal surface having coefficient of friction m = 0.5, if a horizontal force of 100 N acting on it then acceleration of the block will be

(a) 10 m/s² (b) 5 m/s²
(c) 15 m/s² (d) 0.5 m/s². *(2002)*

35. 250 N force is required to raise 75 kg mass from a pulley. If rope is pulled 12 m then the load is lifted to 3 m, the efficiency of pulley system will be

(a) 25% (b) 33.3%
(c) 75% (d) 90%. *(2001)*

36. On the horizontal surface of a truck a block of mass 1 kg is placed ($m = 0.6$) and truck is moving with acceleration 5 m/sec² then the frictional force on the block will be

(a) 5 N (b) 6 N
(c) 5.88 N (d) 8 N. *(2001)*

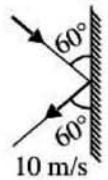
37. A cricketer catches a ball of mass 150 gm in 0.1 sec moving with speed 20 m/s, then he experiences force of

(a) 300 N (b) 30 N
(c) 3 N (d) 0.3 N. *(2001)*

38. A 1 kg stationary bomb is exploded in three parts having mass 1 : 1 : 3 respectively. Parts having same mass move in perpendicular direction with velocity 30 m/s, then the velocity of bigger part will be

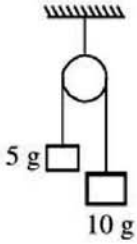
(a) $10\sqrt{2}$ m/sec (b) $\frac{10}{\sqrt{2}}$ m/sec
(c) $15\sqrt{2}$ m/sec (d) $\frac{15}{\sqrt{2}}$ m/sec. *(2001)*

39. A body of mass 3 kg hits a wall at an angle of 60° and returns at the same angle. The impact time was 0.2 sec. The force exerted on the wall



(a) $150\sqrt{3}$ N
(b) $50\sqrt{3}$ N
(c) 100 N
(d) $75\sqrt{3}$ N. *(2000)*

40. Two masses as shown in the figure are suspended from a massless pulley. The acceleration of the system when masses are left free is



(a) $\frac{2g}{3}$ (b) $\frac{g}{3}$
(c) $\frac{g}{9}$ (d) $\frac{g}{7}$. *(2000)*

56. When milk is churned, cream gets separated due to

(a) centripetal force (b) centrifugal force
(c) fricitional force (d) gravitational force *(1991)*

57. A particle of mass m is moving with a uniform velocity v_1. It is given an impulse such that its velocity becomes v_2. The impulse is equal to

(a) $m[|v_2| - |v_1|]$ (b) $\frac{1}{2}m[v_2^2 - v_1^2]$
(c) $m[v_1 + v_2]$ (d) $m[v_2 - v_1]$ *(1990)*

58. A 600 kg rocket is set for a vertical fring. If the exhaust speed is 1000 ms $^{-1}$, the mass of the gas ejected per second to supply the thrust needed to overcome the weight of rocket is

(a) 117.6 kg s $^{-1}$ (b) 58.6 kg s $^{-1}$
(c) 6 kg s $^{-1}$ (d) 76.4 kg s $^{-1}$ *(1990)*

59. A body of mass 5 kg explodes at rest into three fragments with masses in the ratio 1 : 1 : 3. The fragments with equal masses fly in mutually perpendicular directions with speeds of 21 m/s. The velocity of heaviest fragment in m/s will be

(a) $7\sqrt{2}$ (b) $5\sqrt{2}$
(c) $3\sqrt{2}$ (d) $\sqrt{2}$ *(1989)*

60. Starting from rest, a body slides down a 45° inclined plane in twice the time it takes to slide down the same distance in the absence of friction. The coefficient of friction between the body and the inclined plane is

(a) 0.80 (b) 0.75
(c) 0.25 (d) 0.33 *(1988)*