4. Newton's Laws of Motion – Multiple Choice Questions

1. First Law of Motion

1. A particle is moving with a constant speed along a straight-line path. A force is not required to

(a) Increase its speed

(b) Decrease the momentum

(c) Change the direction

(d) Keep it moving with uniform velocity

2. When a bus suddenly takes a turn, the passengers are thrown outwards because of

(a) Inertia of direction (b) Acceleration of motion

(c) Speed of motion (d) Both (b) and (c)

3. A person sitting in an open car moving at constant velocity throws a ball vertically up into air. The ball falls

(a) Outside the car

(b) In the car ahead of the person

(c) In the car to the side of the person

(d) Exactly in the hand which threw it up

4. A ball is travelling with uniform translatory motion. This means that

(a) It is at rest

(b) The path can be a straight line or circular and the ball travels with uniform speed

(c) All parts of the ball have the same velocity (magnitude and direction) and the velocity is constant

(d) The centre of the ball moves with constant velocity and the ball spins about its centre uniformly

2. Second Law of Motion

1. A metre scale is moving with uniform velocity. This implies

(a) The force acting on the scale is zero, but a torque about the centre of mass can act on the scale

(b) The force acting on the scale is zero and the torque acting about centre of mass of the scale is also zero

(c) The total force acting on it need not be zero but the torque on it is zero

(d) Neither the force nor the torque needs to be zero

2. A body of mass 0.4 kg starting at origin at $t = 0$ with a speed of $10 m/s$ in the positive x-axis direction is subjected to a constant force $F = 8 N$ towards negative x-axis. Calculate the position of the particle after 25 seconds

(a) $-6000 m$ (b) $-8000 m$

(c) $+4000 m$ (d) $+7000 m$

3. A particle moves in the $x-y$ plane under the influence of a force such that its linear momentum is

$\vec{p}(t) = A[\hat{i}\cos(kt) - \hat{j}\sin(kt)]$

where A and k are constants. The angle between the force and momentum is

(a) 0° (b) 30°

(c) 45° (d) 90°

4. A force vector applied on a mass is represented as $\vec{F} = 6\hat{i} - 8\hat{j} + 10\hat{k}$ and accelerates with $1 m/s^2$. What will be the mass of the body?

(a) $10\sqrt{2}\ kg$ (b) $2\sqrt{10}\ kg$

(c) $10\ kg$ (d) $20\ kg$

5. A pendulum bob of mass 50 gm is suspended from the ceiling of an elevator. The tension in the string if the elevator goes up with uniform velocity is approximately

(a) 0.30 N (b) 0.40 N

(c) 0.42 N (d) 0.50 N

6. A body with mass $5 kg$ is acted upon by a force $F = (-3\hat{i} + 4\hat{j}) N$. If its initial velocity at $t = 0$ is $v = (6\hat{i} - 12\hat{j}) ms^{-1}$, the time at which it will just have a velocity along the Y-axis is

(a) Never (b) $10 s$

(c) $2 s$ (d) $15 s$

7. A car of mass m starts from rest and acquires a velocity along east, $v = v\hat{i} (v > 0)$ in two seconds. Assuming the car moves with uniform acceleration, the force exerted on the car is

(a) $\frac{mv}{2}$ eastward and is exerted by the car engine

(b) $\frac{mv}{2}$ eastward and is due to the friction on the tyres exerted by the road

(c) More than $\frac{mv}{2}$ eastward exerted due to the engine and overcomes the friction of the road

(d) $\frac{mv}{2}$ exerted by the engine

8. A hockey player is moving northward and suddenly turns westward with the same speed to avoid an opponent. The force that acts on the player is

(a) Frictional force along westward

(b) Muscle force along southward

(c) Frictional force along south-west

(d) Muscle force along south-west

9. A body of mass $2kg$ travels according to the law $x(t) = pt + qt^2 + rt^3$ where, $q = 4\,ms^{-2}, p = 3\,ms^{-1}$ and $r = 5\,ms^{-3}$. The force acting on the body at $t = 2s$ is

(a) $136N$ (b) $134N$

(c) $158N$ (d) $68N$

10. n small balls each of mass m impinge elastically each second on a surface with velocity u. The force experienced by the surface will be

(a) mnu (b) 2 mnu

(c) 4 mnu (d) $\frac{1}{2}mnu$

11. 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) $mg \cos\theta$ (b) $mg \sin\theta$

(c) mg (d) $mg / \cos\theta$

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

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

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

(a) 30 ms^{-2} downwards (b) 4 ms^{-2} upwards

(c) 4 ms^{-2} downwards (d) 14 ms^{-2} upwards

14. Three weights W, $2W$ and $3W$ are connected to identical springs suspended from a rigid horizontal rod. The assembly of the rod and the weights fall freely. The positions of the weights from the rod are such that

(a) $3W$ will be farthest

(b) W will be farthest

(c) All will be at the same distance

(d) $2W$ will be farthest

15. A 10 kg stone is suspended with a rope of breaking strength 30 kg wt. The minimum time in which the stone can be raised through a height 10 m starting from rest is (taking $g = 10N/kg$)

(a) 0.5 seconds (b) 1.0 seconds

(c) $\sqrt{\frac{2}{3}}$ seconds (d) 2.0 seconds

16. A person of mass 60 kg is inside a lift of mass 940 kg and presses the button one control panel. The lift starts moving upwards with an acceleration $1.0\,m/s^2$. If $g = 10\,ms^{-2}$, the tension in the supporting cable is

(a) 1200 N (b) 8600 N

(c) 9680 N (d) 11000 N

17. A mass 1 kg is suspended by a thread. It is

(i) lifted up with an acceleration $4.9\,m/s^2$

(ii) lowered with an acceleration $4.9\,m/s^2$

The ratio of the tensions is

(a) 3 : 1 (b) 1 : 3

(c) 1 : 2 (d) 2 : 1

18. A monkey of mass 20kg 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) 10 m/s^2 (b) 25 m/s^2

(c) 2.5 m/s^2 (d) 5 m/s^2

19. A lift of mass 1000 kg is moving with an acceleration of 1m/s^2 in upward direction. Tension developed in the string, which is connected to the lift is (g=9.8 m/s^2)

(a) 9,800 N (b) 10,000 N

(c) 10,800 N (d) 11,000 N

20. A lift accelerated downward with acceleration 'a'. A man in the lift throws a ball upward with acceleration $a_0 (a_0 < a)$. Then acceleration of ball observed by observer, which is on earth, is

(a) $(a + a_0)$ upward (b) $(a - a_0)$ upward

(c) $(a + a_0)$ downward (d) $(a - a_0)$ downward

21. A constant force acts on a body of mass 0.9 kg at rest for 10s. If the body moves a distance of 250 m, the magnitude of the force is

(a) 3N (b) 3.5N

(c) 4.0N (d) 4.5N

3. Third Law of Motion

1. Swimming is possible on account of

(a) First law of motion (b) Second law of motion

(c) Third law of motion (d) Newton's law of gravitation

2. Sand is being dropped on a conveyor 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

3. A bird weighs 2 kg and is inside a closed cage of 1 kg. If it starts flying, then what is the weight of the bird and cage assembly

(a) 1.5 kg (b) 2.5 kg

(c) 3 kg (d) 4 kg

4. A cold soft drink is kept on the balance. When the cap is open, then the weight

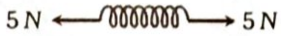
(a) Increases

(b) Decreases

(c) First increases then decreases

(d) Remains same

5. The tension in the spring is



(a) Zero (b) 2.5 N

(c) 5 N (d) 10 N

6. Ten one-rupee coins are put on top of each other on a table. Each coin has a mass m. which of the following statements is not true

(a) The force on the 6^{th} coins (counted from the bottom) due to all the coins on its top is equal to 4 mg (downwards)

(b) The force on 6^{th} coin due to 7^{th} coin is $4mg$ (downwards)

(c) The reaction of the 6^{th} coin on the 7^{th} coin is $4mg$ (upwards)

(d) The total force on the 10^{th} coin is 9 mg (downwards)

7. Conservation of momentum in a collision between articles can be understood from

(a) Conservation of energy

(b) Newton's first law only

(c) Newton's second law only

(d) Both Newton's second and third law

4. Conservation of Linear Momentum and Impulse

1. A shell of mass 200 g is fired by a gun of mass 100 kg. If the muzzle speed of the shell is 80 m/s, calculate the recoil speed of the gun

(a) $-16 cm/s$ (b) $8 m/s$

(c) $4 cm/s$ (d) $16 m/s$

2. A gun of mass $10 kg$ fires 4 bullets per second. The mass of each bullet is 20 g and the velocity of the bullet when it leaves the gun is 300 ms^{-1}. The force required to hold the gun while firing is

(a) 6 N (b) 8 N

(c) 24 N (d) 240 N

3. A ball of mass 150g starts moving with an acceleration of $20 m/s^2$. When hit by a force, which acts on it for 0.1 sec the impulsive force is

(a) 0.5 N-s (b) 0.1 N-s

(c) 0.3 N-s (d) 1.2 N-s

4. A cricket ball of mass $150 g$ has an initial velocity $u = (3\hat{i} + 4\hat{j}) ms^{-1}$ and a final velocity $v = -(3\hat{i} + 4\hat{j}) ms^{-1}$, after being hit. The change in momentum (final momentum – initial momentum) is (in $kgms^{-1}$)

(a) Zero (b) $-(0.45\hat{i} + 0.6\hat{j})$

(c) $-(0.9\hat{j} + 1.2\hat{j})$ (d) $-5(\hat{i} + \hat{j})\hat{i}$

5. In the previous problems (3), the magnitude of the momentum transferred during the hit is

(a) Zero (b) $0.75 kg$ - ms^{-1}

(c) $1.5 kg$ - ms^{-1} (d) $14 kg$ - ms^{-1}

6. 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

7. A bullet is fired from a gun. The force on the bullet is given by $F = 600 - 2 \times 10^5 t$, where F is in $newtons$ and t in seconds. The force on the bullet becomes zero as soon as it leaves the barrel. What is the average impulse imparted to the bullet?

(a) 9 Ns (b) Zero

(c) 0.9 Ns (d) 1.8 Ns

8. Consider the following statement: When jumping from some height, you should bend your knees as you come to rest, instead of keeping your legs stiff. Which of the following relations can be useful in explaining the statement

(a) $\Delta\vec{P_1} = -\Delta\vec{P_2}$ (b) $\Delta E = -\Delta(PE + KE) = 0$

(c) $\vec{F}\Delta t = m\Delta\vec{v}$ (d) $\Delta\vec{x} \propto \Delta\vec{F}$

9. The rate of mass of the gas emitted from rear of a rocket is initially 0.1 kg/sec. If the speed of the gas relative to the rocket is 50 m/sec and mass of the rocket is 2 kg, then the acceleration of the rocket in m/sec^2 is

(a) 5 (b) 5.2

(c) 2.5 (d) 25

10. In the first second of its flight, rocket ejects 1/60 of its mass with a velocity of 2400 ms^{-1}. The acceleration of the rocket is

(a) $19.6 ms^{-2}$ (b) $30.2 ms^{-2}$

(c) $40 ms^{-2}$ (d) $49.8 ms^{-2}$

11. If force on a rocket having exhaust velocity of 300 *m/sec* is 210 *N*, then rate of combustion of the fuel is

(a) 0.7 *kg/s* (b) 1.4 *kg/s*
(c) 0.07 *kg/s* (d) 10.7 *kg/s*

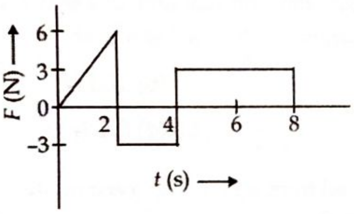
12. A satellite in force-free space sweeps stationary interplanetary dust at a rate $dM/dt = \alpha v$ where M is the mass, v is the velocity of the satellite and α is a constant. What is the de-acceleration of the satellite?

(a) $-2\alpha v^2/M$ (b) $-\alpha v^2/M$
(c) $+\alpha v^2/M$ (d) $-\alpha v^2$

13. A 5000 *kg* rocket is set for vertical firing. The exhaust speed is $800 ms^{-1}$. To give an initial upward acceleration of $20 ms^{-2}$, the amount of gas ejected per second to supply the needed thrust will be ($g = 10 ms^{-2}$)

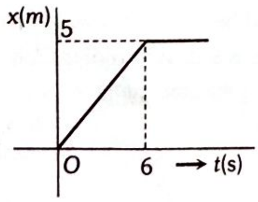
(a) 127.5 $kg\,s^{-1}$ (b) 187.5 $kg\,s^{-1}$
(c) 185.5 $kg\,s^{-1}$ (d) 137.5 $kg\,s^{-1}$

14. 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) 12 *Ns* (b) 6 *Ns*
(c) 24 *Ns* (d) 20 *Ns*

15. The position-time graph of a particle of mass 4 *kg* is shown in the figure. Calculate the impulse (in MKS units) at time $t = 0$ and $t = 6$ seconds respectively



(a) +6.31 and − 6.31
(b) +3.33 and − 3.33
(c) +5.25 and − 5.25
(d) +3.25 and − 3.25

5. Equilibrium of Forces

1. Two forces of magnitude F have a resultant of the same magnitude F. The angle between the two forces is

(a) 45° (b) 120°
(c) 150° (d) 60°

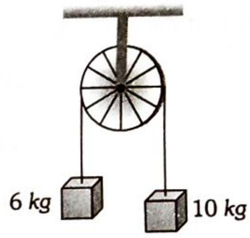
6. Motion of Connected Bodies

1. Two bodies of mass 3 *kg* and 4 *kg* are suspended at the ends of massless string passing over a frictionless pulley. The acceleration of the system is $(g = 9.8\,m/s^2)$

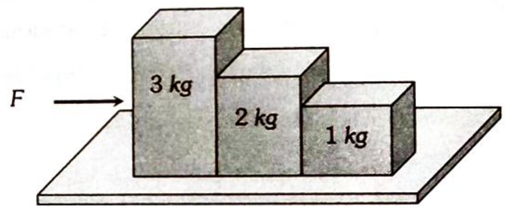
(a) $4.9\,m/s^2$ (b) $2.45\,m/s^2$
(c) $1.4\,m/s^2$ (d) $9.5\,m/s^2$

2. A light string passes over a frictionless pulley. To one of its ends a mass of 6 *kg* is attached. To its other end a mass of 10 *kg* is attached. The tension in the thread will be

(a) 24.5 *N*
(b) 2.45 *N*
(c) 79 *N*
(d) 73.5 *N*



3. Consider the following statements about the blocks shown in the diagram that are being pushed by a constant force on a frictionless table

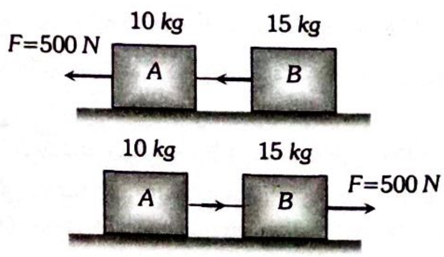


A. All blocks move with the same acceleration
B. The net force on each block is the same

Which of these statements are/is correct?

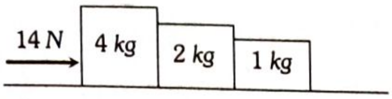
(a) A only (b) B only
(c) Both A and B (d) Neither A nor B

4. Two bodies A and B of masses 10 kg and 15 kg respectively kept on a smooth, horizontal surface are tied to the ends of a light string. If T represents the tension in the string when a horizontal force $F = 500\ N$ is applied to A (as shown in figure 1) and T' be the tension when it is applied to B (figure 2), then which of the following is true



(a) $T = T' = 500\,N$ (b) $T = T' = 250\,N$
(c) $T = 200\,N, T' = 300\,N$ (d) $T = 300\,N, T' = 200\,N$

5. Three blocks of mass $4\,kg$, $2\,kg$, $1\,kg$ respectively are in contact on a frictionless table as shown in the figure. If a force of $14\,N$ is applied on the $4\,kg$ block, the contact force between the $4\,kg$ and the $2\,kg$ block will be



(a) $2\,N$ (b) $6\,N$

(c) $8\,N$ (d) $14\,N$

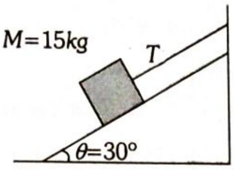
6. A block of mass 15 kg is held by a string on an inclined plane (angle 30°). The tension T in the string is $(g = 10\ m/s^2)$

(a) 55 N

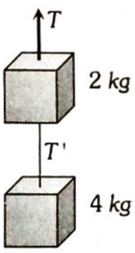
(b) 60 N

(c) 75 N

(d) 90 N



7. Two blocks are connected by a string as shown in the diagram. The upper block is hung by another string. A force F applied on the upper string produces an acceleration of $2 m/s^2$ in the upward direction in both the blocks. If T and T' be the tensions in the two parts of the string, then $(g = 9.8\ m/s^2)$



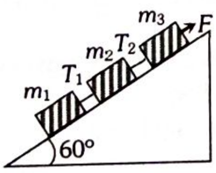
(a) $T = 70.8N$ and $T' = 47.2N$

(b) $T = 58.8N$ and $T' = 47.2N$

(c) $T = 70.8N$ and $T' = 58.8N$

(d) $T = 70.8N$ and $T' = 0$

8. Three blocks, of masses $m_1 = 2.0$, $m_2 = 4.0$ and $m_3 = 6.0\,kg$ are connected by strings on a frictionless inclined plane of 60°, as shown in the figure. A force $F = 120\,N$ is applied upward along the incline to the uppermost block, causing an upward movement of the blocks. The connecting cords are light. The values of tensions T_1 and T_2 in the cords are



(a) $T_1 = 20\,N, T_2 = 60\,N$ (b) $T_1 = 60\,N, T_2 = 60\,N$

(c) $T_1 = 30N, T_2 = 50\,N$ (d) $T_1 = 20\,N, T_2 = 100\,N$

7. IIT-JEE/AIEEE

1. A particle of mass 0.3 kg is subjected to a force $F = -kx$ with $k = 15 N/m$. What will be its initial acceleration if it is released from a point 20 cm away from the origin **[2005]**

(a) 5 m/s^2 (b) 10 m/s^2

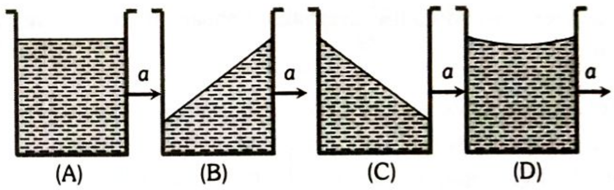
(c) 3 m/s^2 (d) 15 m/s^2

2. A ship of mass 3×10^7 kg initially at rest is pulled by a force of 5×10^4 N through a distance of 3 m. Assume that the resistance due to water is negligible, the speed of the ship is **[1980]**

(a) 1.5 m/s (b) 60 m/s

(c) 0.1 m/s (d) 5 m/s

3. A vessel containing water is given a constant acceleration a towards the right, along a straight horizontal path. Which of the following diagram represents the surface of the liquid **[1981]**



(a) A (b) B

(c) C (d) D

4. A closed compartment containing gas is moving with some acceleration in horizontal direction. Neglect effect of gravity. Then the pressure in the compartment is **[1999]**

(a) Same everywhere (b) Lower in front side

(c) Lower in rear side (d) Lower in upper side

5. 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 the force of the blow exerted by the ball on the hands of player is **[2006]**

(a) 0.3 N (b) 30 N

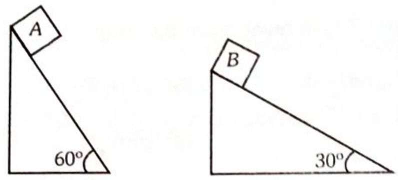
(c) 300 N (d) 3000 N

6. A ball of mass 0.2 kg is thrown vertically upwards by applying a force by hand. If the hand moves 0.2m while applying the force and the ball goes upto 2m height further, find the magnitude of the force. Consider $g = 10 m/s^2$ **[2006]**

(a) 16 N (b) 20 N

(c) 22 N (d) 4 N

7. Two fixed frictionless inclined planes making an angle 30° and 60° with the vertical are shown in the figure. Two blocks A and B are placed on the two planes. What is the relative vertical acceleration of *A* with respect to *B* **[2010]**



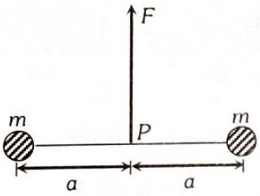
(a) 4.9 ms^{-2} in vertical direction

(b) 4.9 ms^{-2} in horizontal direction

(c) 9.8 ms^{-2} in vertical direction

(d) Zero

8. Two particles of mass *m* each are tied at the ends of a light string of length 2*a*. The whole system is kept on a frictionless horizontal surface with the string held tight so that each mass is at a distance '*a*' from the center *P* (as shown in the figure). Now, the mid–point of the string is pulled vertically upwards with a small but constant force *F*. As a result, the particles move towards each other on the surface. The magnitude of acceleration, when the separation between them becomes 2*x*, is **[2007]**



(a) $\frac{F}{2m}\frac{a}{\sqrt{a^2-x^2}}$ (b) $\frac{F}{2m}\frac{x}{\sqrt{a^2-x^2}}$

(c) $\frac{F}{2m}\frac{x}{a}$ (d) $\frac{F}{2m}\frac{\sqrt{a^2-x^2}}{x}$

9. A flat plate moves normally with a speed υ_1 towards a horizontal jet of water of uniform area of cross-section. The jet discharges water at the rate of volume *V* per second at a speed of υ_2. The density of water is ρ. Assume that water splashes along the surface of the plate at right angles to the original motion. The magnitude of the force acting on the plate due to the jet of water is **[1995]**

(a) $\rho V \upsilon_1$ (b) $\rho V(\upsilon_1+\upsilon_2)$

(c) $\frac{\rho V}{\upsilon_1+\upsilon_2}\upsilon_1^2$ (d) $\rho\left[\frac{V}{\upsilon_2}\right](\upsilon_1+\upsilon_2)^2$

10. A spring balance is attached to the ceiling of a lift. A man hangs his bag on the spring and the spring reads 49 *N*, when the lift is stationary. If the lift moves downward with an acceleration of $5 m/s^2$, the reading of the spring balance will be **[2003]**

(a) 49 *N* (b) 24 *N*

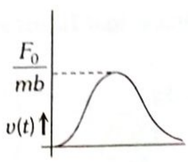
(c) 74 *N* (d) 15 *N*

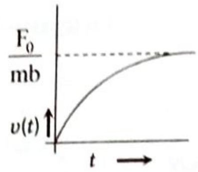
11. A lift is moving down with acceleration *a*. A man in the lift drops a ball inside the lift. The acceleration of the ball as observed by the man in the lift and a man standing stationary on the ground are respectively **[2002]**

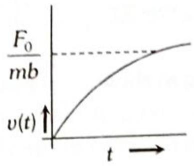
(a) g, g (b) $g-a, g-a$

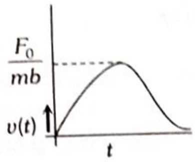
(c) $g-a, g$ (d) a, g

12. A particle of mass *m* is at rest at the origin at time $t=0$. It is subjected to a force $F(t)=F_0e^{-bt}$ in the *x* direction. Its speed $\upsilon(t)$ is depicted by which of the following curves **[2012]**

(a) 

(b) 

(c) 

(d) 

13. A light spring balance hangs from the hook of the other light spring balance and a block of mass *M kg* hangs from the former one. Then the true statement about the scale reading is **[2003]**

(a) Both the scales read *M*/2 *kg* each

(b) Both the scales read *M kg* each

(c) The scale of the lower one reads *M kg* and of the upper one zero

(d) The reading of the two scales can be anything but the sum of the reading will be *M kg*

14. A body of mass m = 3.513 *kg* is moving along the *x*-axis with a speed of 5.00 ms^{-1}. The magnitude of its momentum is recorded as **[2008]**

(a) 17.565 $kg\ ms^{-1}$ (b) 17.56 $kg\ ms^{-1}$

(c) 17.57 $kg\ ms^{-1}$ (d) 17.6 $kg\ ms^{-1}$

15. If the resultant of all the external forces acting on a system of particles is zero, then from an inertial frame, one can surely say that **[2009]**

(a) Linear momentum of the system does not change in time

(b) Kinetic energy of the system does not change in time

(c) Angular momentum of the system does not change in time

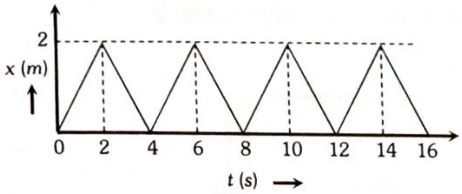
(d) Potential energy of the system does not change in time

16. A machine gun fires a bullet of mass 40 *g* with a velocity 1200 ms^{-1}. The man holding it can exert a maximum force of 144 *N* on the gun. How many bullets can he fire per second at the most **[2004]**

(a) One (b) Four

(c) Two (d) Three

17. The figure shows the position – time $(x-t)$ graph of one-dimensional motion of a body of mass 0.4 kg. The magnitude of each impulse is **[2010]**



(a) 0.2 Ns (b) 0.4 Ns
(c) 0.8 Ns (d) 1.6 Ns

18. A rocket with a lift-off mass 3.5×10^4 kg is blasted upwards with an initial acceleration of 10 m/s^2. Then the initial thrust of the blast is **[2003]**

(a) 1.75×10^5 N (b) 3.5×10^5 N
(c) 7.0×10^5 N (d) 14.0×10^5 N

19. A particle moves in the X-Y plane under the influence of a force such that its linear momentum is $\vec{P}(t)=A[\hat{i}\cos(kt)-\hat{j}\sin(kt)]$, where A and k are constants. The angle between the force and the momentum is **[2007]**

(a) 0° (b) 30°
(c) 45° (d) 90°

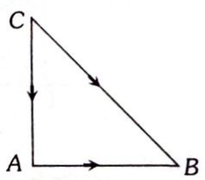
20. The mass of a hydrogen molecule is $3.32\times10^{-27}kg$. If 10^{23} hydrogen molecules strike, per second a fixed wall of area $2\,cm^2$ at an angle of 45° to the normal, and rebound elastically with a speed of $10^3 m/s$, then the pressure on the wall is nearly **[2018]**

(a) $2.35\times10^2 N/m^2$ (b) $4.70\times10^2 N/m^2$
(c) $2.35\times10^3 N/m^2$ (d) $4.70\times10^3 N/m^2$

21. Which of the following is the correct order of forces? **[2002]**

(a) Weak < gravitational forces < strong forces (nuclear) < electrostatic
(b) Gravitational < weak < (electrostatic) < strong force
(c) Gravitational < electrostatic < weak < strong force
(d) Weak < gravitational < electrostatic < strong forces

22. Three forces starts acting simultaneously on a particle moving with velocity $\vec{v}$. These forces are represented in magnitude and direction by the three sides of a triangle ABC (as shown). The particle will now move with velocity **[2003]**



(a) $\vec{v}$ remaining unchanged
(b) Less than $\vec{v}$
(c) Greater than $\vec{v}$
(d) $\vec{v}$ in the direction of the largest force BC

23. Two forces are such that the sum of their magnitudes is 18 N and their resultant is perpendicular to the smaller force and magnitude of resultant is 12 N. Then the magnitudes of the forces are **[2002]**

(a) 12 N, 6 N (b) 13 N, 5N
(c) 10 N, 8 N (d) 16 N, 2 N

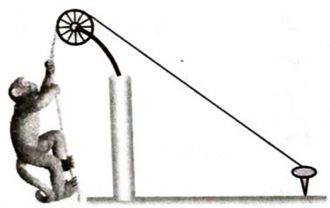
24. When forces F_1, F_2, F_3 are acting on a particle of mass m such that F_2 and F_3 are mutually perpendicular, then the particle remains stationary. If the force F_1 is now removed then the acceleration of the particle is **[2002]**

(a) F_1/m (b) F_2F_3/mF_1
(c) $(F_2-F_3)/m$ (d) F_2/m

25. 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 will be **[2003]**

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

26. One end of a massless rope, which passes over a massless and frictionless pulley P is tied to a hook C while the other end is free. Maximum tension that the rope can bear is 360 N. with what value of minimum safe acceleration (in ms^{-2}) can a monkey of $60kg$ move down on the rope **[2002]**

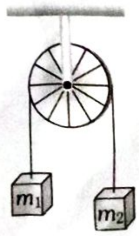


(a) 16
(b) 6
(c) 4
(d) 8

27. 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 the ratio of the masses is **[2002]**

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

28. Two masses $m_1=5kg$ and $m_2=4.8kg$ tied to a string are hanging over a light frictionless pulley. What is the acceleration of the masses when they are free to move $(g=9.8\ m/s^2)$ **[2004]**



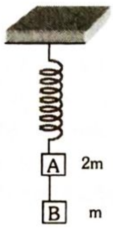
(a) $0.2\ m/s^2$
(b) $9.8\ m/s^2$
(c) $5\ m/s^2$
(d) $4.8\ m/s^2$

29. A block of mass 'm' is connected to another block of mass 'M' by a spring (massless) of spring constant 'k'. The blocks 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 on the block of mass 'm' **[2007]**

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

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

30. Two blocks A and B of masses $2m$ and m, respectively, are connected by a massless and inextensible string. The whole system is suspended by a massless spring as shown in the figure. The magnitudes of acceleration of A and B, immediately after the string is cut, are respectively **[2006]**



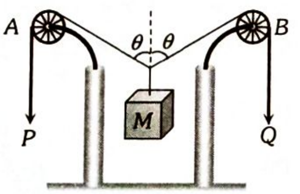
(a) g, $g/2$

(b) $g/2$, g

(c) g, g

(d) $g/2$, $g/2$

31. In the arrangement shown in figure the ends P and Q of an unstretchable string move downwards with uniform speed U. Pulleys A and B are fixed. Mass M moves upwards with a speed **[1982]**



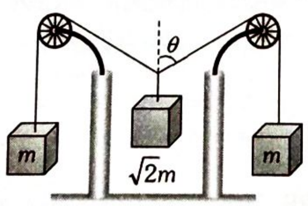
(a) $2U\cos\theta$

(b) $U\cos\theta$

(c) $\frac{2U}{\cos\theta}$

(d) $\frac{U}{\cos\theta}$

32. 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 **[2001]**



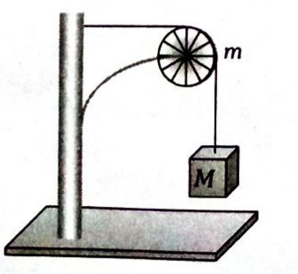
(a) $0°$

(b) $30°$

(c) $45°$

(d) $60°$

33. A string of negligible mass going over a clamped pulley of mass m supports a block of mass M as shown in the figure. The force on the pulley by the clamp is given by **[2001]**



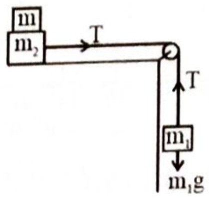
(a) $\sqrt{2}Mg$

(b) $\sqrt{2}mg$

(c) $\sqrt{(M+m)^2+m^2}g$

(d) $\sqrt{(M+m)^2+M^2}g$

34. Two masses $m_1 = 5kg$ and $m_2 = 10kg$ connected by an inextensible string over a frictionless pulley are moving as shown in the figure. The coefficient of friction of horizontal surface of 0.15. The minimum weight m that should be put on top of m_2 to stop the motion is **[2018]**



(a) 43.3 kg (b) 10.3 kg

(c) 18.3 kg (d) 23.3 kg

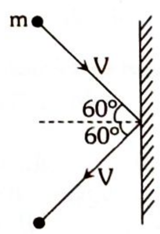
8. NEET/AIPMT

1. 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 **[2009]**

(a) 5 kg (b) 7 kg

(c) 17 kg (d) 3 kg

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

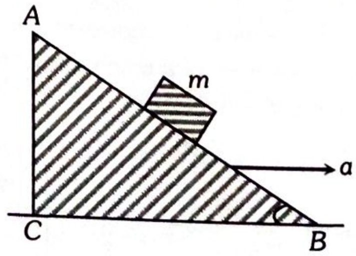


[2016]

(a) $\frac{mV}{2}$ (b) $\frac{mV}{3}$

(c) mV (d) $2mV$

3. A block of mass m is placed on a smooth inclined wedge ABC of inclination θ as shown in the figure. The wedge is given an acceleration 'a' towards the right. The relation between a and θ for the block to remain stationary on wedge is **[2018]**



(a) $a = \frac{g}{\operatorname{cosec}\theta}$ (b) $a = \frac{g}{\sin\theta}$

(c) $a = g\cos\theta$ (d) $a = g\tan\theta$

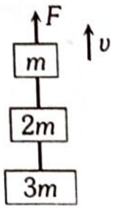
4. Three blocks with masses m, $2m$ and $3m$ are connected by strings, as shown in figure. After an upward force F is applied on block m, the masses move upward at constant speed υ. What is the net force on the block of mass $2m$ (g is the acceleration due to gravity) **[2013]**

(a) 6 mg

(b) Zero

(c) 2 mg

(d) 3 mg



9. AIIMS

1. If a person with a spring balance and a body hanging from it goes up and up in an aeroplane, then the reading of the weight of the body as indicated by the spring balance will **[1998]**

(a) Go on increasing

(b) Go on decreasing

(c) First increase and then decrease

(d) Remain the same

2. A person is standing in an elevator. In which situation he finds his weight less than actual weight **[2005]**

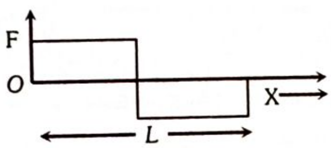
(a) The elevator moves upward with constant acceleration

(b) The elevator moves downward with constant acceleration

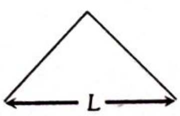
(c) The elevator moves upward with uniform velocity

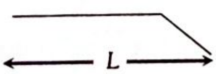
(d) The elevator moves downward with uniform velocity

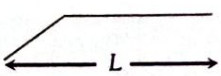
3. A person used force (F), shown in figure to move a load with constant velocity on given surface

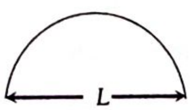


Identify the correct surface profile **[2006]**

(a)


(b)


(c)


(d)


4. A man is standing at a spring platform. Reading of spring balance is 60 kg wt. If man jumps outside platform, then reading of spring balance **[2000]**

(a) First increases then decreases to zero

(b) Decreases

(c) Increases

(d) Remains same

5. A body, whose momentum is constant, must have constant **[2000]**

(a) Force

(b) Velocity

(c) Acceleration

(d) All of these

6. Rocket engines lift a rocket from the earth surface because hot gas with high velocity **[1998]**

(a) Push against the earth

(b) Push against the air

(c) React against the rocket and push it up

(d) Heat up the air which lifts the rocket

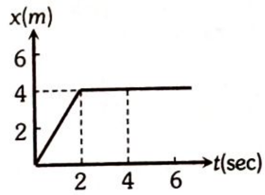
7. In the figure given below, the position-time graph of a particle of mass 0.1 kg is shown. The impulse at $t = 2\ sec$ is **[2005]**

(a) $0.2\ kg\ m\ sec^{-1}$

(b) $-0.2\ kg\ m\ sec^{-1}$

(c) $0.1\ kg\ m\ sec^{-1}$

(d) $-0.4\ kg\ m\ sec^{-1}$



10. Assertion & Reason

Read the assertion and reason carefully to mark the correct option out of the options given below:

(a) If both assertion and reason are true and the reason is the correct explanation of the assertion.

(b) If both assertion and reason are true but reason is not the correct explanation of the assertion.

(c) If assertion is true but reason is false.

(d) If the assertion and reason both are false.

(e) If assertion is false but reason is true.

1. Assertion : If the net external force on the body is zero, then its acceleration is zero.

Reason : Acceleration does not depend on force.

2. Assertion : A man in a closed cabin falling freely does not experience gravity.

Reason : Inertial and gravitational mass have equivalence.

3. Assertion : A body subjected to three concurrent forces cannot be in equilibrium.

Reason : If large number of concurrent forces acting on the same point, then the point will be in equilibrium, if sum of all the forces is equal to zero.

4. Assertion : Aeroplanes always fly at low altitudes.

Reason : According to Newton's third law of motion, for every action there is an equal and opposite reaction.

5. Assertion : Mass is a measure of inertia of the body in linear motion.

Reason : Greater the mass, greater is the force required to change its state of rest or of uniform motion.

6. Assertion : A cyclist always bends inwards while negotiating a curve.

Reason : By bending, cyclist lowers his centre of gravity.

7. Assertion : Linear momentum of a body changes even when it is moving uniformly in a circle.

Reason : Force required moving a body uniformly along a straight line is zero.

8. Assertion : A reference frame attached to earth is an inertial frame of reference.

Reason : The reference frame which has zero acceleration is called a non inertial frame of reference.

9. Assertion : When the lift moves with uniform velocity the man in the lift will feel weightlessness.

Reason : In downward accelerated motion of lift, apparent weight of a body decreases.

10. Assertion : A player lowers his hands while catching a cricket ball and suffers less reaction force.

Reason : The time of catch increases when cricketer lowers its hand while catching a ball.

4. Newton's Laws of Motion – Answers Keys

1. First Law of Motion

1	d	2	a	3	d	4	c

2. Second Law of Motion

1	b	2	a	3	d	4	a	5	d
6	b	7	b	8	c	9	a	10	b
11	d	12	c	13	b	14	c	15	b
16	d	17	a	18	c	19	c	20	d
21	d								

3. Third Law of Motion

1	c	2	c	3	c	4	c	5	c
6	d	7	d						

4. Conservation of Linear Momentum and Impulse

1	a	2	c	3	c	4	c	5	c
6	a	7	c	8	c	9	c	10	c
11	a	12	b	13	b	14	a	15	b

5. Equilibrium of Forces

1	b

6. Motion of Connected Bodies

1	c	2	d	3	a	4	d	5	b
6	c	7	a	8	a				

7. IIT-JEE/AIEEE

1	b	2	c	3	c	4	b	5	b
6	c	7	a	8	b	9	d	10	b
11	c	12	c	13	b	14	b	15	a
16	d	17	c	18	c	19	d	20	c
21	b	22	a	23	b	24	a	25	c
26	c	27	b	28	a	29	c	30	b
31	d	32	c	33	d	34	d		

8. NEET/AIPMT

1	a	2	c	3	d	4	b

9. AIIMS

1	c	2	b	3	a	4	a	5	b
6	c	7	b						

10. Assertion & Reason

1	c	2	a	3	e	4	a	5	a
6	c	7	b	8	d	9	e	10	a