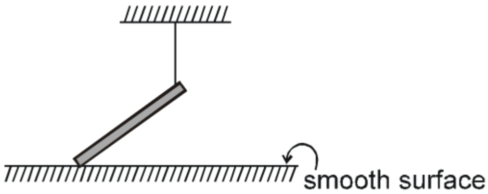
Exercise-1

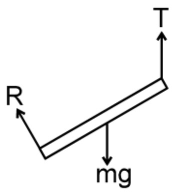
✍ Marked Questions can be used as Revision Questions.

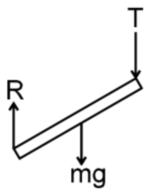
ONLY ONE OPTION CORRECT TYPE

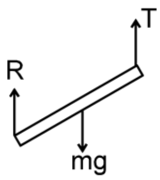
Section (A) : Type of forces, newton's third law, free body diagram

A-1. Which figure represents the correct F.B.D. of rod of mass m as shown in figure :



(1) 

(2) 

(3) 

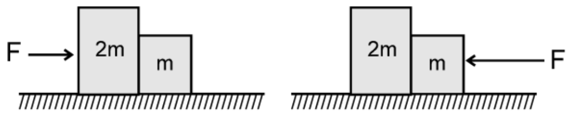
(4) None of these

A-2. In a tug of war each of the two teams apply 1000 Newton force at the ends of a rope, which is found to be in equilibrium, the tension in the rope is-
(1) 2000 newton (2) 1000 newton (3) 500 newton (4) zero

A-3. As an inclined plane is made slowly horizontal by reducing the value of angle θ with horizontal, the component of weight parallel to the plane of a block resting on the inclined plane-
(1) decreases (2) remains same
(3) increases (4) increases if the plane is smooth

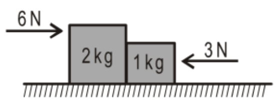
Section (B) : Calculation of normal reaction

B-1. Two blocks are in contact on a frictionless table. One has mass m and the other 2m. A force F is applied on 2m as shown in the figure. Now the same force F is applied from the right on m. In the two cases respectively, the ratio of force of contact between the two blocks will be :



(1) same (2) 1 : 2 (3) 2 : 1 (4) 1 : 3

B-2.✍ Two forces of 6N and 3N are acting on the two blocks of 2kg and 1kg kept on frictionless floor. What is the force exerted on 2kg block by 1kg block ?



(1) 1N (2) 2N (3) 4N (4) 5N

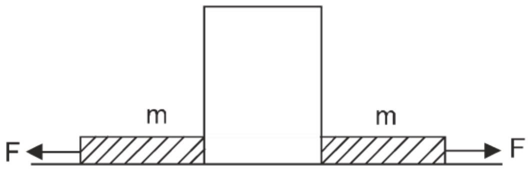
B-3. A force vector applied on a mass is represented as $F = 6\hat{i} - 8\hat{j} + 10\hat{k}$ and accelerates with 1 m/s^2. What will be the mass of the body-
(1) $10\sqrt{2}$ kg (2) $2\sqrt{10}$ kg (3) 10 kg (4) 20 kg

B-4. The engine of a car produces acceleration 4 m/s^2 in the car. If this car pulls another car of same mass. What will be the acceleration produced-
(1) 1 m/s^2 (2) 1.5 m/s^2 (3) 2 m/s^2 (4) 4 m/s^2

B-5. A force of 6N acts on a body at rest of mass 1 kg. During this time, the body attains a velocity of 30 m/s. The time for which the force acts on the body is-
(1) 10 seconds (2) 8 seconds (3) 7 seconds (4) 5 seconds

B-6. A body of mass 40 gm is moving with a constant velocity of 2 cm/sec on a horizontal frictionless table. The force on the table is-
(1) 39200 dyne (2) 160 dyne (3) 80 dyne (4) zero dyne

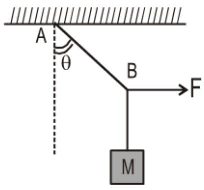
B-7. A heavy block kept on a frictionless surface and being pulled by two ropes of equal mass m as shown in figure. At t = 0, the force on the left rope is withdrawn but the force on the right end continues to act. Let F_1 and F_2 be the magnitudes of the forces by the right rope and the left rope on the block respectively.



(A) $F_1 = F_2 = F$ for $t < 0$ (B) $F_1 = F_2 = F + mg$ for $t < 0$
(C) $F_1 = F$, $F_2 = F$ for $t > 0$ (D) $F_1 < F$, $F_2 = F$ for $t > 0$

Section (C) : Calculation of tension

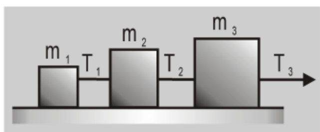
C-1. A mass M is suspended by a rope from a rigid support at A as shown in figure. Another rope is tied at the end B, and it is pulled horizontally with a force F. If the rope AB makes an angle θ with the vertical in equilibrium, then the tension in the string AB is :
(1) F sin θ (2) F/sin θ
(3) F cos θ (4) F/cos θ



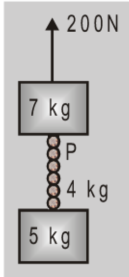
C-2. Two persons are holding a rope of negligible weight tightly at its ends so that it is horizontal. A 15 kg weight is attached to the rope at the mid point which now no longer remains horizontal. The minimum tension required to completely straighten the rope is :
(1) 15 kg (2) $\frac{15}{2}$ kg (3) 5 kg (4) Infinitely large

C-3. A uniform thick rope of length 5m is kept on frictionless surface and a force of 5N is applied to one of its end. Find tension in the rope at 1m from this end-
(1) 1N (2) 3N (3) 4N (4) 5N

C-4. Three block are connected as shown in fig., on a horizontal frictionless table and pulled to the right with a force T_3 = 60 N. If m_1 = 10 kg. m_2 = 20 kg. and m_3 = 30 kg. the tension T_2 is-
(1) 10 N (2) 20 N
(3) 30 N (4) 60 N



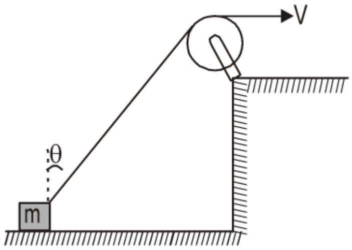
C-5. Two blocks of 7 kg and 5 kg are connected by a heavy rope of mass 4 kg. An upward force of 200N is applied as shown in the diagram. The tension at the top of heavy rope at point P is- ($g = 10\ m/s^2$)
(1) 2.27 N
(2) 112.5 N
(3) 87.5 N
(4) 360 N



C-6. If the tension in the cable of 1000 kg elevator is 1000 kg weight, the elevator
(1) is accelerating, upwards
(2) is accelerting downwards
(3) may be at rest or accelerating
(4) may be at rest or in uniform motion

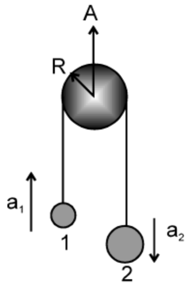
Section (D) : Constrained motion

D-1. A block is dragged on smooth plane with the help of a rope which moves with velocity v. The horizontal velocity of the block is :



(1) v
(2) $\frac{v}{\sin\theta}$
(3) v sin θ
(4) $\frac{v}{\cos\theta}$

D-2. Two masses are connected by a string which passes over a pulley accelerating upward at a rate A as shown. If a_1 and a_2 be the acceleration of bodies 1 and 2 respectively then :



(1) $A = a_1 - a_2$
(2) $A = a_1 + a_2$
(3) $A = \frac{a_1 - a_2}{2}$
(4) $A = \frac{a_1 + a_2}{2}$

D-3. In which of the following cases forces must not be required to keep the-
(1) Particle going in a circle
(2) Particle going along a straight line
(3) The momentum of the particle constant
(4) Acceleration of the particle constant

D-4. Newton's second law gives a measure of-
(1) acceleration (2) force (3) momentum (4) angular momentum

D-5. The average force necessary to stop a hammer having momentum 25 N-s in 0.05 second is-
(1) 25 N (2) 50 N (3) 1.25 N (4) 500 N

Section (E) : Calculation of force & accelertion

E-1. When a constant force is applied to a body, it moves with uniform :
(1) acceleration (2) velocity (3) speed (4) momentum

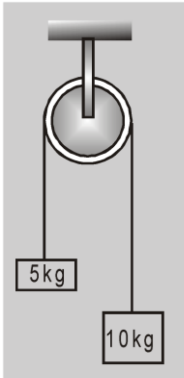
E-2. An object will continue accelerating until :
(1) resultant force on it begins to decrease
(2) its velocity changes direction
(3) the resultant force on it is zero
(4) the resultant force is at right angles to its direction of motion

E-3. A rider on horse falls back when horse starts running, all of a sudden because-
(1) rider is taken back

(2) rider is suddenly afraid of falling
(3) inertia of rest keeps the upper part of body at rest while lower part of the body moves forward with the horse
(4) none of the above

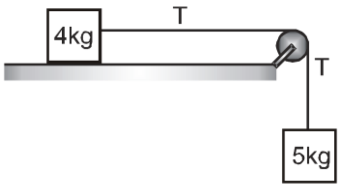
E-4. A man getting down a running bus, falls forward because-
(1) due to inertia of rest, road is left behind and man reaches forward
(2) due to inertia of motion upper part of body continues to be in motion in forward direction while feet come to rest as soon as they touch the road
(3) he leans forward as a matter of habit
(4) of the combined effect of all the three factors stated in (1), (2) and (3)

E-5. Two masses of 5 kg and 10 kg are connected to a pulley as shown. What will be the acceleration if the pulley is set free? [g = acceleration due to gravity]



(1) g
(2) $\frac{g}{2}$
(3) $\frac{g}{3}$
(4) $\frac{g}{4}$

E-6. lies of 5 kg and 4 kg are tied to a string as shown in the fig. If the table and pulley both are smooth, acceleration of 5 kg body will be equal to-

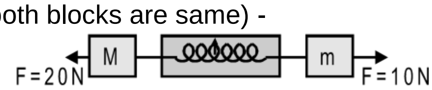


(1) g (2) $\frac{g}{4}$
(3) $\frac{4g}{9}$ (4) $\frac{5g}{9}$

Section (F) : Weighing machine, spring related problems and spring balance

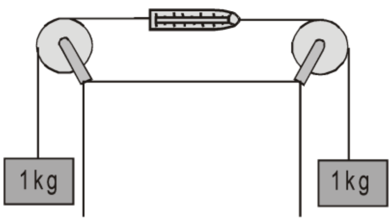
F-1. A spring toy weighing 1 kg on a weighing machine suddenly jumps upward. A boy standing near the toy notices that the scale of the balance reads 1.05 kg. In this process the maximum acceleration of the toy is- (g = 10m sec^{-2})
(1) 0.05 m sec^{-2} (2) 0.5 m sec^{-2} (3) 1.05 m sec^{-2} (4) 1 m sec^{-2}

F-2. A dynamometer D, is connected with to bodies of mass M = 6 kg and m = 4kg. If two forces F = 20 N and F = 10 N are applied on masses according to figure then reading of the dynamometer will be (when acceleration of both blocks are same) -



(1) 10 N (2) 20 N (3) 6 N (4) 14 N

F-3. In the given figure, what is the reading of the spring balance ?



(1) 10 N
(2) 20 N
(3) 5 N
(4) zero

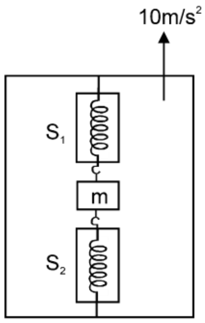
F-4. The ratio of the weight of a man in a stationary lift & when it is moving downward with uniform acceleration 'a' is 3 : 2 . The value of 'a' is : (g = acceleration. due to gravity)
(1) (3/2) g (2) g (3) (2/3) g (4) g/3

F-5. A body of mass 2 kg is hung on a spring balance mounted vertically in a lift. If the lift descands with an acceleration equal to the acceleration due to gravity 'g' the reading on the spring balance will be-
(1) 2 kg (2) 4g kg (3) 2g kg (4) zero

F-6. A man is standing on a weighing machine placed in a lift. When lift is stationary his weight is recorded as 40 kg. If the lift is accelerated upwards with an acceleration of 2 m/s^2, then the weight recorded in the machine will be- (g = 10m/s^2)
(1) 32 kg (2) 40 kg (3) 42 kg (4) 48 kg

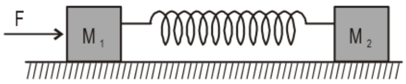
F-7. A lift is ascending with an acceleration of 2 m/sec^2, what will be the apparent weight of a person of 60 kg mass in it-
(1) 720N (2) 72N (3) 48N (4) 480N

F-8. Reading shown in two spring balances S_1 and S_2 is 90 kg and 30 kg respectively when lift is accelerating upwards with acceleration 10 m/s^2. The mass is stationary with respect to lift. Then the mass of the block will be :
(1) 60 kg
(2) 30 kg
(3) 120 kg
(4) None of these



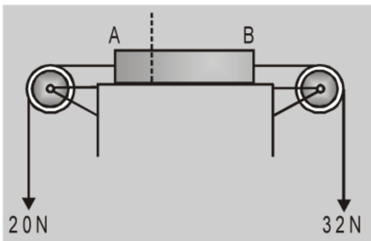
Section (G) : Newton's law for a system

G-1. Two blocks of masses M_1 and M_2 are connected to each other through a light spring as shown in figure. If we push mass M_1 with force F and cause acceleration a_1 in mass M_1, what will be the magnitude of acceleration in M_2?



(1) F/M_2 (2) $F/(M_1 + M_2)$ (3) a_1 (4) $(F - M_1a_1)/M_2$

G-2.✍ Figure shows a uniform rod of mass 3 kg and of length 30 cm. The strings shown in figure are pulled by constant forces of 20 N and 32 N. The acceleration of the rod is-
(1) 2 m/s^2
(2) 3m/s^2
(3) 4m/s^2
(4) 6m/s^2



G-3.✍ In the above question tension in rod at a distance 10cm from end A is-
(1) 18N (2) 20N (3) 24N (4) 36N

Exercise-2

✍ **Marked Questions can be used as Revision Questions.**

PART - I : ONLY ONE OPTION CORRECT TYPE

1. A ball weighing 10 gm hits a hard surface vertically with a speed of 5m/s and rebounds with the same speed. The ball remain in contact with the surface for 0.01 sec. The average force exerted by the surface on the ball is :

(1) 100 N (2) 10 N (3) 1 N (4) 150 N

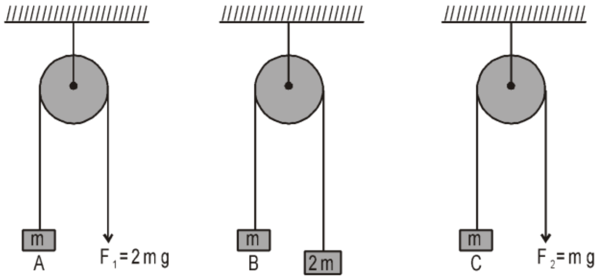
2. A 10 kg wagon is pushed with a force of 7N for 1.5 second, then with a force of 5 N for 1.7 seconds, and then with a force of 10 N for 3 second in the same direction. What is the change in velocity brought about ?

(1) 9.8 m/s (2) 19.6 m/s (3) 4.9 m/s (4) 10 m/s

3. A balloon of gross weight w newton is falling vertically downward with a constant acceleration a(<g). The magnitude of the air resistance is :

(1) w (2) $w\left(1+\frac{a}{g}\right)$ (3) $w\left(1-\frac{a}{g}\right)$ (4) $w\frac{a}{g}$

4. In the figure , the blocks A , B and C of mass m each have acceleration a_1 , a_2 and a_3 respectively. F_1 and F_2 are external forces of magnitudes 2 mg and mg respectively .



(1) $a_1 = a_2 = a_3$ (2) $a_1 > a_2 > a_3$ (3) $a_1 = a_2$, $a_2 > a_3$ (4) $a_1 > a_2$, $a_2 = a_3$

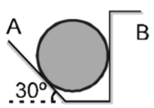
5. A block of mass m is placed on a smooth inclined plane of inclination θ with the horizontal. The force exerted by the plane on the block has a magnitude

(1) mg (2) mg/cos θ (3) mgcos θ (4) mgtan θ

6. 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 has a magnitude.

(1) mg (2) mg/cos θ (3) mgcos θ (4) mgtan θ

7. The 50 kg homogeneous smooth sphere rests on the 30º incline A and bears against the smooth vertical wall B. The contact forces at A and B.



(1) $N_A = \frac{1000}{\sqrt{3}}$ N, $N_B = \frac{500}{\sqrt{3}}$ N (2) $N_A = \frac{1000}{\sqrt{3}}$ N, $N_B = \frac{1000}{\sqrt{3}}$ N

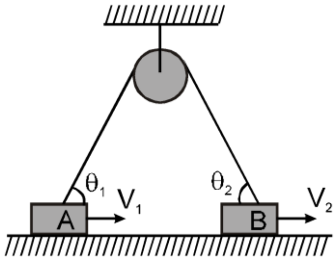
(3) $N_A = \frac{500}{\sqrt{3}}$ N, $N_B = \frac{500}{\sqrt{3}}$ N (4) $N_A = \frac{500}{\sqrt{3}}$ N, $N_B = \frac{400}{\sqrt{3}}$ N

8. A block of mass 0.2 kg is suspended from the ceiling by a light string. A second block of mass 0.3 kg is suspended from the first block through another string. The tensions in the two strings :
Take g = 10 m/s^2.

(1) T_1 = 5 N, T_2 = 3N (2) T_1 = 4 N, T_2 = 3N

(3) T_1 = 5 N, T_2 = 5N (4) T_1 = 3 N, T_2 = 3N

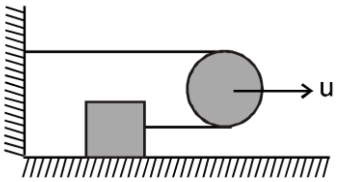
9. In the figure shown, blocks A and B move with velocities v_1 and v_2 along horizontal direction. The ratio of $\frac{v_1}{v_2}$:



(1) $\frac{\sin\theta_2}{\sin\theta_1}$ (2) $\frac{\sin\theta_1}{\sin\theta_2}$

(3) $\frac{\cos\theta_2}{\cos\theta_1}$ (4) $\frac{\cos\theta_1}{\cos\theta_2}$

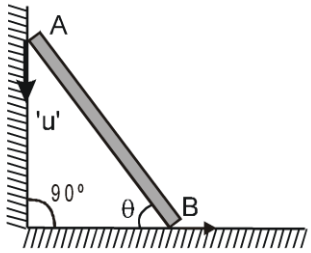
10. In the figure shown, the pulley is moving with velocity u. The velocity of the block attached with string:



(1) 4u (2) 3u

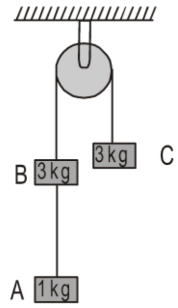
(3) u (4) 2u

11. The velocity of end 'A' of rigid rod placed between two smooth vertical walls moves with velocity 'u' along vertical direction. The velocity of end 'B' of that rod, rod always remains in contact with the vertical walls.



(1) u cot θ
(2) u tan θ
(3) u sin θ
(4) u cos θ

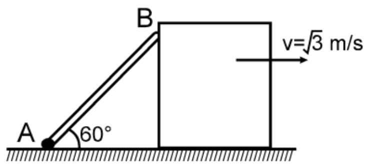
12. In the system shown in the figure, the acceleration of the 1 kg mass and the tension in the string connecting between A and B is :



(1) $\frac{g}{4}$ downwards, $\frac{8g}{7}$ (2) $\frac{g}{4}$ upwards, $\frac{g}{7}$

(3) downwards , $\frac{6}{7}$ g (4) $\frac{g}{2}$ upwards , g

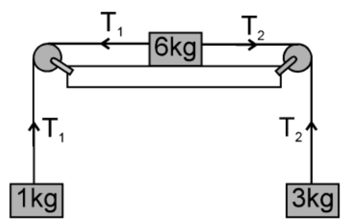
13. A rod AB is shown in figure. End A of the rod is fixed on the ground. Block is moving with velocity $\sqrt{3}$ m/s towards right. The velocity of end B of rod when rod makes an angle of 60º with the ground is:



(1) $\sqrt{3}$ m/s (2) 2 m/s

(3) 2 $\sqrt{3}$ m/s (4) 3 m/s

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



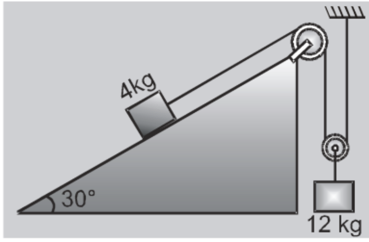
(1) Zero (2) 1 m s^{-2}
(3) 2 m s^{-2} (4) 3 m s^{-2}

15. Block B is moving towards right with constant velocity v_0. Velocity of block A with respect to block B is-

(Assume all pulleys and strings are ideal)

(1) $\frac{v_0}{2}$ left (2) $\frac{v_0}{2}$ right (3) $\frac{3v_0}{2}$ right (4) $\frac{3v_0}{2}$ left

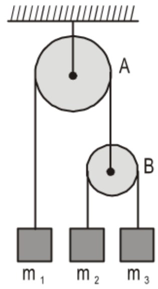
16. Calculate the acceleration of the mass 12 kg shown in the set up of fig. Also calculate the tension in the string connecting the 12 kg mass. The string are weightless and inextensible, the pulleys are weightless and frictionless-



(1) $\frac{9}{10}, \frac{56g}{5}$ N (2) $\frac{2g}{7}, \frac{60g}{7}$ N

(3) $\frac{10}{g}, \frac{5}{56g}$ N (4) $\frac{9}{14}, \frac{5}{56g}$ N

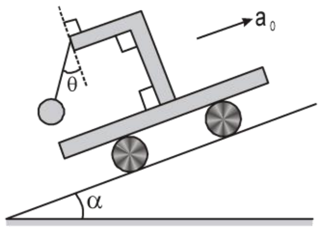
17. In the arrangement shown in figure , pulleys are massless and frictionless and threads are inextensible. Block of mass m_1 will remain at rest if :



(1) $\frac{1}{m_1} = \frac{1}{m_2} + \frac{1}{m_3}$ (2) $\frac{4}{m_1} = \frac{1}{m_2} + \frac{1}{m_3}$

(3) $m_1 = m_2 + m_3$ (4) $\frac{1}{m_3} = \frac{2}{m_2} + \frac{3}{m_1}$

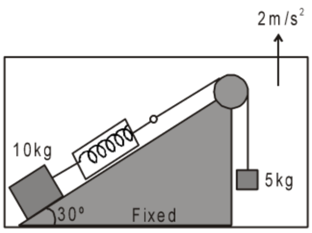
18. A pendulum of mass m hangs from a support fixed to a trolley. The direction of the string when the trolley rolls up a plane of inclination α with acceleration a_0 is (String and bob remain fixed with respect to trolley) :



(1) $\theta = \tan^{-1} \alpha$ (2) $\theta = \tan^{-1}\left(\frac{a_0}{g}\right)$

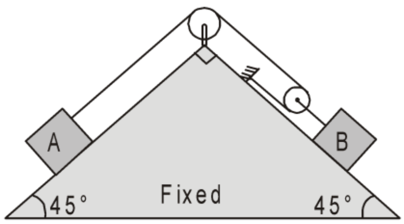
(3) $\theta = \tan^{-1}\left(\frac{g}{a_0}\right)$ (4) $\theta = \tan^{-1}\left(\frac{a_0 + g\sin\alpha}{g\cos\alpha}\right)$

19. According to figure the reading of the spring balance will be : [g = 10 m/s^2]



(1) 6 kg f
(2) 5 kg f
(3) 600 N
(4) 60 kg f

20. Two blocks A and B of mass 10 kg and 40 kg are connected by an ideal string as shown in the figure. Neglect the masses of the pulleys and effect of friction. (g = 10 m/s^2)



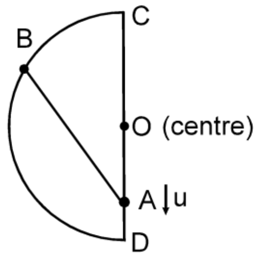
(1) The acceleration of block A is $\frac{5}{\sqrt{2}}$ ms^{-2}

(2) The acceleration of block B is $\frac{50}{2\sqrt{2}}$ ms^{-2}

(3) The tension in the string is N

(4) The tension in the string is $\frac{1500}{\sqrt{2}}$ N

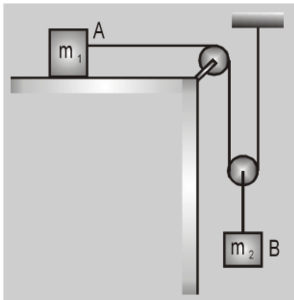
21. Two beads A and B move along a semicircular wire frame as shown in figure. The beads are connected by an inelastic string which always remains tight. At an instant the speed of A is u, ∠BAC = 45° and ∠BOC = 75°, where O is the centre of the semicircular arc. The speed of bead B at that instant is :



(1) $\sqrt{2}u$ (2) u

(3) $\frac{u}{2\sqrt{2}}$ (4) $\sqrt{\frac{2}{3}}u$

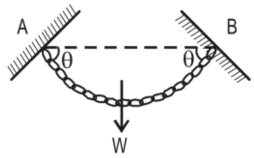
22. The acceleration of block B in the figure will be-



(1) $\frac{m_2g}{(4m_1+m_2)}$ (2) $\frac{2m_2g}{(4m_1+m_2)}$

(3) $\frac{2m_1g}{(m_1+4m_2)}$ (4) $\frac{2m_1g}{(m_1+m_2)}$

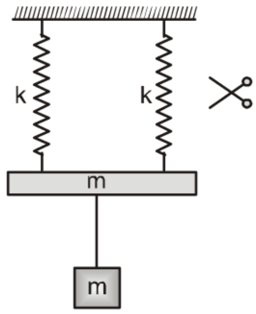
23. A flexible chain of weight W hangs between two fixed points A and B at the same level. The inclination of the chain with the horizontal at the two points of support is θ. What is the tension of the chain at the endpoint.



(1) $\frac{W}{2}$ cosec θ (2) $\frac{W}{2}$ sec θ

(3) W cos θ (4) $\frac{W}{3}$ sin θ

24. System shown in figure is in equilibrium. The magnitude of change in tension in the string just before and just after, when one of the spring is cut. Mass of both the blocks is same and equal to m and spring constant of both springs is k. (Neglect any effect of rotation)



(1) $\frac{mg}{2}$ (2) $\frac{mg}{4}$

(3) $\frac{3mg}{4}$ (4) $\frac{3mg}{2}$

PART - II : MISCELLANEOUS QUESTIONS

Section (A) : Assertion/Reasoning

A-1. **STATEMENT-1 :** Inertia is the property by virtue of which the body is unable to change by itself the state of rest only.

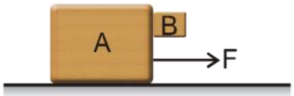
STATEMENT-2 : The bodies do not change their state unless acted upon by a resultant force .

(1) STATEMENT-1 is true, STATEMENT-2 is true and STATEMENT-2 is correct explanation for STATEMENT-1

(2) STATEMENT-1 is true, STATEMENT-2 is true and STATEMENT-2 is not correct explanation for STATEMENT-1

(3) STATEMENT-1 is true, STATEMENT-2 is false
(4) STATEMENT-1 is false, STATEMENT-2 is true

A-2. **STATEMENT-1 :** Block A is moving on horizontal surface towards right under action of force F . All surfaces are smooth. At the instant shown the force exerted by block A on block B is equal to net force on block B.



STATEMENT-2 : From Newton's third law, the force exerted by block A on B is equal in magnitude to force exerted by block B on A.
(1) STATEMENT-1 is true, STATEMENT-2 is true and STATEMENT-2 is correct explanation for STATEMENT-1
(2) STATEMENT-1 is true, STATEMENT-2 is true and STATEMENT-2 is not correct explanation for STATEMENT-1
(3) STATEMENT-1 is true, STATEMENT-2 is false
(4) STATEMENT-1 is false, STATEMENT-2 is true

A-3. **STATEMENT-1 :** A man standing in a lift which is moving upward, will feel his weight to be greater than when the lift was at rest.
STATEMENT-2 : If the acceleration of the lift is 'a' upward, then the man of mass m shall feel his weight to be equal to normal reaction (N) exerted by the lift given by N = m(g+a) (where g is acceleration due to gravity)
(1) STATEMENT-1 is true, STATEMENT-2 is true and STATEMENT-2 is correct explanation for STATEMENT-1
(2) STATEMENT-1 is true, STATEMENT-2 is true and STATEMENT-2 is not correct explanation for STATEMENT-1
(3) STATEMENT-1 is true, STATEMENT-2 is false
(4) STATEMENT-1 is false, STATEMENT-2 is true

A-4. **STATEMENT–1 :** According to the Newton's third law of motion, the magnitude of the action and reaction force in an action reaction pair is same only in an inertial frame of reference.
STATEMENT–2 : Newton's laws of motion are applicable in every inertial reference frame.
(1) STATEMENT-1 is true, STATEMENT-2 is true and STATEMENT-2 is correct explanation for STATEMENT-1
(2) STATEMENT-1 is true, STATEMENT-2 is true and STATEMENT-2 is not correct explanation for STATEMENT-1
(3) STATEMENT-1 is true, STATEMENT-2 is false
(4) STATEMENT-1 is false, STATEMENT-2 is true

Section (B) : Match the Column

B-1. Column-I gives four different situations involving two blocks of mass m_1 and m_2 placed in different ways on a smooth horizontal surface as shown. In each of the situations horizontal forces F_1 and F_2 are applied on blocks of mass m_1 and m_2 respectively and also $m_2 F_1 < m_1 F_2$. Match the statements in column I with corresponding results in column-II and indicate your answer by darkening appropriate bubbles in the 4 × 4 matrix given in the OMR.

Column I	Column II
(1)  . Both the blocks are connected by massless inelastic string. The magnitude of tension in the string is	(p) $\frac{m_1 m_2}{m_1+m_2}\left(\frac{F_1}{m_1}-\frac{F_2}{m_2}\right)$

(2) 

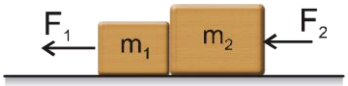
. Both the blocks are connected by massless inelastic string. The magnitude of tension in the string is

(q) $\frac{m_1 m_2}{m_1+m_2}\left(\frac{F_1}{m_1}+\frac{F_2}{m_2}\right)$

(3) 

. The magnitude of normal reaction between the blocks is

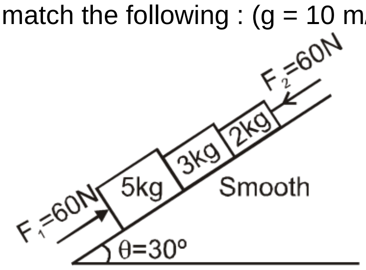
(r) $\frac{m_1 m_2}{m_1+m_2}\left(\frac{F_2}{m_2}-\frac{F_1}{m_1}\right)$

(4) 

. The magnitude of normal reaction between the blocks is

(s) $m_1 m_2\left(\frac{F_1+F_2}{m_1+m_2}\right)$

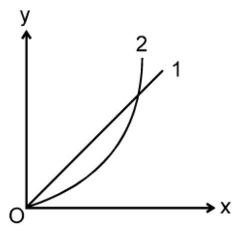
B-2. In the diagram shown in figure, match the following : (g = 10 m/s^2)



Column–I	Column–II	
(1) Acceleration of 2 kg block (in m/s^2)	(p)	5
(2) Acceleration of 3 kg block (in m/s^2)	(q)	50
(3) Normal reaction between 2 kg and 3 kg (in N)	(r)	45
(4) Normal reaction between 3 kg and 5 kg (in N)	(s)	60
	(t)	zero

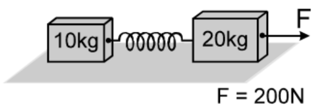
Section (C) : One or More Than One Options Correct

C-1. A particle is resting on a smooth horizontal floor. At t = 0, a horizontal force starts acting on it. Magnitude of the force increases with time according to law F = α.t, where α is a constant. For the figure shown which of the following statements is/are correct ?



(1) Curve 1 shows acceleration against time
(2) Curve 2 shows velocity against time
(3) Curve 2 shows velocity against acceleration
(4) none of these

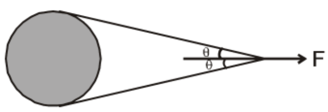
C-2. Two blocks of masses 10 kg and 20 kg are connected by a light spring as shown. A force of 200 N acts on the 20 kg mass as shown. At a certain instant the acceleration of 10 kg mass is 12 ms^{-2} towards right direction.



(1) At that instant the 20 kg mass has an acceleration of 12 ms^{-2}.
(2) At that instant the 20 kg mass has an acceleration of 4 ms^{-2} .
(3) The stretching force in the spring is 120 N.
(4) The collective system moves with a common acceleration of 30 ms^{-2} when the extension in the connecting spring is the maximum.

C-3. A particle stays at rest as seen in a frame. We can conclude that
(1) the frame is inertial.
(2) resultant force on the particle is zero.
(3) if the frame is inertial then the resultant force on the particle is zero.
(4) if the frame is noninertial then there is a nonzero resultant force.

C-4. A light string is wrapped round a cylindrical log of wood which is placed on a horizontal surface with it's axis vertical and it is pulled with a constant force F as shown in the figure.(Friction is absent everywhere)



(1) tension T in the string increases with increase in θ
(2) tension T in the string decreases with increase in θ
(3) tension $T > F$ if $\theta > \pi/3$
(4) tension $T > F$ if $\theta > \pi/4$

C-5. Action and reaction pair
(1) act on two different objects
(2) have equal magnitude
(3) have opposite directions
(4) have same directions

Exercise-3

✍ **Marked Questions can be used as Revision Questions.**

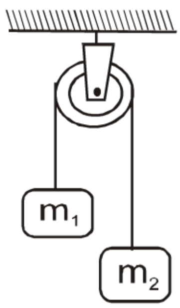
PART - I : JEE (MAIN) / AIEEE PROBLEMS (PREVIOUS YEARS)

1. 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 : **[AIEEE-2003, 4/300]**
(1) 24 N (2) 74 N (3) 15 N (4) 49 N

2. 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 : **[AIEEE-2003, 4/300]**
(1) $\frac{Pm}{M+m}$ (2) $\frac{Pm}{M-m}$ (3) P (4) $\frac{PM}{M+m}$

3. 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 : **[AIEEE-2003, 4/300]**
(1) Both the scale read M kg each
(2) The scale of the lower one reads M kg and of the upper one zero
(3) The reading of the two scales can be anything but the sum of the reading will be M kg
(4) Both the scales read M/2 kg

4. Two masses m_1 = 5 kg and m_2 = 4.8 kg tied to a string are hanging over a light frictionless pulley. What is the acceleration of the masses when system is free to move ? (g = 9.8 m/s^2) **[AIEEE-2004, 4/300]**
(1) 0.2 m/s^2
(2) 9.8 m/s^2
(3) 5 m/s^2
(4) 4.8 m/s^2



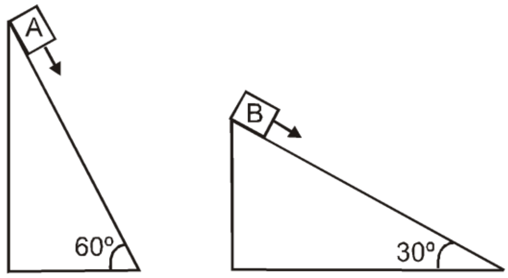
5. A block is kept on a frictionless inclined surface with angle of inclination α. The incline is given an acceleration a to keep the block stationary. The a is equal to **[AIEEE-2005, 4/300]**
(1) g (2) g tan α (3) g/tanα (4) g cosec α

6. A ball of mass 0.2 kg is thrown vertically upwards by applying a constant force by hand. If the hand moves 0.2 m while applying the force and the ball goes upto 2m height further, find the magnitude of the force. Consider g = 10 m/s^2. **[AIEEE-2006, 3/180]**
(1) 20 N (2) 22 N (3) 4 N (4) 16 N

7. A block of mass m is connected to another block of mass M by a string (massless). The blocks are kept on a smooth horizontal plane. Initially the blocks are at rest. 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 **[AIEEE-2007, 3/120]**

(1) $\frac{mF}{m}$ (2) $\frac{(M+m)F}{m}$ (3) $\frac{mF}{(m+M)}$ (4) $\frac{MF}{(m+M)}$

8. Two fixed frictionless inclined planes making an angle 30º and 60º 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? **[AIEEE-2010, 4/144, –1]**

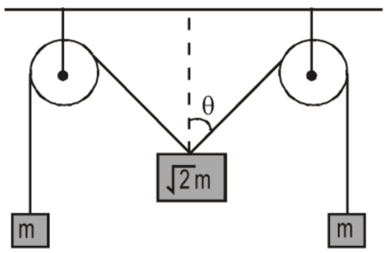


(1) 4.9 ms^{-2} in horizontal direction (2) 9.8 ms^{-2} in vertical direction
(3) Zero (4) 4.9 ms^{-2} in vertical direction

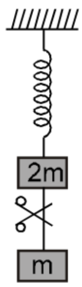
PART - II : JEE (ADVANCED) / IIT-JEE PROBLEMS (PREVIOUS YEARS)

*** Marked Questions may have more than one correct option.**

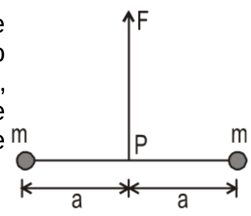
1. The pulleys and strings shown in the figure are smooth and of negligible mass for the system to remain in equilibrium, the angle θ should be
[JEE 2002 (Scr.), 3/105]
(A) 0º
(B) 30º
(C) 45º
(D) 60º



2. System shown in figure is in equilibrium and at rest. The spring and string are massless Now the string is cut. The acceleration of mass 2m and m just after the string is cut will be : **[JEE 2006, 3/184]**
(A) g/2 upwards , g downwards
(B) g upwards, g/ 2 downwards
(C) g upwards , 2g downwards
(D) 2g upwards , g downwards



3.✍ Two particles of mass m each are tied at the ends of a light string of length 2a. 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 centre 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 2x, is **[JEE 2007, 3/81]**



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

4.✍ A piece of wire is bent in the shape of a parabola $y = kx^2$ (y-axis vertical) with a bead of mass m on it. The bead can slide on the wire without friction. It stays at the lowest point of the parabola when the wire is at rest. The wire is now accelerated parallel to the x-axis with a constant acceleration a. The distance of the new equilibrium position of the bead, where the bead can stay at rest with respect to the wire, from the y-axis is **[JEE 2009, 3/160, –1]**

(A) $\frac{a}{gk}$ (B) $\frac{a}{2gk}$ (C) $\frac{2a}{gk}$ (D) $\frac{a}{4gk}$

Answers

EXERCISE-1

Section (A)

A-1. (3) **A-2.** (2) **A-3.** (1)

Section (B)

B-1. (2) **B-2.** (3) **B-3.** (1)
B-4. (3) **B-5.** (4) **B-6.** (1)
B-7. (A)

Section (C)

C-1. (2) **C-2.** (4) **C-3.** (3)
C-4. (3) **C-5.** (2) **C-6.** (4)

Section (D)

D-1. (2) **D-2.** (3) **D-3.** (3)
D-4. (2) **D-5.** (4)

Section (E)

E-1. (1) **E-2.** (3) **E-3.** (3)
E-4. (2) **E-5.** (3) **E-6.** (4)

Section (F)

F-1. (2) **F-2.** (4) **F-3.** (1)
F-4. (4) **F-5.** (4) **F-6.** (4)
F-7. (1) **F-8.** (2)

Section (G)

G-1. (4) **G-2.** (3) **G-3.** (3)

EXERCISE-2

PART - I

1. (2) **2.** (3) **3.** (3)
4. (2) **5.** (3) **6.** (2)
7. (1) **8.** (1) **9.** (3)
10. (4) **11.** (2) **12.** (3)
13. (2) **14.** (3) **15.** (2)
16. (2) **17.** (2) **18.** (4)
19. (1) **20.** (1) **21.** (1)
23. (1) **24.** (1)

PART – II

Section (A)

A-1. (4) **A-2.** (4) **A-3.** (4)
A-4. (4)

Section (B)

B-1. $(1\rightarrow q)$, $(2\rightarrow r)$, $(3\rightarrow q)$, $(4\rightarrow r)$

B-2. $(1\rightarrow p)$, $(2\rightarrow p)$, $(3\rightarrow s)$, $(4\rightarrow r)$

Section (C)

C-1. (1, 2, 3) **C-2.** (2, 3) **C-3.** (3, 4)
C-4. (1, 3) **C-5.** (1, 2, 3)

EXERCISE-3

PART - I

1. (1) **2.** (4) **3.** (1)
4. (1) **5.** (2) **6.** (2)
7. (3) **8.** (4)

PART – II

1. (C) **2.** (A) **3.** (B)
4. (B)