# Exercise-1

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

## PART - I : SUBJECTIVE QUESTIONS

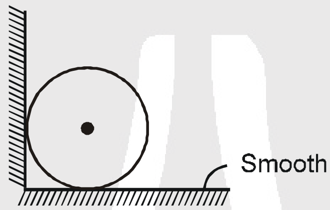
### Section (A) : Type of forces, Newton’s third law, Free body diagram :

**A-1.** Which type of forces does a proton exerts on a proton inside nucleus ?

**A-2.** A block ‘A’ exerts a force on ‘B’ of magnitude 20 N. Calculate the magnitude of force exerted by ‘B’ on ‘A’.

**A-3.** Two forces of same magnitude act on an isolated body in opposite directions to keep it at equilibrium position, is this true according to Newton’s third law ?

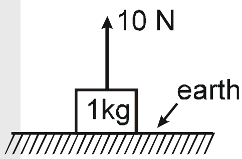
**A-4.** Draw F.B.D. of the sphere of mass M placed between a vertical wall and ground as shown in figure (All surfaces are smooth).



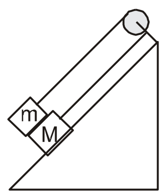

**A-5.✍** A block of mass 1 kg placed on ground is pulled by a string by applying 10 N force : (g = 10 m/s$^2$)

(i) Draw F.B.D. of block.

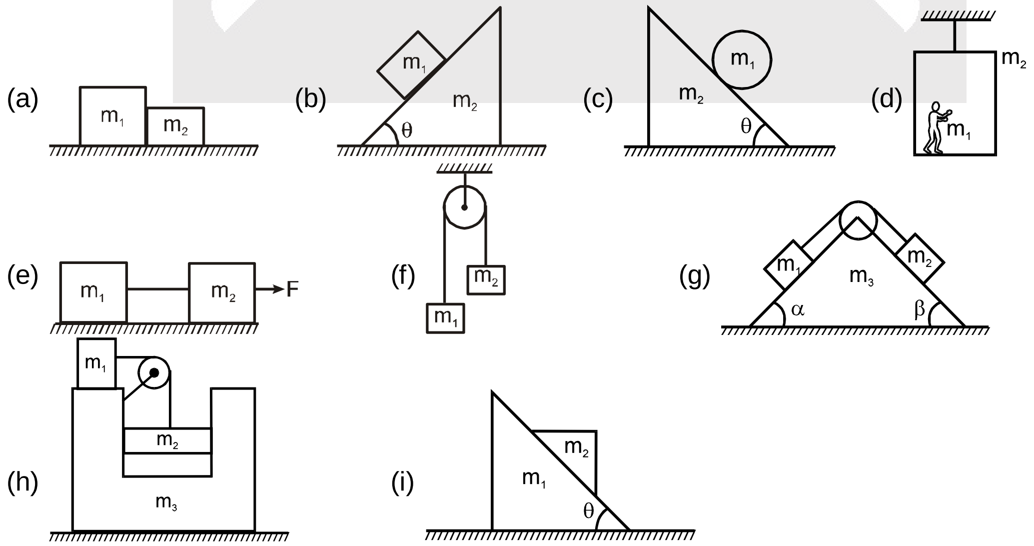
(ii) Give action–reaction pair involved in the above problem.




**A-6.** Draw free body diagrams for masses m and M shown in figure. Identify all action-reaction pairs between two blocks. The pulley is frictionless and massless and all surfaces are smooth.

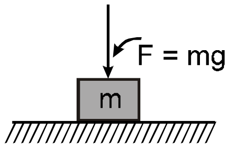



**A-7.** Draw the FBD for the following individual parts of the systems :
(Pulley are massless and friction less)

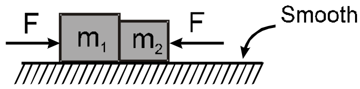


## Section (B) : Calculation of normal reaction

**B-1.** A block of mass 'm' is placed on ground and an additional force F = mg is applied on the block as shown in figure. Calculate contact force between ground and block.

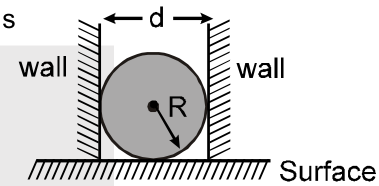



**B-2.** Two blocks of masses $m_1$ and $m_2$ are placed on ground as shown in figure. Two forces of magnitude F act on $m_1$ and $m_2$ in opposite directions.

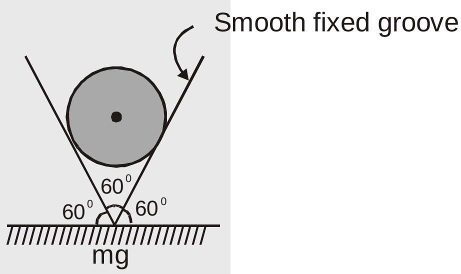



(i) Draw F.B.D. of masses $m_1$ and $m_2$.
(ii) Calculate the contact force between $m_1$ and $m_2$.
(iii) What will be the value of normal force between $m_1$ and $m_2$ .
(iv) Calculate force exerted by ground surface on mass $m_1$ and $m_2$

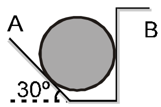
**B-3.** A sphere of mass 'm', radius 'R' placed between two vertical walls having separation 'd' which is slightly greater than '2R' :
(i) Calculate force exerted by walls on the sphere.
(ii) Calculate force exerted by ground surface on the sphere.



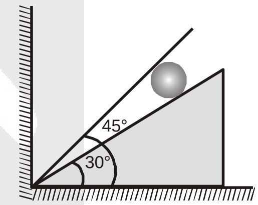

**B-4.** A cylinder of weight w is resting on a fixed V-groove as shown in figure.
(a) Draw its free body diagram.
(b) Calculate normal reactions between the cylinder and two inclined walls.




**B-5.** The 50 kg homogeneous smooth sphere rests on the 30º incline A and bears against the smooth vertical wall B. Calculate the contact forces at A and B.



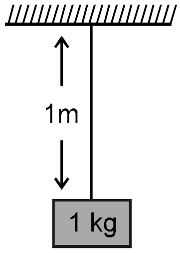

**B-6.** A spherical ball of mass m = 5 kg rests between two planes which make angles of 30° and 45° respectively with the horizontal. The system is in equilibrium. Find the normal forces exerted on the ball by each of the planes. The planes are smooth.



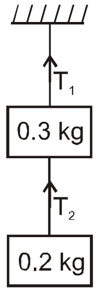

## Section (C) : Calculation of Tension

**C-1.** A one meter long massless string fixed with a wall is pulled horizontally by applying a force of magnitude 10 N. Calculate:
(a) the tension at a point 0.5m away from wall.
(b) the tension at a point 0.75 m away from wall.
(c) force exerted by string on the rigid support.

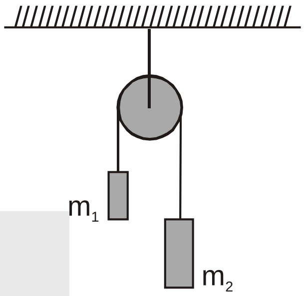
**C-2.** A block of mass 1 kg is suspended by a string of mass 1 kg, length 1m as shown in figure. (g = 10 m/s$^2$) Calculate:
(a) the tension in string at its lowest point.
(b) the tension in string at its mid–point.
(c) force exerted by support on string.



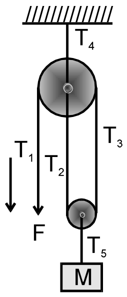
**C-3.** A block of mass 0.3 kg is suspended from the ceiling by a light string. A second block of mass 0.2 kg is suspended from the first block through another string. Find the tensions in the two strings.
Take g = 10 m/s$^2$.




**C-4.** Two unequal masses $m_1$ and $m_2$ are connected by a string going over a clamped light smooth pulley as shown in figure $m_1$ = 3 kg and $m_2$ = 6 kg. The system is released from rest. (a) Find the distance travelled by the first block in the first two seconds. (b) Find the tension in the string. (c) Find the force exerted by the clamp on the pulley. (g = 10 m/s$^2$)

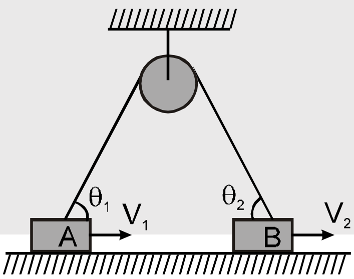



**C-5.** A mass M is held in place by an applied force F and a pulley system as shown in figure. The pulleys are massless and frictionless.
(a) Draw a free body diagram for each pulley
(b) Find the tension in each section of rope $T_1$, $T_2$, $T_3$, $T_4$ and $T_5$.
(c) Find the magnitude of F.

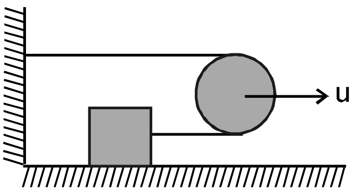



## Section (D) : Constrained motion

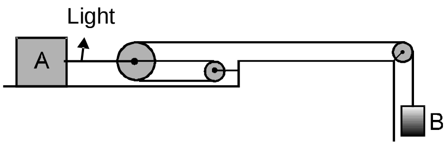
**D-1.** In the figure shown, blocks A and B move with velocities $v_1$ and $v_2$ along horizontal direction. Find the ratio of $v_1/v_2$.



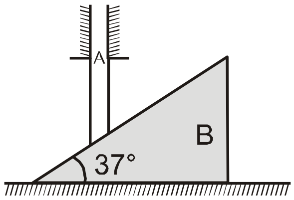

**D-2.** In the figure shown, the pulley is moving with velocity u. Calculate the velocity of the block attached with string.



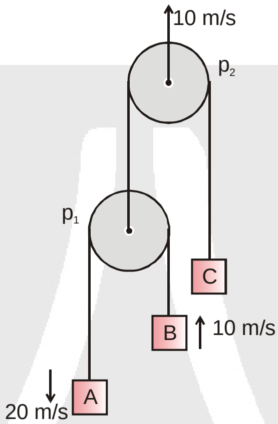
**D-3.** If block A has a velocity of 0.6 m/s to the right, determine the velocity of block B.



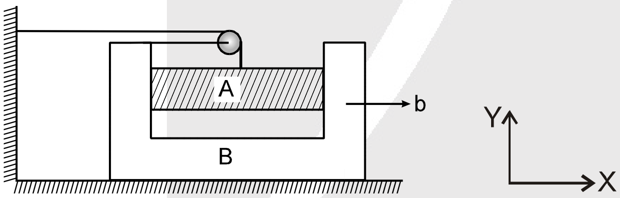

**D-4.** Find the acceleration of rod A and wedge B in the arrangement shown in figure if the mass of rod equal that of the wedge and the friction between all contact surfaces is negligible and rod A is free to move downwards only. Take angle of wedge as $37^{o}$.




**D-5.** Velocities of blocks A, B and pulley $p_2$ are shown in figure. Find velocity of pulley $p_1$ and block C.




**D-6.** Find the acceleration of A in term of b.

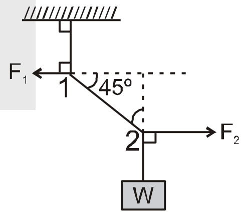



## Section (E) : Calculation of Force and Acceleration

**E-1.** In the figure the tension in the string between 1 and 2 is 60 N.

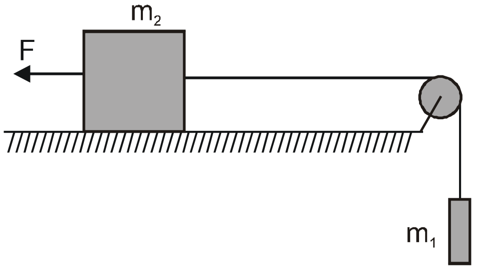
(a) Find the magnitude of the horizontal force $\vec{F}_1$ and $\vec{F}_2$ that must be applied to hold the system in the position shown.

(b) What is the weight of the suspended block ?

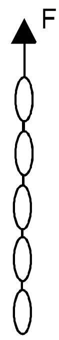



**E-2.** A 3.0 kg mass is moving in a plane, with its x and y coordinates given by $x = 5t^2 - 1$ and $y = 3t^3 + 2$, where x and y are in meters and t is in second. Find the magnitude of the net force acting on this mass at t = 2 sec.

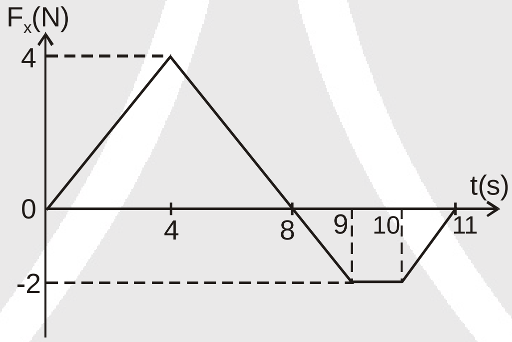
**E-3.** A constant force $F = m_1g / 2$ is applied on the block of mass $m_2$ as shown in figure. The string and the pulley are light and the surface of the table is smooth. Find the acceleration of $m_2$.



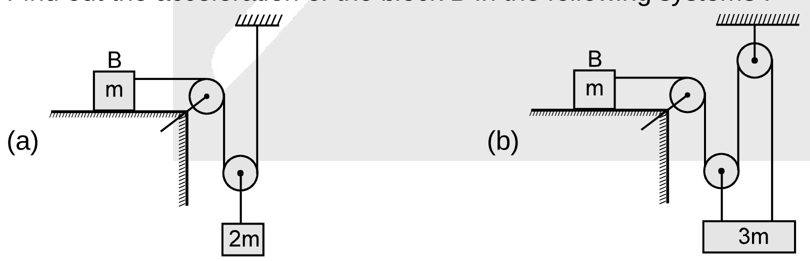

**E-4.** A chain consisting of five links each with mass 100gm is lifted vertically with constant acceleration of $2 m/s^2$ (↑) as shown. Find : ($g = 10 m/s^2$) :
(a) the forces acting between adjacent links
(b) the force F exerted on the top link by the agent lifting the chain
(c) the net force on each link.



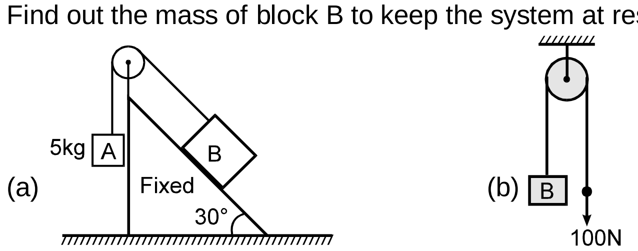

**E-5.** A 2 kg toy car can move along an x axis. Graph shows force $F_x$, acting on the car which begins at rest at time t = 0. The velocity of the car at t = 10 s is :




**E-6.** Find out the acceleration of the block B in the following systems :




**E-7.** Find out the mass of block B to keep the system at rest : ($g = 10 m/s^2$)

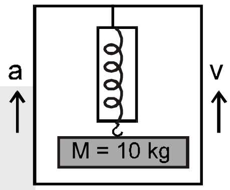


## Section (F) : Weighing machine, Spring related problems and Spring balance

**F-1.** A man of mass 60 kg is standing on a weighing machine placed in a lift moving with velocity 'v' and acceleration 'a' as shown in figure. Calculate the reading of weighing machine in following situations : ($g = 10\ m/s^2$)

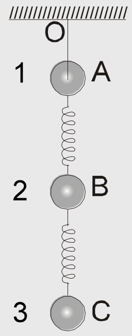

(i) $a = 0$, $v = 0$
(ii) $a = 0$, $v = 2\ m/s$
(iii) $a = 0$, $v = -2 m/s$
(iv) $a = 2 m/s^2$, $v = 0$
(v) $a = -2\ m/s^2$ $v = 0$
(vi) $a = 2\ m/s^2$, $v = 2\ m/s$
(vii) $a = 2\ m/s^2$, $v = -2\ m/s$
(viii) $a = -2\ m/s^2$, $v = -2\ m/s$

**F-2.** What will be the reading of spring balance in the figure shown in following situations? ($g = 10\ m/s^2$)




(i) $a = 0$, $v = 0$
(ii) $a = 0$, $v = 2\ m/s$
(iii) $a = 0$, $v = -2 m/s$
(iv) $a = 2 m/s^2$, $v = 0$
(v) $a = -2\ m/s^2$ $v = 0$
(vi) $a = 2\ m/s^2$, $v = 2\ m/s$
(vii) $a = 2\ m/s^2$, $v = -2\ m/s$
(viii) $a = -2\ m/s^2$ $v = -2\ m/s$

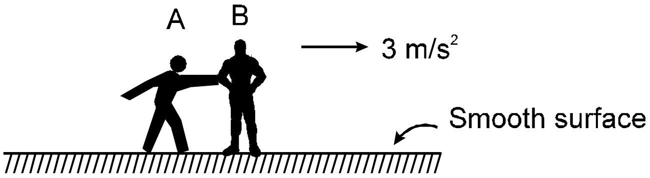
**F-3.** Three identical balls 1,2,3 are suspended on springs one below the other as shown in the figure. OA is a weightless thread. The balls are in equilibrium



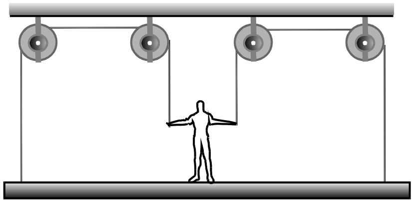

**(a)** If the thread is cut, the system starts falling. Find the acceleration of all the balls at the initial instant
**(b)** Find the initial accelerations of all the balls if we cut the spring BC, which is supporting ball 3, instead of cutting the thread.

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

**G-1.** Man 'A' of mass 60 kg pushes the other man 'B' of mass 75 kg due to which man 'B' starts moving with acceleration $3\ m/s^2$. Calculate the acceleration of man 'A' at that instant.



**G-2.** A painter of mass M stands on a platform of mass m and pulls himself up by two ropes which hang over pulley as shown. He pulls each rope with the force F and moves upward with uniform acceleration 'a'. Find 'a'

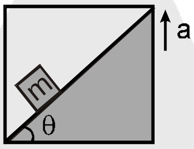


**G-3.** Three monkeys A, B and C with masses of 10, 15 & 8 Kg respectively are climbing up & down the rope suspended from D. At the instant represented, A is descending the rope with an acceleration of 2 m/s$^2$ & C is pulling itself up with an acceleration of 1.5 m/s$^2$. Monkey B is climbing up with a constant speed of 0.8 m/s. Calculate the tension T in the rope at D. (g = 10 m/s$^{-2}$)


## Section (H) : Pseudo Force

**H-1.** An object of mass 2 kg moving with constant velocity $10\hat{i}$ m/s is seen in a frame moving with constant velocity $10\hat{i}$ m/s. What will be the value of 'pseudo force' acting on object in this frame.

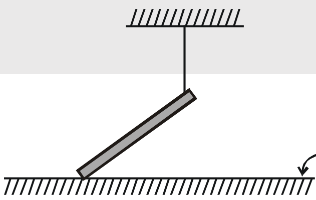
**H-2.** In the adjoining figure, a wedge is fixed to an elevator moving upwards with an acceleration 'a'. A block of mass 'm' is placed over the wedge. Find the acceleration of the block with respect to wedge. Neglect friction.

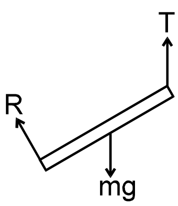



## PART - II : ONLY ONE OPTION CORRECT TYPE

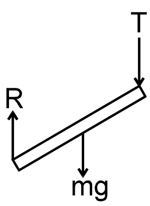
## Section (A) : Type of forces, Newton's third law, Free body diagram :

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

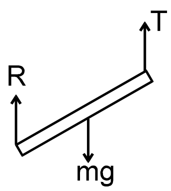



(A)




(B)



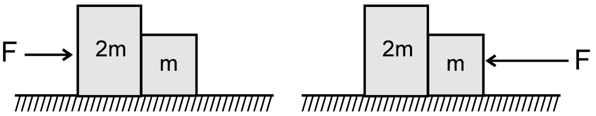

(C)

(D) None of these

**A-2.** When a horse pulls a cart , the force needed to move the horse in forward direction is the force exerted by
(A) the cart on the horse (B) the ground on the horse
(C) the ground on the cart (D) the horse on the ground

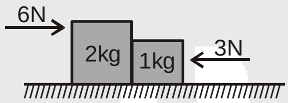
## Section (B) : Calculation of normal reaction

**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 :




(A) same (B) 1 : 2 (C) 2 : 1 (D) 1 : 3

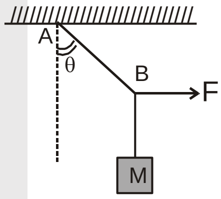
**B-2.** Two forces of 6N and 3N are acting on the two blocks of 2kg and 1kg kept on frictionless floor. What is the force exerted on 2kg block by 1kg block ?




(A) 1N (B) 2N (C) 4N (D) 5N

## 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 $\theta$ with the vertical in equilibrium, then the tension in the string AB is :

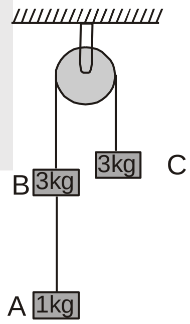



(A) F sin $\theta$ (B) F/sin $\theta$
(C) F cos $\theta$ (D) F/cos $\theta$

**C-2.** Two persons are holding a light rope 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 :

(A) 15 kg (B) $\frac{15}{2}$ kg (C) 5 kg (D)Infinitely large(or not possible)

**C-3.** 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 :



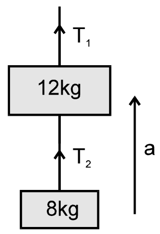

(A) $\frac{g}{4}$ downwards , $\frac{8g}{7}$

(B) $\frac{g}{4}$ upwards, $\frac{g}{7}$

(C) $\frac{g}{7}$ downwards , $\frac{6}{7}$g

(D) $\frac{g}{2}$ upwards , g

**C-4.** A body of mass 8 kg is hanging from another body of mass 12 kg. The combination is being pulled by a string with an acceleration of 2.2 m $s^{-2}$. The tension $T_1$ and $T_2$ will be respectively :
(use g = 9.8m/$s^2$ )

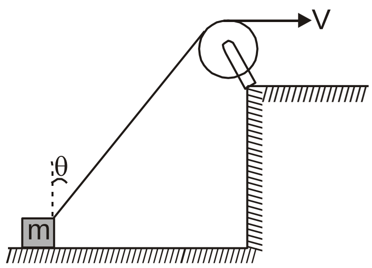



(A) 200 N, 80 N (B) 220 N, 90 N
(C) 240 N, 96 N (D) 260 N, 96 N

**C-5.** A particle of small mass m is joined to a very heavy body by a light string passing over a light pulley. Both bodies are free to move. The total downward force on the pulley due to string is nearly
(A) mg (B) 2 mg (C) 4 mg (D) can not be determined

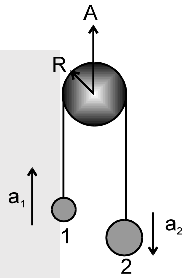
## Section (D) : Constrained motion

**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 :



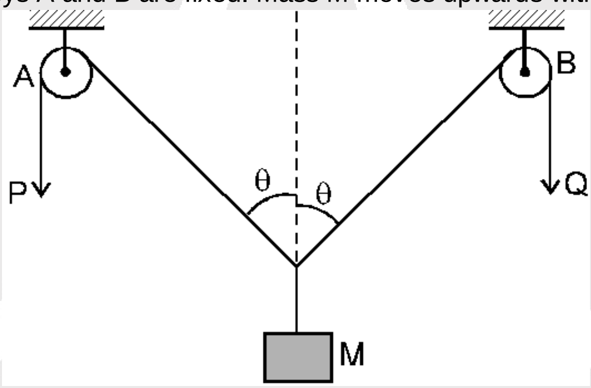

(A) v (B) $\frac{v}{\sin\theta}$
(C) v sin θ (D) $\frac{v}{\cos\theta}$

**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 :



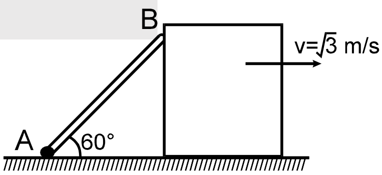

(A) $A = a_1 - a_2$ (B) $A = a_1 + a_2$
(C) $A = \frac{a_1 - a_2}{2}$ (D) $A = \frac{a_1 + a_2}{2}$.

**D-3.** In the arrangement shown in fig. 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.



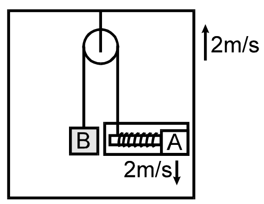

(A) 2 U cos θ (B) U cos θ (C) 2 U/cos θ (D) U/cos θ

**D-4.** 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:



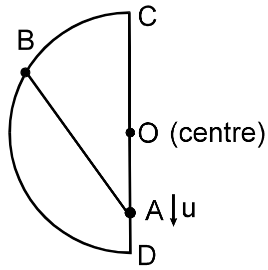

(A) $\sqrt{3}$ m/s (B) 2 m/s
(C) 2 $\sqrt{3}$ m/s (D) 3 m/s

**D-5.** In the figure shown the velocity of lift is 2 m/s while string is winding on the motor shaft with velocity 2 m/s and block A is moving downwards with a velocity of 2 m/s, then find out the velocity of block B.




(A) 2 m/s ↑ (B) 2 m/s ↓
(C) 4 m/s ↑ (D) 8 m/s ↑

**D-6.** Two beads A and B move along a fixed 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, $\angle BAC = 45°$ and $\angle BOC = 75°$, where O is the centre of the semicircular arc. The speed of bead B at that instant is :




(A) $\sqrt{2}\,u$ (B) u
(C) $\frac{u}{2\sqrt{2}}$ (D) $\sqrt{\frac{2}{3}}\,u$

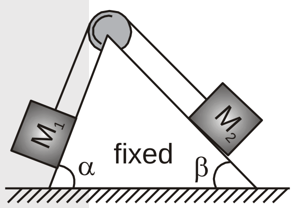
## Section (E) : Calculation of Force and Accelertion

**E-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 its momentum
(C) change the direction (D) keep it moving with uniform velocity

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

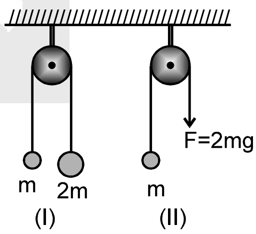
**E-3.** In which of the following cases the net force is not zero ?
(A) A kite skillfully held stationary in the sky
(B) A ball freely falling from a height
(C) An aeroplane rising upwards at an angle of 45º with the horizontal with a constant speed
(D) A cork lying on the surface of water

**E-4.** Two masses $M_1$ and $M_2$ are attached to the ends of a light string which passes over a massless pulley attached to the top of a double inclined smooth plane of angles of inclination $\alpha$ and $\beta$. If $M_2 > M_1$ and $\beta > \alpha$ then the acceleration of block $M_2$ down the inclined will be:




(A) $\frac{M_2 g(\sin\beta)}{M_1 + M_2}$ (B) $\frac{M_1 g(\sin\alpha)}{M_1 + M_2}$
(C) $\left(\frac{M_2\sin\beta - M_1\sin\alpha}{M_1 + M_2}\right)g$ (D) zero

**E-5.** The pulley arrangements shown in figure are identical, the mass of the rope being negligible. In case I, the mass m is lifted by attaching a mass 2m to the other end of the rope. In case II, the mass m is lifted by pulling the other end of the rope with a constant downward force F = 2mg, where g is acceleration due to gravity. The acceleration of mass in case I is:




(A) zero (B) more than that in case II
(C) less than that in case II (D) equal to that in case II

**E-6.** A force produces an acceleration of 4 $ms^{-2}$ in a body of mass $m_1$ and the same force produces an acceleration of 6 $ms^{-2}$ in another body of mass $m_2$. If the same force is applied to $(m_1 + m_2)$, then the acceleration will be:
(A) 10 $ms^{-2}$ (B) 2 $ms^{-2}$ (C) 2.4 $ms^{-2}$ (D) 5.4 $ms^{-2}$

**E-7.** A body of mass M is acted upon by a force F and the acceleration produced is a. If three coplaner forces each equal to F and inclined to each other at 120º act on the same body and no other forces are acting. The acceleration produced will be:

(A) $\sqrt{2}$ a (B) a/$\sqrt{3}$ (C) 3a (D) zero

**E-8.** A fireman wants to slide down a rope. The rope can bear a tension of $\frac{3}{4}^{th}$ of the weight of the man. With what minimum acceleration should the fireman slide down :

(A) $\frac{g}{3}$ (B) $\frac{g}{6}$ (C) $\frac{g}{4}$ (D) $\frac{g}{2}$

**E-9.** A force $\vec{F} = 6\hat{i} - 8\hat{j} + 10\hat{k}$ newton produces acceleration 1 m/s$^2$ in a body. The mass of the body is (in kg) :

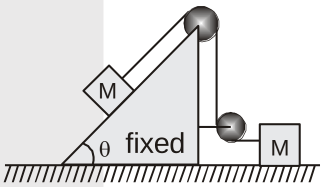
(A) $6\hat{i} - 8\hat{j} + 10\hat{k}$ kg (B) $10\sqrt{2}$ kg

(C) 100 kg (D) 10 kg

**E-10.** A body is moving with a speed of 1 m/s and a constant force F is needed to stop it in a distance x. If the speed of the body is 3 m/s the force needed to stop it in the same distance x will be

(A) 1.5 F (B) 3F (C) 6 F (D) 9F

**E-11.** Two blocks, each having mass M, rest on frictionless surfaces as shown in the figure. If the pulleys are light and frictionless, and M on the incline is allowed to move down, then the tension in the string will be:

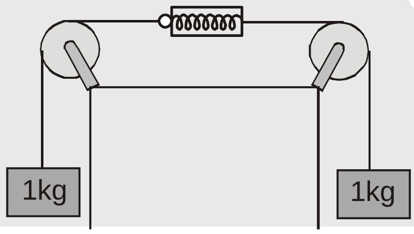



(A) $\frac{2}{3}$ Mg sin $\theta$ (B) $\frac{3}{2}$ Mg sin $\theta$

(C) $\frac{Mg\sin\theta}{2}$ (D) 2 Mg sin $\theta$

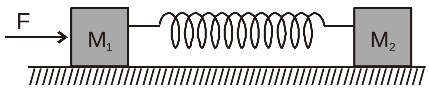
## Section (F) : Weighing machine, Spring related problems and Spring balance

**F-1.** In the given figure, what is the reading of the spring balance ?



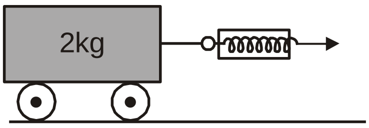

(A) 10 N (B) 20 N (C) 5 N (D) zero

**F-2.** 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 right direction. What will be the magnitude of acceleration in $M_2$?




(A) $F/M_2$ (B) $F/(M_1 + M_2)$ (C) $a_1$ (D) $(F – M_1a_1)/M_2$

**F-3.** A massless spring balance is attached to 2 kg trolley and is used to pull the trolley along a flat surface as shown in the fig. The reading on the spring balance remains at 10 kg during the motion. The acceleration of the trolley is (Use g = 9.8 $ms^{-2}$)



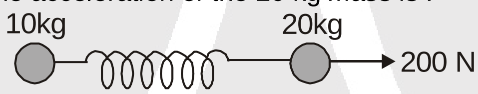

(A) 4.9 $ms^{-2}$ (B) 9.8 $ms^{-2}$ (C) 49 $ms^{-2}$ (D) 98 $ms^{-2}$

**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)
(A) (3/2) g (B) g (C) (2/3) g (D) g/3

**F-5.** A body of mass 32 kg is suspended by a spring balance from the roof of a vertically operating lift and going downward from rest. At the instants the lift has covered 20 m and 50 m, the spring balance showed 30 kg & 36 kg respectively. The velocity of the lift is:
(A) Decreasing at 20 m & increasing at 50 m
(B) increasing at 20 m & decreasing at 50 m
(C) Continuously decreasing at a constant rate throughout the journey
(D) Continuously increasing at constant rate throughout the journey
(E) Remaining constant throughout the journey.

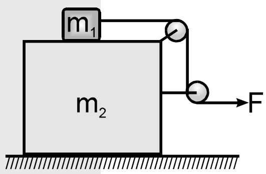
## Section (G) : Newton's law for a system

**G-1.** Two masses of 10 kg and 20 kg respectively are connected by a massless spring as shown in figure. A force of 200 N acts on the 20 kg mass at the instant when the 10 kg mass has an acceleration of 12 $ms^{-2}$ towards right, the acceleration of the 20 kg mass is :




(A) 2 $ms^{-2}$ (B) 4$ms^{-2}$ (C) 10$ms^{-2}$ (D) 20$ms^{-2}$

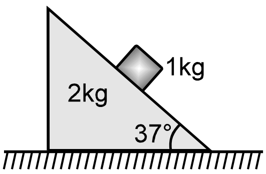
**G-2.** In the arrangement shown in the figure all surfaces are frictionless, pulley and string are light. The masses of the block are $m_1$ = 20 kg and $m_2$ = 30 kg. The accelerations of masses $m_1$ and $m_2$ will be if F = 180 N is applied according to figure.




(A) $a_{m_1} = 9 m/s^2$, $a_{m_2} = 0$ (B) $a_{m_1} = 9 m/s^2$, $a_{m_2} = 9$ m/s2
(C) $a_{m_1} = 0$, $a_{m_2} = 9$ $m/s^2$ (D) None of these

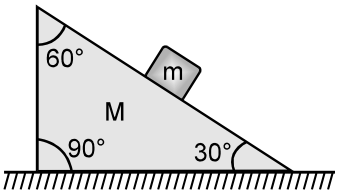
## Section (H) : Pseudo force

**H-1.** Figure shows a wedge of mass 2kg resting on a frictionless floor. A block of mass 1 kg is kept on the wedge and the wedge is given an acceleration of 5 m/sec$^2$ towards right. Then :



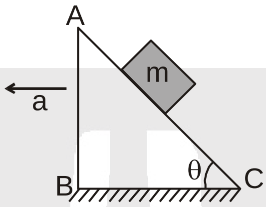

(A) block will remain stationary w.r.t. wedge
(B) the block will have an acceleration of 1 m/sec$^2$ w.r.t. the wedge
(C) normal reaction on the block is 11 N
(D) net force acting on the wedge is 2 N

**H-2.** A triangular block of mass M rests on a smooth surface as shown in figure. A cubical block of mass m rests on the inclined surface. If all surfaces are frictionless, the force that must be applied to M so as to keep m stationary relative to M is :




(A) Mg tan 30° (B) mg tan 30° (C) (M+m)g tan 30° (D) (M+m)g cos 30°

**H-3.** A block of mass m resting on a wedge of angle $\theta$ as shown in the figure. The wedge is given an acceleration a towards left. What is the minimum value of **a** due to external agent so that the mass m falls freely ?




(A) g (B) g cos $\theta$ (C) g cot $\theta$ (D) g tan $\theta$

## PART - III : MATCH THE COLUMN

**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

**Column I**

(A) 

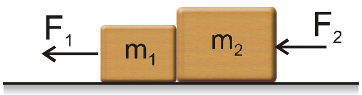
. Both the blocks are connected by massless inelastic string. The magnitude of tension in the string is

(B) 

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

(C) 

. The magnitude of normal reaction between the blocks is

(D) 

. The magnitude of normal reaction between the blocks is

**Column II**

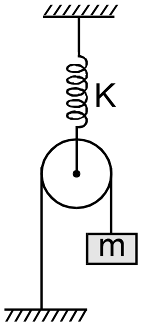
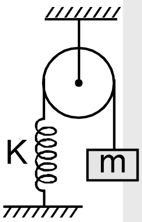
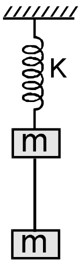
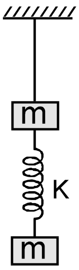
(p) $\dfrac{m_1 \; m_2}{m_1 + m_2}\left(\dfrac{F_1}{m_1} - \dfrac{F_2}{m_2}\right)$

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

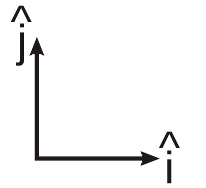
(r) $\dfrac{m_1 \; m_2}{m_1 + m_2}\left(\dfrac{F_2}{m_2} - \dfrac{F_1}{m_1}\right)$

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

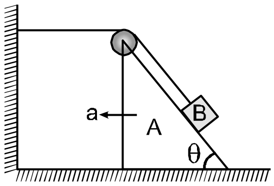
**2.** In column I four different sitiuation are given and in column II tension in string (which is not connected with spring) & extention in spring at equilibrium is given Match the statements in column I with corresponding results in column-II

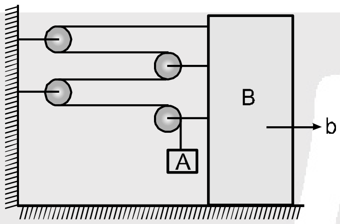
| **Column-I** | **Column-II** |
|---|---|
| (A)  | (p) mg |
| (B)  | (q) 2mg |
| (C)  | (r) $\frac{mg}{k}$ |
| (D)  | (s) $\frac{2mg}{k}$ |

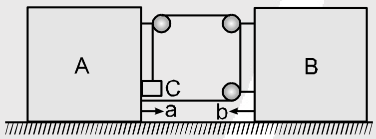
**3.** In column - I four different situation are given column -II corresponding result are given. Match the statements in column I with corresponding results in column-II in the question below take the unit vector as follows :

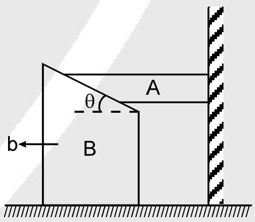



| **Column– I** | **Column– II** |
|---|---|
| (A) The acceleration of B w.r.t ground if θ = 60° & a = 2m/s$^2$ | (p) $4\hat{j}$ |
| (B). The acceleration of A w.r.t. ground if b = 1m/s$^2$ | (q) $-2\hat{j}$ |
| (C). The acceleration of C w.r.t. ground if a = b = 1m/s$^2$ | (r) $-\hat{i}-\sqrt{3}\hat{j}$ |
| (D) The acceleration of wedge A if θ = 45° & b = 2m/s$^2$ | (s) $\hat{i}-4\hat{j}$ |



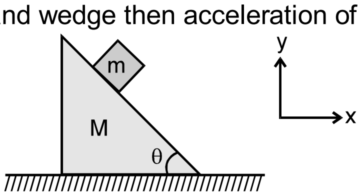




## Exercise-2

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

## PART - I : ONLY ONE OPTION CORRECT TYPE

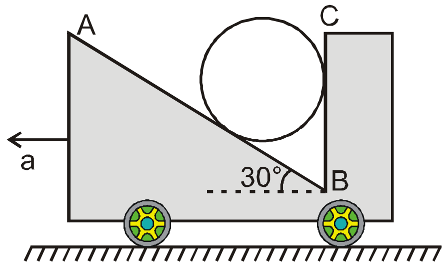
**1.** Consider the shown arrangement. Assume all surfaces to be smooth. If 'N' represents magnitude of normal reaction between block and wedge then acceleration of 'M' along horizontal equals:




(A) $\frac{N\sin\theta}{M}$ along + ve-x-axis (B) $\frac{N\cos\theta}{M}$ along-ve x-axis

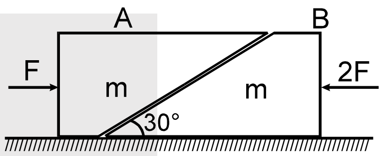
(C) $\frac{N\sin\theta}{M}$ along – ve x-axis (D) $\frac{N\sin\theta}{m+M}$ along –ve x-axis

**2.** A cylinder rests in a supporting carriage as shown. The side AB of carriage makes an angle 30º with the horizontal and side BC is vertical. The carriage lies on a fixed horizontal surface and is being pulled towards left with an horizontal acceleration '*a*'. The magnitude of normal reactions exerted by sides AB and BC of carriage on the cylinder be $N_{AB}$ and $N_{BC}$ respectively. Neglect friction everywhere. Then as the magnitude of acceleration '*a*' of the carriage is increased, pick up the correct statement:



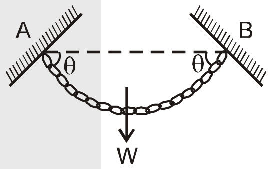

(A) $N_{AB}$ increases and $N_{BC}$ decreases.
(B) Both $N_{AB}$ and $N_{BC}$ increase.
(C) $N_{AB}$ remains constant and $N_{BC}$ increases.
(D) $N_{AB}$ increases and $N_{BC}$ remains constant.

**3.** Two blocks 'A' and 'B' each of mass 'm' are placed on a smooth horizontal surface. Two horizontal forces F and 2F are applied on the two blocks 'A' and 'B' respectively as shown in figure. The block A does not slide on block B. Then the normal reaction acting between the two blocks is :



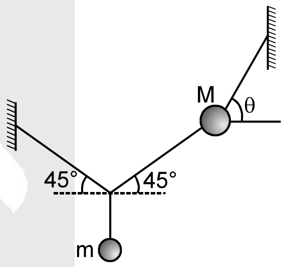

(A) F
(B) F/2
(C) $\frac{F}{\sqrt{3}}$
(D) 3F

**4.** 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 $\theta$. What is the tension of the chain at the endpoint.



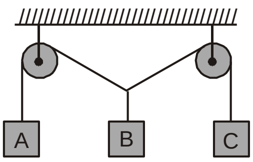

(A) $\frac{W}{2}$ cosec $\theta$
(B) $\frac{W}{2}$ sec $\theta$
(C) W cos $\theta$
(D) $\frac{W}{3}$ sin $\theta$

**5.** Two masses m and M are attached with strings as shown. For the system to be in equilibrium we have



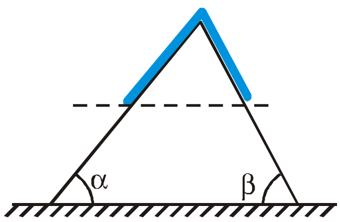

(A) $\tan\theta = 1 + \frac{2M}{m}$
(B) $\tan\theta = 1 + \frac{2m}{M}$
(C) $\tan\theta = 1 + \frac{M}{2m}$
(D) $\tan\theta = 1 + \frac{m}{2M}$

**6.** Three blocks A , B and C are suspended as shown in the figure. Mass of each block A and C is m. If system is in equilibrium and mass of B is M, then :



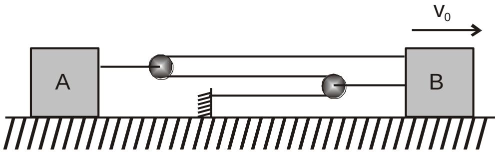

(A) M = 2 m
(B) M < 2 m
(C) M > 2 m
(D) M = m

**7.** A uniform rope of length L and mass M is placed on a smooth fixed wedge as shown. Both ends of rope are at same horizontal level. The rope is initially released from rest, then the magnitude of initial acceleration of rope is



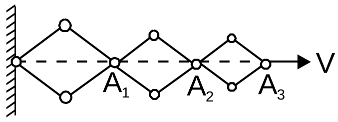

(A) Zero
(B) M( $\cos\alpha - \cos\beta$) g
(C) M( $\tan\alpha - \tan\beta$)g
(D) None of these

**8.** Block B moves to the right with a constant velocity $v_0$. The velocity of block A relative to B is :




(A) $\frac{v_0}{2}$, towards left (B) $\frac{v_0}{2}$, towards right (C) $\frac{3v_0}{2}$, towards left (D) $\frac{3v_0}{2}$, towards right

**9.** A hinged construction consists of three rhombus with the ratio of sides (5 : 3 : 2). Vertex $A_3$ moves in the horizontal direction with velocity V. Velocity of $A_2$ will be :

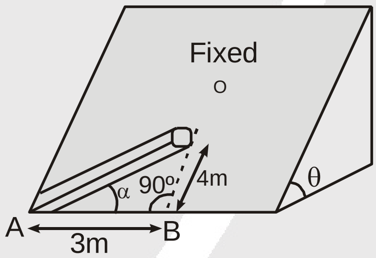



(A) 2.5 V (B) 1.5V (C) (2/3)V (D) 0.8V

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

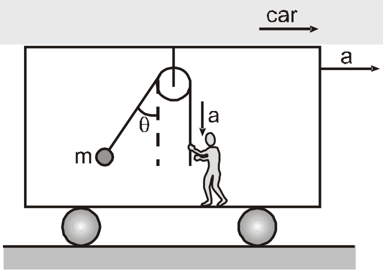
(A) w (B) $w\left(1+\frac{a}{g}\right)$ (C) $w\left(1-\frac{a}{g}\right)$ (D) $w\frac{a}{g}$

**11.** There is an inclined surface of inclination $\theta$ = 30º. A smooth groove is cut into it forming angle $\alpha$ with AB. A steel ball is free to slide along the groove. If the ball is released from the point O at top end of the groove, the speed when it comes to A is: [$g = 10\ m/s^2$]




(A) $\sqrt{40}$ m/s (B) $\sqrt{20}$ m/s (C) $\sqrt{10}$ m/s (D) $\sqrt{15}$ m/s

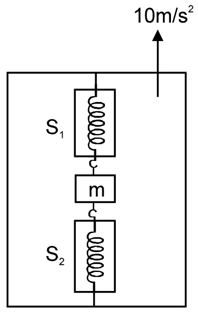
**12.** A bob is hanging over a pulley inside a car through a string. The second end of the string is in the hand of a person standing in the car. The car is moving with constant acceleration 'a' directed horizontally as shown in figure. Other end of the string is pulled with constant acceleration 'a' (relative to car) vertically. The tension in the string is equal to (assume $\theta$ remains constant)




(A) $m\sqrt{g^2+a^2}$ (B) $m\sqrt{g^2+a^2} - ma$

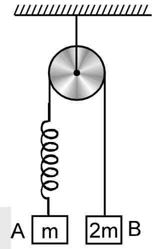
(C) $m\sqrt{g^2+a^2} + ma$ (D) $m(g + a)$

**13.** 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 :



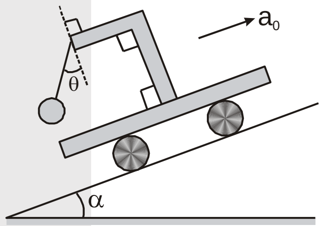

(A) 60 kg
(B) 30 kg
(C) 120 kg
(D) None of these

**14.** In the figure a block 'A' of mass 'm' is attached at one end of a light spring and the other end of the spring is connected to another block 'B' of mass 2m through a light string. 'A' is held and B is in static equilibrium. Now A is released. The acceleration of A just after that instant is 'a'. In the next case, B is held and A is in static equilibrium. Now when B is released, its acceleration immediately after the release is 'b'. The value of a/b is : (Pulley, string and the spring are massless)




(A) 0 (B) $\frac{1}{2}$ (C) 2 (D) undefined

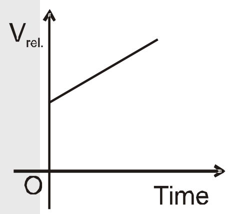
**15.** A pendulum of mass m hangs from a support fixed to a trolley. The direction of the string when the trolley rolls up a plane of inclination $\alpha$ with acceleration $a_0$ is (String and bob remain fixed with respect to trolley) :




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

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

**16.** A particle is observed from two frames $S_1$ and $S_2$. The graph of relative velocity of $S_1$ with respect to $S_2$ is shown in figure. Let $F_1$ and $F_2$ be the pseudo forces on the particle when seen from $S_1$ and $S_2$ respectively. Which one of the following is not possible?

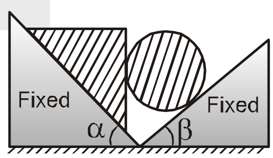



(A) $F_1 = 0, F_2 \neq 0$ (B) $F_1 \neq 0, F_2 = 0$

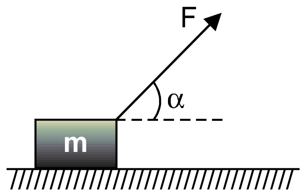
(C) $F_1 \neq 0, F_2 \neq 0$ (D) $F_1 = 0, F_2 = 0$

## PART - II : SINGLE AND DOUBLE VALUE INTEGER TYPE

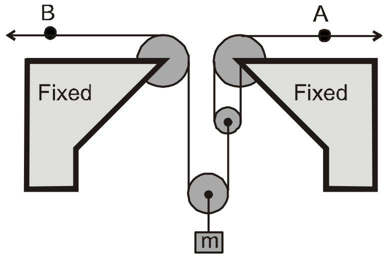
**1.** A cylinder and a wedge of same masses with a vertical face, touching each other, move along two smooth inclined planes forming the some angle and $\beta$ respectively with the horizontal. Determine the force of normal N (in newton) exerted by the wedge on the cylinder, neglecting the friction between them. If $m = \frac{1}{\sqrt{3}}$ kg, $\alpha = 60°$, $\beta = 30°$ and $g = 10$m/s$^2$



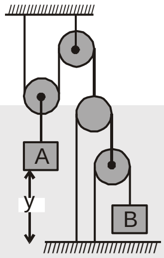

**2.** At the moment t = 0 the force F = at N is applied to a small body of mass m kg resting on a smooth horizontal plane (a is constant). The permanent direction of this force forms an angle $\alpha$ with the horizontal (as shown in the figure). Then the distance traversed by the body up to this moment of its breaking off the plane is $\frac{m^2g^3\cos\alpha}{Pa^2\sin^3\alpha}$ m. Then find value of P.



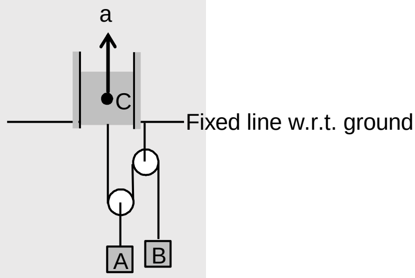
3. For the pulley system, each of the cables at A and B is given velocity of 4m/s in the direction of the arrow. Determine the upward velocity v of the load m. (in m/s)



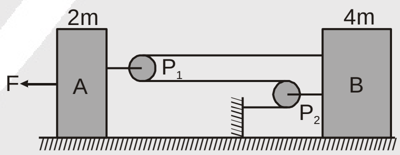

4. The vertical displacement of block A in meter is given by $y = t^2/4$ where t is in second. Calculate the downward acceleration $a_B$ of block B. (in m/s$^2$)



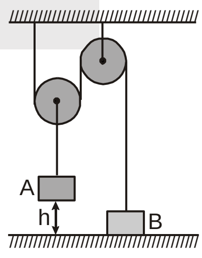

5. The block C shown in the figure is ascending with an acceleration a = 3 m/s$^2$ by means of some motor not shown here. The bodies A and B of masses 10 kg and 5 kg respectively, assuming pulleys and strings are massless and friction is absent everywhere. Then find acceleration of body A. (in m/s$^2$)



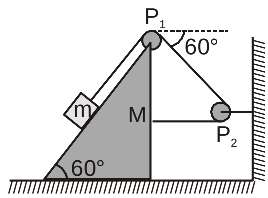

6. The acceleration of the block B in the figure, assuming the surfaces and the pulleys $P_1$ and $P_2$ are all smooth and pulleys and string are light is $\frac{3F}{xm}$ then value of x is.



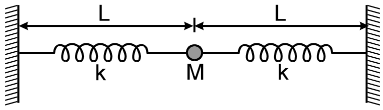

7. In the arrangement shown in figure, the mass of the body A is n = 4 times that of body B. The height h=20 cm. At a certain instant, the body B is released and the system is set in motion. What is the maximum height (in cm) the body B will go up? Assume enough space above B and A sticks to ground. (A and B are of small size) (g = 10 m/s$^2$)




8. In the arrangement shown in the fig, the block of mass m = 2 kg lies on the wedge of mass M = 8 kg. The initial acceleration of the wedge if the surfaces are smooth and pulley & strings are massless is $\frac{30\sqrt{3}}{x}$ m/s$^2$ then x is.

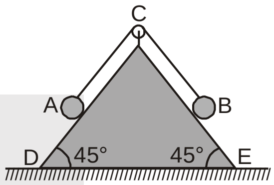


**9.** A ball of mass M is suspended from two identical springs each with spring constant k and undeformed length L. The ball is held in line with two springs as shown in the figure. When the ball begins to fall, find the magnitude of the acceleration of the ball at the instant when it has fallen through a vertical distance x (in $m/s^2$) if M = 250g , K = 130N/m , L = 12cm, x= 5cm and g = $10m/s^2$




**10.** A bead of mass m is fitted on to a rod of a length of $2\ell$ and can move on it without friction. At the initial moment the bead is in the middle of the rod. The rod moves translationally in a horizontal plane with an acceleration 'a' in a direction forming an angle $\alpha$ with the rod. Find the time when the bead will leave the rod. If $\ell$ = 2m, a = $2m/s^2$ and $\alpha$ = 60°

**11.** Two particles A and B of masses 3 kg and 2 kg are connected by a light inextensible string. The particles are in contact with the smooth faces of a wedge DCE of mass 10 kg resting on a smooth horizontal plane. When the system is moving freely, find the acceleration of the wedge (in $cm/s^2$).




## PART - III : ONE OR MORE THAN ONE OPTIONS CORRECT TYPE

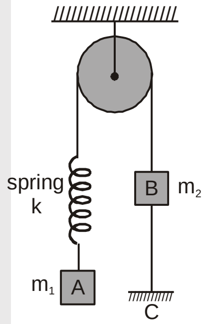
**1.** In the system shown in the figure $m_1 > m_2$. System is held at rest by thread BC. Just after the thread BC is burnt :

(A) acceleration of $m_2$ will be upwards

(B) magnitude of acceleration of both blocks will be equal to $\left(\frac{m_1 - m_2}{m_1 + m_2}\right)g$

(C) acceleration of $m_1$ will be equal to zero

(D) magnitude of acceleration of two blocks will be non–zero and unequal.



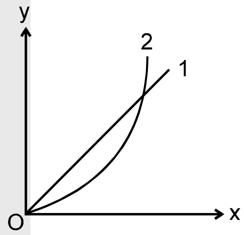

**2.** A particle is resting on a smooth horizontal floor. At t = 0, a horizontal force starts acting on it. Magnitude of the force increases with time according to law F = $\alpha$.t, where $\alpha$ is a constant. For the figure shown which of the following statements is/are correct ?

(A) Curve 1 shows acceleration against time

(B) Curve 2 shows velocity against time

(C) Curve 2 shows velocity against acceleration

(D) None of these



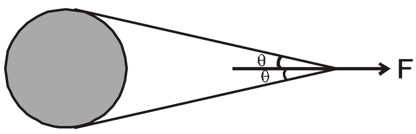

**3.** A light string is wrapped round a cylindrical log of wood which is placed on a horizontal surface with it's axis vertical and it is pulled with a constant force F as shown in the figure.(Friction is absent everywhere)

(A) tension T in the string increases with increase in $\theta$

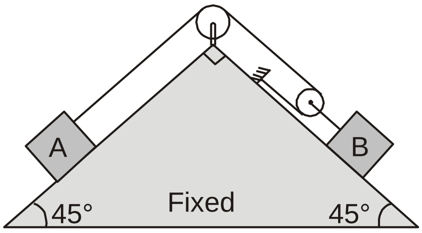
(B) tension T in the string decreases with increase in $\theta$

(C) tension T > F if $\theta > \pi/3$

(D) tension T > F if $\theta > \pi/4$

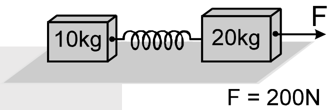


**4.** Two blocks A and B of mass 10 kg and 40 kg are connected by an ideal string as shown in the figure. Neglect the masses of the pulleys and effect of friction. ($g = 10\ m/s^2$)



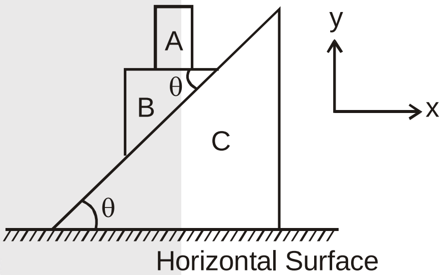

(A) The acceleration of block A is $\frac{5}{\sqrt{2}}\ ms^{-2}$
(B) The acceleration of block B is $\frac{5}{2\sqrt{2}}\ ms^{-2}$
(C) The tension in the string is $\frac{125}{\sqrt{2}}$ N
(D) The tension in the string is $\frac{150}{\sqrt{2}}$ N

**5.** 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.




(A) At that instant the 20 kg mass has an acceleration of 12 $ms^{-2}$.
(B) At that instant the 20 kg mass has an acceleration of 4 $ms^{-2}$.
(C) The stretching force in the spring is 120 N.
(D) None of these

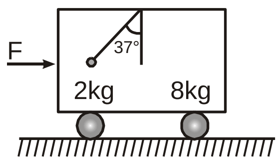
**6.** In the figure shown all the surface are smooth. All the blocks A, B and C are movable X-axis is horizontal and y-axis vertical as shown. Just after the system is relased from the position as shown.




(A) Acceleration of 'A' relative to ground is in negative y-direction
(B) Acceleration of 'A' relative to B is in positive x-direction
(C) The horizontal acceleration of 'B' relative to ground is in negative x-direction.
(D) The acceleration of 'B' relative to ground directed along the inclined surface of 'C' is greater than g sin $\theta$.

**7.** A particle stays at rest as seen from a frame. We can conclude that
(A) the frame is inertial.
(B) resultant force on the particle is zero.
(C) if the frame is inertial then the resultant force on the particle is zero.
(D) if the frame is noninertial then there is a nonzero resultant force.

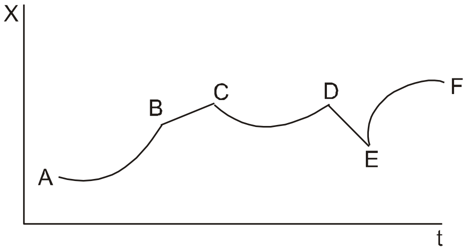
**8.** A trolley of mass 8 kg is standing on a frictionless surface inside which an object of mass 2 kg is suspended. A constant force F starts acting on the trolley as a result of which the string stood at an angle of $37^0$ from the vertical (bob at rest relative to trolley) Then :




(A) acceleration of the trolley is 40/3 m/sec$^2$.
(B) force applied is 60 N
(C) force applied is 75 N
(D) tension in the string is 25 N

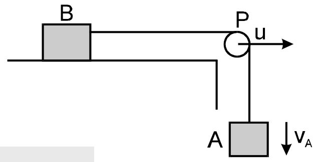
**9.** A particle is found to be at rest when seen from a frame $S_1$ and moving with a constant velocity when seen from another frame $S_2$. Markout the possible options.
(A) Both the frames are inertial
(B) Both the frames are noninertial.
(C) $S_1$ is inertial and $S_2$ is noninertial.
(D) $S_1$ is noninertial and $S_2$ is inertial.

**10.** Figure shows the displacement of a particle going along the X-axis as a function of time. Find the region where force acting on the particle is zero




(A) AB (B) BC (C) CD (D) DE

**11.** In the Figure, the pulley P moves to the right with a constant speed u. The downward speed of A is $v_A$, and the speed of B to the right is $v_B$.



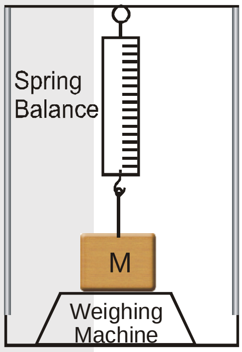

(A) $v_B = v_A$
(B) $v_B = u + v_A$
(C) $v_B + u = v_A$
(D) the two blocks have accelerations of the same magnitude

## PART - IV : COMPREHENSION

**Comprehension**

Figure shows a weighing machine kept in a lift. Lift is moving upwards with acceleration of 5 m/s$^2$. A block is kept on the weighing machine. Upper surface of block is attached with a spring balance. Reading shown by weighing machine and spring balance is 15 kg and 45 kg respectively.

Answer the following questions. Asume that the weighing machine can measure weight by having negligible deformation due to block, while the spring balance requires larger expansion: (take g = 10 m/s$^2$)



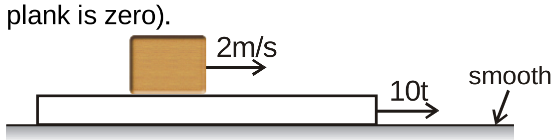

**1.** Mass of the object in kg and the normal force acting on the block due to weighing machine are :
(A) 60 kg, 450 N (B) 40 kg, 150 N (C) 80 kg, 400 N (D) 10 kg, zero

**2.** If lift is stopped and equilibrium is reached. Reading of weighing machine and spring balance will be :
(A) 40 kg, zero (B) 10 kg, 20 kg (C) 20 kg, 10 kg (D) zero, 40 kg

**3.** Find the acceleration of the lift such that the weighing machine shows true weight of block.
(A) $\frac{45}{4}$ m/s$^2$ (B) $\frac{85}{4}$ m/s$^2$ (C) $\frac{22}{4}$ m/s$^2$ (D) $\frac{60}{4}$ m/s$^2$

**Comprehension 2**

A small block of mass 1 kg starts moving with constant velocity 2 m/s on a smooth long plank of mass 10 kg which is also pulled by a horizontal force F = 10 t N where t is in seconds and F is in newtons. (the initial velocity of the plank is zero).



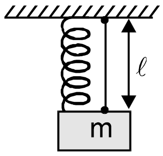

**4.** Displacement of 1 kg block with respect to plank at the instant when both have same velocity is
(A) $4\frac{4}{3}$ m (B) 4 m (C) $\frac{8}{3}$ m (D) 2 m

**5.** The time ($t \neq 0$) at which displacement of block and plank with respect to ground is same will be :
(A) 12 s (B) $2\sqrt{3}$ s (C) $3\sqrt{3}$ s (D) $\sqrt{3}/2$ s

**6.** Relative velocity of plank with respect to block when acceleration of plank is 4 m/s$^2$ will be
(A) Zero (B) 10 m/s (C) 6 m/s (D) 8 m/s

**Comprehension 3**

An object of mass m is suspended in equilibrium using a string of length $\ell$ and a spring having spring constant K (< 2 mg/$\ell$) and unstreched length $\ell$/2.




**7.** Find the tension in the string in newton ?
(A) $mg - \frac{k\ell}{2}$ (B) mg–k$\ell$ (C) $2mg - \frac{k\ell}{2}$ (D) 2mg – k$\ell$

**8.** Find the acceleration of block just after cut the string ?
(A) $2g - \frac{k\ell}{2m}$ (B) $g - \frac{k\ell}{2m}$ (C) $2g - \frac{k\ell}{m}$ (D) $g - \frac{k\ell}{m}$

**9.** What happens if K > 2 mg/$\ell$ ?
(A) at equilibrium tension in string is negative
(B) at equilibrium position change in length of spring is greater then $\frac{\ell}{2}$
(C) at equilibrium tension in string is zero.
(D) If we cut the sting, block will accelerate in upword direction.

# Exercise-3

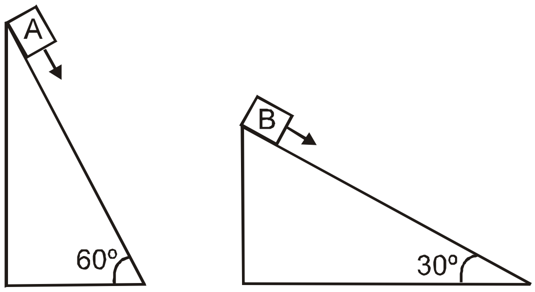
**Marked Questions can be used as Revision Questions.**
*** Marked Questions may have more than one correct option.**

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

**1.** 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) $\frac{a}{4gk}$

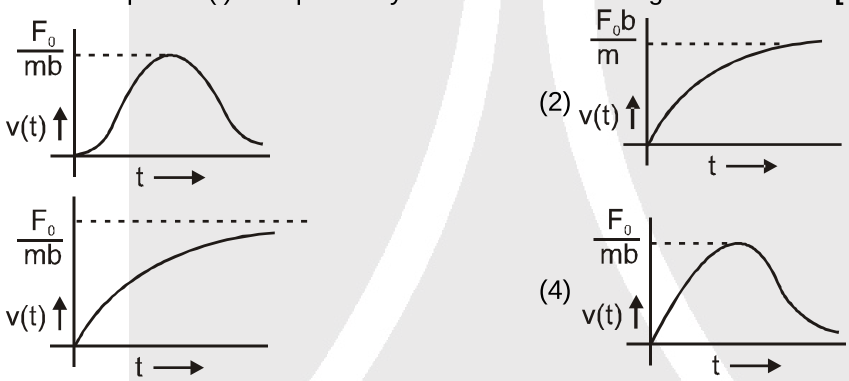
## PART - II : JEE (MAIN) / AIEEE PROBLEMS (PREVIOUS YEARS)

**1.** 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 respectively. 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

**2.** 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 v(t) is depicted by which of the following curves ? **[AIEEE 2012 ; 4/120, –1]**




**3.** A ball is thrown upward with an initial velocity $V_0$ from the surface of the earth. The motion of the ball is affected by a drag force equal to $m\gamma\upsilon^2$ (where m is mass of the ball, $\upsilon$ is its instantaneous velocity and $\gamma$ is a constant). Time taken by the ball to rise to its zenith is : **[JEE (Main) 2019 April ; 4/120, –1]**

(1) $\frac{1}{\sqrt{\gamma g}}\tan^{-1}\left(\sqrt{\frac{\gamma}{g}}V_0\right)$ (2) $\frac{1}{\sqrt{\gamma g}}\ln\left(1+\sqrt{\frac{\gamma}{g}}V_0\right)$

(3) $\frac{1}{\sqrt{\gamma g}}\sin^{-1}\left(\sqrt{\frac{\gamma}{g}}V_0\right)$ (4) $\frac{1}{\sqrt{2\gamma g}}\tan^{-1}\left(\sqrt{\frac{2\gamma}{g}}V_0\right)$

**4.** A mass of 10 kg is suspended by a rope of length 4 m, from the ceiling. A force F is applied horizontally at the mid-point of the rope such that the top half of the rope makes an angle of 45° with the vertical. Then F equals : (Take g = 10 $ms^{-2}$ and the rope to be massless)
**[JEE (Main) 2020, 07 January; 4/100, –1]**
(1) 75 N (2) 90 N (3) 100 N (4) 70 N

# Answers

## EXERCISE-1

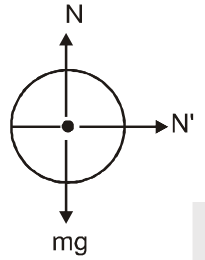
## PART - I

### Section (A)

**A-1.** Gravitational, Electromagnetic, Nuclear.

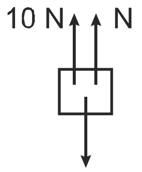
**A-2.** 20 N  **A-3.** No

**A-4.**




Vertical wall does not exert force on sphere (N' = 0).

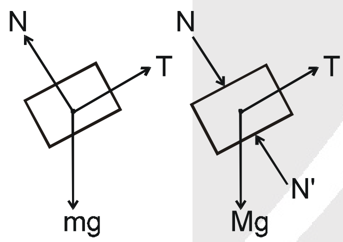
**A-5.** (i)




(N = 0).

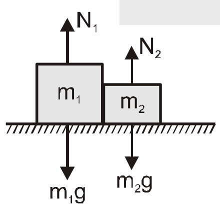
(ii) Gravitational between earth and block.

**A-6.**

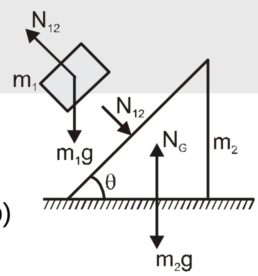



Normal reaction

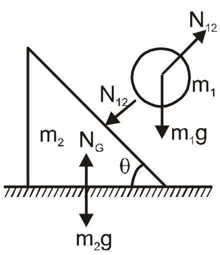
**A-7.** (a)



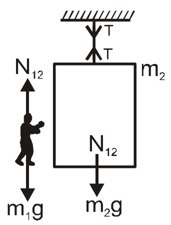

(b)



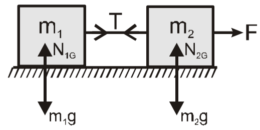

(c)



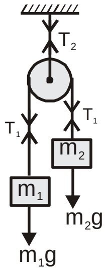

(d)



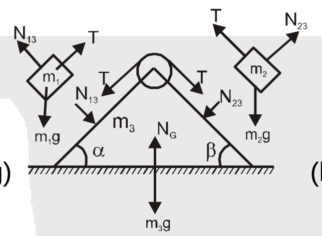

(e)



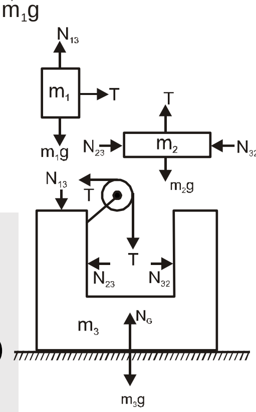

(f)



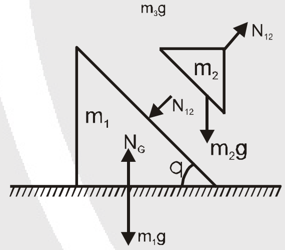

(g)




(h)



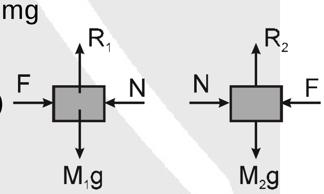

(i)




### Section (B)

**B-1.** 2 mg

**B-2.** (i)

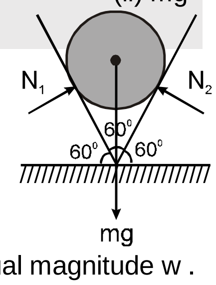



(ii) N = F

(iii) F  (iv) $m_1g$, $m_2g$.

**B-3.** (i) zero  (ii) mg

**B-4.** (a)




(b) equal magnitude w .

**B-5.** $N_A = \dfrac{1000}{\sqrt{3}}$ N, $N_B = \dfrac{500}{\sqrt{3}}$ N

**B-6.** $N_{45} = \dfrac{50\sqrt{2}}{\sqrt{3}-1} = 96.59$ N; $N_{30} = \dfrac{100}{\sqrt{3}-1} = 136.6$ N

## Section (C)

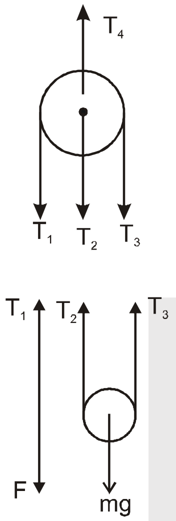
**C-1.** (a) 10 N, (b) 10 N, (c) 10 N.

**C-2.** (a) 10 N (b) 15 N (c) 20 N

**C-3.** $T_1 = 5N$, $T_2 = 2N$

**C-4.** (a) $\frac{2g}{3} = 6.7$ m (b) 40 N (c) 80 N

**C-5.** (a)




(b) $T_1 = T_2 = T_3 = \frac{Mg}{2}$, $T_5 = Mg$ and $T_4 = \frac{3Mg}{2}$

(c) $F = \frac{Mg}{2}$

## Section (D)

**D-1.** $\frac{\cos\theta_2}{\cos\theta_1}$

**D-2.** 2u

**D-3.** $V_B = 3\,V_A = 1.8$ m/s in downward direction.

**D-4.** $a_A = \frac{9g}{25}$, $a_B = \frac{12g}{25}$

**D-5.** $V_{P_1} = 5$ m/s downward

$V_C = 25$ m/s upward

**D-6.** $b\,\hat{i} + b\,\hat{j}$

## Section (E)

**E-1.** (a) $|\vec{F}_1| = |\vec{F}_2| = 30\sqrt{2}$ N (b) $W = 30\sqrt{2}$ N

**E-2.** $|F| = \sqrt{(30)^2 + (108)^2} = 112.08$ N

**E-3.** $\frac{m_1 g}{2(m_1 + m_2)}$

**E-4** (a) 4.8 N, 3.6 N, 2.4N, 1.2 N

(b) F = 6 N (c) 0.2 N

**E-5.** 6.5 m/s

**E-6.** (a) 2g/3 (b) 3g/4

**E-7.** (a) $m_B = 10$ kg (b) $m_B = 10$ kg

## Section (F)

**F-1.** (i) 600 N, (ii) 600 N, (iii) 600 N, (iv), 720 N, (v) 480 N, (vi) 720 N, (vii) 720 N, (viii) 480 N

**F-2.** (i) 100 N, (ii) 100 N, (iii) 100 N, (iv) 120 N, (v) 80 N, (vi) 120 N, (vii) 120 N, (viii) 80 N.

**F-3.** **(a) 3 g$\downarrow$, 0, 0,** **(b) 0, g $\uparrow$, g $\downarrow$**

## Section (G)

**G-1.** $\frac{15}{4}$ m/s$^2$, opposite direction.

**G-2.** $a = \frac{4F}{M+m} - g$.

**G-3.** 322 N

## Section (H)

**H-1.** F = 0

**H-2.** $(g + a)\sin\theta$

# PART - II

## Section (A)

**A-1.** (C) **A-2.** (B)

## Section (B)

**B-1.** (B) **B-2.** (C)

## Section (C)

**C-1.** (B) **C-2.** (D) **C-3.** (C)

**C-4.** (C) **C-5.** (C)

## Section (D)

**D-1.** (B) **D-2.** (C) **D-3.** (D)

**D-4.** (B) **D-5.** (D) **D-6.** (A)

## Section (E)

**E-1.** (D) **E-2.** (C) **E-3.** (B)

**E-4.** (C) **E-5.** (C) **E-6.** (C)

**E-7.** (D) **E-8.** (C) **E-9.** (B)

**E-10.** (D) **E-11.** (C)

## Section (F)

**F-1.** (A) **F-2.** (D) **F-3.** (C)

**F-4.** (D) **F-5.** (B)

## Section (G)

**G-1.** (B) **G-2.** (A)

## Section (H)

**H-1.** (C) **H-2.** (C) **H-3.** (C)

## PART - III

**1.** (A) q (B) r (C) q (D) r
**2.** (A) ps,(B) qr , (C) ps, (D) qr
**3.** (A) r (B) p (C) s (D) q

# EXERCISE-2

## PART - I

| | | | | | |
|---|---|---|---|---|---|
| **1.** | (C) | **2.** | (C) | **3.** | (D) |
| **4.** | (A) | **5.** | (A) | **6.** | (B) |
| **7.** | (A) | **8.** | (B) | **9.** | (D) |
| **10.** | (C) | **11.** | (A) | **12.** | (C) |
| **13.** | (B) | **14.** | (C) | **15.** | (D) |
| **16.** | (D) | | | | |

## PART - II

| | | | | | |
|---|---|---|---|---|---|
| **1.** | 5 | **2.** | 6 | **3.** | 3 |
| **4.** | 4 | **5.** | 1 | **6.** | 17 |
| **7.** | 60 | **8.** | 23 | **9.** | 6 |
| **10.** | 2 | **11.** | 40 | | |

## PART - III

| | | | | | |
|---|---|---|---|---|---|
| **1.** | (A) (C) | **2.** | (A)(B)(C) | **3.** | (A)(C) |
| **4.** | (A) (B) (D) | **5.** | (B)(C) | | |
| **6.** | (A)(B)(C)(D) | **7.** | (C) (D) | **8.** | (C)(D) |
| **9.** | (A)(B) | **10.** | (B) (D) | **11.** | (B) (D) |

## PART - IV

| | | | | | |
|---|---|---|---|---|---|
| **1.** | (B) | **2.** | (D) | **3.** | (A) |
| **4.** | (C) | **5.** | (B) | **6.** | (C) |
| **7.** | (A) | **8.** | (B) | **9.** | (C) |

# EXERCISE - 3

## PART - I

**1.** (B)

## PART - II

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