PHYSICS

AAKASH INSTITUTE ENGLISH

LAWS OF MOTION

EXAMPLES

1. Explain why a bullet fired against a glass windowpane makes a hole in it but the glass pane is not cracked.

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2. A moving bicycle comes to rest after sometime if we stop pedalling it. But Newton's first law of motion that a moving body should continue to move for ever, unless some external force acts on it. How do you explain the bicycle case?

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3. Why is it advised to tie any luggage kept on the roof of a bus with a rope?

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4. A body of mass 5 kg starts from the origin with an intial with an intial velocity $\overrightarrow{u} = 30\hat{i} + 40\hat{j}$. . If the body collides with a wall and after collision its velocity becomes $\overrightarrow{v} = -30\hat{i} + 40\hat{j}$, then what is change in momentum of body ?

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5. Let us consider two forces F_1 and F_2 acting on body of mass 2 kg as shown in the figure $F_1 = 10N$, $F_2 = 2N$, what will be the accelaration ?

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6. A bus starts from rest and moves down a hill with constant acceleration. The bus travels a

distance of 400 m in 10 second. If mass of the bus is 5 metric tonne, then what will be its acceleration and force acting on it? (1 metric tonne = 1000 kg)

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7. A block of mass 5 kg is moving with a speed of 8 m/s. A force of 10 N is applied on it for 3 s . Find the final speed of the block if the force is applied (i) along the motion , (ii) opposite to the motion and (iii) normal to the initial direction of motion of the block.

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8. A stone of mass 1 kg is thrown with a velocity of 20 m/s across the frozen surface of a take and it comes to rest after travelling a distance of 50 m . What is the magnitude of the force opposing the motion of the stone ?

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9. A rubber ball of mass 0.4 kg hits the ground at same angle without any change in speed . If the speed of ball is 1 m/s and the period of contact between the ball and floor is 0.4 s, find the average force exerted by the ball on the ground .

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10. A man is at rest in the middle of apond on perfectly smooth ice. He can get himself to the shore by making use of Newton's

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11. Aktar, Karan and Rahul were riding in a motor car that was moving with a high velocity on an express highway when an insect hils the windshield and got stuck on the wind-screen. Aktar and Karan started pondering over the situation. Karan suggested that the insect suffered a greater change in momentum as compared to the change in momentum of the motor car (because the change in the velocity of the insect was much more than that of motor car). Aktar said that since the motor car was moving with a larger velocity, it exerted a larger force on the insect and as a result the insect died. Rahul while putting an entirely new explanation said that both the motor car and the insect experienced the same force and a change in their momentum. Comment on these suggestions.

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12. A bullet of mass 50 g is fired from a gun with initial velocity of 35 m/s . If mass of the gun is 4 kg , then calculate the recoil velocity of the gun .

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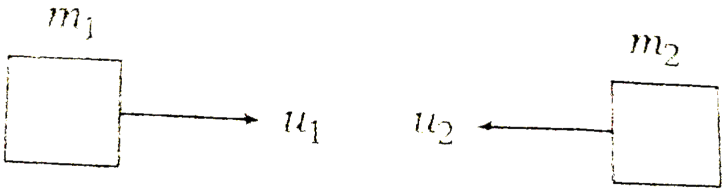
13. Two objects each of mass 5 kg are moving in the same straight line but in the opposite direction towards each other with some speed of 3 m/s. They stick to each other after collision. What will be the velocity of the combined object after collision?



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14. Find the tension in the horizontal string PQ and the string QR in the given figure [Take g = $10m / s^2$]

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15. A wooden block of mass 1 kg rests on a soft horizontal floor. When an iron cylinder of mass 20kg is placed on top of the block, the floor yields steadily and booth go down with an acceleration of $0.1ms^{-2}$. What is the action of the block on the floor (a) before and (b) after the floor yields? (Take $g = 10ms^{-2}$). Identify the action and reaction pairs in the problem.

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16. Two masses 2 kg and 4 kg are connected at two ends of light inextensible string passing over a frictionless pulley . If the masses are released , then find the accelaration of the masses and the tension in the string .

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17. A wooden block of mass $0 \cdot 8$ kg is dragged along a level frictionless surface by a hanging

block of mass $0 \cdot 2$ kg as shown in the figure . Calculate the tension in the string and the acceleration of blocks .

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18. A 1000 kg engine pulls a train of 4 wagons each of 2500 kg along a horizontal railway track. If the engine exerts a force of 50000 N on wagons and track offers force of friction 10000 N, then calculate

(i) The net accelerating force

(ii) The acceleration of the train

(iii) The force of wagon-1 on wagon-2

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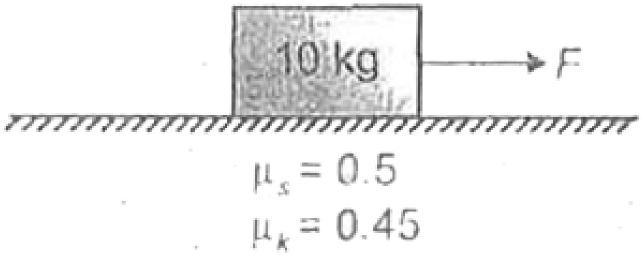
19. A body of mass 10 kg is kept on a horizontal floor of coefficient of static friction $\mu_s = 0.5$ and coefficient of kinetic friction $\mu_k = 0.45$ as shown in figure.



$\mu_s = 0.5$

$\mu_k = 0.45$

Find the acceleration, force of friction and contact force on the body by the plane when the driving force is $(g = 10m/s^2)$

(i) 40 N

(ii) 60 N

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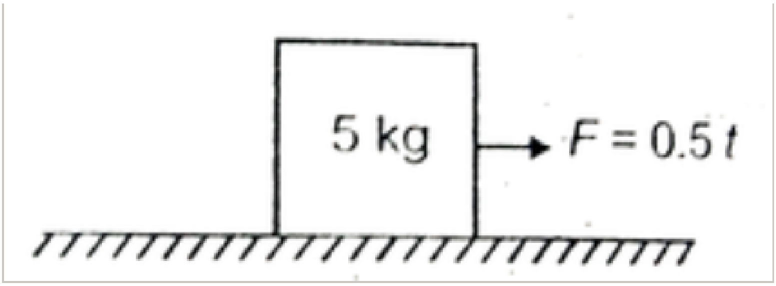
20. A block of mass 5 kg is kept on a rough horizontal surface. The coefficient of friction for the contact force block and surface are $\mu_s = 0 \cdot 1$ and $\mu_k = 0 \cdot 9$ respectively . A horizontal force F given by F $0 \cdot 5t$ is applied at t = 0 . Here t represent time in seconds . Determine the force of friction and acceleration of the block at



(i) t = 1s (ii) t= 10 s (iii) t = 12 s

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21. A block of mass 5 kg rests on a inclined plane at an angle of 30° with the horizontal. If the block just begins to slide, then what is the coefficient of static friction between the block and the surface?

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22. A block of mass 8 kg is sliding on a surface inclined at an angle of 45° with the horizontal

. Calculate the acceleration of the block . The coefficient of friction between the block and surface is $0 \cdot 6$ (Take g = $10m / s^2$)

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23. Find the maximum speed with which a car can turn on a bend without skidding, if radius of bend is 20 m and coefficient of friction between the road and the tyres is $0 \cdot 4$

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24. A circular racetrack of radius 100 m is banked at an angle of 45°. What is the

(i) Optimum speed of race car to avoid wear and tear of its tyres?

(ii) Maximum permissible speed to avoid slipping if the coefficient of friction is 0.2?

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25. A cyclist speeding at 4.5km h^{-1} on a level road takes a sharp circular turn of radius 3 m without reducing the speed The coefficient of static friction between the road and the tyres is 0.1 will the cyclist slip while taking the turn (i) with a speed of $4.5 \mathrm{km\,h}^{-1}$ and (ii) with a speed of $9kmk^{-1}$?

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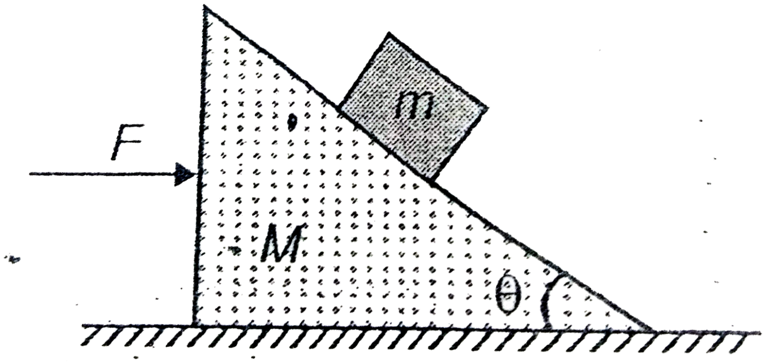
26. A block of mass m is placed on a wedge of mass M and a force F is acting on its as shown . If all surfaces are smooth , find the force F such that, there is no relative motion between m and M.



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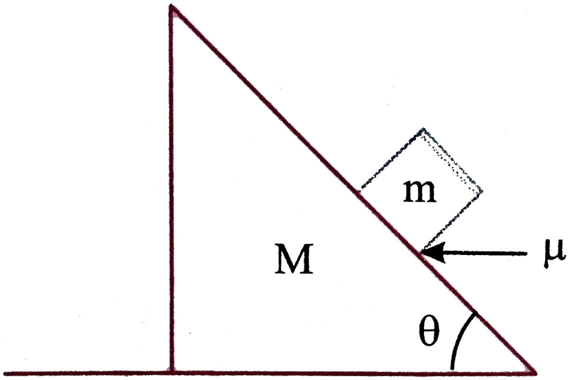
27. Calculate angle of friction between wedge and block system is at rest M coefficient of friction between wedge and block.



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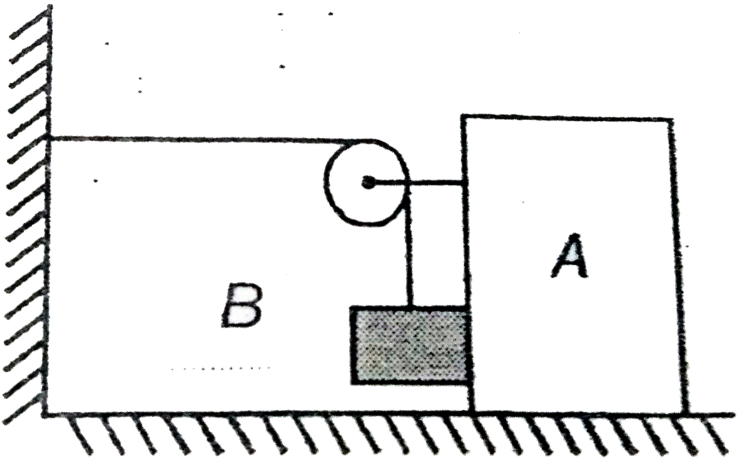
28. A 5 kg block B is suspended from a cord attached to a 40 kg cart A . Find the accelerations of both the block and cart . (All surfaces are frictionles) (g = $10m / s^2$)



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29. In the pulley-block arrangement shown in figure , find the relation between acceleration of blocks A and B

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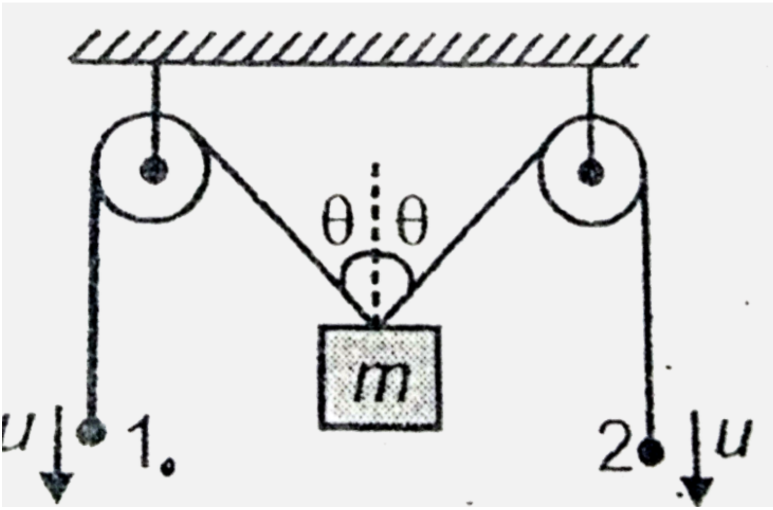
30. In the arrangement shown in figure if speed of point 1 and point 2 are u, then what is the velocity of block at given instant of time.



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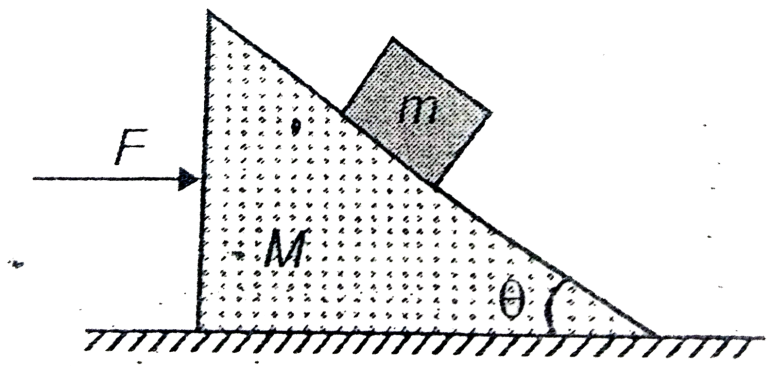
31. A block of mass m is placed on a wedge of mass M and a force F is acting on its as shown . If all surfaces are smooth , find the force F such that, there is no relative motion between m and M.



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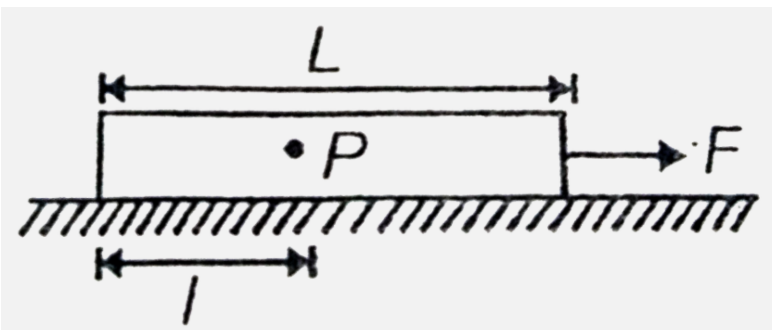
32. Figure shows a rope of variable mass whose linear mass density is given by , $\lambda = Ax$, where A is + ve constant and x is distance from left end . It bis placed on a smooth horizontal surface . A force F is acting on it as shown .

(i) Find total mass of the rope .

(ii) Find tension at point P.



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33. A light rope is passed over a pulley such that at its one end a block is attached , and on the other end a boy is climbing up with acceleration $\frac{g}{2}$ relative to rope. Mass of the block is 30 kg and that of the boy is 40 kg. Find the tension and acceleration of the rope .

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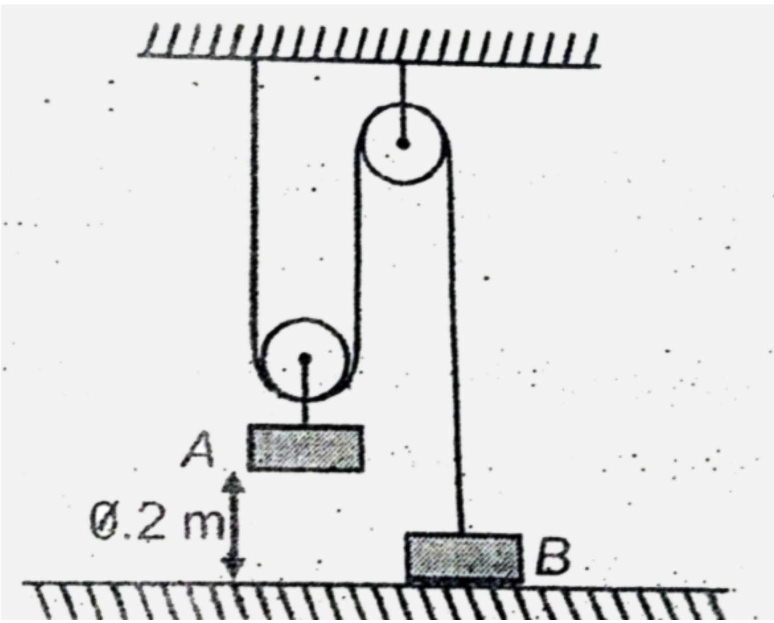
34. In the arrangment shown in figure , the mass of the body A is 4 m and that of body B is m . The height $h = 0 \cdot 2$ m . If the body B is released , then till what maximum height the body B will go up ? (g = $10m/s^2$)



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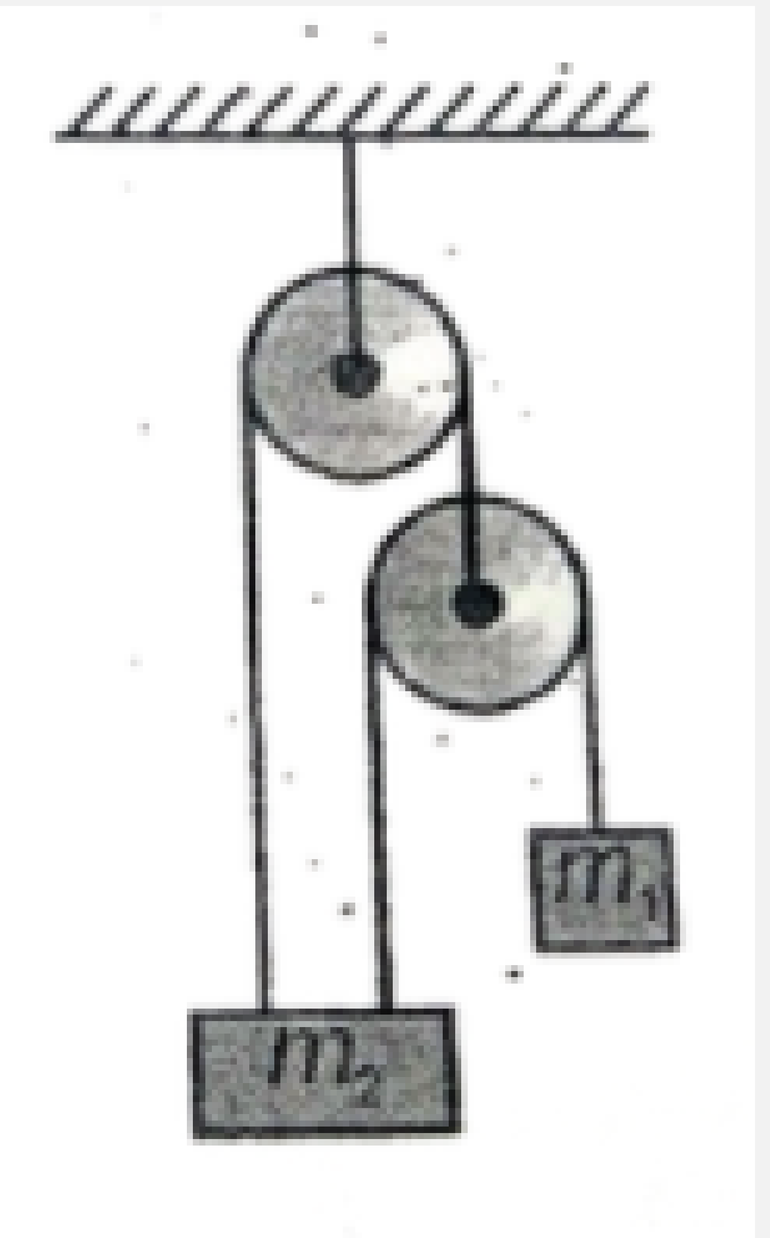
35. In the given diagram , find the relation between acceleration of blocks m_1 and m_2 . (

m_2 remains horizontal).



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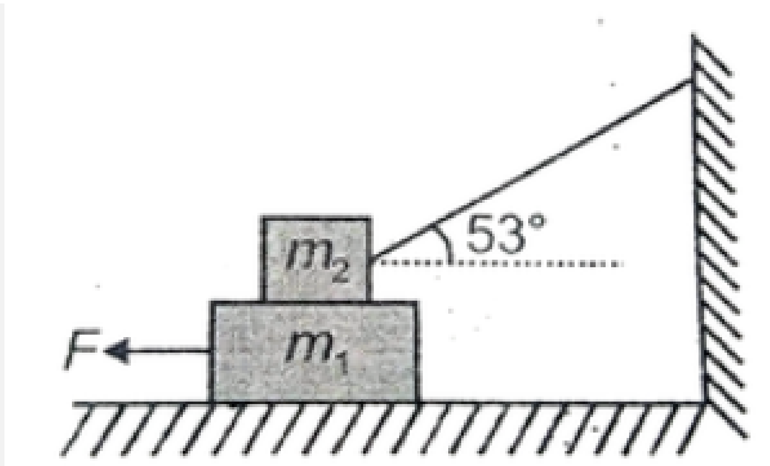
36. Calculate the Force (F) required to cause the block of mass $m_1 = 20kg$ just to slide under the block of mass $m_2 = 10kg$ [coefficient of friction $\mu = 0 \cdot 25$ for all surfaces]



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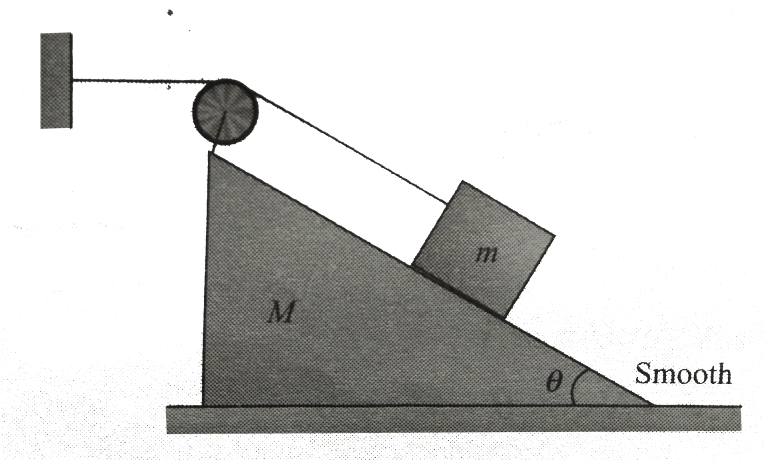
37. A mass m_1 kept by a light cord passing over a light frictionless pulley to another block mass m_2 as shown in figure . A force of magnitude F, at an angle θ with the horizontal , is applied to m_1 as shown . The coefficient of kinetic friction between m_1 and the surface is μ . Determine the magnitude of acceleration of the masses and the tension in the cord . (The forceb is sufficient to cause motion)

38. The mass of wedge, shown in figure is M and that of the block is m. Neglecting friction at all the places and mass of the pulley. Calculate the acceleration of wedge. Thread is inextensible.



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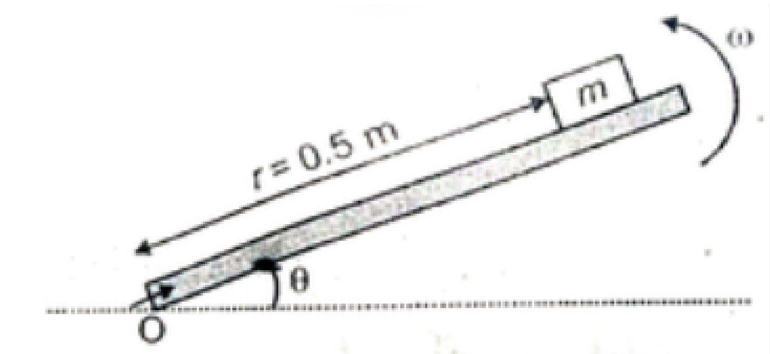
39. A wooden plank OA rotates in vertical plane about horizontal axis through O with a constant angular velocity $\omega = 3\text{rad/s}$. As it passes the position $\theta = 0$, a small mass m is placed upon it at a radial distance $r = 0 \cdot 5$ m . If the mass m starts sliding at $\theta = 37^\circ$, find the coefficient of friction between mass and the plane .



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40. A car starts from rest on a horizontal circular road of radius 190 m and gains speed at a uniform rate $1.2 m / s^2$. The coefficient of static friction between the road and the tyres is 0.37 . Calculate the distance travelled by the car before it begins to skid.

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Illustration

1. Consider an object of mass m moving in free space with velocity given by $\vec{v} = v_0 \cos \omega t \hat{i} + v_0 \sin \omega t \hat{j}$. Here v_0 and ω are constants and t represents time. calculate force acting on object and angle between force and momentum.

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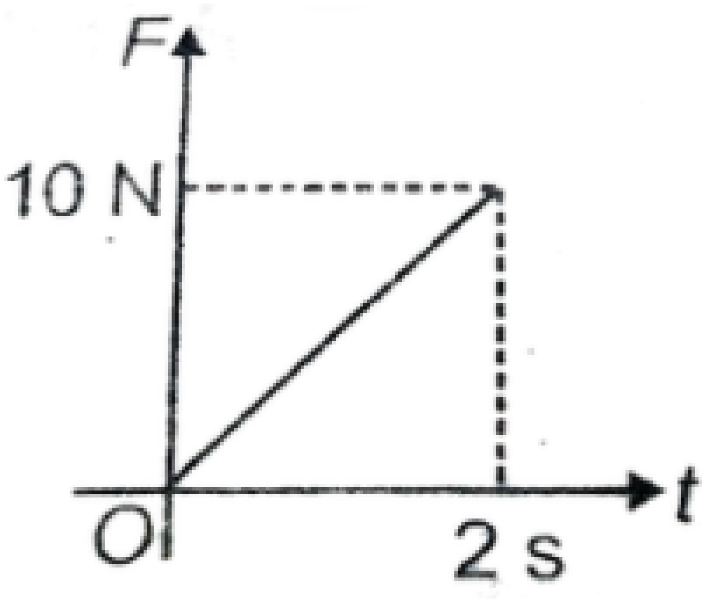
2. A variable force acts on a body of mass 2 kg intially at rest as shown in figure . Calculate the impulse of the force in first 2 seconds and speed of the body after 2 seconds .



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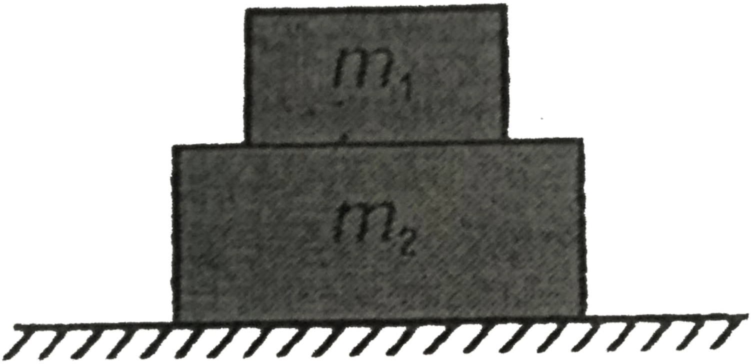
3. A two block system is shown in figure . We shall draw complete free body diagram and find normal reaction between m_1 and m_2 and

between m_2 and ground .



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4. Two blocks of masses m_1 and $m_2(m_1 > m_2)$ connected by a massless string passing over a frictionless pulley Magnitude of acceleration of blocks would be

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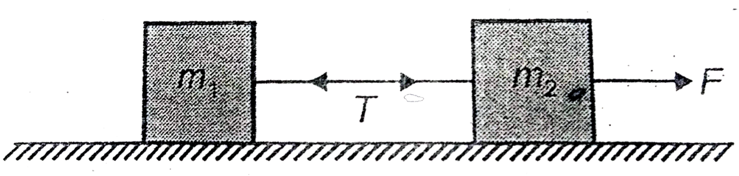
5. Two block of masses m_1 and m_2 are lying on a frictionless horizontal table connected by a light string m_2 is pulled by horizontal force F. Calculate the tension in the string .



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6.

$$NH_4Cl + (A) \longrightarrow \text{Microcosmic salt} \xrightarrow{\text{Heat}} (B) \xrightarrow[+\ MnO]{\text{Heat}} \underset{\text{Violet bead}}{(C)}$$

(A), (B) and (C) respectively are

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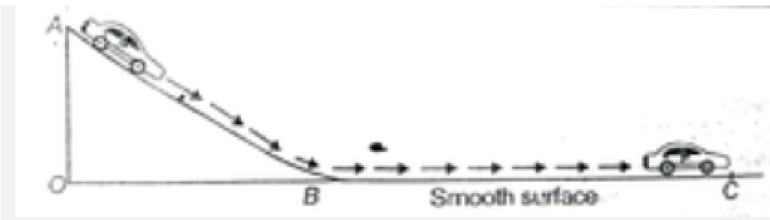
7.

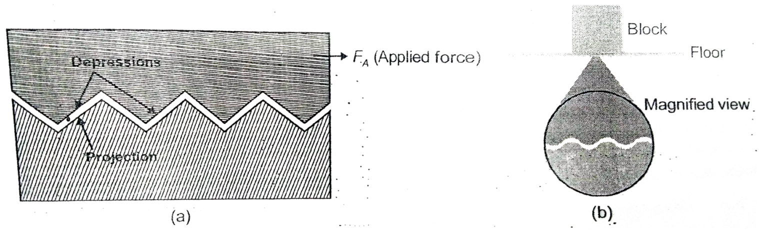


Now when the surface is smooth , the toy car travels larger distance.

It is found that friction is caused by

interlocking of irregularities on the two surfaces in contact .

Irregularities between two surfaces in contact.



The above figure shows minute irregularities on two surfaces which are locked into one another . If we want to move any surface , some part of the external force applied is used to overcome this interlocking want to maove any surface , some part of the external force applied is used to overcome this interlocking .

A rough surface has a large number of irregularities , so the force of friction is greater .

A smooth surface has small number of irregularities , so the force of friction is less.

2. Normal reaction : The force of friction depends on the normal reaction also. As the normal reaction increases , the interlocking between two surfaces in contact increases as they press harder against each other and hence friction increases .

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TRY YOURSELF

1. Which of the following has more inertia: (a) a rubber ball and a stone of the same size? (b) a bicycle and a train? (c) a fiverupees coin and a one-rupee coin?

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2. An astronaut accidentally gets separated out llf his small spaceship accelerating in interstellar space at a constant rate of $100 ms^2$

.What is the acceleration of the astronaut the instant after he is outside the spaceship? (Assume that there are no nearby stars to exert gravitational force on him)

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3. Why does the horse rider fall forward when a horse at full gallop stops suddenly ?

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4. Why does the horse rider falls falls forward when a horse at full gallop stops suddenly ?

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5. Give reason for the statement that "The rotating wheels of any vehicle throw out mud, if any tangentially".

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6. Can a body remain at rest position when external forces are acting on it?

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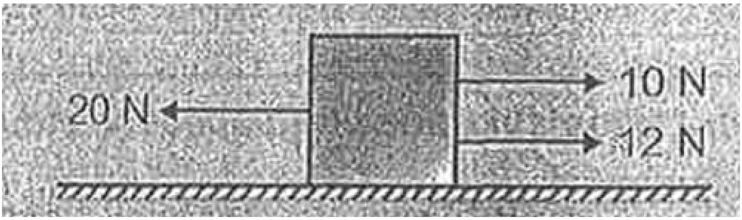
7. What will be the net acceleration of a given block of mass 2kg kept on a smooth surface?



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8. A car of mass 800 kg is moving with a constant velocity 40 km/h . Find the net force on it.

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9. How much force is required to stop a bus (in 10 seconds) of mass 5000 kg moving with a speed of 72 km/h?

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10. A constant force of 5 N can produce an acceleration of 1 m/s^2 on the body of mass m_1 and $2m/s^2$ on the body of mass m_2 . If both the masses are tied together and same force is applied then what will be the acceleration of the system ?

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11. A car weighing 1600 kg moving with a velocity of 30 m/s retards uniformly coming to rest in 2 seconds . Calculate the

(i) Initial and final momentum of the car

(ii) Rate of change of momentum of the car .

(iii) Acceleration of the car .

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12. Walking becomes difficult, When the ground is covered with snow or sand this is because

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13. If a man jumps out from a boat, the boat moves backwards. Why?

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14. A cannon of mass 100 kg is kept on a frictionless floor. If a cannon ball of mass 1 kg is fired from it with a speed of 200 m/s. With what velocity the cannon will move ?

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15. Why does the heavier guns are preffered over lighter ones ?

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16. A bomb of mass 12 kg explodes into two piece of masess 4 kg and 8kg . The velocity of mass 4 kg is 20 m/s . Find the velocity of mass 8 kg

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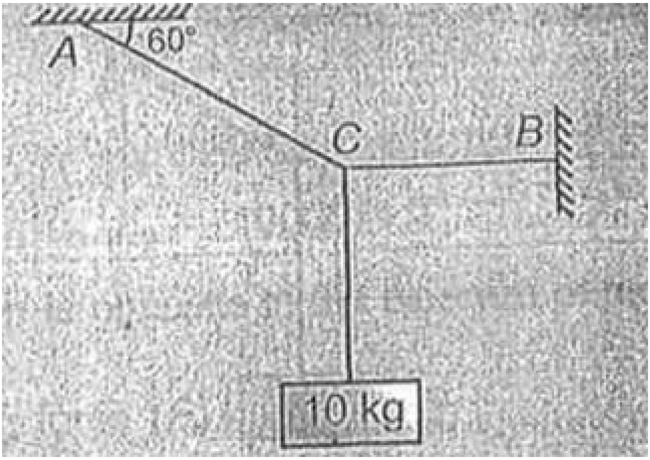
17. A girl of mass 25 kg running with a speed of $1 \cdot 5 \frac{m}{s}$ jumps on a skateboard of mass 2 kg kept on a surface . What will be their combined velocity ?

18. Find the tension in the strings AC and BC shown in figure.



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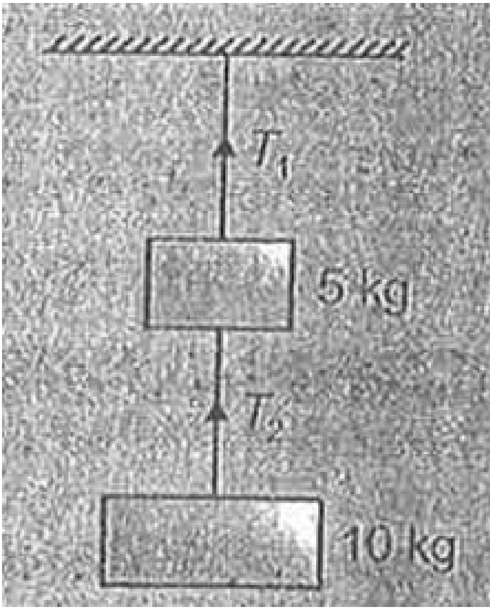
19. Find T_1 and T_2 in the given figure.



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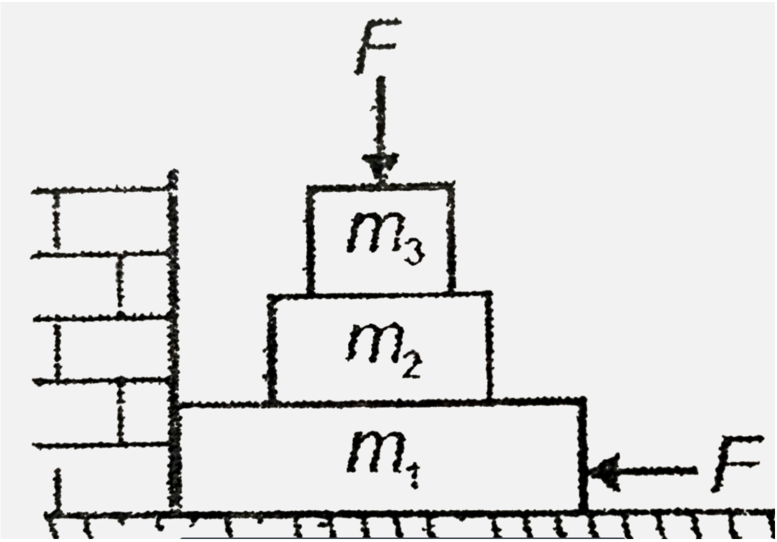
20. Draw the free body diagram of following system :



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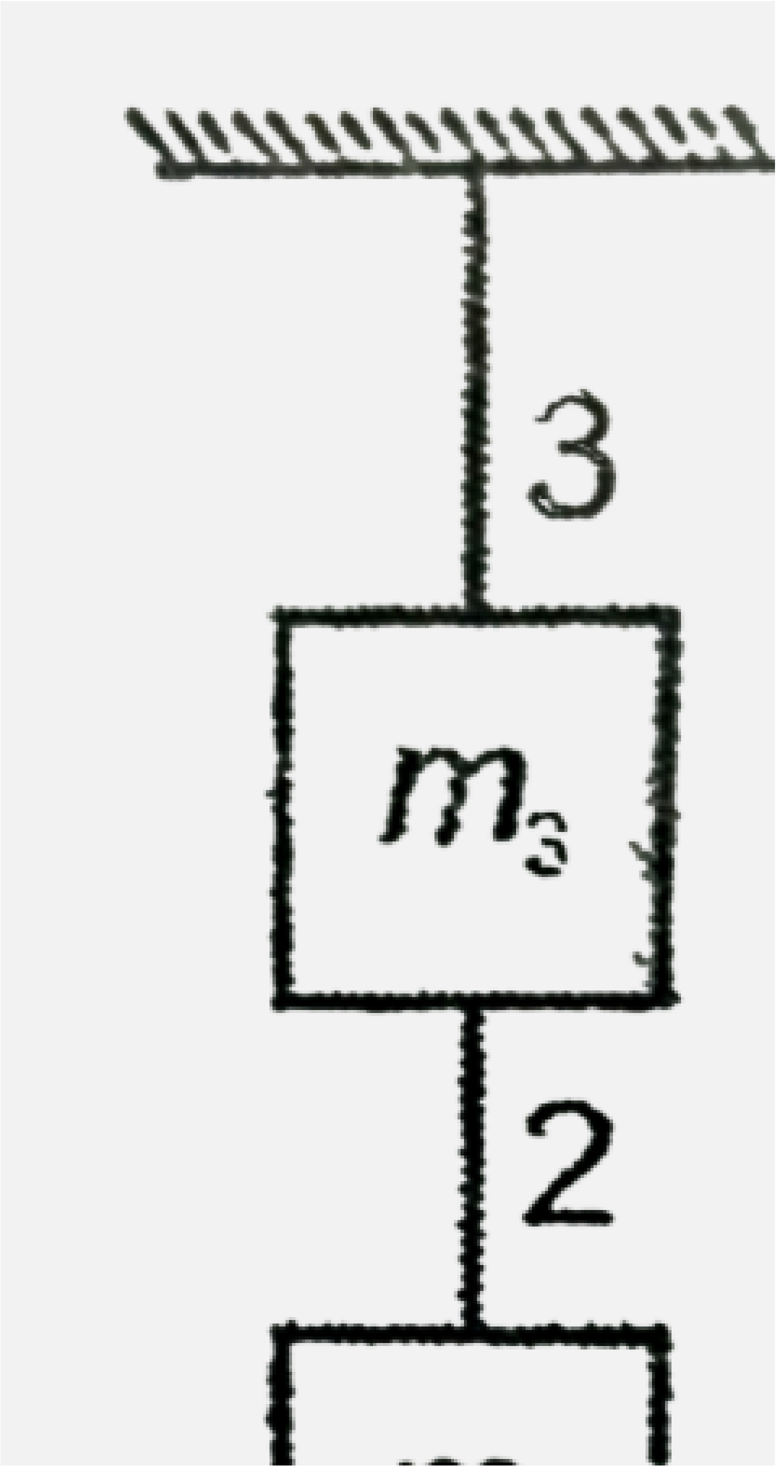
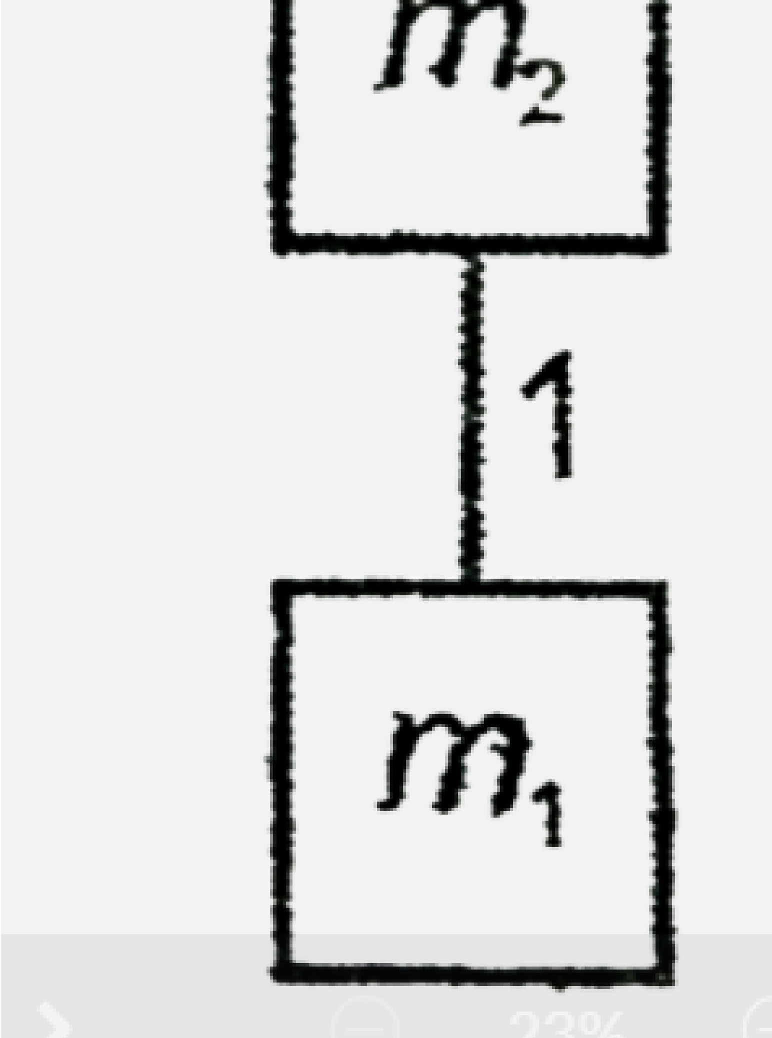
21. Figure shows a three blocks are connected by strings. Its free body diagrams and find forces of interaction





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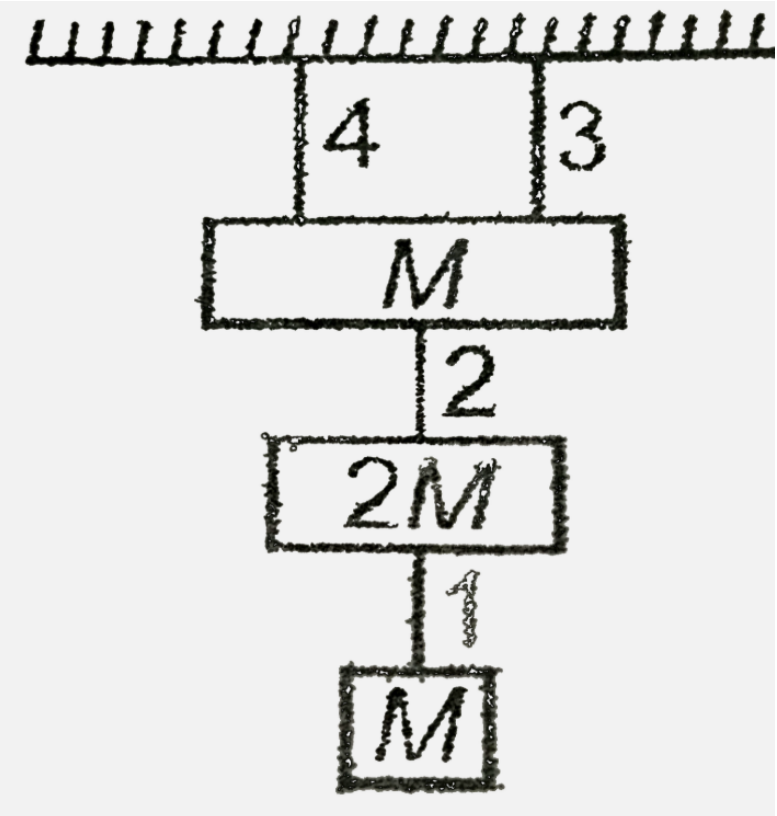
22. Draw the free body diagram of following also find the tension in each string



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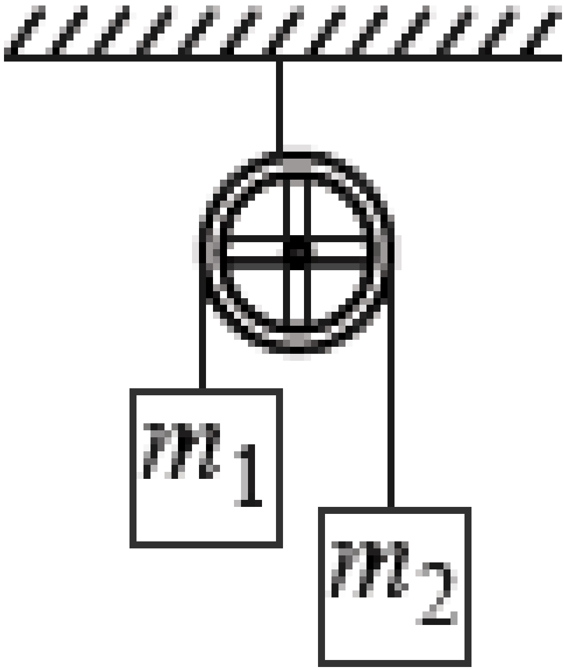
23. Two masses m_1 and $m_2 (m_2 > m_1)$ are hanging vertically over frictionless pulley. The acceleration of the two masses is :



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24. Two blocks of masses 2 kg and 4 kg tied to a string passing over a frictionless pulley. What will be the magnitude of acceleration of the masses, when they are allowed to move freely?

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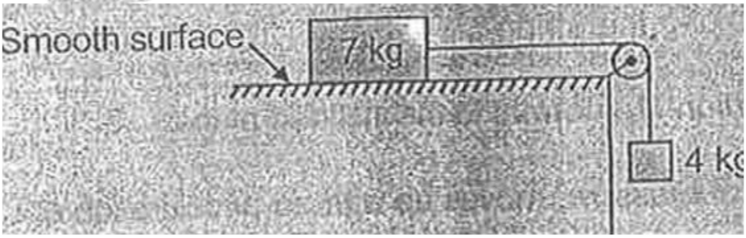
25. In the given figure, what will be acceleration of block of mass 7 kg?



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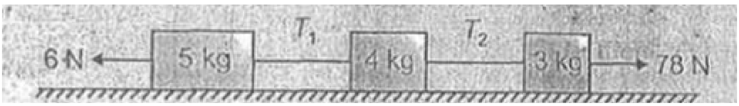
26. What will be the tension T_1 and T_2 in the given figure?



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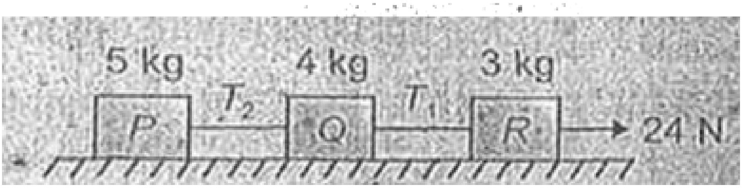
27. Three blocks, P, Q and R of masses 5 kg, 4 kg and 3 kg respectively are connected by a light inextensible string and they are moved on a smooth horizontal plane. If a force of 24 N is applied to the string connected to R, tensions T_1 and T_2 in the string are



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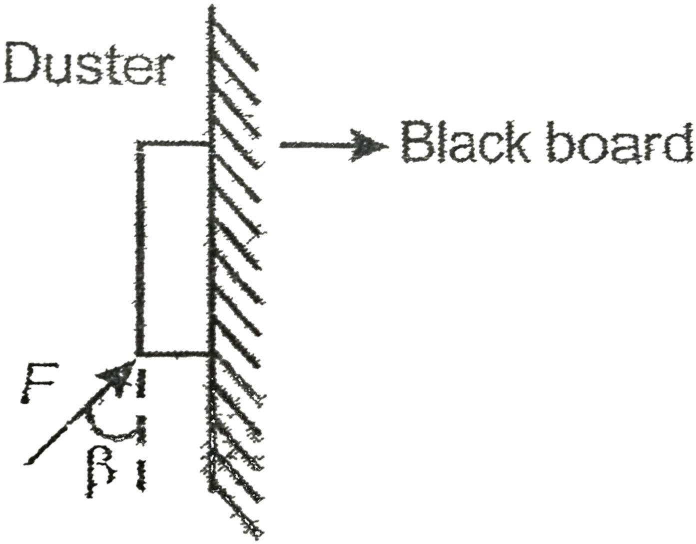
28. A student is cleansing a black board by moving a light duster up and down on it as shown . The coefficient of static friction between the duster and the board is μ_s



The duster will not move no matter how large the force is if

(1) $\tan \beta > \mu_s$ (2) $\tan \beta < \mu_s$

(3) $\tan \beta > \frac{1}{\mu_s}$ (4)$\tan \beta < \frac{1}{\mu_s}$

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29. A stone of weight W is thrown straight up from the ground with an intial speed V0. If a drag force of constant magnitude f acts - on the same through out its flight , the speed of stone just before reaching the ground is

(1) $V0\sqrt{\frac{W-f}{W}}$ (2) $V0\sqrt{\frac{W+f}{f}}$

(3)$V0\sqrt{\frac{W+f}{W-f}}$ (4) $V0\sqrt{\frac{W-f}{W+f}}$

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30. Determine the maximum acceleration of the truck in which a box lying on the floor of its back will remain stationary, given that the coefficient of static friction between the box and truck's floor is 0.2.

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31. Why is it difficult to climb up a greasy pole ?

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32. STATEMENT -1 : Friction always opposes motion .

STATEMENT - 2 : Lesser the friction on a surface it is easier to walk on it.

STATEMENT -3 : Soles of shoes gets flat due to friction .

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33. A ball rolled on ice with a velocity of 14 ms^{-1} comes to rest after travelling 40 m . Find the coefficient of friction . (Given $g = 9.8m/s^2$

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34. An aircraft executes a horizontal loop at a speed of 540 km/h with its wings banked at 45°. What is the radius of the loop?

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35. A curved road of diameter $1 \cdot 8$ km is banked so that no friction is required at a speed of 30 ms^{-1}. What is the banking angle ?

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36. Which of the following bodies have more inertia?

(i) A metal ball and a rubber ball of the same size.

(b) A car and a bus.

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37. An astronaut accidentally gets separateed out of his small spaceship accelerating in inter-stellar space at a constant rate of $50ms^{-2}$. What is the acceleration of the astronaut the instant after he is outside the spaceship? (Assume that there are no nearby stars to exert gravitational force on him.)

Watch Video Solution

38. Why does an athlete run some distance, before taking a long jump?

Watch Video Solution

39. Why does the horse rider falls forward when a horse at full gallop stops suddenly?

Watch Video Solution

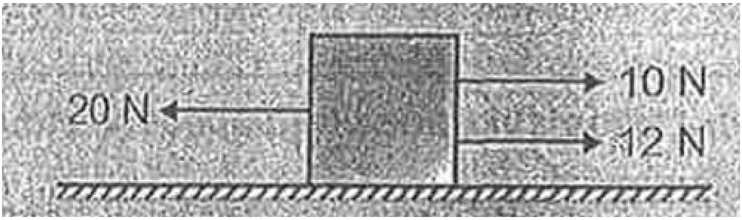
40. Give reason for the statement that "The rotating wheels of any vehicle throw out mud, if any tangentially".

Watch Video Solution

41. Can a body remain at rest position when external forces are acting on it?

Watch Video Solution

42. What will be the net acceleration of a given block of mass 2kg kept on a smooth surface?



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43. A car of mass 800 kg is moving with a constant velocity 40 km/h. Find the net force on it.

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44. How much force is required to stop a bus (in 10 seconds) of mass 5000 kg moving with a speed of 72 km/h?

Watch Video Solution

45. A constant force of 5 N can produce an acceleration of 1 m/s^2 on the body of mass m_1 and $2m/s^2$ on the body of mass m_2. If both the masses are tied together and same force is applied then what will be the acceleration of the system ?

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46. A car weighing 1600 kg moving with a velocity of 30 m/s retards uniformly coming to rest in 2 seconds . Calculate the

(i) Initial and final momentum of the car

(ii) Rate of change of momentum of the car .

(iii) Acceleration of the car .

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47. A particle of mass m moves with constant speed v on a circular path of radius r. Find magnitude of average force on it in half revolution.

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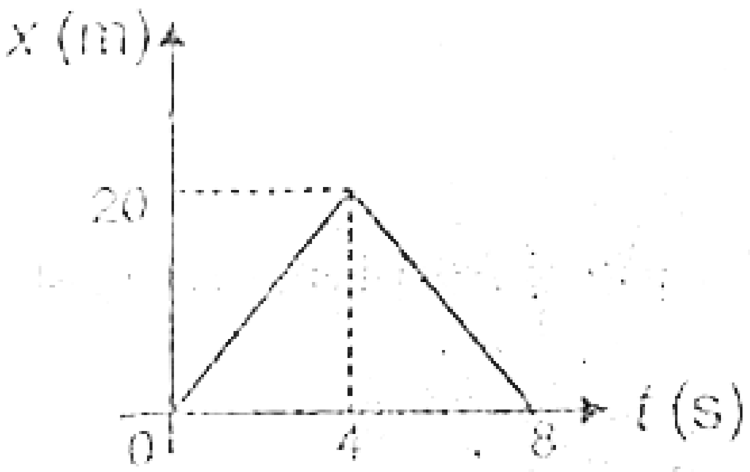
48. On an object of mass 1 kg moving along x-axis with constant speed 8 m/s, a constant force 2 N is applied in positive y-direction. Find its speed after 4 seconds.

Watch Video Solution

49. The position (X)-time (t) graph for a particle of mass 1 kg moving along x-axis is shown in figure. Find impulse on particle at t = 4 s.



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50. A ball of mass 1 kg is dropped from 20 m height on ground and it rebounds to height 5m. Find magnitude of change in momentum during its collision with the ground. (Take $g = 10m/s^2$)

Watch Video Solution

51. Why is it difficult to walk on sand?

Watch Video Solution

52. Give reason for the fact that " when a man jumps out from a boat , the boat moves backward ".

Watch Video Solution

53. A cannon of mass 100 kg is kept on a frictionless floor. If a cannon ball of mass 1 kg is fired from it with a speed of 200 m/s. With what velocity the cannon will move ?

Watch Video Solution

54. Why does the heavier guns are preffered over lighter ones ?

Watch Video Solution

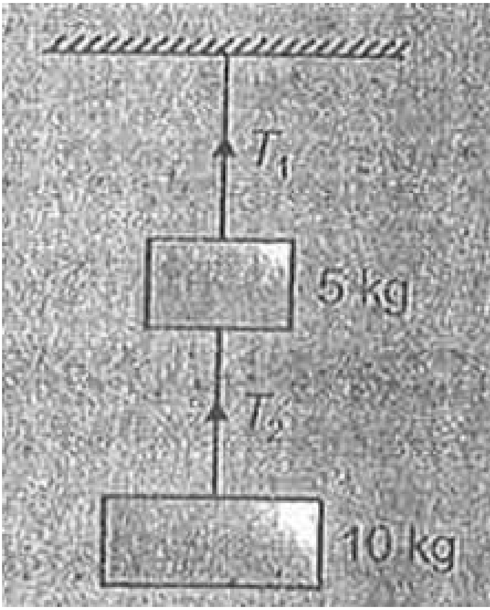
55. A bomb of mass 12 kg explodes into two pieces of masses 4 kg and 8 kg. The velocity of mass 4 kg is 20 m/s. Find the velocity of mass 8 kg.

Watch Video Solution

56. A girl of mass 25 kg running with a speed of 1.5 m/s jumps on a skateboard of mass 2 kg kept on a smooth surface. What will be their combined velocity?

Watch Video Solution

57. Find T_1 and T_2 in the given figure.



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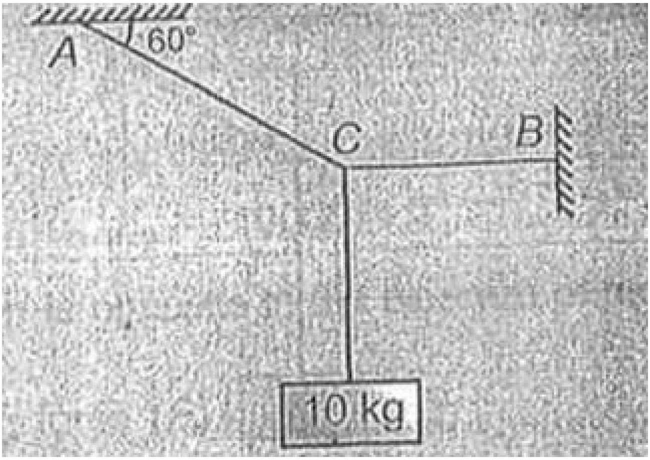
58. Find the tension in the strings AC and BC shown in figure.



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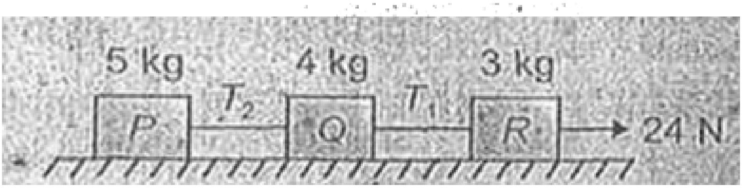
59. Three blocks, P, Q and R of masses 5 kg, 4 kg and 3 kg respectively are connected by a light inextensible string and they are moved on a smooth horizontal plane. If a force of 24 N is applied to the string connected to R, tensions T_1 and T_2 in the string are



A. 20N, 5N

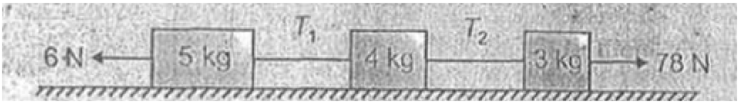
B. 5N, 20N

C. 10N, 18N

D. 18N, 10N

Watch Video Solution

60. What will be the tension T_1 and T_2 in the given figure?



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61. Two blocks of masses m_1 and $m_2 (m_1 > m_2)$ connected by a massless string passing over a frictionless pulley Magnitude of acceleration of blocks would be

A. $\left(\frac{m_1 - m_2}{m_1 + m_2}\right)g$

B. $\left(\frac{m_1 + m_2}{m_1 - m_2}\right)g$

C. $\left(\frac{m_2 - m_1}{m_1 + m_2}\right)g$

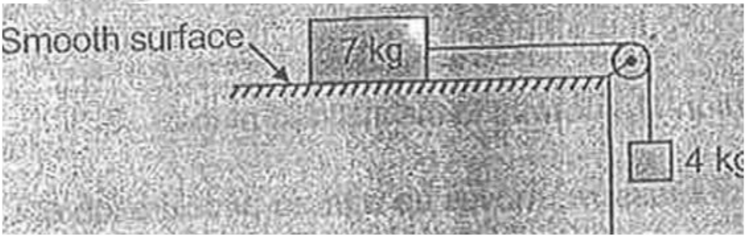
D. $\left(\frac{m_2 + m_1}{m_2 - m_1}\right)g$

Watch Video Solution

62. Two blocks of masses 2 kg and 4 kg tied to a string passing over a frictionless pulley. What will be the magnitude of acceleration of the masses, when they are allowed to move freely?

Watch Video Solution

63. In the given figure, what will be acceleration of block of mass 7 kg?



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64. Determine the maximum acceleration of the truck in which a box lying on the floor of its back will remain stationary, given that the coefficient of static friction between the box and truck's floor is 0.2.

Watch Video Solution

65. Why is it difficult to climb up a greasy pole ?

Watch Video Solution

66. Does friction always oppose the motion?

Watch Video Solution

67. A ball rolled on ice with a velocity of $14ms^{-1}$ comes to rest after travelling 20 m.

Find the coefficient of friction. (Given $g = 9.8 m / s^2$)

Watch Video Solution

68. An aircraft executes a horizontal loop at a speed of 540 km/h with its wings banked at 45°. What is the radius of the loop?

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69. A curved road of diameter 1.8 km is banked so that no friction is required at a speed of $30ms^{-1}$. What is the banking angle?

Watch Video Solution

ASSIGNMENT (SECTION -A)

1. An athlete does not come to rest immedietly after crossing the winning line due to the

A. Inertia of rest

B. Inertai of motion

C. Inertia of direction

D. None of these

Answer: B

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2. What force should be applied on a body of mass 500 kg to change its velocity from 4 ms^1 to 6 ms^{-1} in one second ?

A. 250 N

B. 500 N

C. 1000 N

D. 2000 N

Answer: C

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3. A machine gun fires n bullets per second and the mass of each bullet is m. If v is the speed of each bullet, then the force exerted on the machine gun is

A. mvn

B. mng

C. mnvg

D. $\frac{mnv}{g}$

Answer: A

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4. A metalic ball strikes a wall and drops dead whereas tennis ball having the same mass and velocity bounces back. Which of the following is correct ?

A. The Tennis ball suffers a greater change in momentum

B. Metalic ball suffers a greater change in momentum

C. The momentum of the tennis ball is graeater than that of metallic ball before collision

D. The momentum of the metallic ball is greater than the tennis ball before collision

Answer: A

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5. A body of mass 1 kg is attracted by the Earth with a force which is equal to ____________

A. $9 \cdot 8$N

B. 1 N

C. 980 dyne

D. 12 N

Answer: A

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6. Swimming is possible on account of

A. Newton's laws of gravitation

B. Newton's first law of motion

C. Newton's second law of motion

D. Newton's third law of motion

Answer: D

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7. A 10 kg object is subjected to two forces (in newton)

$\overrightarrow{F}_1 = 16\hat{i} - 11\hat{j}$ and $\overrightarrow{F}_2 = 8\hat{i} + 18\hat{j}$, , the magnitude of resulting acceleration in ms^{-2}

will be

A. $1\,ms^{-2}$

B. $2 \cdot 5ms^{-2}$

C. $3 \cdot 5ms^{-2}$

D. $5ms^{-2}$

Answer: B

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8. Normal reaction on a body by a floor depends on its

A. Velocity on the floor

B. Mass

C. Acceleration on the floor

D. Dislpacement on the floor

Answer: B

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9. Action and reaction

A. Act on two different objects

B. Have opposite direction

C. Have equal magnitude

D. All of these

Answer: D

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10. A bomb at rest explodes into three parts of the same mass. The momentum of the two parts are $x\hat{i}$ and $-2x\hat{j}$. The momentum of the third part will have a magnitude of

A. x

B. $\sqrt{5x}$

C. $x\sqrt{5}$

D. Zero

Answer: C

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11. A 10 g bullet moving at 200 m/s stops after penetrating 5 cm of wooden plank. The average force exerted by the bullet will be

A. $2000N$

B. $-2000N$

C. $4000N$

D. $-4000N$

Answer: D

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12. The unit of impulse is the same as that of

A. Force

B. Acceleration

C. Momentum

D. Energy

Answer: C

Watch Video Solution

13. In a rocket, fuel burns at the rate of 2 kg/s. This fuel gets ejected from the rocket with a velocity of 80 km/s. Force exerted on the rocket is -

A. 16, 000N

B. 1, 60, 000 N

C. 1600N

D. 16N

Answer: B

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14. A bullet fired from a gun experiences a force of $600 - 2 \times 10^5$ t in the barrel of the gun. Here t is in second . The force becomes zero as soon as the bullet leaves the barrel of the gun . The time for which the bullet was in the barrel of the gun is

A. 2×10^{-5}s

B. $10^{-5}s$

C. 3×10^{-5}

D. 3×10^{-3}s

Answer: D

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15. A player kicks a football of mass 0.5 kg and the football begins to move with a velocity of 10 m/s . If the contact between the leg and the football lasts for $\frac{1}{50}$sec , then the force acted on the football should be

A. 250 N

B. 125 N

C. 0 N

D. $3 \cdot 75N$

Answer: A

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16. A grenade having mass of 10 kg flying horizontally with a velocity of 10 m/s explodes into two fragments. The larger fragment has a velocity of 25 m/s in the direction of the intial velocity of the grenade. The smaller fragment has a velocity of 12.5 m/s in the opposite dirction. The masses of the fragments are

A. 2 kg , 8 kg

B. 3 kg, 7kg

C. 4 kg, 6 kg

D. $4.5kg, 5.5kg$

Answer: C

Watch Video Solution

17. A ball of mass $0 \cdot 2$ kg moving with a speed of 30 m/s strikes a bat returns in opposite direction with speed of 90m/s . Magnitude of change in momentu,m of ball will be

A. Zero

B. 6 kg m/s

C. 12 kg m/s

D. 24 kg m/s

Answer: C

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18. A machine gun fires a bullet of mass 65 g with a velocity of 1300 m/s. The main holding it can exert a maximum force of 169 N on the gun. The number of bullets he can fire per second will be

A. 1

B. 2

C. 3

D. 4

Answer: B

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19. The masses of two bodies are in the ratio $1:6$ and their velocities are in the ratio $3:2$ Then their momentum will be in the ratio

A. $2:3$

B. $2:1$

C. $4:1$

D. $1:4$

Answer: D

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20. If two bodies collide , then impulsive foce between them can change

A. Speed of each s

B. Kinetic energy of each

C. Momentum of each

D. All of these

Answer: D

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21. Choose the correct statement

A. Friction force always opposes the motion of the body

B. The direction of the force of friction always opposes the tendency of relative motion of a body

C. The coefficient of kinetic friction is usually grater than the coefficeint of static friction

D. Friction force depends on the surface area of contact

Answer: B

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22. A bullet of mass A and velocity B is fired into a wooden block of mass C. If the bullet geta embedded in the wooden block.then velocity of wooden block after collision

A. $\frac{A+B}{AC}$

B. $\frac{A+C}{B+C}$

C. $\frac{AC}{B+C}$

D. $\frac{AB}{A+C}$

Answer: D

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23. A boy of mass 50 kg jumps with horizontal velocity of 1 m/s on to a stationary cart. If mass of the cart will be 5 kg[Assume friction between the wheels the cart and road is zero]

A. $\frac{10}{11}$ m/s

B. $\frac{11}{10}$ m/s

C. $0 \cdot 65$ m/s

D. $0 \cdot 8$ m/s

Answer: A

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24. A bullet of mass 40 g is fired from a gun of mass 10 kg. If velocity of bullet is 400 m/s. then the recoil velocity of the gun wil be

A. $1 \cdot 6$ m/s in the direction of bullet

B. $1 \cdot 6$ m/s opposite to the direction of bullet

C. $1 \cdot 8$ m/s in the direction of bullet

D. $1 \cdot 8$ m/s opposite to the direction of bullet

Answer: B

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25. A ball of mass 50 g is dropped from a height of 20 m. A boy on the ground hits the ball vertically upwards with a bat with an average force of 200 N, so that it attains a vertical height of 45 m. The time for which the ball remains in contact with the bat is [Take $g = 10m/s^2$]

A. 1/20th of a second

B. 1/40th of a second

C. 1/8oth of a second

D. 1/20th of a second

Answer: C

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26. A string tied on a roof can bear a maximum tension of 50 kg wt. The minimum acceleration that can be acquired by a man of 98 kg to descend will be [take g = $9 \cdot 8 \frac{m}{s^2}$]

A. $9 \cdot 8 \frac{m}{s^2}$

B. $4 \cdot 9 \frac{m}{s^2}$

C. $4 \cdot 8 \frac{m}{s^2}$

D. $5 \frac{m}{s^2}$

Answer: C

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27. If a block moving up at $\theta = 30^{\circ}$ with a velocity 5m/s, stops after 0.5 sec, then what is μ

A. 0.5

B. 0.6

C. 0.9

D. 1.1

Answer: B

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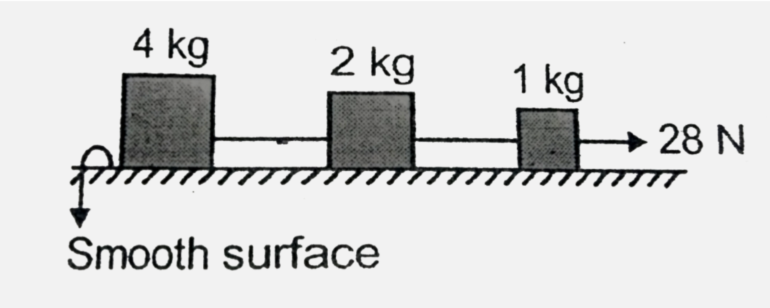
28. In the given figure , what wil be the acceleration of each block ?



A. $2m/s^2$

B. $4m/s^2$

C. $6m/s^2$

D. $8m/s^2$

Answer: B

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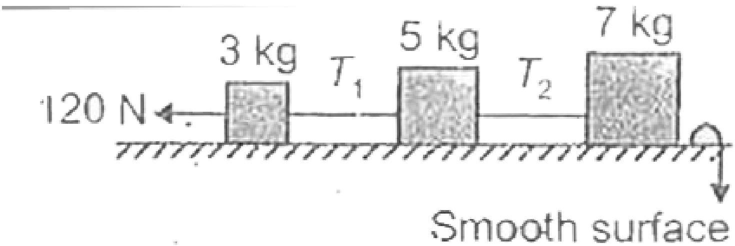
29. T_1 and T_2 in the given figure are



A. 28 N, 48 N

B. 48 N, 28 N

C. 96 N, 56 N

D. 56 N , 96 N

Answer: C

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30. Which of the following is a contact force :

A. Tension

B. Friction

C. Muscular force

D. Al of these

Answer: D

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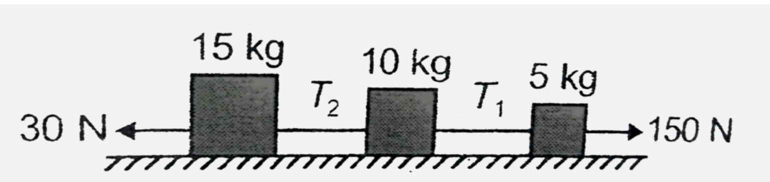
31. Three blocks of masses 5 kg, 10 kg and 15 kg are connected to - light inextensible string placed on smooth horizontal tble as shown below.



$\frac{T_1}{T_2}$ will be

A. $\frac{7}{3}$

B. $\frac{3}{2}$

C. $\frac{15}{7}$

D. $\frac{13}{9}$

Answer: D

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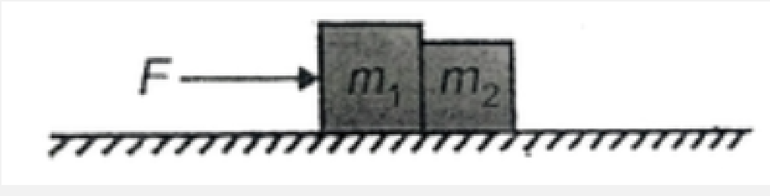
32. Two blocks of mass m_1 and m_2 lie on smooth horizontal table in contact with each other as shown in figure



If a force F is applied to the mass m_1 then the contact force between the block will be

A. $\frac{m_1F}{m_1 + m_2}$

B. $\frac{m_1 - m_2}{m_1 + m_2}$

C. $\frac{m_1m_2g}{m_1 + m_2}$

D. $\frac{m_2F}{m_1 + m_2}$

Answer: D

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33. In the figure given below , with what acceleration does the block of mass m will move ? (Pulley and strings are massless and frictionless)

A. $\frac{g}{3}$

B. $\frac{2g}{5}$

C. $\frac{2g}{3}$

D. $\frac{g}{2}$

Answer: C

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34. Two masses m_1 and m_2 are connected to the end of a string passing over a smooth pulley . The magnitude of tension in the string is T and the masses are moving with magnitude of acceleration a . If the masses are interchanged , then

A. Both a and T will change

B. a will change but T will remain unchanged

C. T will change but a will remain unchanged

D. None of these will change

Answer: D

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35. An elevator is moving vertically up with a acceleration a the force exerted on the floor by a passenger of mass m is

A. $\frac{1}{2}mg$

B. mg

C. mg+ma

D. Zero

Answer: C

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36. A20 kg block is initally at rest. A 75 N force is required to set the block in motion. After the motion starts, a force of 60 N is required to keep the block moving with constant speed. The coefficient of static friction is

A. 0.62

B. 0.52

C. 0.44

D. 0.375

Answer: D

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37. Which of the following is a self adjusting force?

A. Static friction

B. Limiting friction

C. Kinetic friction

D. Rolling friction

Answer: A

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38. What is the SI unit of force of friction ?

A. Newton

B. joule

C. n/m^2

D. N/m

Answer: A

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39. A particle of mass 2m moving with velocity v strikes a stationary particle of mass 3m and sticks to it . The speed of the system will be

A. $0.8v$

B. $0.2v$

C. $0.6v$

D. $0.4v$

Answer: D

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40. A cubical block rests on a plane of $\mu = \sqrt{3}$. The angle through which the plane be inclined to the horizontal so that the block just slides down will be -

A. 30°

B. 45°

C. 60°

D. 75°

Answer: C

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41. Tyres are grooved to

A. Decrease friction

B. Increase friction

C. Increase weight

D. Decrease the weight

Answer: B

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42. Select the correct statement

A. $\mu_s < \mu_s$

B. $\mu_s > \mu_k$

C. $\mu_s = \mu_k$

D. $\mu_s < \ < \mu_k$

Answer: B

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43. Assertion : It is difficult to move a cylce along the roda with its brakes on .

Reason : Sliding friction is greater than rolling friction.

A. Rolling friction opposes motion on road

B. Sliding friction opposes motion on road

C. Rolling friction is more than sliding friction

D. Sliding friction is more than the rolling friction

Answer: D

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44. Which is a suitable method to decrease friction

A. Polishing

B. Lubrication

C. Ball bearing

D. All of these

Answer: D

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45. Maximum value of frictional force is called

A. Limiting friction

B. Static friction

C. Sliding friction

D. Rolling friction

Answer: A

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46. A cystlist riding a bicycle at a speed of $14\sqrt{3}$ m/s takes a turn around a circular road of radius $20\sqrt{3}$ m without skidding . What is his inclination to the vertical ?

A. 30°

B. 45°

C. 60°

D. 75°

Answer: C

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47. A bus turns a slippery road having coefficient of friction of $0 \cdot 5$ with a speed of 10 m/s .The minimum radius of the arc in which bus turns is [Take g = 10 $\left.\frac{m}{s^2}\right]$

A. 4m

B. 10m

C. 15m

D. 20m

Answer: D

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48. A car is moving on a horizontal circular track of radius 0.2 km with a constant speed. If coefficient of friction between tyres of car and road is 0.45, then maximum speed of car may be [Take $g = 10m / s^2$]

A. 15 m/s

B. 30 m/s

C. 20m/s

D. 40m/s

Answer: B

Watch Video Solution

49. Roads are banked on curves so that

A. A vehicle may go with less speed

B. A vehicle may go with more speed

C. A vehicle can slip easily

D. None of these

Answer: B

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50. Select the correct equation for optimum speed of a car on a banked road of angle of banking θ and radius of curvature r.

A. $v = \sqrt{rg}$

B. $v = \sqrt{rg \sin \theta}$

C. $v = \sqrt{rg \tan \theta}$

D. $v = \sqrt{rg \cos \theta}$

Answer: C

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ASSIGNMENT (SECTION -B) objective type questions (one option is correct)

1. A block of mass 'm' is held stationary against a rough wall by applying a force F as shown. Which one of the following statement is incorrect ?

A. Friction force = mg

B. F will not produce torque

C. Normal will not produce torque

D. Normal reaction = F

A. Friction force = mg

B. F will not produce torque

C. Normal will not produce torque

D. Normal reaction = F

Answer: C

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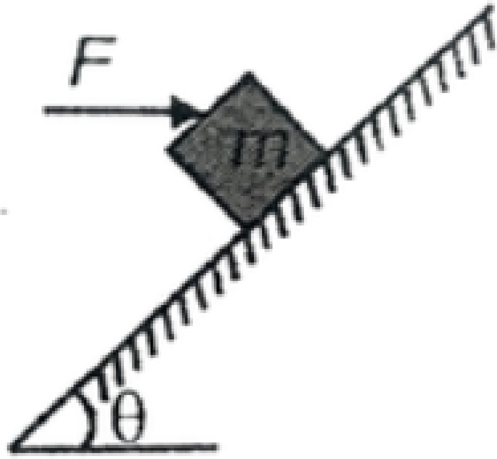
2. A block is placed on a smooth inclined plane as shown . For what value of horizontal force F, the block will remain at rest ?



A. $mg\tan\theta$

B. $mg\sin\theta$

C. $mg\cos\theta$

D. $mg\cot\theta$

Answer: B

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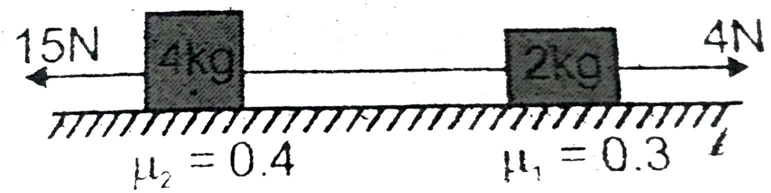
3. In the figure shown , two blocks of masses 2 kg and 4kg are connected by a massless string which is just taut (i.e., tension is zero at this moment). Now two forces 4 N and 15 N are applied on blocks . The tension in the string is (coefficient of static and kinetic friction are same). [g = m / s^2]



A. 2N

B. Zero

C. 6N

D. 1 N

Answer: B

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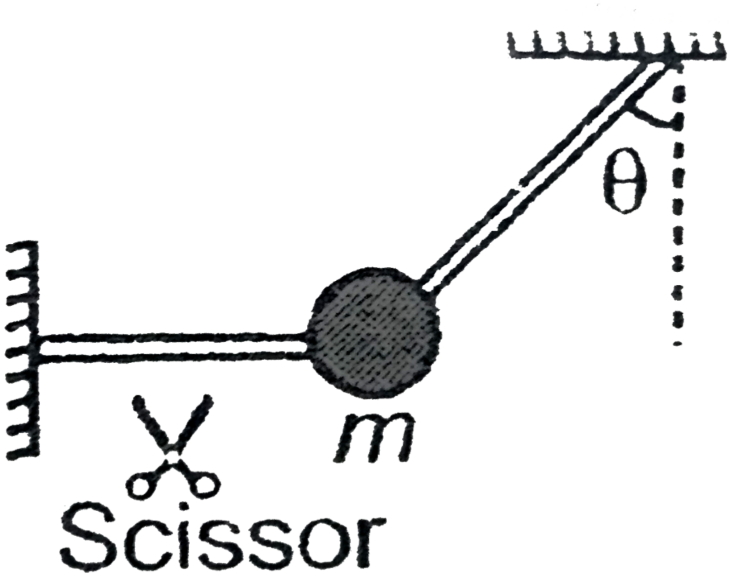
4. Figure shows a small ball of mass m held at rest by means of two light and inextensible strings. The tensions in the inclined string at the instant shown and just after cutting the horizontal atring are respectively



A. a. $mg\cos\theta$, $\cos\theta$

B. b. $mg\cos\theta$, $\frac{mg}{\cos\theta}$

C. c. $\frac{mg}{\cos\theta}$, $mg\cos\theta$

D. d. $\frac{mg}{\cos\theta}$, $\frac{mg}{\cos\theta}$

Answer: C

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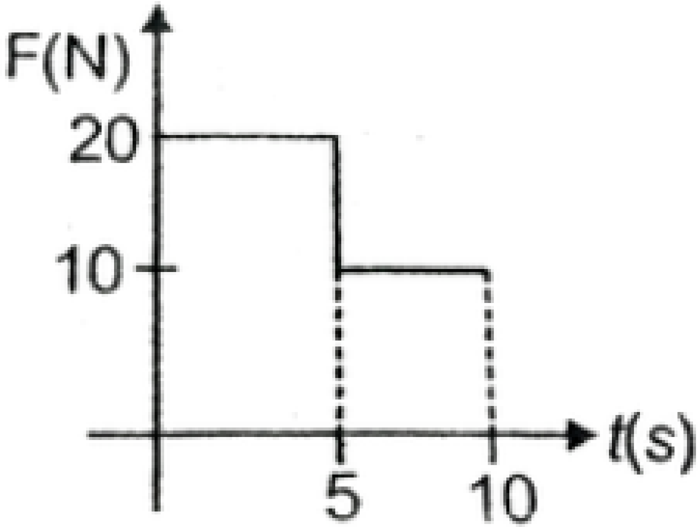
5. Force is applied on an object of mass 2 kg at rest on a frictionless horizontal surface as shown in the graph. The speed of object at t=10 s will be



A. 7.5m/s

B. 12.5 m/s

C. 10 m/s

D. 25 m/s

Answer: C

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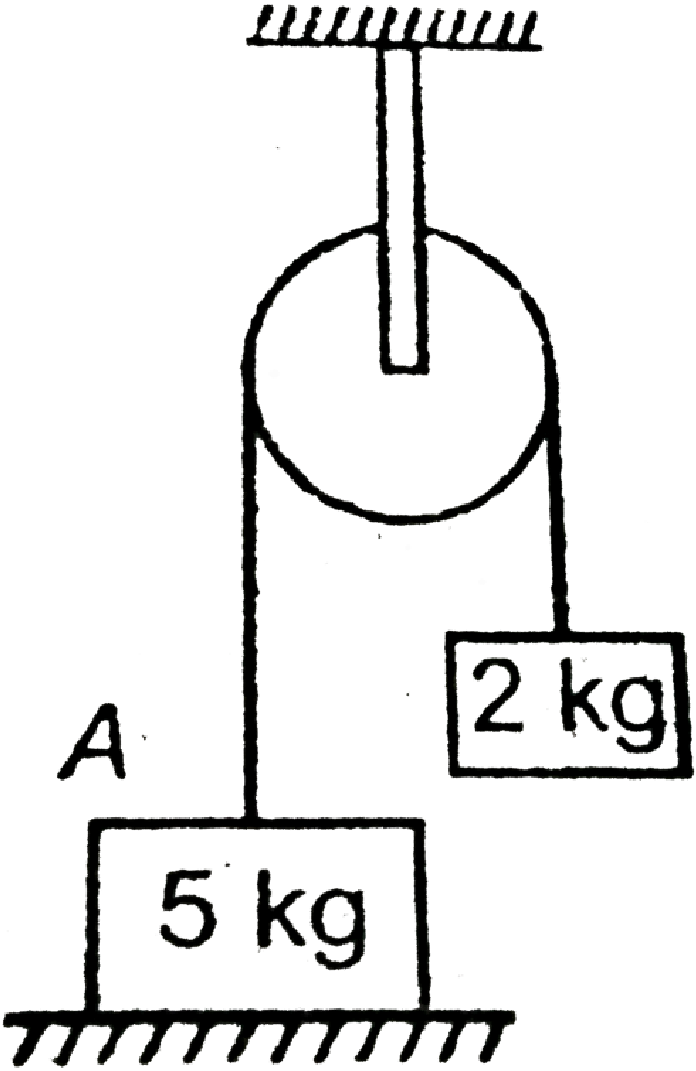
6. In the arrangement shown, what is the normal reaction the block A (mass = 5 kg) and ground



A. 50 N

B. 20 N

C. 30 N

D. Zero

Answer: C

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7. A block of mass 2 kg rests on the floor of an elevator , which is moving down with an acceleration 'g' , then the apparent weight of the block is [take g = $10m / s^2$]

A. 20 N

B. 12 N

C. 16 N

D. Zero

Answer: D

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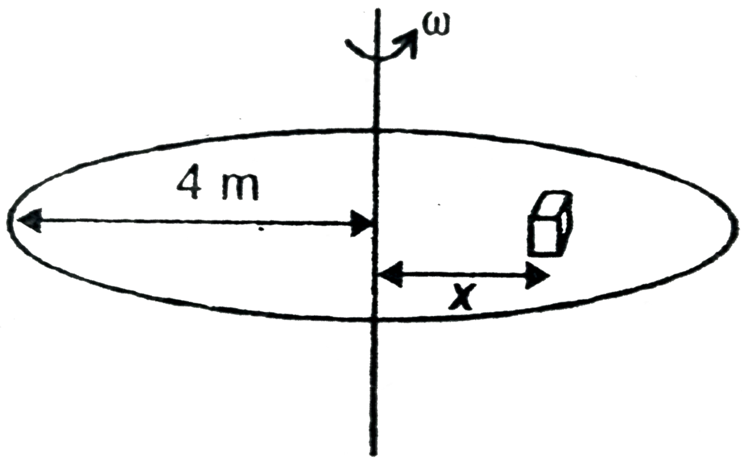
8. A disc of radius 4 m is rotating about its fixed center with a constant angular velocity ω = 2 rad /s (in the horizontal plane.) A bloc s also rotating with disc without slippng . If co-efficient of friction between the bloc and the disc is $0 \cdot 4$ then the maximum distance at which the block can rotate without slipping s (g = $10m / s^2$) brgt



A. 1m

B. 2 m

C. 3 m

D. 4 m

Answer: A

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9. A circular track of radius 600 m is tio be designed for cars at an average speed of 180 km/hr. What should be the angle of banking of the track?

A. $\tan^{-1}\left(\frac{3}{40}\right)$

B. $\tan_1\left(\frac{3}{20}\right)$

C. $\tan^{-1}\left(\frac{3}{16}\right)$

D. $\tan^1\left(\frac{3}{80}\right)$

Answer: D

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10. A particle of mass m is moving on a circular path of radius r with uniform speed v , rate of change of linear momentum is

A. Zero

B. Independent of speed

C. Proportional to radius r

D. Proportional to v^2

Answer: D

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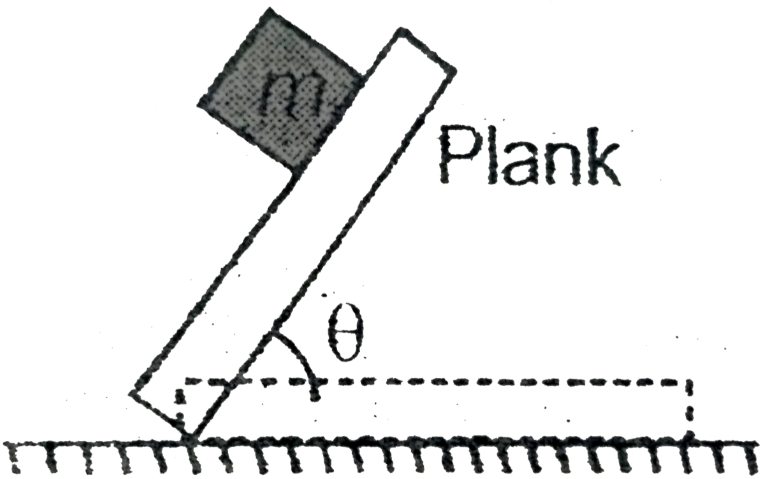
11. A block of mass m is kept on a plank . The coefficient of friction between the plank and block is 1. The plank is slowly raised from one end so that it makes angle θ with horizontal .

The forces of friction acting on the plank , when $\theta = 30^\circ$ and $\theta 60^\circ$ are respectively,



A. a. $\left(m\frac{g}{2}\right), \left(m\frac{g}{2}\right)$

B. b. $\frac{\sqrt{3mg}}{2}, \frac{mg}{2}$

C. c. $\frac{mg}{2}, \frac{\sqrt{3mg}}{2}$

D. d. mg, mg

Answer: A

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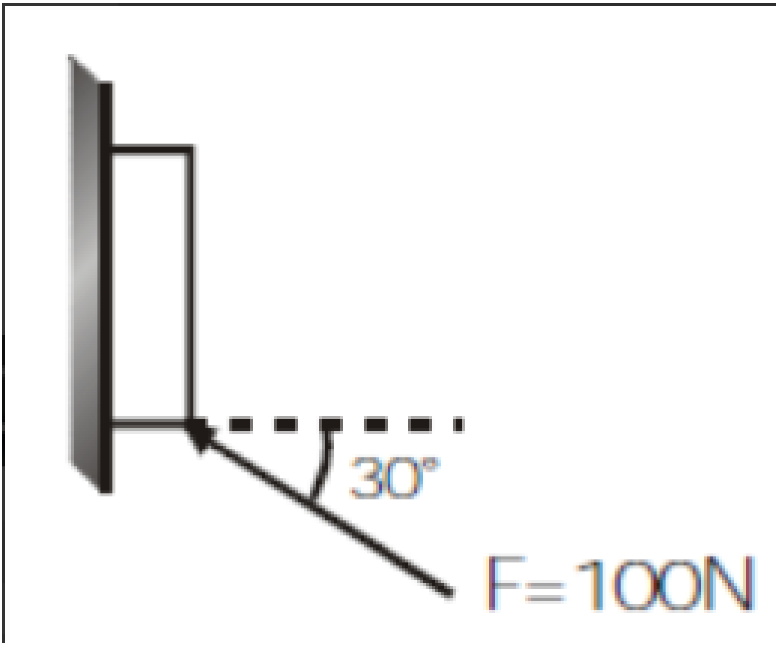
12. A force of 100 N is applied on a block of mass 3 kg as shown in figure. The coefficient of friction between the surface and the block is $\frac{1}{4}$ .Then the friction force acting on the block is



A. 15 N downwards

B. 20 N downwards

C. 25 N upwards

D. 30 N upwards

Answer: B

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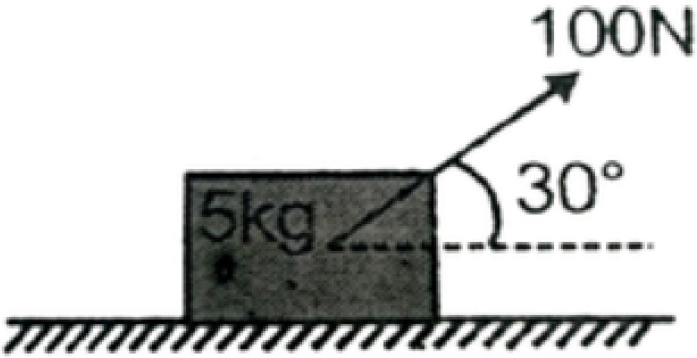
13. A block of mass 5 kg is placed on a rough horizontal plane . The coefficients of stastic and kinetic friction between the block and surface are $0 \cdot 5$ and $0 \cdot 3$ respectively. A force of 100 N is applied at an angle 30° with the horizontal as shown in the figure . The acceleration of the block will be [g = $10m/s^2$]



A. $\left(10 - \sqrt{3}\right)\sqrt{3}m/s^2$

B. $20m/s^2$

C. Zero

D. $10\sqrt{3}m/s^2$

Answer: D

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14. In the figure shown coefficient of friction between 8 kg block and surface is zero and coefficient of friction (both static and kinetic) between the blocks is 0.4. A force of 20 N is applied on 8 kg block as shown . The acceleration of 4 kg mass is [g = $10m / s^2$]

A. $4m / s^2$

B. $0.5m / s^2$

C. $\frac{5}{3}m/s^2$

D. $\frac{3}{5}m/s^2$

A. $4m/s^2$

B. $0.5m/s^2$

C. $\frac{5}{3}m/s^2$

D. $\frac{3}{5}m/s^2$

Answer: C

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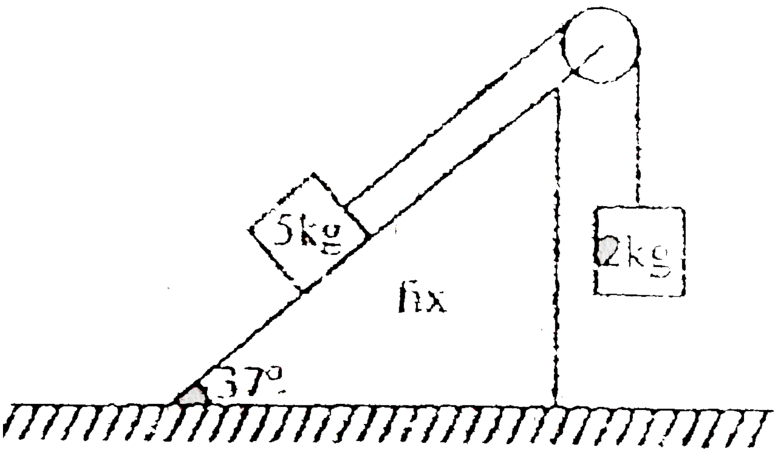
15. In the arrangement shown in figure coefficient of friction between 5kg block and incline plane is mu=0.5. Friction force acting on the 5kg block is



A. 20N

B. 10N

C. 15N

D. 5N

A. 20N

B. 10N

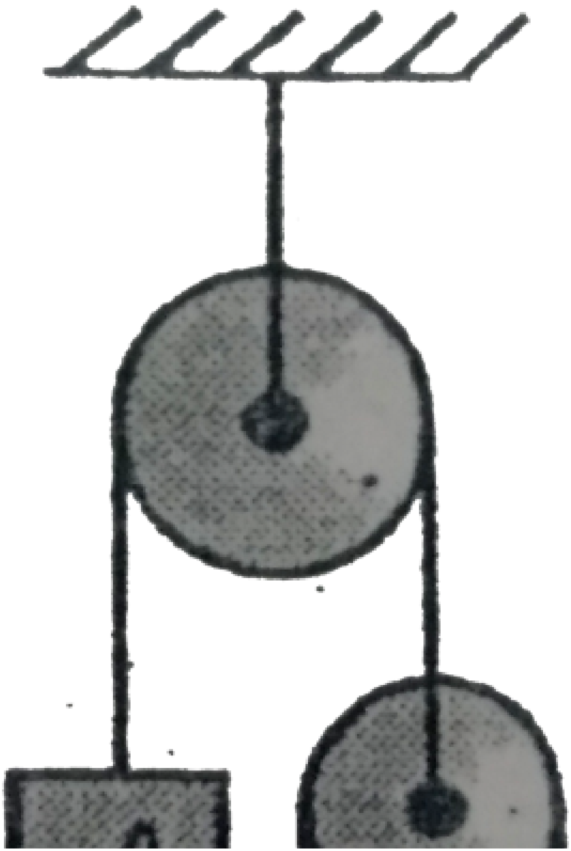
C. 15N

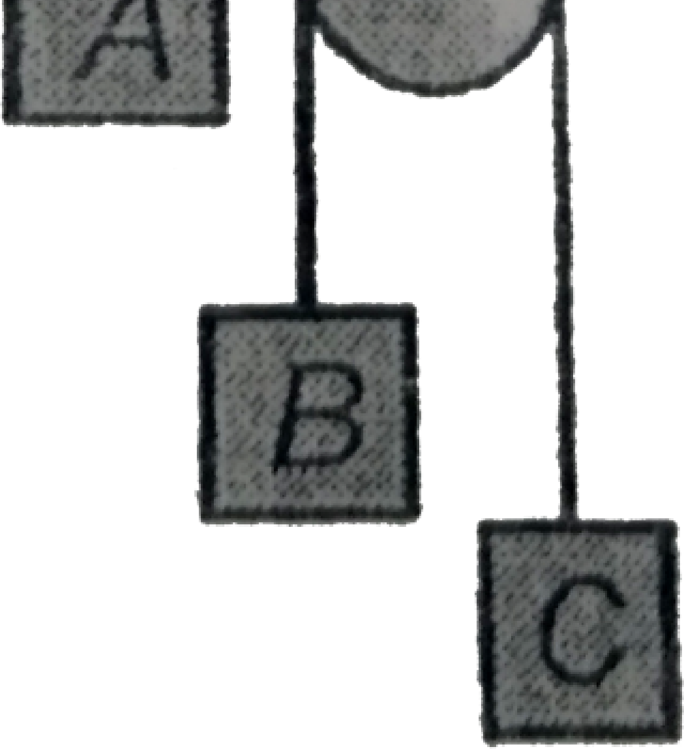
D. 5N

Answer: B

Watch Video Solution

16. At a certain moment of time, acceleration of the block A is 2 m/s^2 . Upward and acceleration of block B is 3 m/s^2 upward. The acceleration of block C is (masses of pulleys and string are negligible)





A. $5m / s^2$ upward

B. $7m / s^2$

C. $8m / s^2 downward$

D. $7m / s^2 downward$

Answer: D

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17. A train is moving forward with a horizontal acceleration a. A man sitting in the train drops a coin on the floor of the train . The acceleration of the coin w.r.t man is

A. g downward

B. a downward

C. $\sqrt{a^2+g^2}at\tan^{-1}\left(\frac{g}{a}\right)$ with horizontal in forward direction

D. $\sqrt{a^2+g^2}at\tan^{-1}\left(\frac{g}{a}\right)$ with horizontal in backward direction

Answer: D

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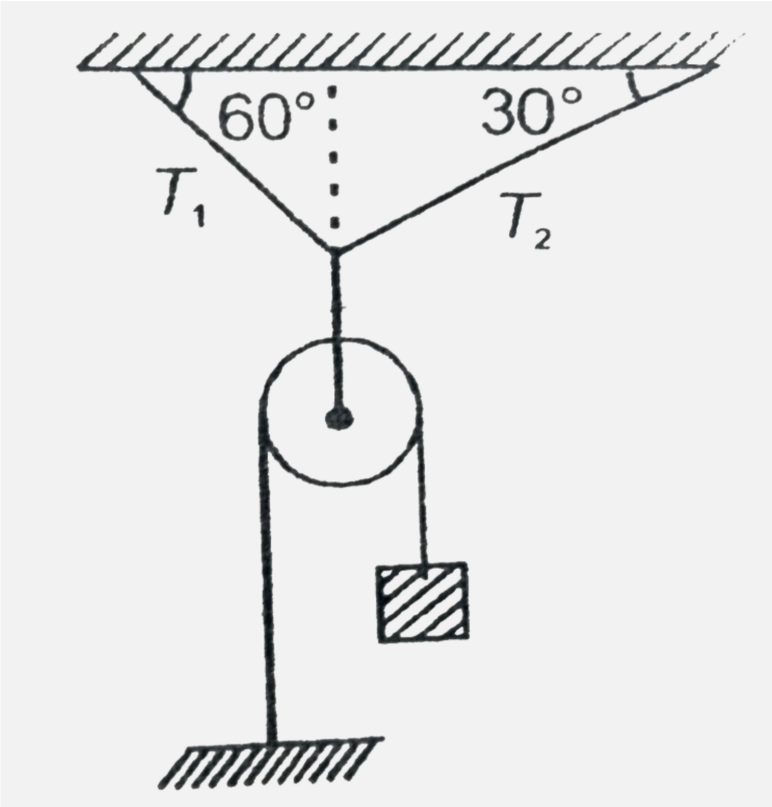
18. If pulley and all strings as shown are massless, then tension $T_2 = 100N$. Calculate weight of the block (g = $10 m / s^2$)



A. 50 N

B. 100 N

C. $50\sqrt{3}$

D. $100\sqrt{3}$

Answer: B

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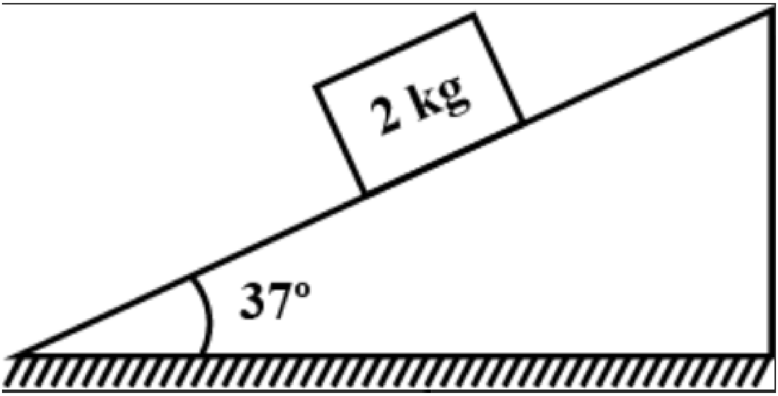
19. A block of mass 2 kg rests on an inclined plane of inclination angle 37° , then calculate the force of friction acting on the block [take g = $10m/s^2$)



A. 20 N

B. 12 N

C. 16 N

D. Zero

Answer: B

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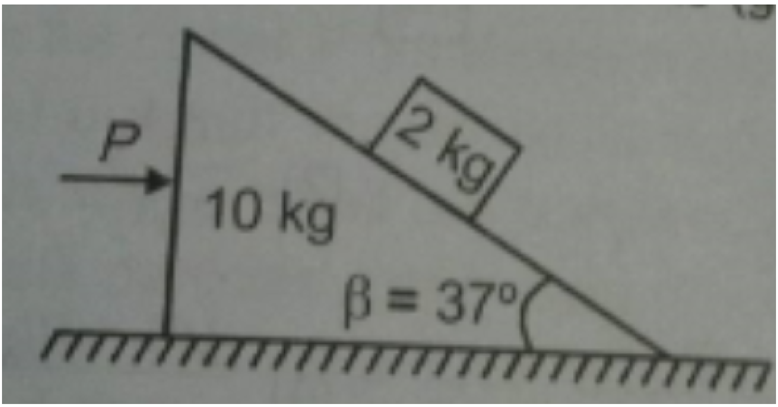
20. All surfaces shown in the figure are frictionless. A block of mass 2 kg is kept on a wedge of mass 10 kg. If the mass m remains stationary w.r.t wedge , the magnitude of force P is (g = $10m/s^2$)



A. 15 N

B. 90 N

C. 12 N

D. 45 N

Answer: B

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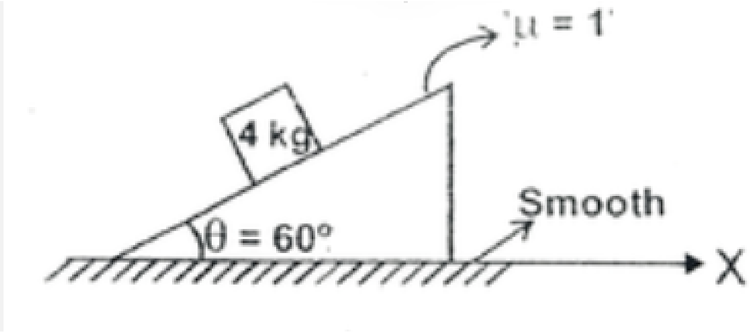
21. In the given figure the co- efficient of friction between the block and the incline plane is '1'. The acceleration with which the system should be accelerated so that the friction between the block and the wedge becomes zero (g = $10m/s^2$) is



A. $\vec{a} = \left(\frac{10}{\sqrt{3}}\right)\hat{i}$

B. $\vec{a} = \frac{-10}{\sqrt{3}}\hat{i}$

C. $\vec{a} = -5\hat{i}$

D. $\vec{a} = \frac{-5}{\sqrt{3}}\hat{i}$

Answer: A

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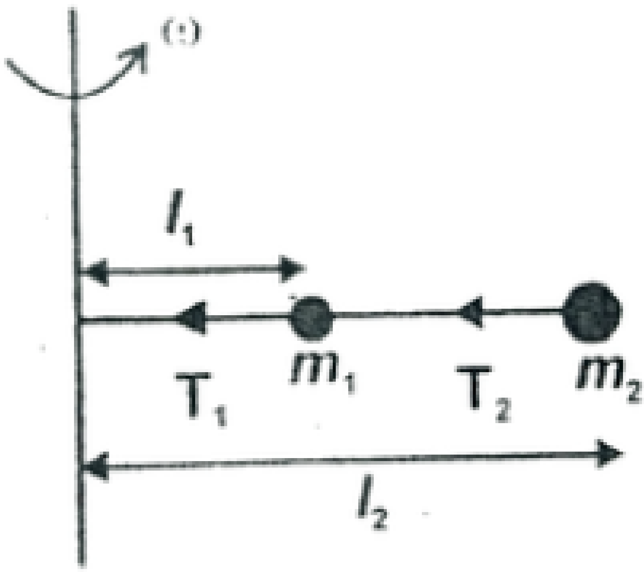
22. The whole set up shown in the figure is rotating with constant angular velocity ω on a horizontal frictionless table. The ratio of tensions $\frac{T_1}{T_2}$ is

$$\left(\text{Given}\frac{l_2}{l_2} = \frac{2}{1}\right)$$



A. $\frac{m_1}{m_2}$

B. $\frac{(m_1 + 2m_2)}{2m_2}$

C. $\frac{m_2}{m_1}$

D. $\frac{(m_2 + m_1)}{m_2}$

Answer: B

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23. A block of mass 10 kg is placed on rough inclined plane of inclination angle 37° .Coefficient of friction between block & plane is $0 \cdot 8$, find minimum magnitude of F so that block remains at rest .

A. 4 N

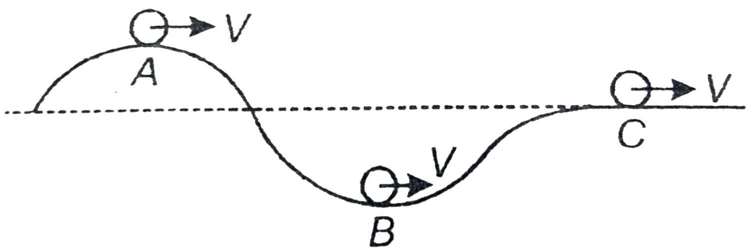
B. 124 N

C. 122 N

D. Zero

Answer: D

24. A body of mass 'm' is moving with constant speed V on a track shown in figure . At point A & point B radius of curvature is R. $N_A, N_B, \& N_C$ represents normal reactions at A,B,& C. Which of the gollowing option is correct ?



A. a. $N_A = mg - \frac{mV^2}{R}$

B. b. $N_B = mg + \frac{mV^2}{R}$

C. c. $N_C = mg$

D. d. All of these

Answer: D

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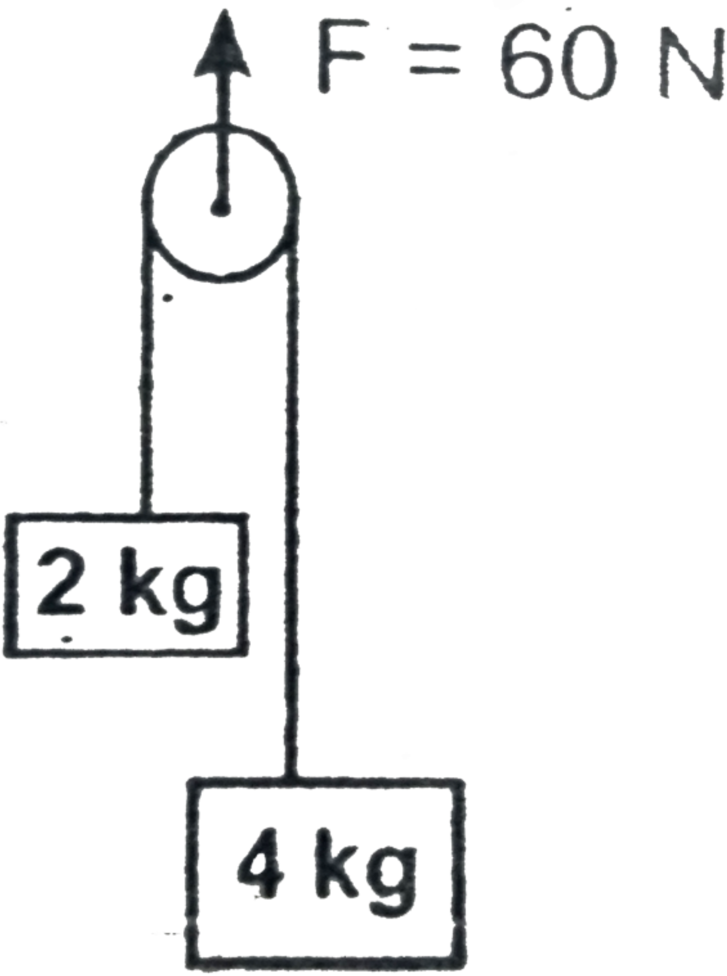
25. The magnitudes of accelerations of blocks of mass 2 kg and 4 kg are respectively . (Pulleys and threads are massless) (g = 10

m/s^2)



A. $a_1 = 5m/s^2, a_2 = 2 \cdot 5m/s^2$

B. $a_1 = a_2 = 0$

C. $a_1 = a_2 = \frac{20}{6} m / s^2$

D. $a_1 = 20 m / s^2, a_2 = 5 m / s^2$

Answer: A

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26. Swimming is possible by

A. First law of motion

B. Second law of motion

C. Third law of motion

D. Newtion's law of gravitation

Answer: C

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27. When we jump out of a boat standing in water it moves

A. Backward

B. Forward

C. Sideways

D. Noneof these

Answer: A

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28. A force of 49 N just able to move a block of wood weighing 10 kg on a rough horizontal surface , then coefficient of friction is

A. $\frac{1}{2}$

B. $\frac{1}{4}$

C. $\frac{1}{6}$

D. $\frac{1}{8}$

Answer: A

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29. Answer the question briefly and the point:

What is the angle of friction between two surfaces in contact having coefficient of friction $\frac{1}{\sqrt{3}}$?

A. 15°

B. 30°

C. 45°

D. 60°

Answer: B

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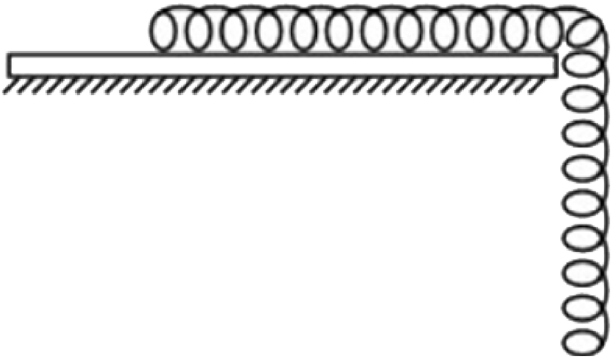
30. A chain is placed on a rough table, partially hanging, as shown in the figure. The coefficient of static friction between the chain and the table is μ = 0.4. If the maximum possible length of the hanging part is x and the length of the chain is L, then what is the value of $\frac{L}{x}$?



A. $\frac{\mu L}{1+\mu}$

B. $\frac{\mu L}{1-\mu}$

C. $\frac{(1-\mu)L}{1+\mu}$

D. μL

Answer: A

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31. A road is 8 m wide. Its radius of curvature is 40 m. The outer edge is above the lower edge by a distance of 1.2 m. This road is most suited for a velocity of

A. $5 \cdot 7$ m/s

B. $7 \cdot 7$m/s

C. $36 \cdot 1$ m/s

D. $9 \cdot 7$ m/s

Answer: B

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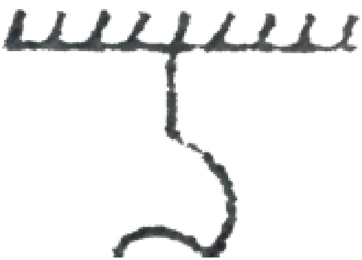
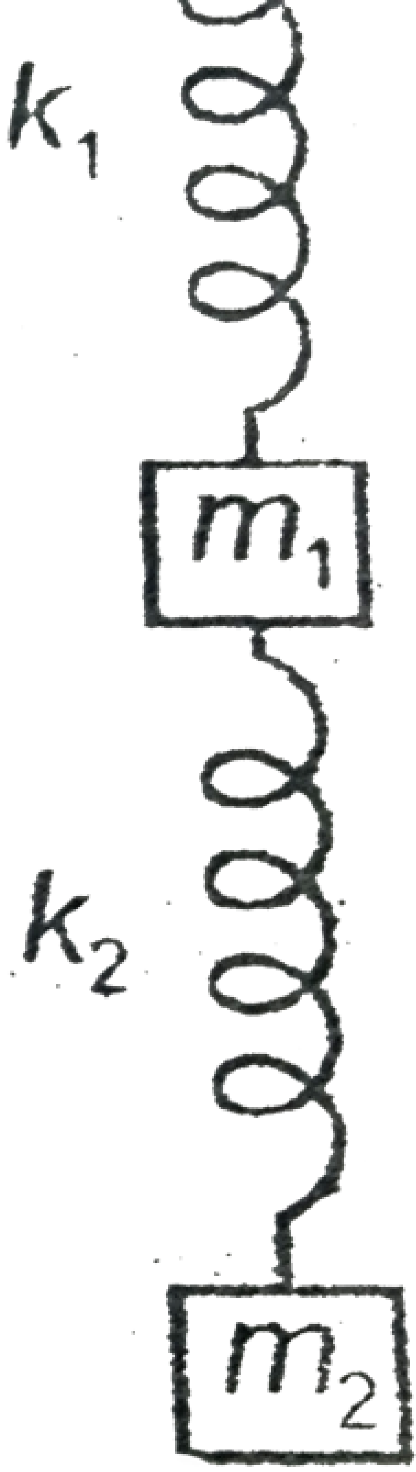
32. Find the ratio of the extension in upper spring to lower spring





k_1
m_1
k_2
m_2

A. $\dfrac{m_1 k_1}{m_2 k_2}$

B. $\dfrac{m_2 k_1}{m_1 k_2}$

C. $\dfrac{(m_1 + m_2)k_2}{m_1 k_1}$

D. $\dfrac{(m_1 + m_2)k_2}{m_2 k_1}$

Answer: D

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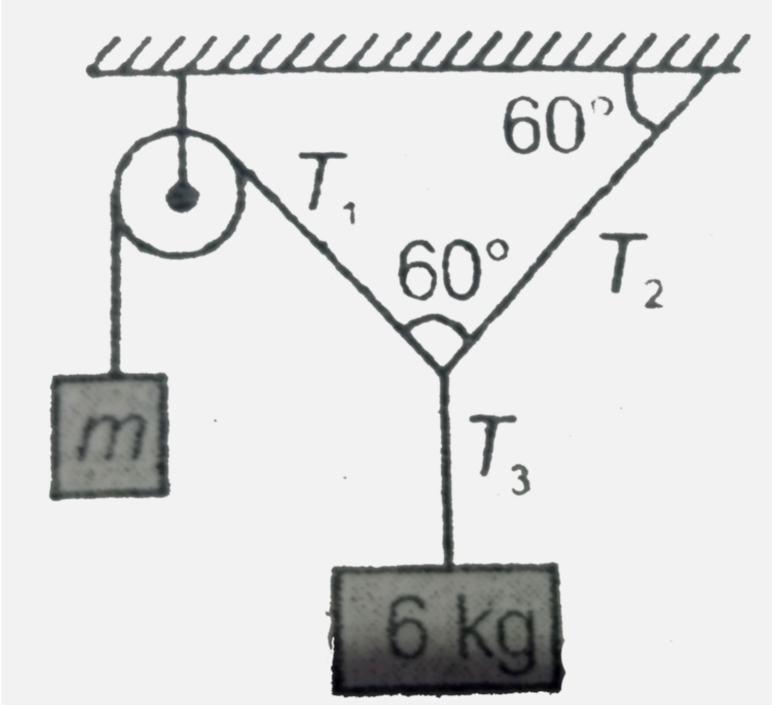
33. For the system shown in figure , to be in equilibrium , determine mass m .



A. $3 \cdot 46$kg

B. $2 \cdot 46$ kg

C. $1 \cdot 67$ kg

D. $3 \cdot 67$ kgs

Answer: A

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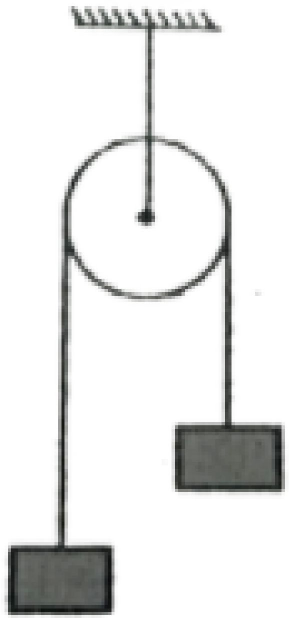
34. If two identical masses, attached by a light string passing over a light , frictionless pulley (fixed) of an Atwood's machine (at different heights) , are released from rest .



A. a. The lower mass will go down

B. b. The higher mass will go down

C. c. The masses will not move

D. d. The motion will depend on the actual value of each mass

Answer: C

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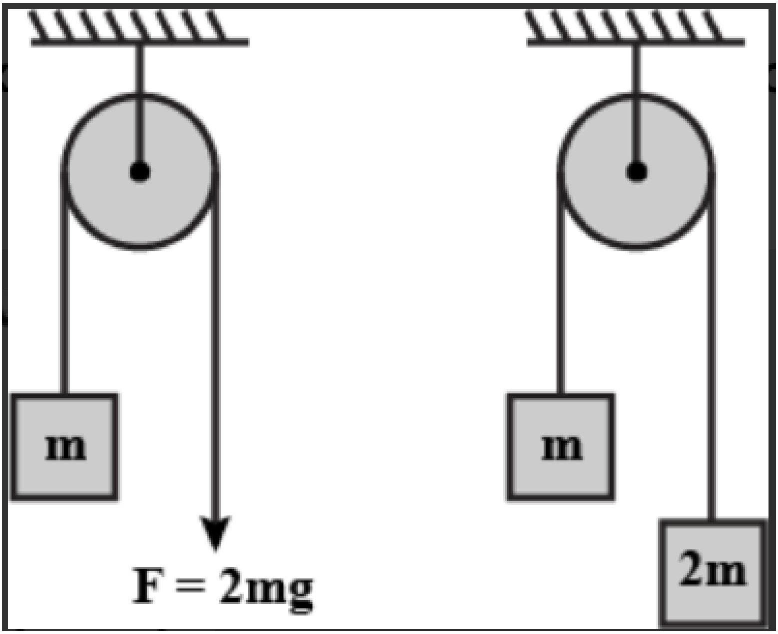
35. The magnitud of difference in accelerations of blocks of mass m in . Both the cases shown below is



A. g

B. $\frac{2g}{3}$

C. Zero

D. $\frac{g}{3}$

Answer: B

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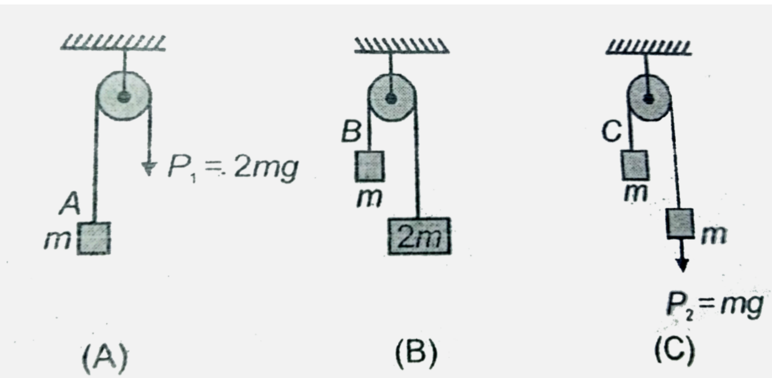
36. In the figure the blocks A, B and C of mass m each , having accelerations a_1, a_2 and a_3 respectively . P_1 and P_2 are external forces of magnitude 2 mg and mg respecttively .



A. $a_1 > a_3 > a_2$

B. $a_1 = a_2, a_2 = a_3$

C. $a_1 = a_2 = a_3$

D. $a_1 > a_2 a_2 = a_3$

Answer: A

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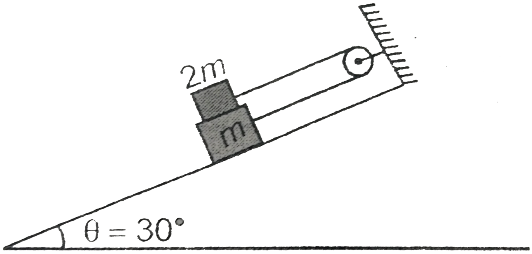
37. Figure shows a block of mass 2m sliding on a block of mass m. Find the acceleration of each block . (All surface are smoth)



A. $\frac{40}{3}\frac{m}{s^2}$

B. $\frac{20}{3}\frac{m}{s^2}$

C. $\frac{5}{3}\frac{m}{s^2}$

D. $\frac{10}{3}\frac{m}{s^2}$

Answer: C

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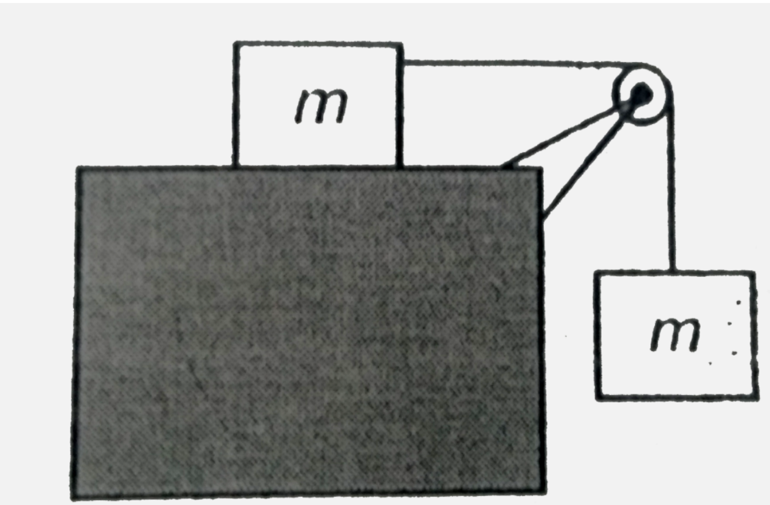
38. Two identical masses are attached by a light string that passes over a small pulley, as shown . The table and the pulley are frictionless. The hanging block is moving



A. with an acceleration less than g

B. With an acceleration equal to g

C. With an acceleration greater than g

D. At constant speed

Answer: A

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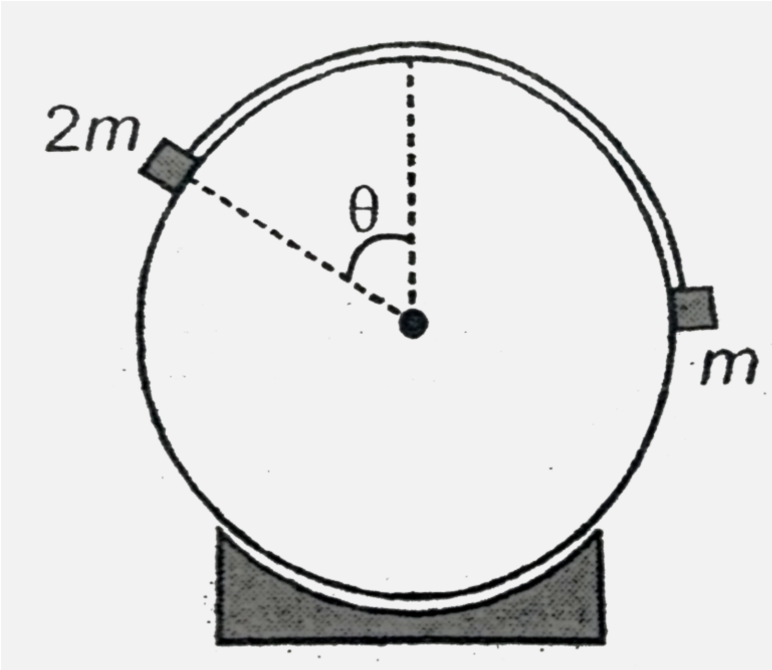
39. A mass 2m lies on a fixed , smooth cylinder . An ideal string attached to 2m passes over the cylinder to mass m . Then the value of angle θ

for which system is in equilibrium



A. 40°

B. 45°

C. 60°

D. 30°

Answer: D

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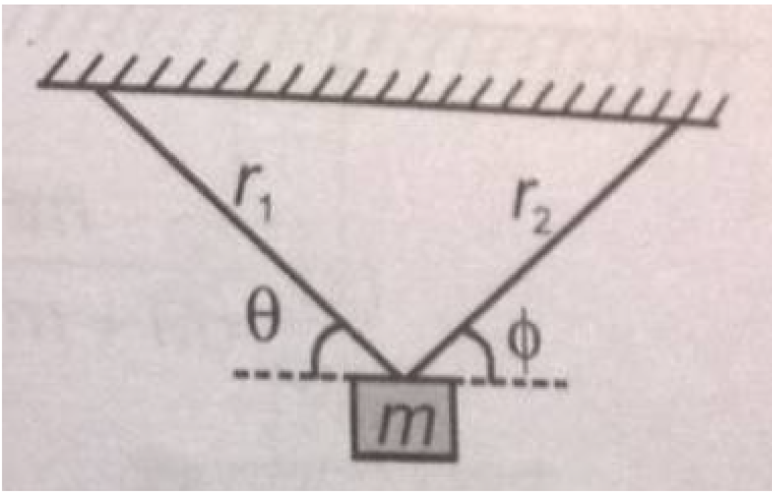
40. A block is suspended by two light ropes r_1 and r_2 as shown in figure . Then what is the tension the rope r_2



A. $\dfrac{mg}{\sin\phi + \cos\phi\tan\theta}$

B. $\dfrac{mg}{\cos\phi + \sin\phi\tan\theta}$

C. $\dfrac{mg}{\sin\phi - \cos\phi\tan\theta}$

D. $\dfrac{mg}{\cos\phi - \sin\phi\tan\theta}$

Answer: A

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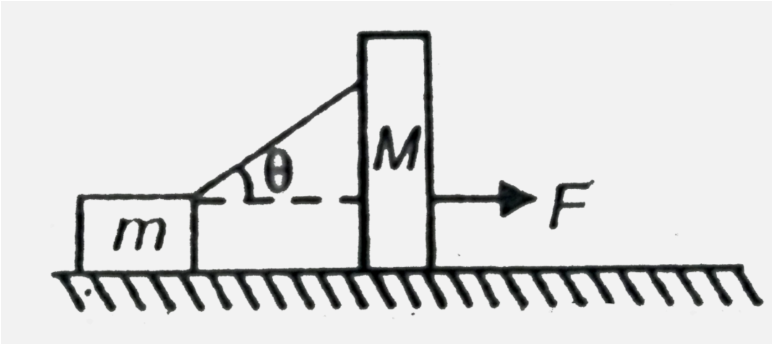
41. Two blocks of masses m and M are connected by an inextensible light string . When a constant horizontal force acts on the block of mass M. The tension in the string is



A. $\dfrac{mF}{(M+m)\cos\theta}$

B. $\dfrac{mF}{(M+m)\sin\theta}$

C. $\dfrac{MF}{(m+M)\cos\theta}$

D. $\dfrac{MF}{(M+m)\sin\theta}$

Answer: A

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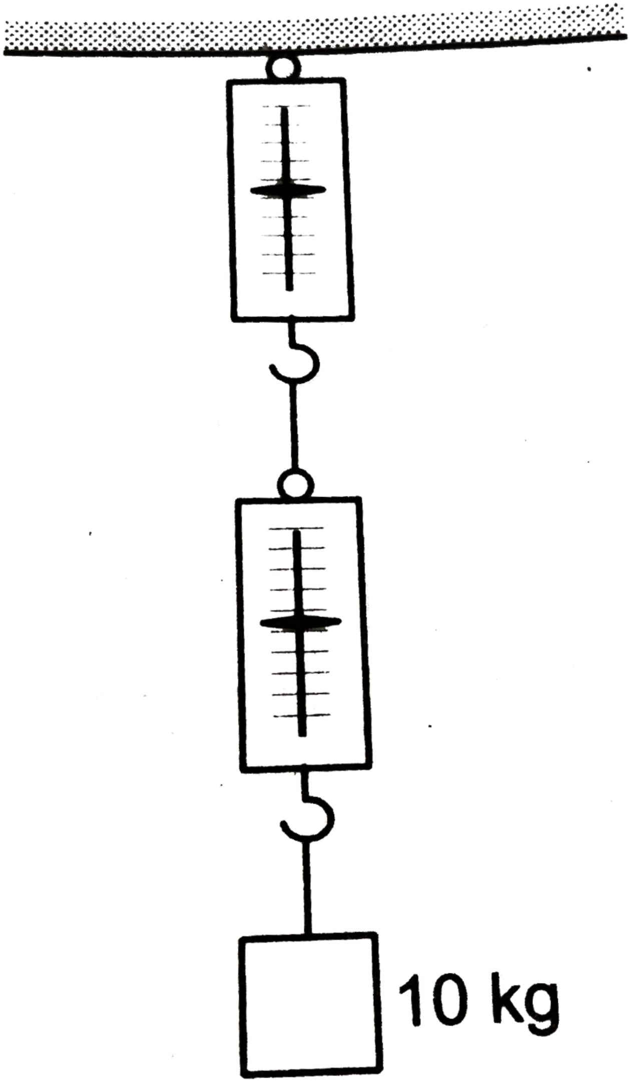
42. A block of mass 10 kg is suspended through two light spring balances as shown in figure



A. Both the scale will ready 5 kg

B. The upper scale will read 10 kg and the lower zero

C. Both the scale will read 10 kg

D. The readings may be any thing but their sum will be 10 kg

Answer: C

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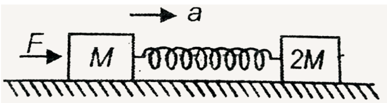
43. Two blocks of masses M and 2M are connected to each other through a light spring as shown in figure . If we push the mass M with a force F which cause acceleration a in mass M. what will the acceleration in 2M?



A. $\frac{F}{2M}$

B. $\frac{F}{3M}$

C. a

D. $\frac{F-Ma}{2M}$

Answer: D

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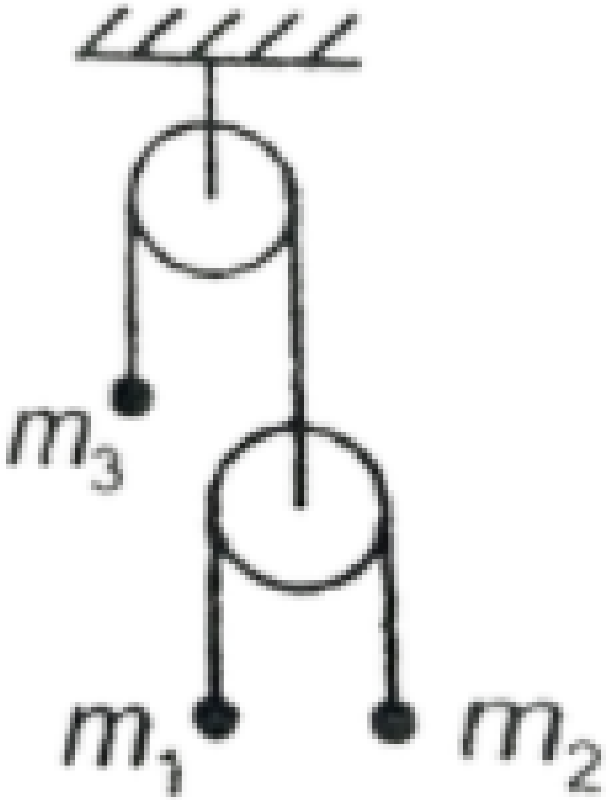
44. Three masses m_1, m_2 and m_3 are attached to a string -pulley system as shown . All the three masses are held at rest and then released If m_3 remains at rest , then



A. $4m_1m_2 = m_1m_3 + m_2m_3$

B. $2m_1m_2 = m_1m_3 + m_2m_3$

C. $4m_1m_3 = m_1m_2 + m_3m_2$

D. $m_3 = m_1 + m_2$

Answer: A

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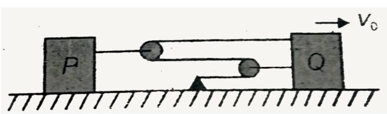
45. The block Q moves to the right with a constant velocity v_0 as shown in figure. The relatives velocity of body P with respect to Q is (assume all pulleys and strings are ideal)



A. $\frac{1}{2}v_0$ towardsleft

B. $\frac{3}{2}v_0$ towards right

C. $\frac{1}{2}v_0$ tawards right

D. $\frac{3}{2}v^0$ towards left

Answer: B

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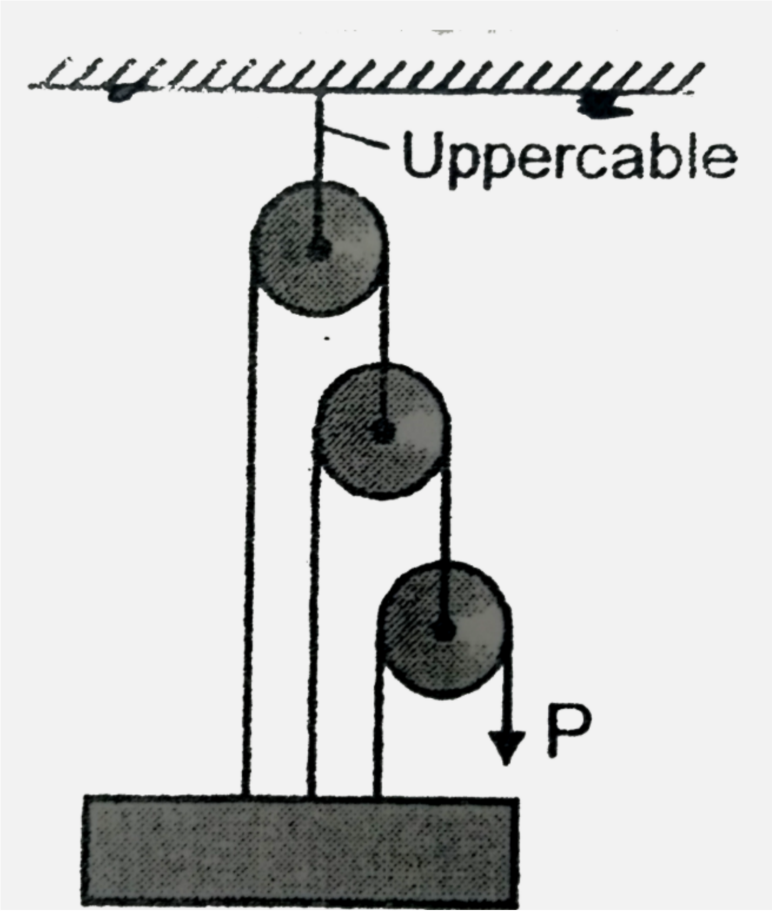
46. The pull P is just sufficient to keep the 14 N block in equilibrium as shown . Pulleys are ideal . Find the tension (in N) in the upper cable connected with celling



A. 4N

B. 8N

C. 12N

D. 16N

Answer: D

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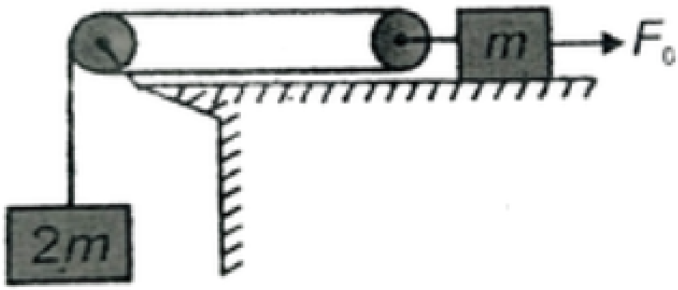
47. A block of mass m on a smooth horizontal surface is. Connected to a second mass 2m by a light cord over a light frictionless pulley as shown. (Neglect the mass of the cord and of the pulley). A force of magnitude F_0 is applied to mass m as shown. Neglect any fiction . Find the value of force F_0 for which the system will be in equilibrium



A. mg

B. 2mg

C. 3 mg

D. 4mg

Answer: D

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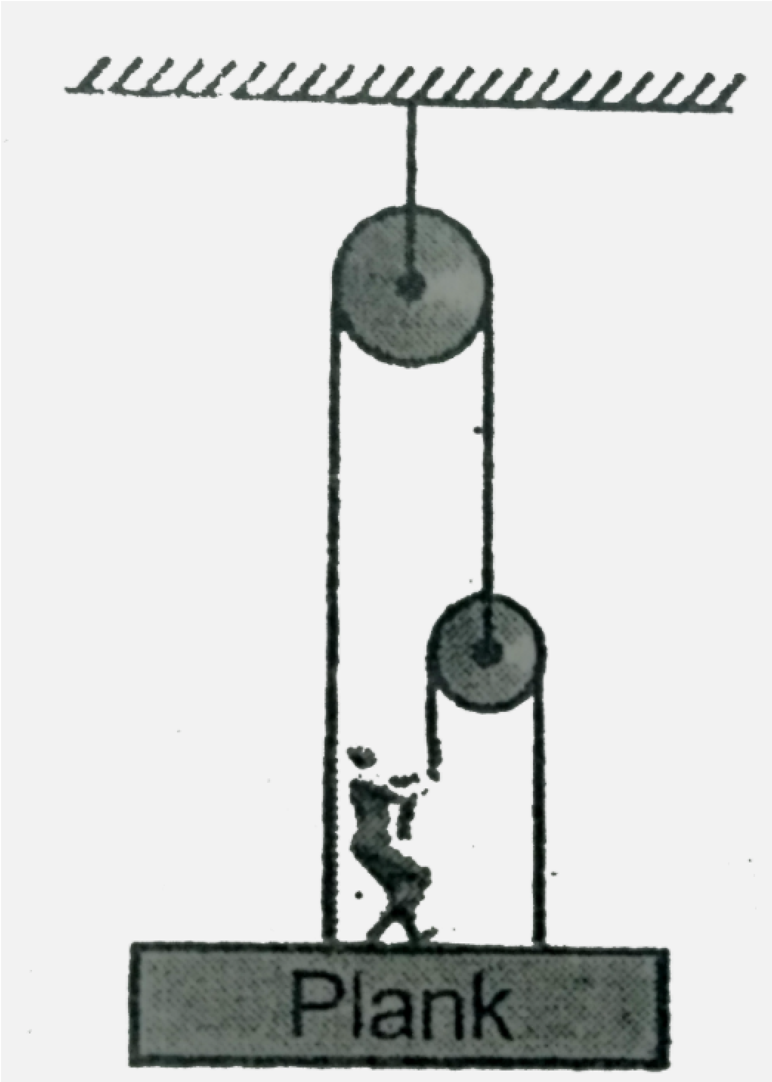
48. With what force must a man pull on the rope to hold the plank in position it the man weights 60 kg? Neglect the weight of the plank, rope and pulley (Take g= $10 m / s^2$)



A. 100 N

B. 150 N

C. 125 N

D. 130 N

Answer: B

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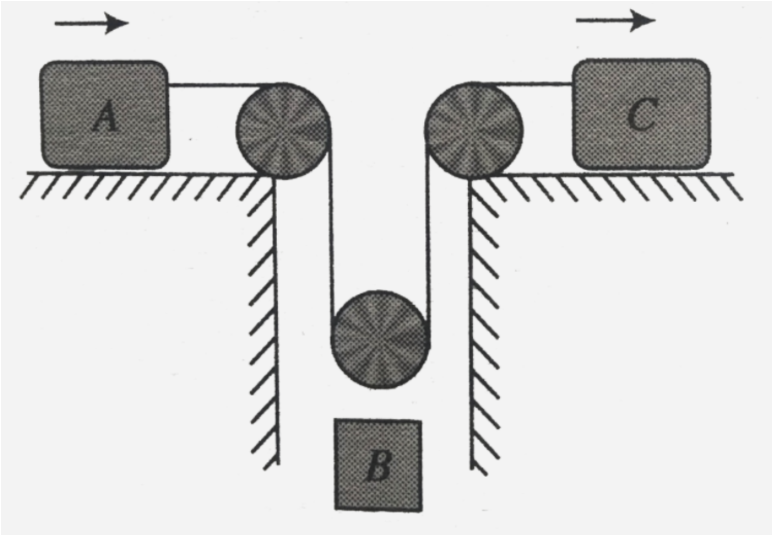
49. Blocks P and R starts from rest and moves to the right with acceleration $a_p = 12tm / s^2$ and $a_R = 3m / s^2$. Here t is in seconds . The time when block Q again comes to rest is



A. 1 s

B. $\frac{3}{2}s$

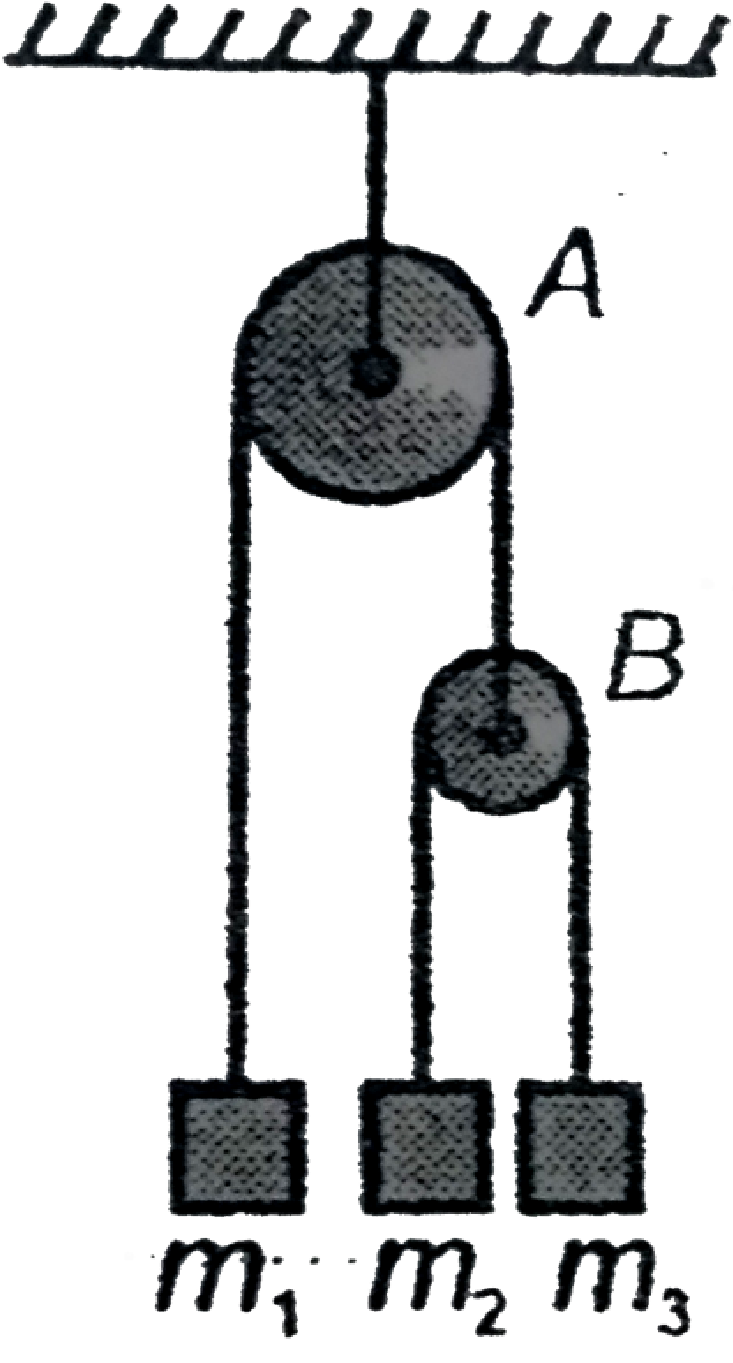
C. 2 s

D. $\frac{1}{4}s$

Answer: D

Watch Video Solution

50. In the arrangement , shown below pulleys are massless and frictionless and threads are inextensible , block of mass m_1 will remain at rest if



A. $\frac{4}{m_1} = \frac{1}{m_2} + \frac{1}{m_3}$

B. $m_1 = m_2 = m_3$

C. $\frac{1}{m_1} = \frac{1}{m_2} + \frac{1}{m_3}$

D. $\frac{1}{m_3} = \frac{2}{m_2} + \frac{3}{m_1}$

Answer: A

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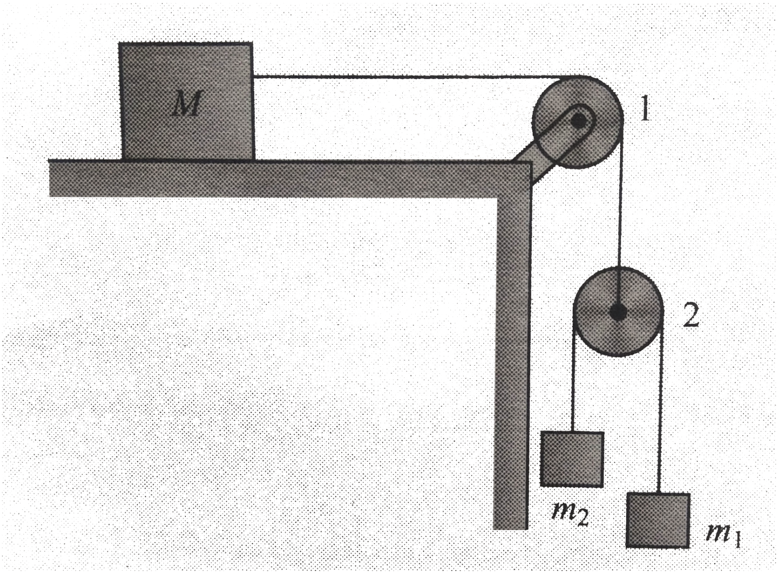
51. In the arrangement shown in fig. $m_1 = 1kg, m_2 = 2kg$. Pulleys are massless and strings are light. For what value of M, the mass m_1 moves with constant velocity.



A. 4 kg

B. 8 kg

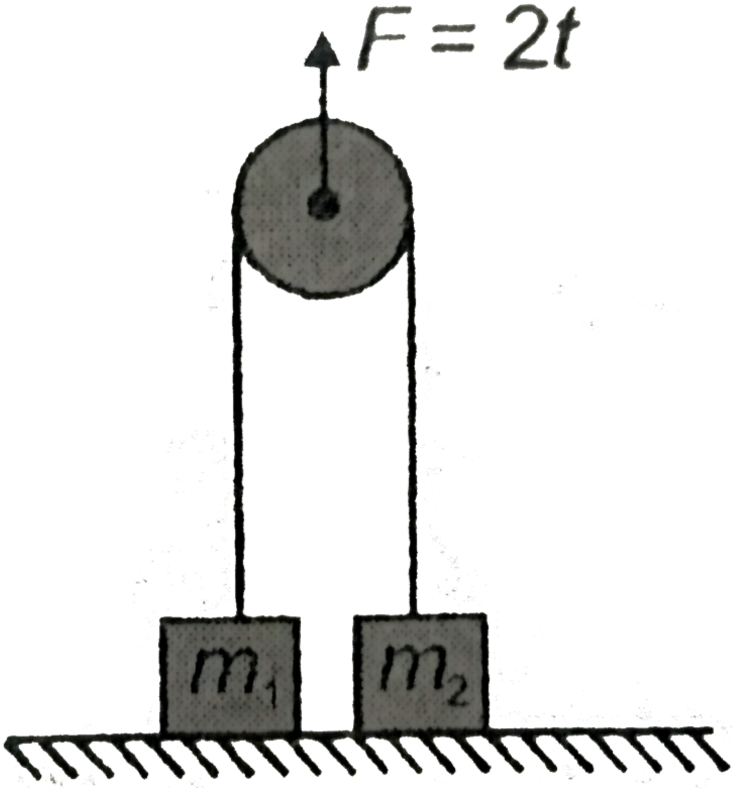
C. 6 kg

D. 10 kg

Answer: A

Watch Video Solution

52. In the figure shown $m_1 = 1kg, m_2 = 2kg,$ pulley is ideal . At t = 0 , both msses touches the ground and string is tout . A force F = 2t is applied to pulley (t is in second) then m_1 is lifted off the ground at time (g = 10 m/s^2)



A. a. 5 s

B. b. 12 s

C. c. 10 s

D. d. 15s

Answer: C

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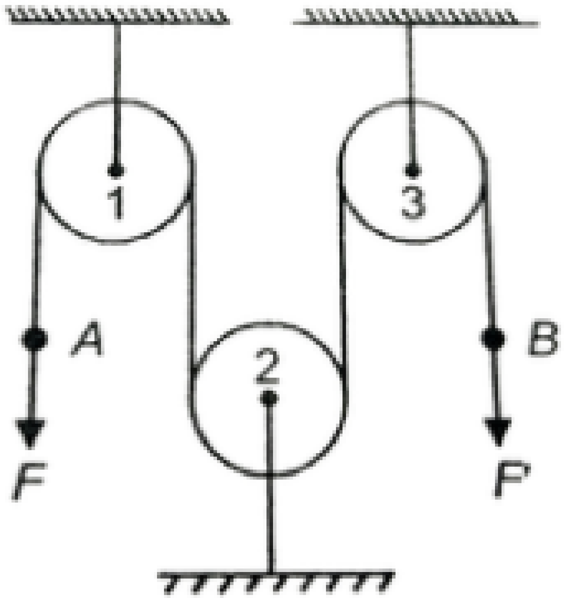
53. The tension at any point of the string AB will be same if



A. It is a single string

B. The string is massless

C. The string is smooth

D. All of these

Answer: D

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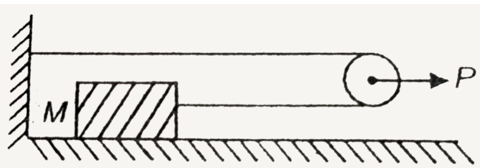
54. In the following diagram a massless pulley is pulled by a constant force of magnitude P. There is no friction between the block and the floor. The acceleration produced in the block of mass m is



A. $\dfrac{P}{m}$

B. $\dfrac{P}{2m}$

C. $\frac{P}{3m}$

D. $\frac{P}{4m}$

Answer: B

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55. A price of length 1 m and mass 1 kg is suspended vertically from one end of a massless string passing on asmooth , fixed pulley . A ball of mass 2 kg is attached to the other end from the position shown . Time taken by the ball to cross the pipe is shown.

Time taken by the ball to cross the pipe is

A. $\sqrt{\frac{3}{2g}}$

B. $\sqrt{\frac{3}{4g}}$

C. $\sqrt{\frac{3}{g}}$

D. $\sqrt{\frac{3}{8g}}$

Answer: A

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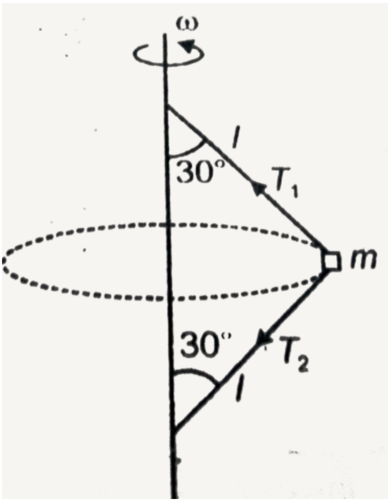
56. A particle of mass m is whirled in horizontal circle with the help of two threads of length l each as shown in figure . Angular velocity equals ω, then



A. $T_1 = T_2$

B. $T_1 > T_2$

C. $T_1 < T_2$

D. Data insufficient

Answer: B

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57. A particle of mass m is whirled in horizontal circle with the help of two threads of length l each as shown in figure . Angular velocity equals ω, then

T_1 equals

A. $\dfrac{mg}{\sqrt{3}} + \dfrac{m\omega^2 l}{2}$

B. $\dfrac{mg}{\sqrt{3}} + \dfrac{m\omega^2 l}{2}$

C. $\dfrac{m\omega^2 l}{2}$

D. $\dfrac{mg}{\sqrt{3}}$

Answer: A

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58. A car is taking a turn of radius 400 m on a horizontal circle . Coefficient of friction between the ground and tyres of car is 0.2 .

Find the maximum speed with a safe turn can be taken

A. 80 m/s

B. $40\sqrt{2}\frac{m}{s}$

C. $20\sqrt{2}\frac{m}{s}$

D. None of these

Answer: C

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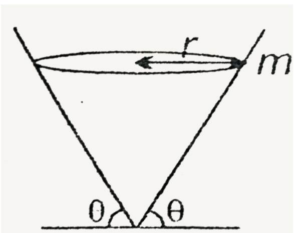
59. A ball of mass 'm' is rotating in a circle of radius 'r' with speed v inside a smooth cone as shown in figure. Let N be the normal reaction on the ball by the cone .then choose the wrong option.



A. $N = mg\cos\theta$

B. $g\sin\theta = \frac{v^2}{r}\cos\theta$

C. $N\sin\theta - \frac{mv^2}{r} = 0$

D. None of these

Answer: A

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ASSIGNMENT (SECTION -C) objective type questions (More than one options are correct)

1. In a tug of war contest , two groups of people pull on a horizontal rope from the two ends (Assume massless rope)

A. The winning group will be one which exerts greater force on the rope

B. The winning group will be one which exerts greater force on the ground

C. The tension in the rope will be equal to force exerted by each teams in the rope

D. The winning group will be one which exerts a force on rope , greater than its breaking strength

Answer: B::C

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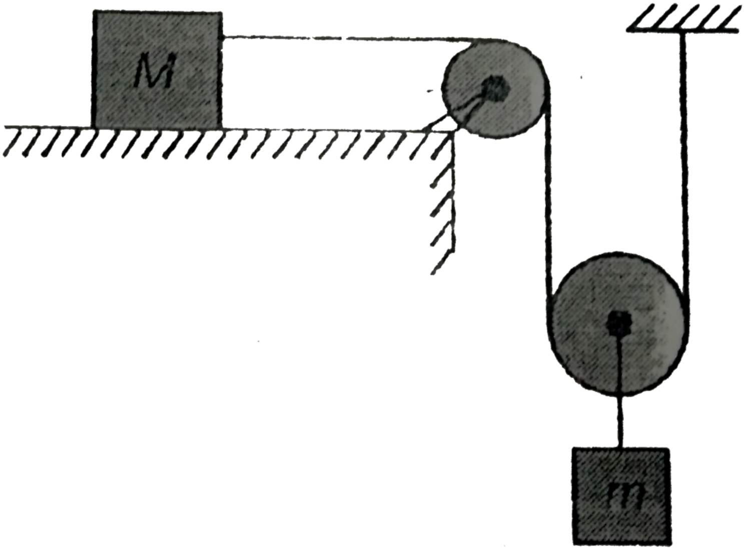
2. A block of mass M is placed on a horizontal surface. It is tied with an inextensible string that passes through ideal pulleys. A mass m is connected to the pulley as shown. For what value of m, the block M will accelerate towards the fixed pulley ?



A. a. $\frac{M}{2}$

B. b. $> \frac{M}{2}$

C. c. $< \frac{M}{2}$

D. d. For any non- zero value of m

Answer: A::B::C::D

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3. An arrangement of pulleys and blocks is shown in the figure . The two pulleys and the strings are ideal. If $m_2 > m_1$, then which of the following (s) is / are wrong ?

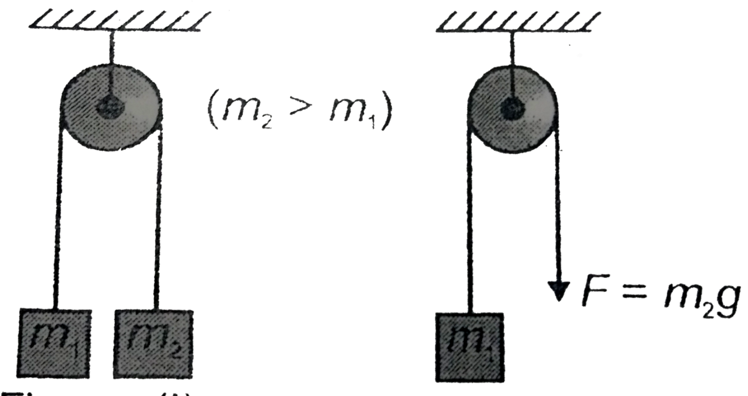

Figure (i) Figure (ii)

A. a.The magnitude of acceleration in both the cases are same

B. b.The tension in both the string is same

C. c.Net pulling force in both the cases are same

D. d.Both pulleys exert equal pressure on ceilings

Answer: A::B::D

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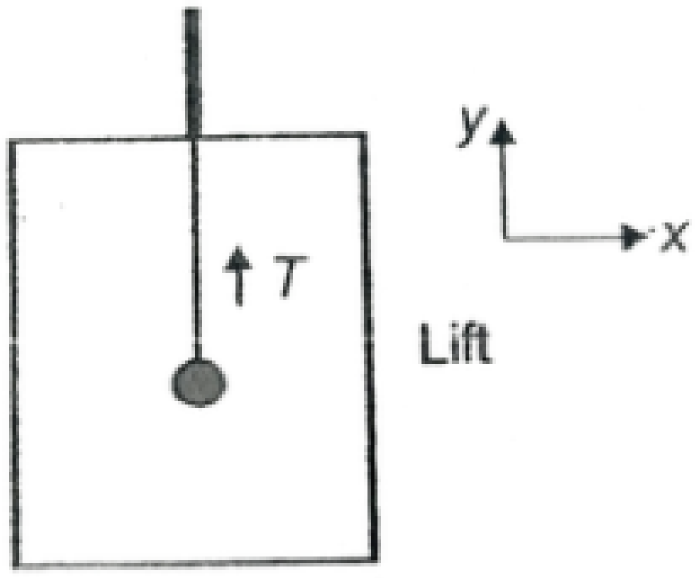
4. A pendulum bob of mass 50 gm is hanging from the ceiling of a lift by a light , inextensible string. Choose the correct options (g = 9.8 m/s^2)



A. When the lift has an acceleration $\left(1.2m / s^2\right)\hat{j}$ the tension in the string is 0.55 N

B. When the left has a constant velocity $\left(1.2m / s^{-1}\right)\hat{j}$ the tension in the string is 0.49 N

C. When the left has an acceleration $-\left(1.2m / s^{-2}\right)\hat{j}$, the tension in the string is 0.43 N

D. When the lift has a constant velocity $-(1.2m/s^{-1})\hat{j}$, the tension in the string is 0.55 N

Answer: A::B::C

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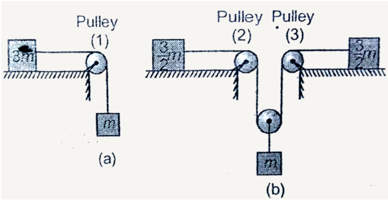
5. The two arrangement of identical frictionless and massless pulleys , string and blocks are shown in figure (a) and figure (b) . Which of the following statement (s) is/are correct ?



A. The acceleration of block m is same in both cases

B. The magnitudes of acceleration of block 3m and $\frac{3m}{2}$ is same in both cases

C. The reaction at pulley in all cases (1),(2) & (3) is same

D. Tension in the strings passing over the pulley in both cases are different

Answer: A::B::D

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6. Two blocks of masses 4 kg and $2\sqrt{3}$ kg are placed on fixed smooth wedge . They are connected by means of a massless inextensible string that passes over the pulley/ The angle of inclinations are

30° and 60° as shown in figure . Select the correct alternative (g = 10 m/s^2)

A. The blocks will remain at rest

B. The magnitude of acceleration of blocks is $\frac{5}{2+\sqrt{3}}m/s^2$

C. The tension in the string is $20\left(\frac{3+\sqrt{3}}{2+\sqrt{3}}\right)$ N

D. The tension in the sring is $20\sqrt{3}$ N

Answer: B::C

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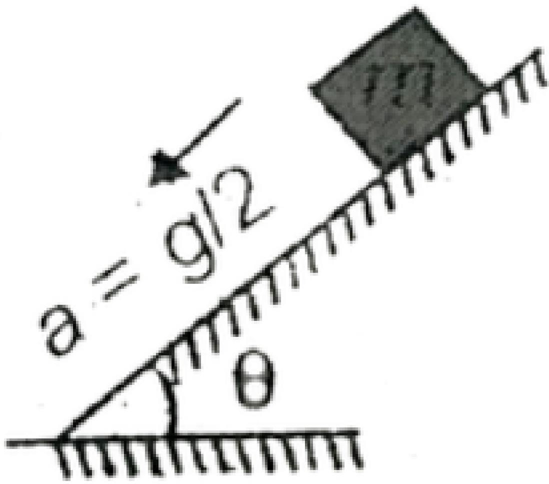
7. A block of mass m slides down a rough inclined plane with an acceleration $\frac{g}{2}$



A. The coefficient of friction (μ) between block ans incline is $\mu = \tan\theta - \frac{1}{2}\sec\theta$

B. Normal reaction on block m is $mg\cos\theta$

C. When we increase $\mu as \mu > \tan\theta,$ then acceleration of the block will cease

D. For the given acceleration , the value of coefficient of friction may vary from $\mu = \tan\theta \text{ to} \mu = \tan\theta - \frac{1}{2}\sec\theta$

Answer: A::B::C

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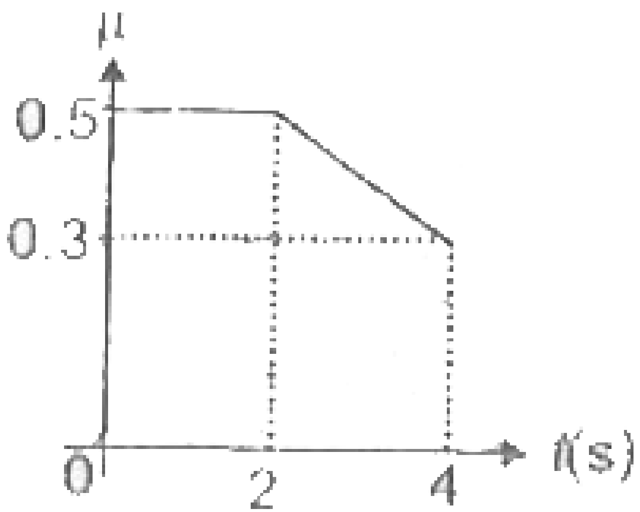
8. A block is projected with speed 20 m/s on a rough horizontal surface. The coefficient of friction (μ) between the surface varies with time (t) as shown in figure. The speed of body at the end of 4 second will be $\left(g = 10m / s^2\right)$



A. The force exerted by horizontal surface on body is constant throughtout its motion

B. Reaction by horizontal surface on the body is constant throughout its motion

C. During $t = 1s \text{to} \ t = 3s$, force of riction is constant

D. From $t = 0 \rightarrow t = 1s$ retardation of body increases

Answer: A::B::C

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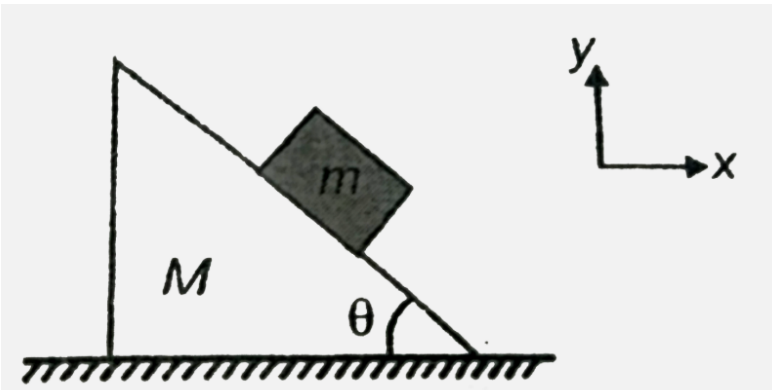
9. A block of mass m is placed on a smooth wedge of mass M, as shown in the figure . Just after placiing block m over wedge M.



A. The wedge moves horizontaly along negative x - axis with respect to ground

B. Two forces are acting on the block according to stationary observer

C. The horizontal acceleration of block and wedge are equal according to stationary observer

D. The horizontal force force acting on the wedge according to stationary observeer

Answer: A::B::D

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10. A block can slide on a smooth inclined plane of inclination θ kept on the floor of a lift. When the lift is descending with a retardation a , the acceleration of the block relative to the incline is

A. The acceleration of block relative to inclined is $(g - a)\sin\theta$

B. The normal force on block by the incline is $m(g + a)\cos\theta$

C. The acceleration of block relative to ground is g

D. The acceleration of block relative to incline is $(g + a)\sin\theta$

Answer: B::D

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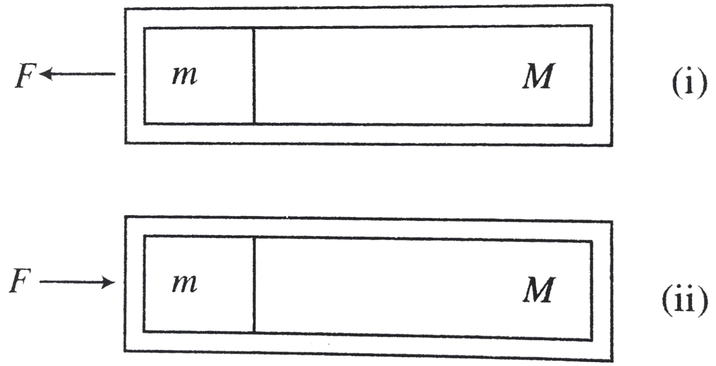
11. A block of mass m is placed in contact with one end of a smooth tube of mass M. A horizontal force F acts on the tube in each case (i) and (ii). Then,



A. After time $t=\sqrt{\frac{2MI}{F}}$, block m will fall down .

B. The relative acceleration between block and plank is zero.

C. The acceleration of block m is zero w.r.t ground before falling on ground

D. The contact force between plank and block will be zero

Answer: A::C

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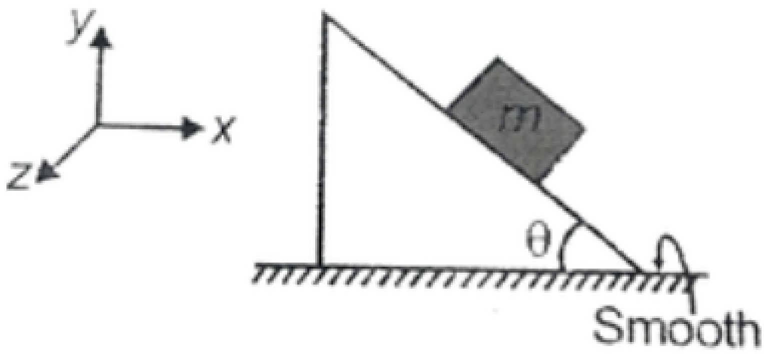
12. A wedge of inclination θ is placed on a smooth surface. Ablock of mass m placed on the wedge is found to be stationary w.r.t the wedge . Select the correct alternative .



A. If the wedge is accelerating in -x direction the wedge surface must be rough

B. If the wedge is accelerating in x-y plane in a direction making angle α with the x -

direction where $0 < \alpha < \frac{\pi}{2} - \theta$, the wedge may be smooth

C. Wedge may be accelerating along - y - direction . In this case, it may be smooth
.

D. Wedge may be accelerating along z - direction . In this case, it must be rough enough

Answer: B::D

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13. Consider a vehicle going on a horizontal rod towards east. Neglect any force by the air. The frictional forces on the vehicle by the road

A. Is always towards east if the vehicle is accelerating

B. Is zero if the vehicle is moving with a uniform velocity

C. Must be toward east

D. Must be toward west

Answer: A::B

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14. The position vector of a particle in a circular motion about the origin sweeps out equal area in equal time. Its

A. Velocity remain constant

B. Speed remain constant

C. Acceleration remain constant

D. Tangential acceleration remain constant

Answer: B::D

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15. A car of maas M is moving on a horizontal circular path of radius r. At an instant its speed is v and is increasing at a rate a.

A. The acceleration of the car is towards the centre of the path

B. The magnitude of the frictional force on the car is greater then $\frac{mv^2}{r}$

C. The friction coefficient between the ground and the car is $\mu = \dfrac{\tan^{-1}(v^2)}{rg}$

D. The friction coefficient between the ground and the car is $\mu = \dfrac{\tan^{-1}(v^2)}{rg}$

Answer: B::C

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16. Two carnot engines A and B are operating between the same sink and source .Engine A uses an ideal gas as the working fluid ,while engine B uses van der waals gas as the working fluid .which one of the following is correct?

A. The efficiency of engine A is less than that of engine B

B. The efficiency of engine A is equal to that of engine B

C. The efficiency of engine A is more than that of engine B

D. No comparision can be made

Answer: A::D

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17. A body hangs from a spring balance supported from the roof of an elevator.

(a) If the elevator has an upward acceleration of $2.45ms^{-2}$ and the balance reads 50N, what is the true weight of the body?

(b) Under what circumstances will the balance read 30N?

(c) What will be the balance reading if the elevator, cable breaks?

A. True weight of the body is 40 N

B. True weight of the body is 60 N

C. Reading of balance if the elevator cable brakes is zero

D. Reading of balance it the elevator cable brakes is equal to the true weight of body

Answer: A::C

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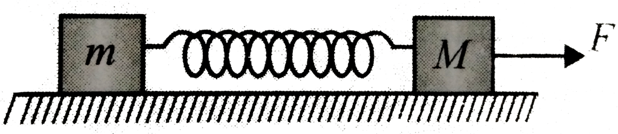
18. A block of mass m is connected to another block of mass M by a massless spring of spring constant k. the blocks are kept of a smooth horizontal plane and are at rest. The spring is unstretched when a constant force F starts acting on the block of mass M of pull it. Find the maximum extension of the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



A. Tension in the string is (m2m3/m2+m3)

B. Acceleration of m zero

C. Acceleration of 3m is (m3/m1+m2+m3)

D. Acceleration of 2m is $\frac{3g}{5}$

Answer: A::B::D

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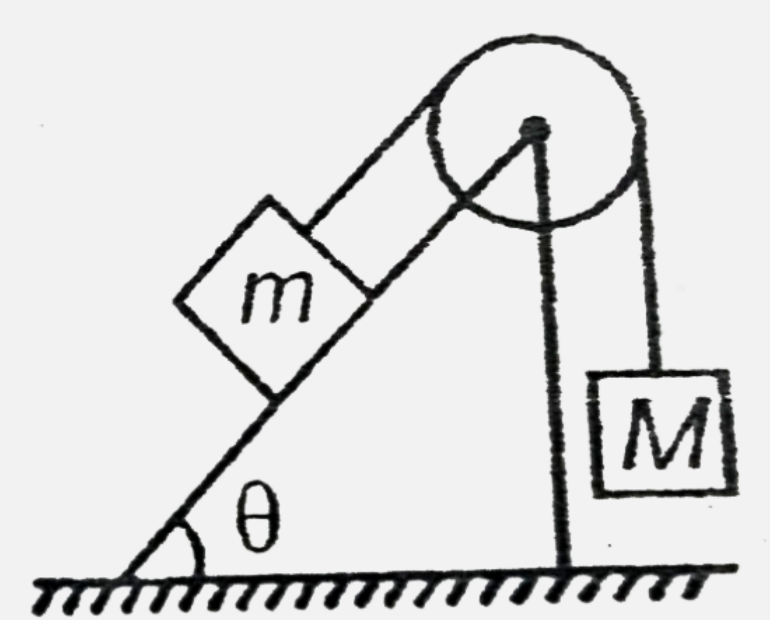
19. Wedge shown in the figure is fixed . System is released from rest (Neglect friction)



A. Acceleration of block is $\dfrac{(M - m\sin\theta)g}{M+m}$

B. Tension in the spring is

$$\frac{Mgm(1+\sin\theta)}{M+m}$$

C. Net force on pulley is zero

D. Net force on wedge is zero

Answer: A::B::C::D

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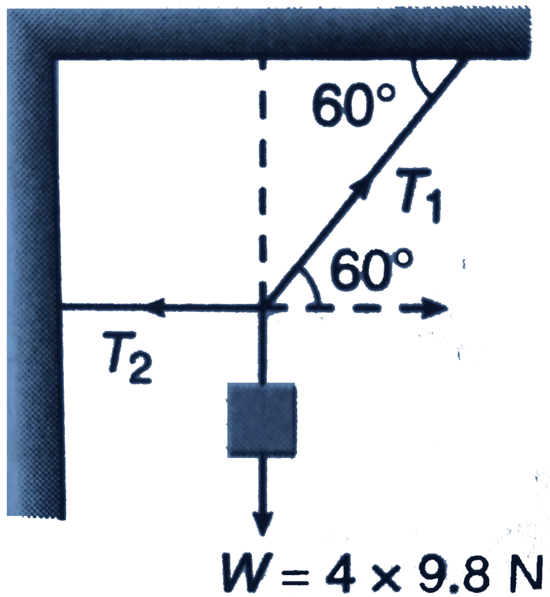
20. Determine the tensions T_1 and T_2 in the string as shown in figure.



A. $\tan \phi_1 . \frac{1}{2}$

B. $\tan \phi_2 = 1$

C. $T_1 = \sqrt{5}mg$

D. $T_2 = \sqrt{2}mg$

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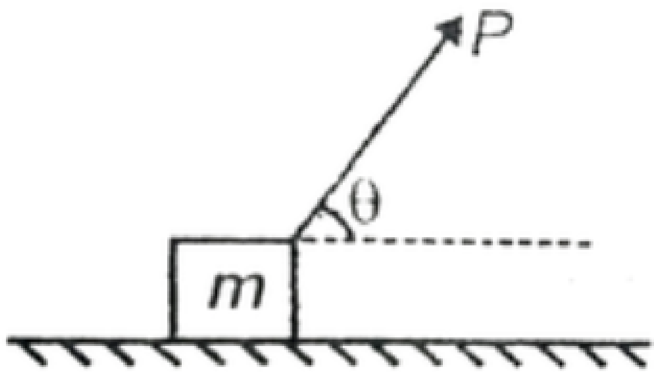
21. A force P acts on a smooth block of mass m placed on a horizontal floor at an angle θ with

with horizontal on the block



A. The net force $= P\cos\theta,$ if

$P\sin\theta < mg$

B. Acceleration $= \dfrac{P\cos\theta}{m},$ when

$p > mg\cos ec\theta$

C. Acceleration $= \dfrac{P}{m}$, if $P\sin\theta > mg$

D. $N = mg - P\sin\theta$, if $P\sin\theta < mg$

Answer: A::B::C::D

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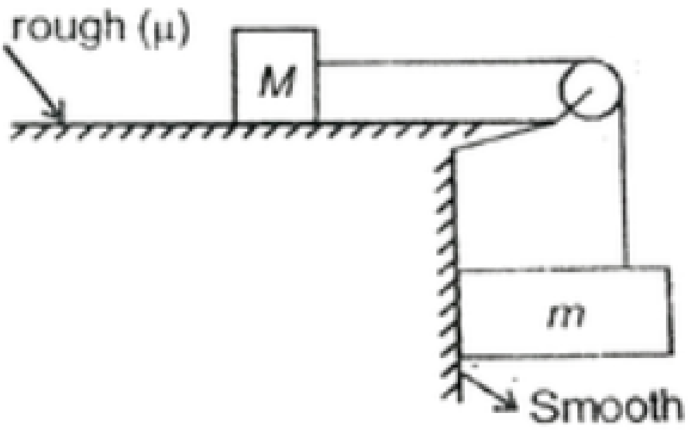
ASSIGNMENT (SECTION -D) Linked Comprehension Type Question

1. A block of mass M is placed on a rough horizontal surface. It is connected by means of a light inextensible string passing over a smooth pulley . The other end of string is connected to a block of mass m. There is no friction between vertical surface and block m



The minimum value of coefficient of friction μ

such that system remains at rest , is

A. $\dfrac{m+M}{m}$

B. $\dfrac{M}{m}$

C. $\dfrac{m}{M}$

D. $\dfrac{m}{M+m}$

Answer: C

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ASSIGNMENT (SECTION -D) Linked Comprehension Type Question (Comprehension - I)

1. A block of mass M is placed on a rough horizontal surface. It is connected by means of a light inextensible string passing over a smooth pulley . The other end of string passing over a smooth pulley. The other end of string is connected to a block of mass m. There is no friction between vertical surface and block m

If the coefficient of friction of friction μ is less than the above value, then downward acceleration of block m is

A. $\left(\frac{m-\mu M}{m+M}\right) g$

B. $\left(\frac{m+\mu M}{m+M}\right) g$

C. $\left(\frac{M-\mu m}{M+m}\right) g$

D. μg

Answer: A

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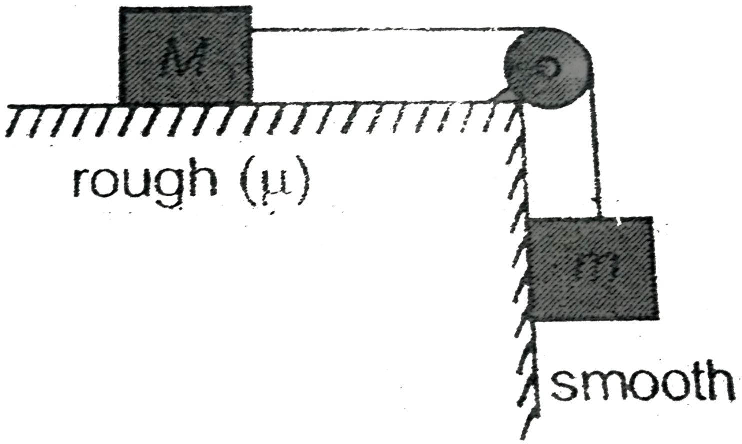
2. A block of mass M is placed on a rough horizontal surface. It is connected by means of a light inextensible string passing over a smooth pulley . The other end of string passing over a smooth pulley. The other end of string is connected to a block of mass m.

There is no friction between vertical surface and block m



If the whole system (horizontal surface + blocks) accelerates towards right the value of maximum on the horizontal surface is

A. $\left(\frac{\mu M + M}{m + M}\right) g$

B. $\left(\frac{\mu M + m}{M}\right) g$

C. $\left(\dfrac{\mu m + M}{m + M}\right)g$

D. $\left(\dfrac{\mu M + M}{M + m}\right)g$

Answer: B

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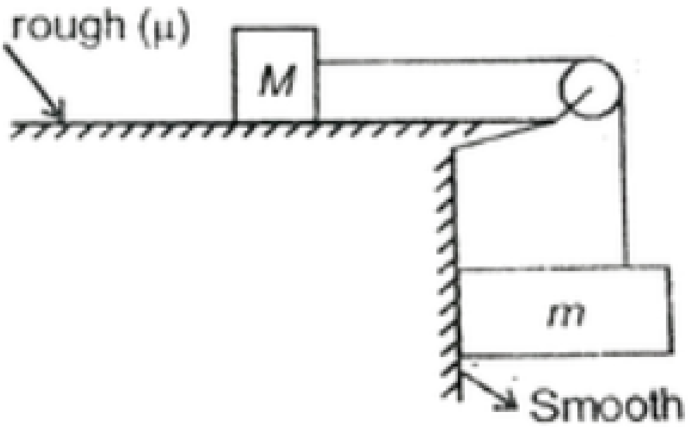
ASSIGNMENT (SECTION -D) Linked Comprehension Type Question (Comprehension - II) (Choose the correct answer :)

1. A block of mass M is placed on a rough horizontal surface. It is connected by means of a light inextensible string passing over a smooth pulley . The other end of string is connected to a block of mass m. There is no friction between vertical surface and block m



The minimum value of coefficient of friction μ such that system remains at rest , is

A. $\frac{m+M}{m}$

B. $\frac{M}{m}$

C. $\frac{m}{M}$

D. $\frac{m}{M+m}$

Answer: C

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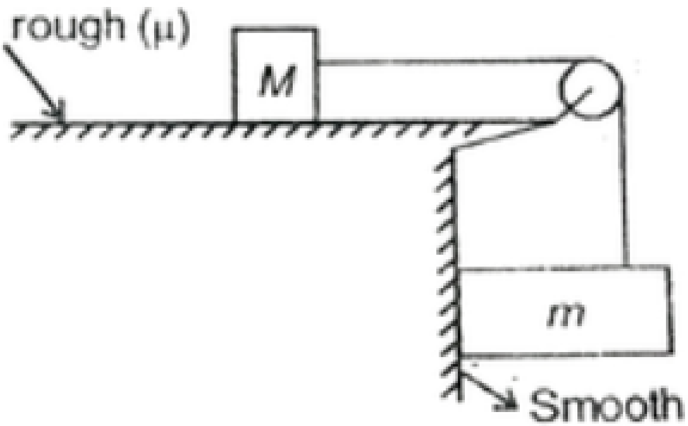
2. A block of mass M is placed on a rough horizontal surface. It is connected by means of a light inextensible string passing over a smooth pulley . The other end of string is connected to a block of mass m. There is no friction between vertical surface and block m



The minimum value of coefficient of friction μ such that system remains at rest , is

A. $\left(\frac{m-\mu M}{m+M}\right)g$

B. $\left(\frac{m+\mu M}{m+M}\right)g$

C. $\left(\frac{M-\mu m}{M+m}\right)g$

D. μg

Answer: A

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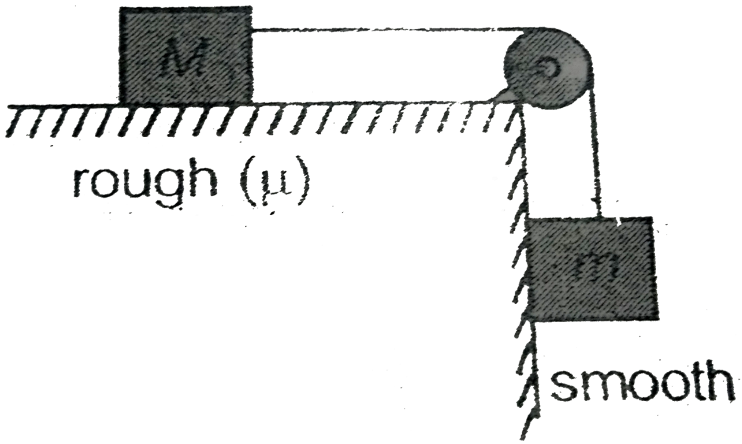
3. A block of mass M is placed on a rough horizontal surface. It is connected by means of a light inextensible string passing over a smooth pulley . The other end of string passing over a smooth pulley. The other end of string is connected to a block of mass m.

There is no friction between vertical surface and block m



If the whole system (horizontal surface + blocks) accelerates towards right the value of maximum on the horizontal surface is

A. $\left(\frac{\mu M}{M+m}\right)g$

B. $\left(\frac{\mu M+m}{m+M}\right)g$

C. $\left(\frac{\mu m+M}{M}\right)g$

D. $\left(\frac{\mu M+m}{M+m}\right)g$

Answer: B

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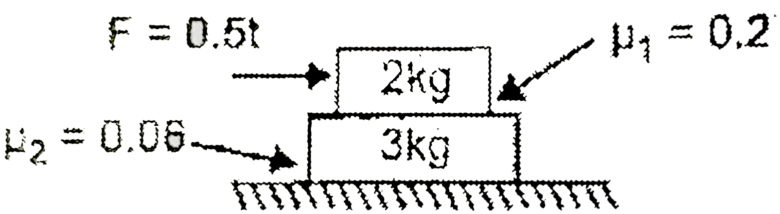
ASSIGNMENT (SECTION -D) Linked Comprehension Type Question (Comprehension - III) (Choose the correct answer :)

1. In the given diagram, the block of mass 2 kg and 3 kg are placed one over the other . The contact surfaces are rough with coefficient of friction $\mu_1 = 0.2, \mu_{92}) = 0.06)$. A force $F = \frac{1}{2} t$ N (where t is in second) is applied on upper block in the direction (Given that g = $10 m / s^2)$



The acceleration time graph for 4 kg block is :

The relative slipping between the blocks occurs at t =

A. 6 s

B. 8 s

C. $\frac{28}{3}$ s

D. Never

Answer: C

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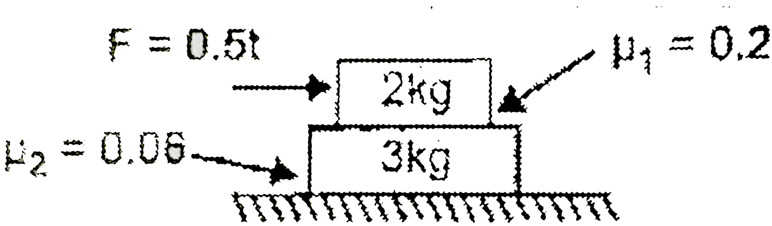
2. In the given diagram, the block of mass 2 kg and 3 kg are placed one over the other . The contact surfaces are rough with coefficient of friction $\mu_1 = 0.2, \mu_{92}) = 0.06)$. A force $F = \frac{1}{2}t$ N (where t is in second) is applied on upper block in the direction (Given that g =

$10m/s^2$)



The acceleration time graph for 4 kg block is :

Friction force acting between the two blocks

at t=8 s

A. 4 N

B. 3 N

C. $3.6N$

D. $3.2N$

Answer: C

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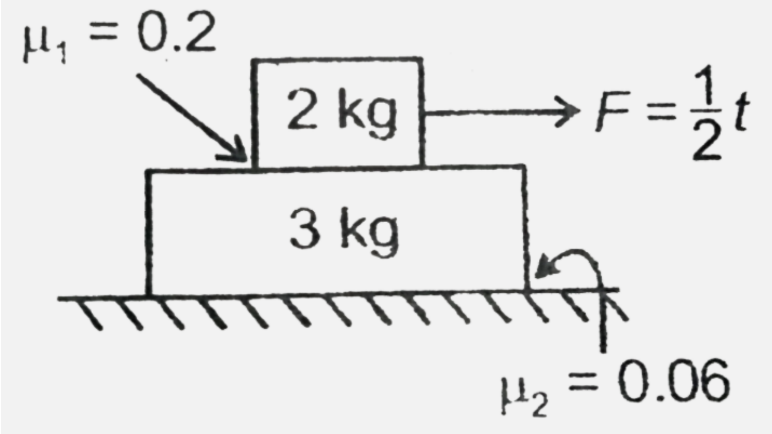
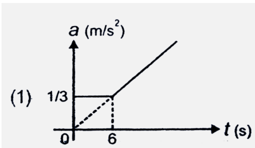
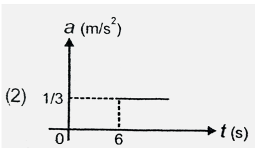
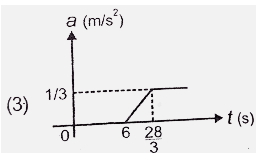
3. In the given diagram, the block of mass 2 kg and 3 kg are placed one over the other . The contact surfaces are rough with coefficient of friction $\mu_1 = 0.2, \mu_{92}) = 0.06)$. A force $F = \frac{1}{2}t$ N (where t is in second) is applied on upper block in the direction (Given that g = $10m / s^2)$

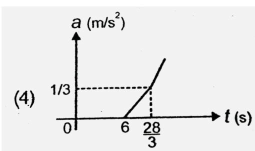


The acceleration time graph for 3 kg block is

A. 

B. 

C. 

D. 

Answer: C

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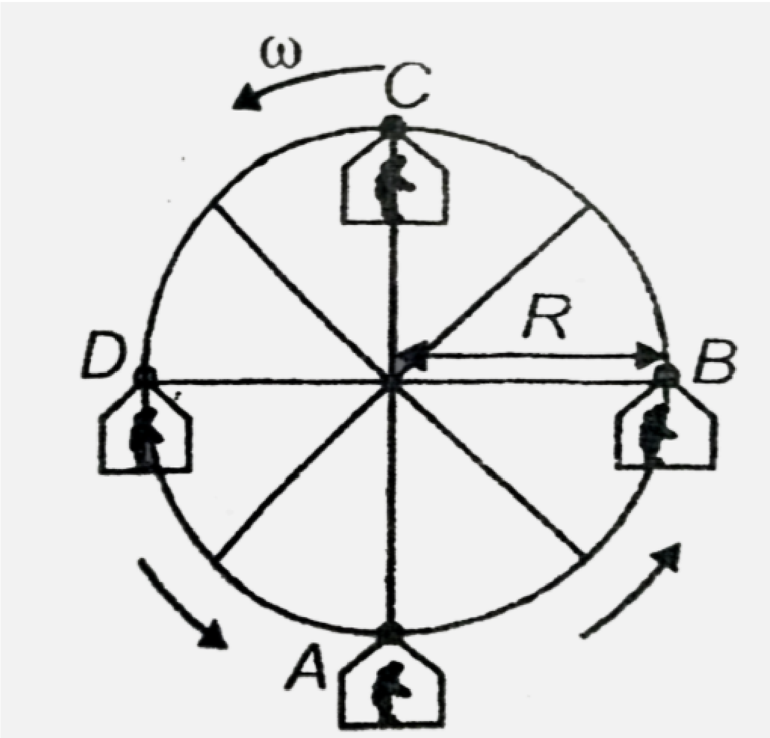
ASSIGNMENT (SECTION -D) Linked Comprehension Type Question (Comprehension - IV) (Choose the correct answer :)

1. Following figure shows a giant wheel that you must have seen in a fair . The wheel rotates with a constant angular speed ω Your younger brother is standing in one of the boxes that are fitted at the periphery of the wheels . So, he is also in a state of uniform circular motion in a vertical pane .



Let N be the normal reaction between your brother and floor of the box . select the correct alternative .

A. $N_A < N_B < N_C < N_D$

B. $N_A < N_B = N_D < N_C$

C. $N_A > N_B = N_D > N_C$

D. $N_A > N_B > N_C > N_D$

Answer: C

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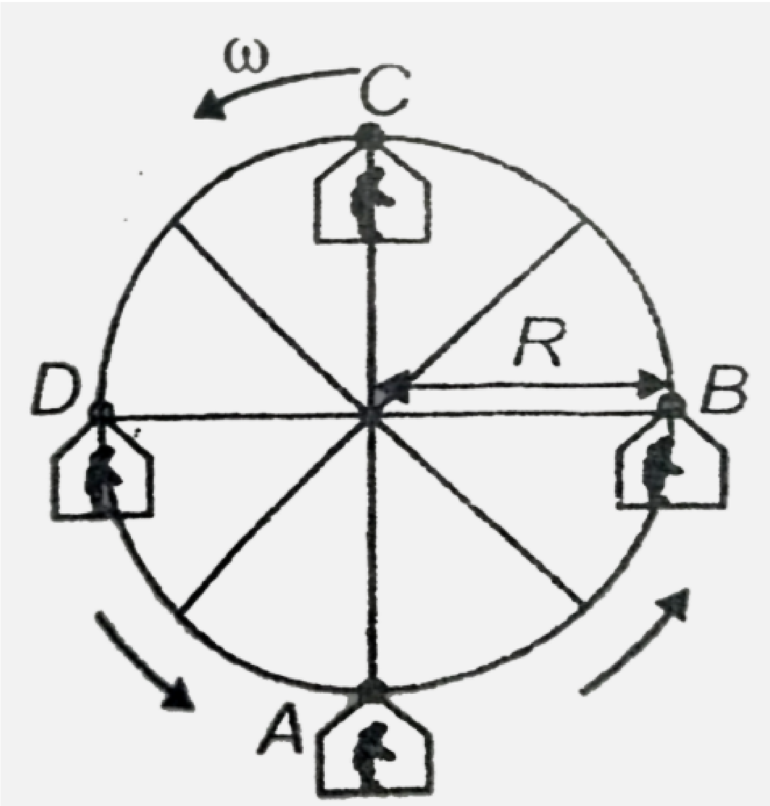
2. Following figure shows a giant wheel that you must have seen in a fair . The wheel rotates with a constant angular speed ω Your younger brother is standing in one of the boxes that are fitted at the periphery of the wheels . So, he is also in a state of uniform circular motion in a vertical pane .`



If your brother stands vertically without holding anything in the box , which of the following forces provides centripetal force to him at position B.

A. Resultant of weight and normal reaction

B. Friction between your brother and floor of the box

C. Force on the honge at which box is suspended

D. Normal reaction between floor and your brother

Answer: B

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3. The general motion of a rigid body can be considered to be a combination of (i) a motion .... of its centre of mass about an axis, and (ii) its motion about an instantaneous axis passing through the centre of mass. These axes need not be stationary. Consider, for example, a thin uniform disc welded (rigidly fixed) horizontally at its rim to a massless stick, as shown in the figure. When the disc-stick system is rotated about the origin on a horizontal frictionless plane with angular speed ω , the motion at any instant can be taken as a combination of (i) a rotation of the centre of mass of the disc about the z-axis, and (ii) a rotation of the disc through an instantaneous vertical axis passing through its centre of mass (as is seen from the changed orientation of points P and Q). Both these motions have the same angular speed ω in this case.

Now consider two similar systems as shown in the figure: case (a) the disc with its face vertical and parallel to x-z plane, case (b) the disc with its face making an angle of 45º with x-y plane and its horizontal diameter parallel to x-axis. In both the cases, the disc is welded at point P, and the system are rotated with constant angular speed ω about the z-axis

Which of the following statement regarding the angular speed about the instantaneous axis (passing through the centre of mass) is correct ?

A. $\sqrt{\dfrac{2g}{R}}$

B. $\sqrt{\dfrac{3g}{R}}$

C. $\sqrt{gR}$

D. $\sqrt{\frac{g}{R}}$

Answer: D

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ASSIGNMENT (SECTION -E) Assertion - Reason Type Questions

1. STATEMENT -1 : In a tug of war game, the two teams always pull the masless rope with same magnitude of force .

and

STATEMENT -2 : The force exerted by any team on the rope is equal to tension developed in the rope which will be same at both the ends .

A. Statement -1 True, Statement -2 is True , Statement - 2 is a correct explanation for Statement -1

B. Statement -1 is True , Statement -2 is True , Statement -2 is NOT a correct explanation for statement -1

C. Statement -1 is true, Statement -2 is False

D. Statement - 1 is False , Statement - 2 is True

Answer: A

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2. STATEMENT-1 : Tension at every point in a string with mass at every cross section must be unequal , if the string is accelerating .

and

STATEMENT - 2 : If we draw free body diagram for any section of the string , net external force acting on the string has to be equal to product of its mass (which is non- zero) and its acceleration .

A. Statement -1 True, Statement -2 is True , Statement - 2 is a correct explanation for Statement -2

B. Statement -1 is True , Statement -2 is True , Statement -2 is NOT a correct

explanation for statement -2

C. Statement -1 is true, Statement -2 is False

D. Statement - 1 is False , Statement - 2 is True

Answer: D

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3. STATEMENT -1 : You are sleeping . Now , earth suddenly stops attracting objects near its surface . You will start flying up . (Neglect earth's effect of rotation).

and

STATEMENT -2 : Normal force by surface of bed on you will be zero, if your weight becomes zero while you are sleeping .

A. Statement -1 True, Statement -2 is True , Statement - 2 is a correct explanation for Statement -1

B. Statement -1 is True , Statement -2 is True , Statement -2 is NOT a correct explanation for statement -1

C. Statement -1 is true, Statement -2 is False

D. Statement - 1 is False , Statement - 2 is True

Answer: D

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4. STATEMENT - 1 : A monkey climbing down a massless rope with magnitudes of acceleration lesses than his weight is applying force onrope lesser than its weight .

and

STATEMENT -2 : Force applied a body equals product of its mass and its acceleration .

A. Statement -1 True, Statement -2 is True , Statement - 2 is a correct explanation for Statement -4

B. Statement -1 is True , Statement -2 is True , Statement -2 is NOT a correct explanation for statement -4

C. Statement -1 is true, Statement -2 is False

D. Statement - 1 is False , Statement - 2 is True

Answer: D

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5. STATEMENT -1 : A cyclist has to bend while traversing a turn on a horizontal road .

and

STATEMENT -2: Normal force acting on the tyres of bicycle has horizontal component , (which provides the necessary centripetal force) only when cycle is bent

A. Statement -1 True, Statement -2 is True , Statement - 2 is a correct explanation for Statement -1

B. Statement -1 is True , Statement -2 is True , Statement -2 is NOT a correct explanation for statement -5

C. Statement -1 is true, Statement -2 is False

D. Statement - 1 is False , Statement - 2 is True

Answer: C

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6. A particle is projected so as to just move along a vertical circle of radius r. The ratio of the tension in the string when the particle is at the lowest and highest point on the circle is infinite

A. Statement -1 True, Statement -2 is True , Statement - 2 is a correct explanation for Statement -6

B. Statement -1 is True , Statement -2 is True , Statement -2 is NOT a correct

explanation for statement -6

C. Statement -1 is true, Statement -2 is False

D. Statement - 1 is False , Statement - 2 is True

Answer: D

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7. STATEMENT-1 : Acceleration of a particle in a reference frame may be non- zero , even if net external force acting on the particle is zero.

and

STATEMENT : 2 In a non- - inertial reference frame, Newton's second law is not valid.

A. Statement -1 True, Statement -2 is True , Statement - 2 is a correct explanation for Statement -1

B. Statement -1 is True , Statement -2 is True , Statement -2 is NOT a correct explanation for statement -1

C. Statement -1 is true, Statement -2 is False

D. Statement - 1 is False , Statement - 2 is True

Answer: A

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8. STATEMENT - 1 : A body has no inertia, when it is at the centre of the earth.

and

STATEMENT - 2 : At centre of the earth the mass of a body is non - zero .

A. Statement -1 True, Statement -2 is True , Statement - 2 is a correct explanation for Statement -1

B. Statement -1 is True , Statement -2 is True , Statement -2 is NOT a correct

explanation for statement -1

C. Statement -1 is true, Statement -2 is False

D. Statement - 1 is False , Statement - 2 is True

Answer: D

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ASSIGNMENT (SECTION -F) Matrix - Match Type Questions

1. Column (I) contains some forces, laws or statement and Column (II) contains its definition/explanation. Find best match

Column I	Column II
(A) Inertia of a body	(p) It cannot form an action reaction pair
(B) Friction force	(q) Always opposes relative motion or its tendency.
(C) Free body diagram	(r) Determined by the matter content of the body
(D) Centrifugal force	(s) Shows various forces acting on a body

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2. Match the entries in column II with the statements given in column I.

Column I	Column II
(A) We cannot have an isolated force	(p) Frictional force
(B) Magnitude of this frictional force is constant	(q) Pseudo-force
(C) The force can accelerate a body but does not follow Newton's IIIrd law	(r) Kinetic friction
(D) A force which is electromagnetic in nature	(s) Newton's IIIrd law

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3. A block of mass m is thrown upwards with some initial velocity up a rough inclined plane as shown

Match the following Column-I with Column-II

Column I	Column II
(A) Net force along the plane	(p) $m(g\sin^2\theta + \mu g\sin\theta\cos\theta)$
(B) Net force perpendicular to the plane	(q) $m(g\sin\theta + \mu g\cos\theta)$
(C) Net force in horizontal direction	(r) Zero
(D) Net force in vertical direction	(s) $m(g\sin\theta\cos\theta + mg\cos^2\theta)$

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4. A carnot engine has an efficiency of 1/6 .On reducing the sink temperature by 65 C ,the efficiency becomes 1/2 .the source temperature is given by ?

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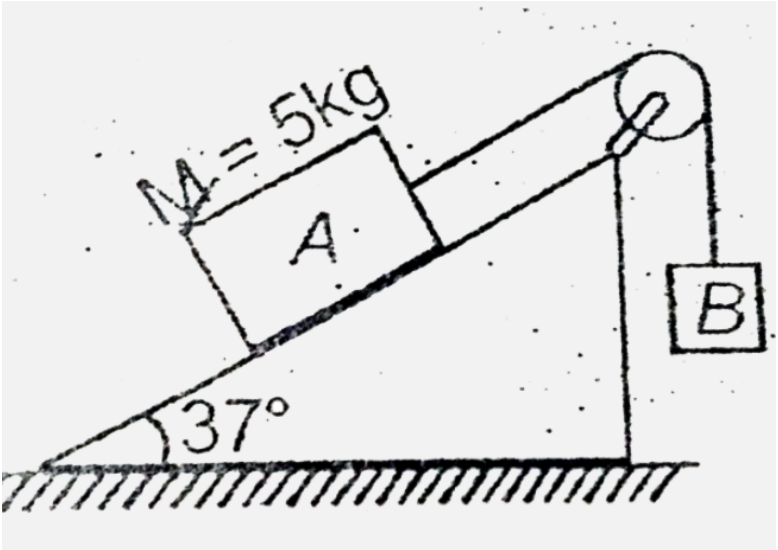
ASSIGNMENT (SECTION -G) Integer Answer Type Questions

1. Two blocks A and B are connected by a string as shown as shown in the figure . Friction coefficient of the inclined plane is 0.5 . The mass of the block A is 5 kg. If minimum and maximum values of mass of the block B for which the block A remains in equilibrium are m_1 and m_2 then find the value of $(m_2 - m_1)$

[in kg]



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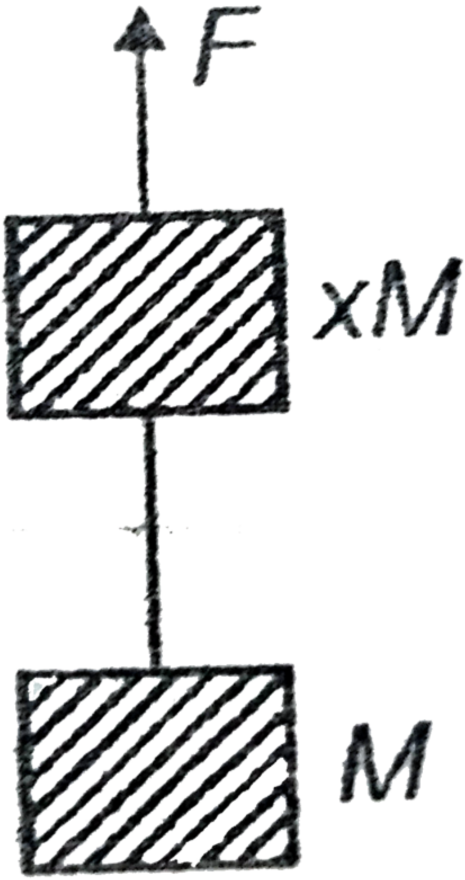
2. Two blocks of masses M and xM are pulled vertically upward with force F as shown in the figure . If the tension in string connecting two blocks is $\frac{F}{3}$ then find the value of x .



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3. In the arrangement shown in figure in which four blocks are suspended by cords . The top card loops over a frictionless pulley and pulls with a force of magnitude 98 N on the wall to which is attached . If the tensions in the shorter cords are $T_1 = 58.8N, T_2 = 49.0$ and $T_3 = 9.8N,$

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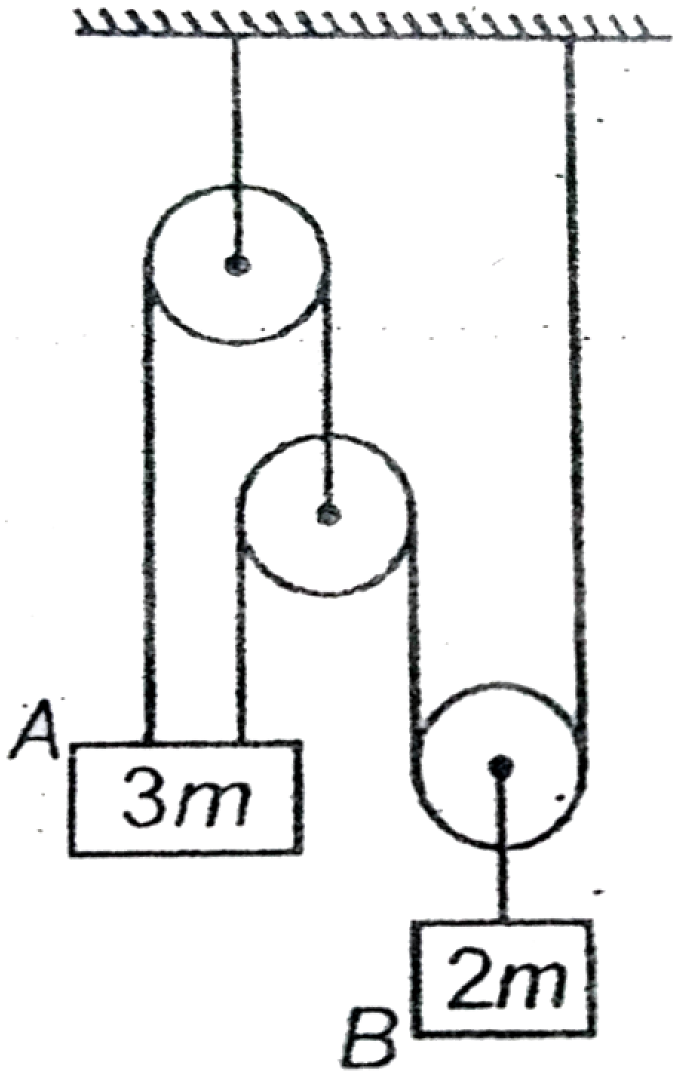
4. Consider the system shown in figure

Mass of block A= 3m ,

Mass of block B= 2m .

Find the acceleration of A and B.



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5. Find the acceleration of block A immediately after the string is cut .

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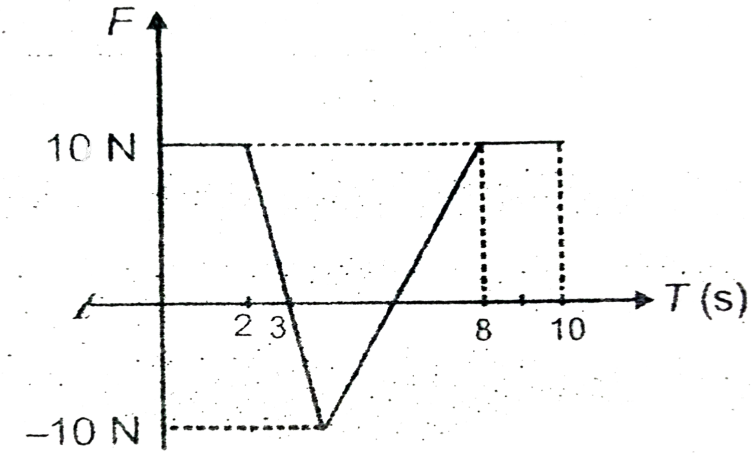
6. A time varying force acts on a particle of mass 5 kg as shown in figure . Find the speed of the particle, in m/s , after 10 s , if particle was intially at rest .



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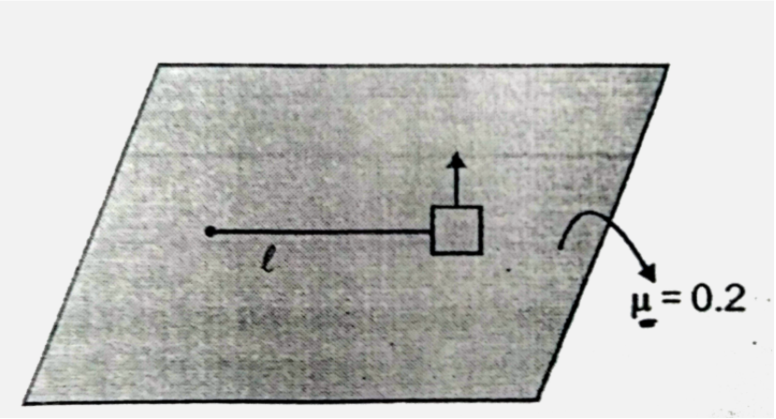
7. A block is tied with a thread of length / and moved in a horizontal circle on a rough table. Coefficient of friction between block and table is $\mu = 0.2. \text{Find} \tan\theta, \quad \text{where} \theta$ is tha angle between acceleration and frictional force at the instant when speed of particle is $v=\sqrt{1.6lg}$



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ASSIGNMENT (SECTION -H) Multiple True - False Type Questions (Identify the correct combination of true (T) and false (F) of the given three statements.)

1. STATEMENT -1 : Net force on a particle w.r.t an inertial frame does notdepend on the velocity of the intertial frame. ,

STATEMENT - 2 : If net force on A is $\overrightarrow{F}_A$ and net force on B is $\overrightarrow{F}_B$ then force on A w.r.t B is $\left(ven(F)_A - \overrightarrow{F}_B\right)$.

STATEMENT - 2 : If acceleration of A is $\overrightarrow{a}_A$ and acceleration of B is $\overrightarrow{a}_B$ then, the acceleration of A w.r.t B is $\left(\overrightarrow{a}_A - \overrightarrow{a}_B\right)$

A. $F \quad \mathrm{T} \quad F$

B. $T \quad \mathrm{F} \quad T$

C. $T \quad \mathrm{T} \quad F$

D. $F \quad \mathrm{T} \quad T$

Answer: B

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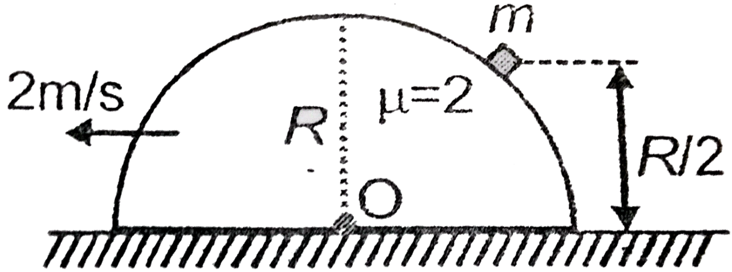
2. Consider a block (of mass m) shown in the figure , placed on a rough hemisphere of radius R. The hemisphere is moving horizontally with spped 2 m/s. Height of the block - from ground is constant .



STATEMENT -1 : Force of friction on the block is

mg .

STATEMENT -2 : Force of friction on the block is

kinetic in nature .

STATEMENT - 3 : Net force on the block is zero.

A. $T \quad \mathrm{T} \quad F$

B. $T\mathrm{T} \quad T$

C. $F \quad \mathrm{F} \quad T$

D. $T \quad \mathrm{F} \quad T$

Answer: C

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3. STATEMENT -1 : Force of friction depends on the actual area of contact .

STATEMENT -2 : Centripetal and centrifugal forces always cancel each other .

STATEMENT - 3 : A horse cannot run a cart in empty space.

A. $T \quad \mathrm{T} \quad F$

B. $T \quad \mathrm{T} \quad T$

C. $F \quad \mathrm{F} \quad T$

D. $T \quad \mathrm{F} \quad T$

Answer: C

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4. STATEMENT -1 : Real forces are frame independent .

STATEMENT - 2 : Pseudo force is frame

dependent .

STATEMENT -3 : Pseudo force is not is real force .

A. $T \mathrm{T} \quad T$

B. $T \quad \mathrm{T} \quad F$

C. $F \quad \mathrm{F} \quad F$

D. $F \quad \mathrm{T} \quad T$

Answer: A

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5. STATEMENT -1 : Friction always opposes motion .

STATEMENT - 2 : Lesser the friction on a surface it is easier to walk on it.

STATEMENT -3 : Soles of shoes gets flat due to friction .

A. $T \mathrm{T} \quad T$

B. $F \quad \mathrm{F} \quad F$

C. $T \quad \mathrm{F} \quad T$

D. $F \quad \mathrm{F} \quad T$

Answer: D

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6. STATEMENT - 1 : If an object is at rest then there should not be any friction on it .

STATEMENT - 2: If an object is moving then the friction acting on it has to be kinetic .

STATEMENT -3 : If an object is at rest then kinetic friction cannot act on it.

A. $T \quad \mathrm{T} \quad T$

B. $F \quad \mathrm{T} \quad T$

C. $F \quad \mathrm{F} \quad T$

D. $F \quad \mathrm{F} \quad F$

Answer: D

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7. STATEMENT -1 : Action and reaction acting on a particle cancels each other .

STATEMENT -2 : Action and reaction pair acts on different particles .

STATEMENT -3 : If an object is placed on a table then normal reaction by the table and weight are action reaction pair and they cancel each other .

A. $T \quad \mathrm{T} \quad T$

B. $T \quad \mathrm{F} \quad T$

C. $F \quad \mathrm{T} \quad F$

D. $F \quad \mathrm{F} \quad F$

Answer: C

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8. STATEMENT -1 : In non - uniform circular motion acceleration of a particles is along the tangent of the circle .

STATEMENT -2 : In uniform circular motion acceleration of a particle is zero .

STATEMENT -3 : In no - uniform circular motion acceleration of a particle is towards the centre of the circle.

A. $T \quad \mathrm{T} \quad T$

B. $T \quad \mathrm{T} \quad F$

C. $F \quad \mathrm{F} \quad F$

D. $F \quad \mathrm{T} \quad T$

Answer: C

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ASSIGNMENT (SECTION -I) Subjective Type Questions

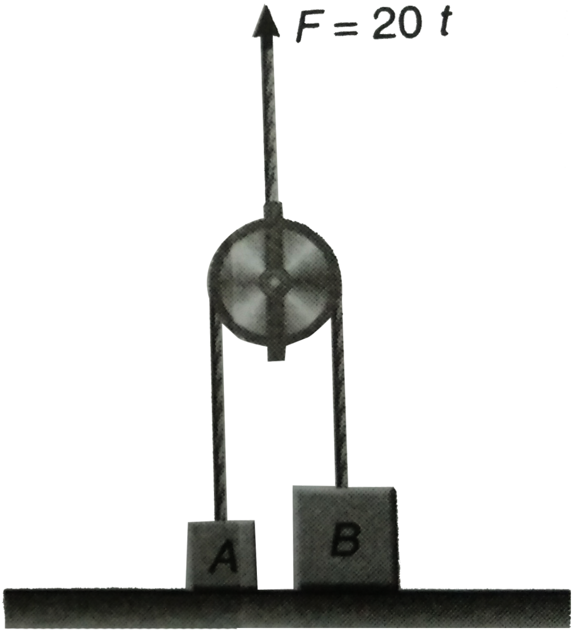
1. A 5 kg block is placed on the top of a 15 kg block as shown in figure . A horizontal force of

60 N is applied to the 15 kg block and the 5kg block is tied to the wall . The coefficient of friction between moving surfaces is 0.2

(a) Draw the free body diagram for each block w.r.t ground and identify the action reaction forces between two blocks .

(b) Determine the tension in the string and magnitude of the acceleration of the 15 kg block .

2. Two block A and B of masses $1kg$ and$2kg$ respectively are connected by a string, passing over a light frictionless pulley B as shown. Another string connect the center of pulley. Both the blocks are resting on a horizontal floor and the pulley is help such that string remains just taut. At moment $t=0$, a force $F=20t$ starts acting on the pully along vertically upwards direction as shown in figure.Calculate



(a) velocity of A when B loses contact with the floor.

(b) height raised by the pulley upto that instant.

(Take =$g = 10m/s^2$)

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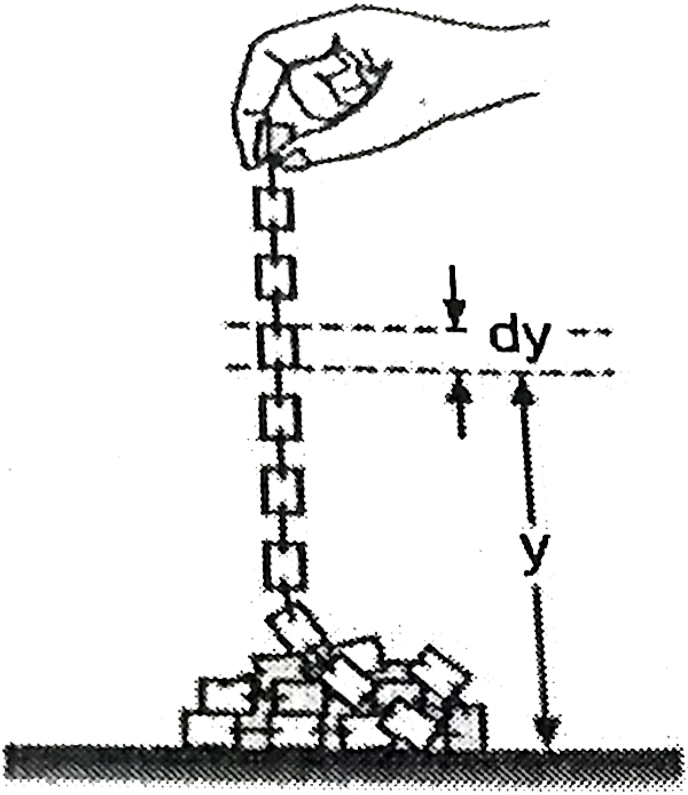
3. A very flexible uniform chain of mass M and length L is suspended vertically so that its lower and just touches the surface of a table. When the upper end of the chain is released it falls with each link coming to rest the instant it strikes the table. Find the force exerted by the chain on the table at the moment when y part of the chain has already rested on the table.



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4. Having gone through a plank of thickness h, a bullet changed its velocity from v_0 to v_1. Find the time of motion of the bullet on the plank, assuming the resistance force to be proportional to the square of the velocity.

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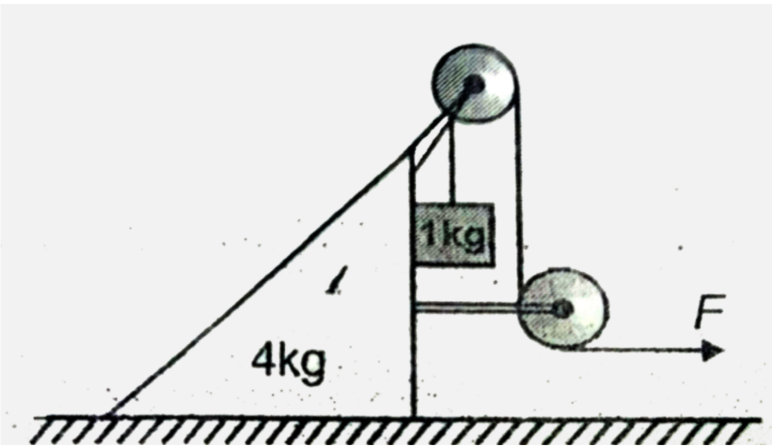
5. An arrangement is shown in the figure . The mass of the wedge is 4 kg and that of the block is 1 kg . There is no friction between wedge and ground , but coefficient of friction between vertical surface of the wedge and to the block is mu= 0.1. . (Assume ideal pulley and string) (g = $10m/s^2$) and assuming the pulley to be massless and friction. calucalate the maximum possible values of force upto while bock remain stationary relative to wedge.



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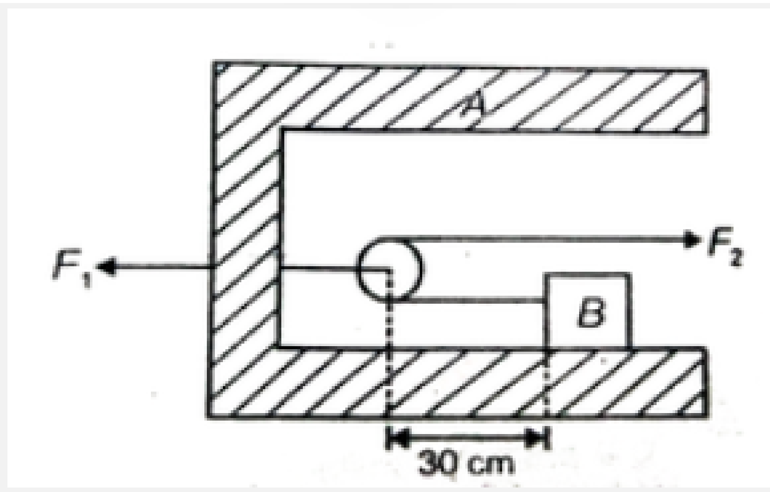
6. A 1 kg block B rests as shown on a bracket A of same mass. Constant forces $F_1 = 25N$ and $F_2 = 10N$ start to act at time t=0 when the distance . Find time when block B reaches the pulley .



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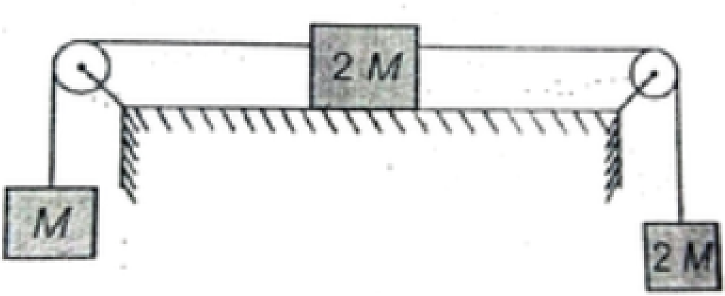
7. The three blocks in figure are released from rest and accelerate at the rate of 2 $\frac{m}{s^2}$. If M = 5 kg , what is the coefficient of friction between the surface and the block B ?



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8. A block of mass m slides in right angled incliine through as shown in the figure . If the

coefficient of kinetic friction between the block and the through is μ_k , find the acceleration of the block .

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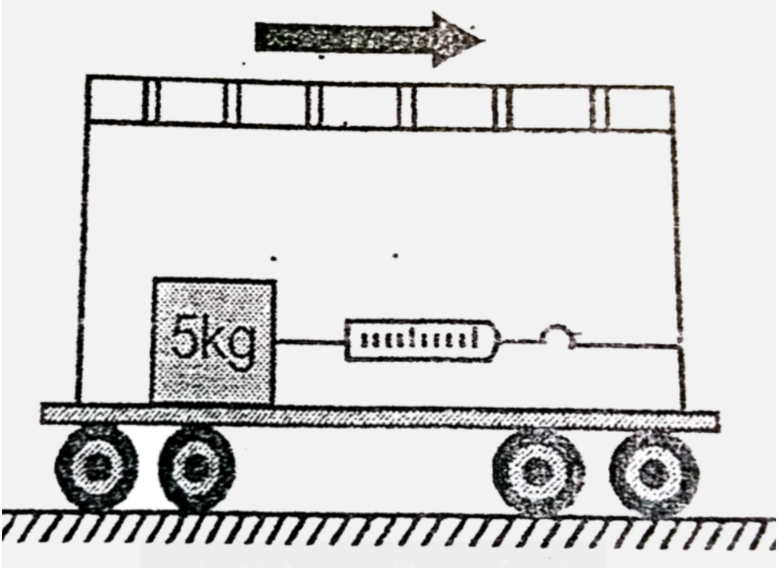
9. A 5 kg mass attached to a spring scale rests on a frictionless , horizontal surface as in figure . The spring scale, attached to the front end of a box car, reads 18 N when the car is in motion .



(a) If the spring reads zero when the car is at rest , determine acceleration of the car while it is in motion .

(b) What will the spring scale read if the car moves with constant velocity ?

(c) Describe the forces on the mass as observed by someone in the car and by someone at rest outside the car.

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ASSIGNMENT (SECTION -J) Aakash Challengers Questions

1. The linear mass density , i.e mass per unit length of the rope as shown in figure , varies 0 to λ from one end to another . The acceleration of the combined system of figure will be

A. $\dfrac{F}{\left(M+\frac{\lambda L}{2}\right)}$

B. $\dfrac{F}{(M + \lambda L)}$

C. $\dfrac{F}{(M + 2\lambda L)}$

D. $\dfrac{F}{\left(\frac{M}{2} + \lambda L\right)}$

Answer: A

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2. A uniform rope of length l and mass m lies on a smooth horizontal table with its length perpendicular to the edge of the table and a small part of the rope having over the edge.

The rope starts sliding from rest under the weight of the over hanging end. The velocity of the rope when the length of the hanging part is . x

A. $\sqrt{\frac{gx}{l}}$

B. $\sqrt{\frac{gx^2}{l}}$

C. $\frac{gx}{l}$

D. $\frac{gx^2}{l}$

Answer: B

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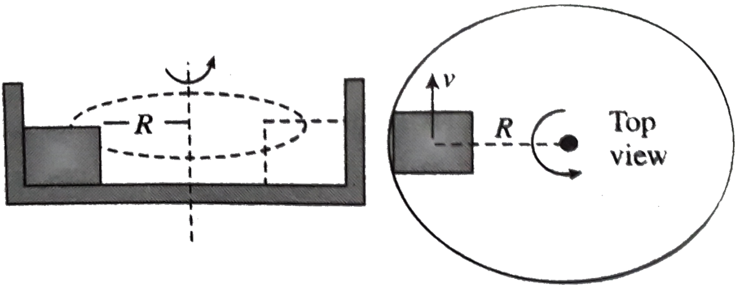
3. A block of mass m is revolving in a smooth horizontal plane with a constant speed v.If the radius of the circle path is R find the total contact force received by the block



A.

B.

C.

D.

Answer: C

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4. A block of mass 2 kg hangs by an inextensible light string that passes over smooth pulley Another mass 1 kg hangs from the other end of the string and is connected with a vertical massless spring . The system is stationary. Just after the string is cut, the acceleraion of 1 kg and 2 kg are respectively .

Given that $g = 10m / s^2$

A. 0,0

B. $0, 10\frac{m}{s^2} \downarrow$

C. $5m / s^2 \uparrow , 10m / s^2 \downarrow$

D. $20m / s^2 \uparrow , 10m / s^{20 \uparrow}$

Answer: D

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5. A particle P is moving on a circle under the action of only one force acting always fixed point O on the circumference . Find ratio of

$$\frac{d^2\phi}{dt^2} \text{ and } \left(\frac{d\phi}{dt}\right)$$

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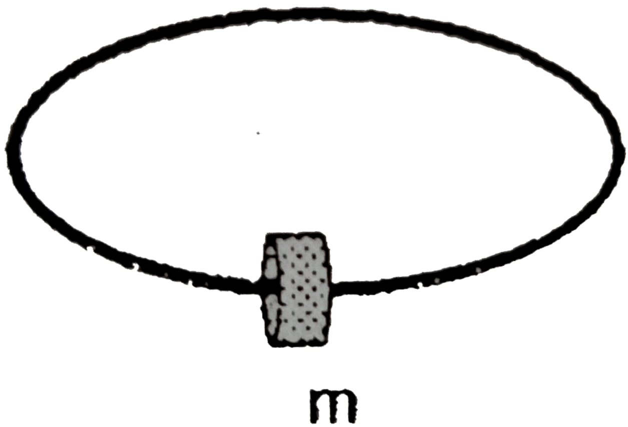
6. Choose the correct option:

A small collar of mass m is given an initial velocity of magnitude v_0 on the horizontal circular track fabricated from a slender rod. If the coefficient of kinetic friction is μ_K, determine the distance traveled before the collar comes to rest. (Recognize that the friction force depends on the net normal force).



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7. A unifrom flexible chain of length $\frac{3}{2}$ m rests on a fixed smooth sphere of radius $R = \frac{2}{\pi}$ m such that one end A of chain is on the top of the sphere while the other end B is hanging freely. Chain is helpd stationary by a horizontal thread PA as shown . Calculate the acceleration of chain when the horizontal string PA is burnt (g = 10 m/s^2)

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8. A long plank begins to move at $t = 0$ and accelerates along a straight track wit a speed given by $v = 2t^2$ for $0 \leq t \leq 2$ (where v is in m/s and t is in second). After 2 sec the plane continues to move at the constant speed acquired. A small initially at rest on the plank begins to slip at $t = 1$ sec and stops sliding at $t = 3$ sec. If the coefficient of static friction and kinetic friction between the plank and the block is $0.\,s$ and $0.\,k$ (where s and k are digits) respectively, find $s + k$ (take $g = 10m/s^2$)

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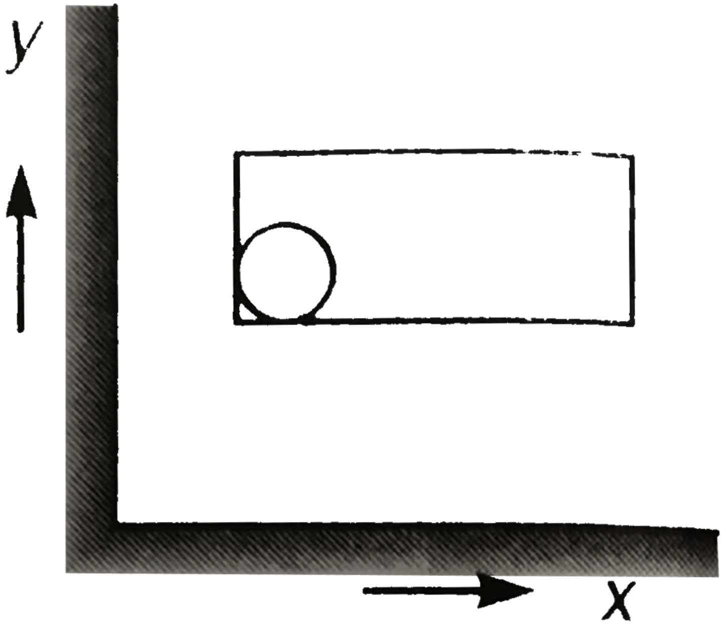
9. A sphere of mass $1kg$ rests at one corner of a cube. The cube is moved with a velocity $v = \left(8t\hat{i} - 2t^2\right)\hat{j}$, where t is time in second . The force by sphere on the cube at $t = 1s$ is $\left(g = 10m/s^{-2}\right)$ [figure shown vertical plane of the cube]



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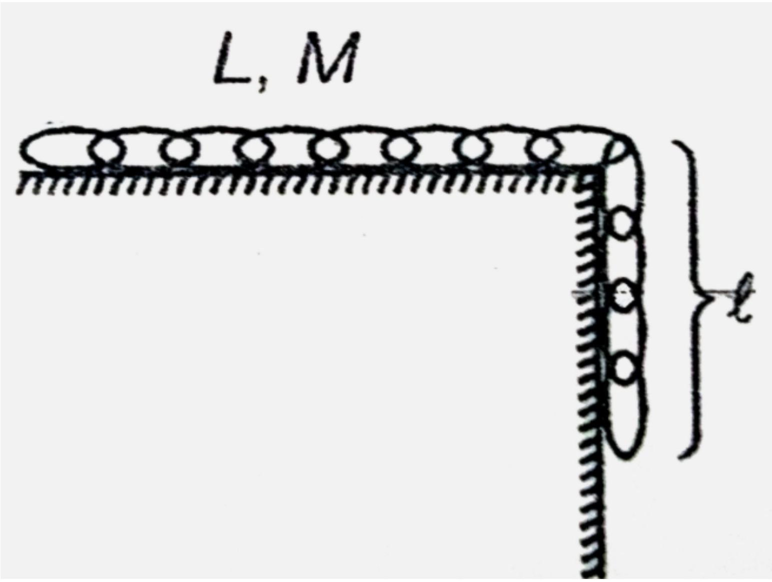
10. A uniform chain of mass M and length L is hanging from the table. The chain is in limiting equilibrium when l length of chain over hangs . It is slightly disturbed from this position. Find the speed just after it completely comes off the table.



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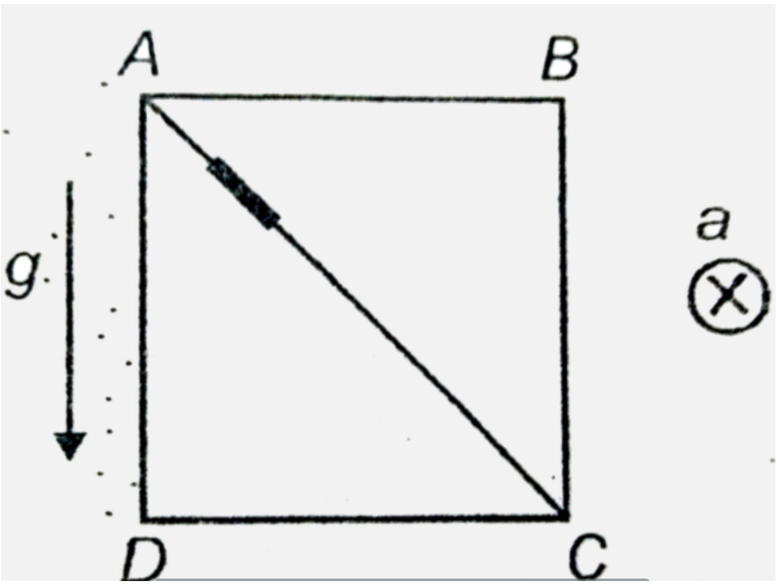
11. A rectangular wire frame ABCD is in vertical plane is moving with a constant acceleration a into the plane as shown . Direction of gravity is shown inn figure . A collar can move on wire AC of length l . Coefficient of friction between wire and collar is μ. Find



ltbr. (i)

The ..... (i) maximum acceleration a so that collar does not slip on wire.

(ii) The time taken by collar to reach C if acceleration is half the value calculated in part

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12. The system is released from rest. All surface are smooth . Find the angle theta at which the acceleration of wedge is maximum. (given . $\frac{M}{m} = \frac{1}{2}$)

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Example

1. Explain why a bullet fired against a glass windowpane makes a hole in it but the glass pane is not cracked.

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2. A moving bicycle comes to rest after some time if we stop pedaling it. But Newton's first law of motion says that a moving body should continue to move forever, unless some external force acts on it . Is it failure of Newton's law ? Explain

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3. Why is it advised to tie any luggage kept on the roof of a bus with a rope?

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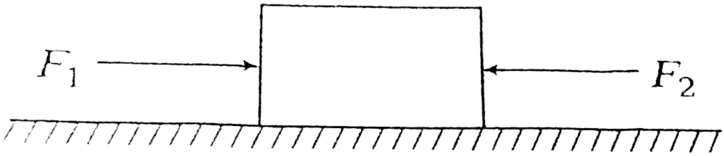
4. Let us consider two forces F_1 and F_2 acting on a body of mass 2 kg as shown in the figure. $F_1 = 10N$, $F_2 = 2\text{N}$, what will be the

acceleration?



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5. A bus starts from rest and moves down a hill with constant acceleration. The bus travels a distance of 400 m in 10 second. If mass of the bus is 5 metric tonne, then what will be its acceleration and force acting on it? (1 metric tonne = 1000 kg)

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6. A stone of mass 1 kg is thrown with a velocity of $20ms^{-1}$ across the frozen surface of a lake and it comes to rest after travelling a distance of 50m. What is the magnitude of the force opposing the motion of the stone?

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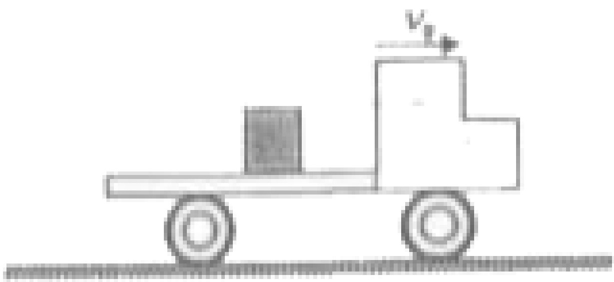
7. An iron block of mass m = 500 kg is kept at the back of a truck moving at a speed $v_0 = 90kmh^{-1}$. The driver applies the brakes and shows down to a speed of $v = 54kmh^{-1}$ in 10s. What constant force acts on the block during this time if the block does not slide on the truck-bed?



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8. A force $F = \left(2t\hat{i} + 3t^2\hat{j}\right)$N acts on an object moving in XY-plane. Find the magnitude of change in momentum of the object in the time interval t=0 to t=2s.

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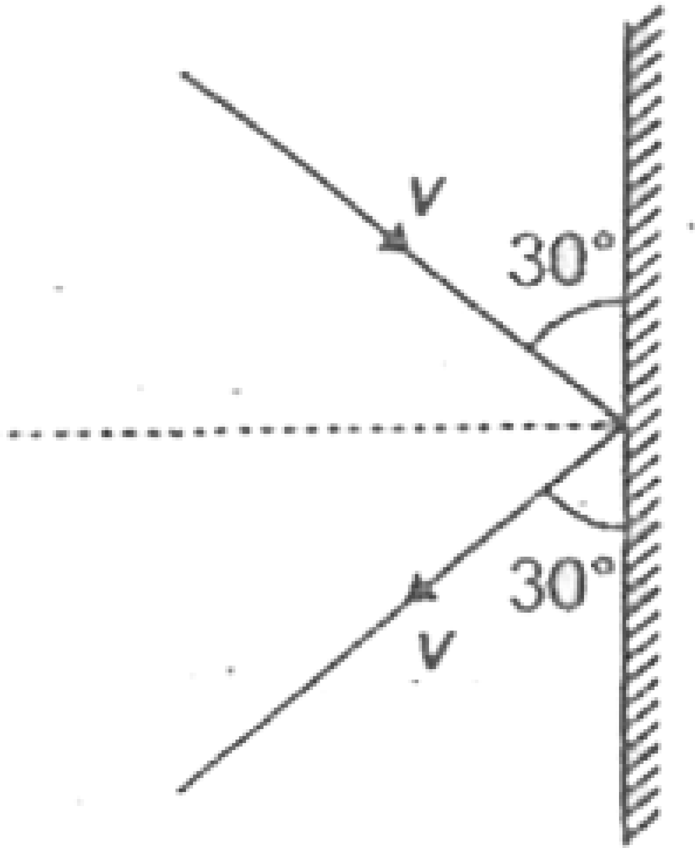
9. A ball of mass m strikes a rigid wall with speed v and gets reflected without any loss of speed, as shown in the figure.



(a) What is the magnitude of the impulse imparted to the ball by the wall?

(b) What is the direction of the force on the wall due to the ball?

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10. A 800 kg rocket is fired from earth so that exhaust speed is 1200 m/s. Then calculate mass of fuel burning per second, to provide initial thurst to overcome its weight. $(g = 10m/s^2)$.

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11. Akhtar, Kiran and Rahul were riding in a motorcar that was a high velocity on an

expressway when an insect hit the windshield and got stuck on the windscreen . Akhtar and Kiran started pondering over the situation. Kiran suggested that the insect suffered a greater change in momentum as compared to the change in momentum of the motorcar (because the change in the velocity of the insect was much more than that of the motorcar). Akhtar said that since the motorcar was moving with a larger velocity, it exerted a larger force on the insect. And as a result, the insect died. Rahul while putting an entirely new explanation said that both the motorcar and the insect experienced the same force and a change in their momentum. Comment on these suggestions.

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12. A bullet of mass 50 g is fired from a gun with initial velocity of 35 m/s. If mass of the gun is 4 kg, then calculate the recoil velocity of the gun.

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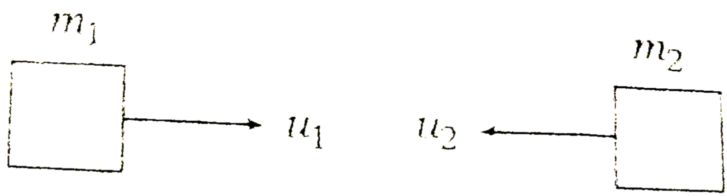
13. Two objects each of mass 5 kg are moving in the same straight line but in the opposite direction towards each other with some speed of 3 m/s. They stick to each other after collision. What will be the velocity of the combined object after collision?



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14. A 1000 kg engine pulls a train of 4 wagons each of 2500 kg along a horizontal railway track. If the engine exerts a force of 50000 N on wagons and track offers force of friction 10000 N, then calculate

(i) The net accelerating force

(ii) The acceleration of the train

(iii) The force of wagon-1 on wagon-2

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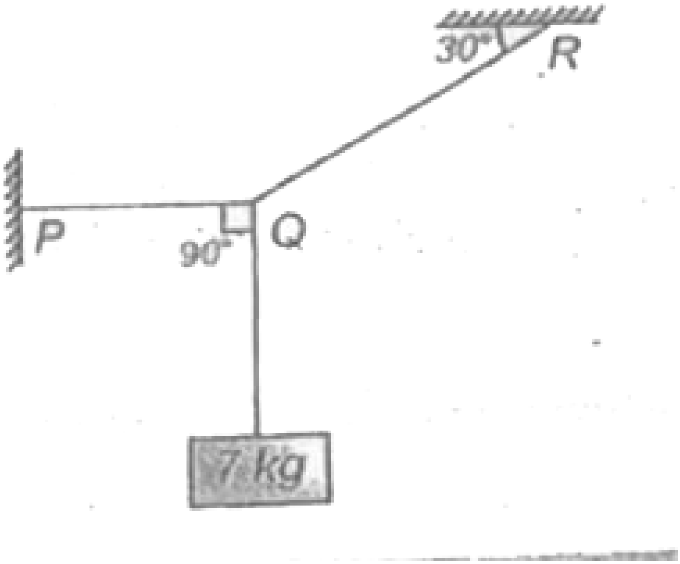
15. Find the tension in the horizontal string PQ and the string QR in the given figure. [Take $g = 10m/s^2$]



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16. Two masses 2 kg and 4 kg are connected at the two ends of light inextensible string passing over a frictionless pulley. If the masses are released, then find the acceleration of the masses and the tension in the string.

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17. A block of mass 8 kg is sliding on a surface inclined at an angle of 45° with the horizontal. Calculate the acceleration of the block. The coefficient of friction between the block and surface is 0.6. (Take $g = 10 m / s^2$)

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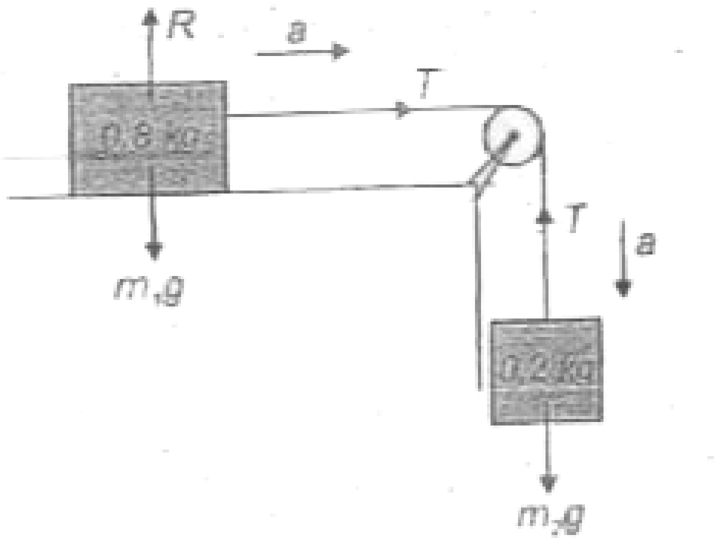
18. A wooden block of mass 0.8 kg is dragged along a level frictionless surface by a hanging block of mass 0.2 kg as shown in the figure. Calculate the tension in the string and the acceleration of blocks.



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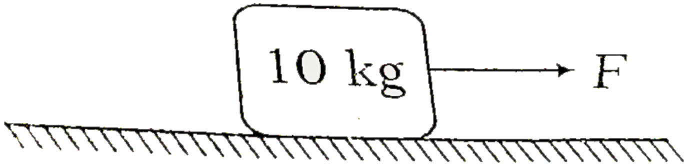
19. A body of mass 10 kg is kept on a horizontal floor of coefficent of static friction $\mu_s = 0.5$ and coefficient of kinetic friction $\mu_k = 0.45$ as shown in figure.



$\mu_s = 0.5$

$\mu_k = 0.45$

Find the acceleration, force of friction and contact force on the body by the plane when the driving force is $\left(g = 10ms^{-2}\right)$

(i) 40 N (ii)60N

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20. A block of mass 5 kg rests on a inclined plane at an angle of 30° with the horizontal. If the block just begins to slide, then what is the coefficient of static friction between the block and the surface?

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21. Find the maximum speed with which a car can turn on a bend without skidding, if radius of bend is 20 m and coefficient of friction between the road and the tyres is 0.4.

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22. A circular racetrack of radius 100 m is banked at an angle of 45°. What is the

(i) Optimum speed of race car to avoid wear and tear of its tyres?

(ii) Maximum permissible speed to avoid slipping if the coefficient of friction is 0.2?

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23. A cyclist speeding at 4.5 km/h on a level road takes a sharp circular turn of radius 3 m without reducing the speed. The coefficient of static friction between the road and the tyres is 0.1.

(i) Will he slip while taking the turn?

(ii) Will he slip if his speed is 9 km/h?

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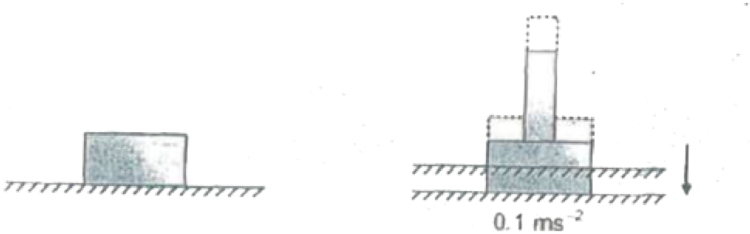
24. A wooden block of mass 1 kg rests on a soft horizontal floor. When an iron cylinder of mass 20kg is placed on top of the block, the floor yields steadily and booth go down with an acceleration of $0.1ms^{-2}$. What is the action of the block on the floor (a) before and (b) after the floor yields? (Take $g = 10ms^{-2}$). Identify the action and reaction pairs in the problem.



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EXERCISE

1. The concept of inertia is explained in :-

A. Newton's first law

B. Newton's second law

C. Newton's third law

D. All of these

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2. Inertia of a body has direct dependence on

A. Impulse

B. Momentum

C. Mass

D. Area

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3. According to Newton's 2nd law of motion correct equation is (where symbols have their usual meanings)

A. $\overrightarrow{F} = \frac{d\overrightarrow{p}}{dt}$

B. $\overrightarrow{F} = m\overrightarrow{a}$

C. $\overrightarrow{F} = \overrightarrow{v}\frac{dm}{dt}$

D. All of these

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4. A body of mass 6 kg is acted on a by a force so that its velocity changes from $3ms^{-1}$ to $5ms^{-1}$, then change in momentum is

A. 48 Ns

B. 24 Ns

C. 30 Ns

D. 12 Ns

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5. The momentum p (in kg ms^{-1}) of a particle is varying with time t (in second) as $p = 2 + 3t^2$. The force acting on the particle at $t = 3s$ will be

A. 18 N

B. 54 N

C. 9 N

D. 15 N

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6. A body is acted upon by balanced forces

A. If it is in rest only

B. If it is moving with constant speed

C. If even number of forces are acting on it

D. If it is not acceleraating

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7. Impulse on a body is equal to

A. Change in momentum

B. Force $\times$ time interval

C. Force $\times$ speed

D. Both (1) & (2)

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8. A bull of mass m is moving towards a player with velocity v. If player stopped it, then impulse applied by the player is

A. $-m\overrightarrow{v}$

B. $+m\overrightarrow{v}$

C. $-2m\overrightarrow{v}$

D. $+2m\overrightarrow{v}$

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9. A body of mass m is projected with intial speed u at an angle θ with the horizontal. The change in momentum of body after time t is :-

A. $mu \sin \theta$

B. $2mu \sin \theta$

C. mgt

D. Zero

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10. The working of rocket is based on the principle of _______________.

A. Newton's first law of motion

B. Newton's second law of motion

C. Newton's third law of motion

D. Both (1) & (2)

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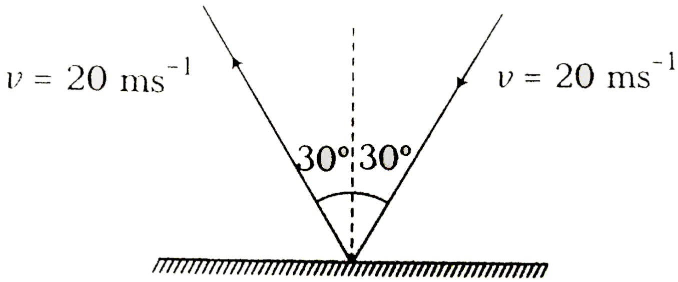
11. A ball is moving with speed $20ms^{-2}$ collides with a smooth surface as shown in figure. The magnitude of change in velocity of the ball will be



(Smooth horizontal surface)

A. $10\sqrt{3}m / s$

B. $20\sqrt{3}m / s$

C. $\frac{40}{\sqrt{3}}m / s$

D. $40m / s$

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12. If impulse I varies time t as I $(kgms^{-1}) = 20t^2 - 40t$.

The change in momentum is minimum at :-

A. t = 2s

B. t = 1s

C. $t = \frac{1}{2}s$

D. $t = \frac{3}{2}s$

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13. A machine gun fires n bullets per second and the mass of each bullet is m. If v is the speed of each bullet, then the force exerted on the machine gun is

A. nmu

B. $2nmu$

C. $4nmu$

D. $\frac{nmu}{2}$

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14. An initially stationary device lying on a frictionless floor explodes into two pieces and slides across the floor one piece is moving in positive x direction then other peice is moving in

A. Positive y direction

B. Negative y direction

C. Negative x direction

D. At angle from x direction

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15. If final momentum is equal to initial momentum of the system then

A. No net force on the system

B. Always net force on the system

C. May be net force on the system

D. Both (1) & (2)

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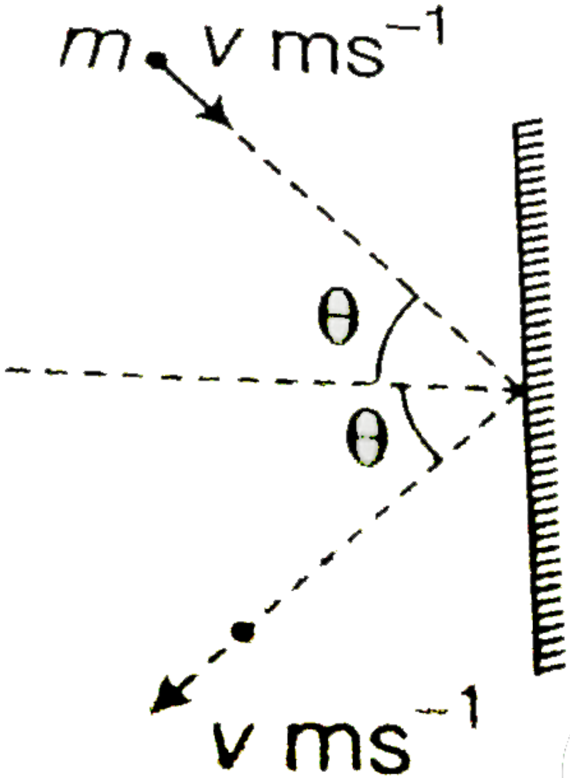
16. A ball is moving towards the wall as shown in diagram then momentum is conserved



A. Along the wall

B. Along the perpendicular to the wall

C. Along any direction

D. Both (1) & (2)

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17. A body of mass 5 kg is moving with velocity of $v = \left(2\hat{i} + 6\hat{j}\right)ms^{-1}$ at t=0s. After time t=2s, velocity of body is $\left(10\hat{i} + 6\hat{j}\right)$, then change in momentum to body is

A. $40\hat{i}kgm/s$

B. $20\hat{i}kgm/s$

C. $30\hat{i}kgm/s$

D. $\left(50\hat{i}+30\hat{j}\right)kgm/s$

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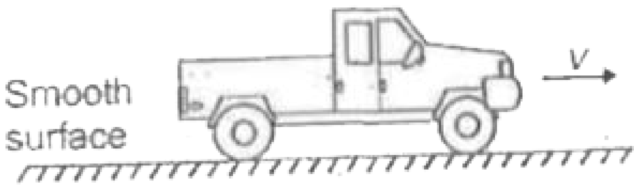
18. A cart loaded with sand moving with velocity v. Sand is falling through the hole as shown in diagram then after falling on the ground sand is



A. Moving with cart

B. Moving in opposite direction with speed

V

C. Stationary on the ground

D. Moving with speed v_1

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19. A particle of mass m strikes elastically on a wall with velocity v, at an angle of 60° from the wall then magnitude of change in momentum of ball along the wall is

A. Zero

B. 2mv

C. $\sqrt{3}mv$

D. mv

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20. The average force necessary to stop a hammer with momentum p (in N-s) in 0.5 s is :-

A. 2p N

B. p N

C. 4p N

D. $\frac{p}{2}$N

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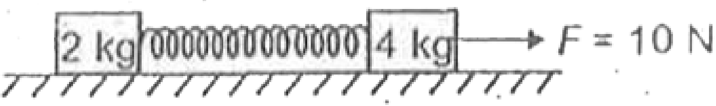
21. Two blocks of mass 2 kg and 4 kg are accelerated with same acceleration by a force 10 N as shown in figure on a smooth horizontal surface. Then the spring force between the two blocks will be (spring is massless)



A. 5N

B. 10N

C. $\frac{10}{3}N$

D. $\frac{5}{3}$N

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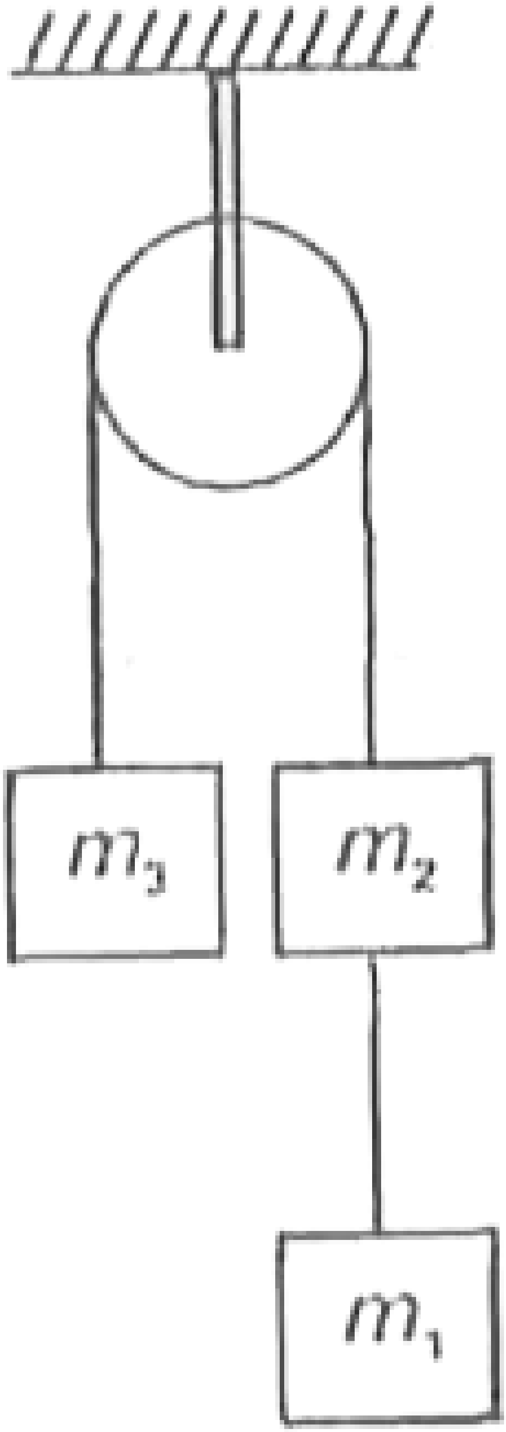
22. Three blocks of masses $m_1 = 4kg, m_2 = 2kg, m_3 = 4kg$ are connected with ideal strings passing over a smooth, massless pulley as shown in figure. The acceleration of blocks will be

$$\left(g = 10m / s^2\right)$$



m_3
m_2
m_1

A. $2m/s^2$

B. $4m/s^2$

C. $3m/s^2$

D. $5m/s^2$

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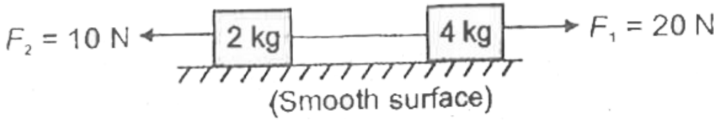
23. The tension in the string connected between blocks is



A. $\frac{80}{3}$N

B. $\frac{40}{3}$N

C. $\frac{50}{7}$N

D. 26N

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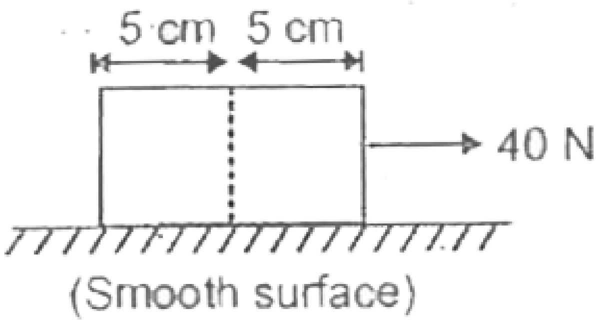
24. A block of mass m as shown in figure is pulled by a force 40N. The tension at the middle of the block is



A. 10 N

B. 20 N

C. 25 N

D. 30 N

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25. A block is stationary on a rough inclined plane. How many forces are acting on the block?

A. 2

B. 3

C. 4

D. 5

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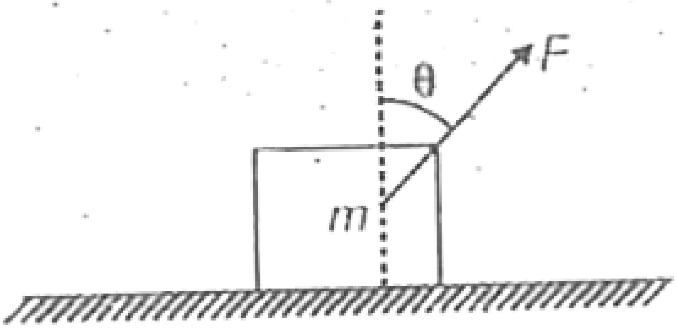
26. In the given arrangement, the normal force applied by block on the ground is



A. mg

B. $mg - F\cos\theta$

C. $mg + F\cos\theta$

D. $F\cos\theta$

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27. A book of mass 5 kg is placed on a table and it is pressed by 10 N force then normal force exerted by the table on the book is

A. 10 N

B. 70 N

C. 59 N

D. 50 N

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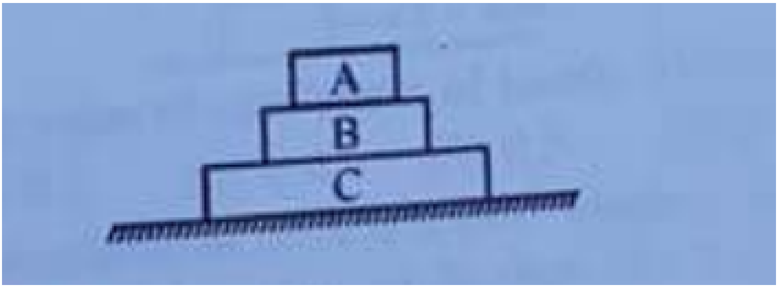
28. Three blocks are placed as shown in figure. Mass of A, B and C are m_1, m_2, and m_3 respectively. The force exerted by block 'C' on

'B' is :-



A. $m_1 g$

B. $(m_1 + m_2)g$

C. $m_2 g$

D. $(m_1 + m_2 + m_3)g$

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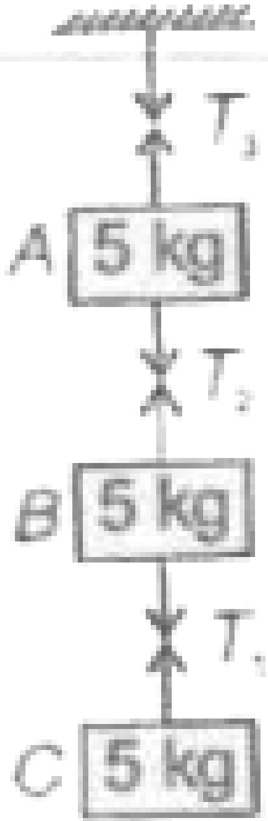
29. The value of $\dfrac{T_3}{T_1}$ is



A. 1

B. 2

C. 3

D. $\frac{3}{2}$

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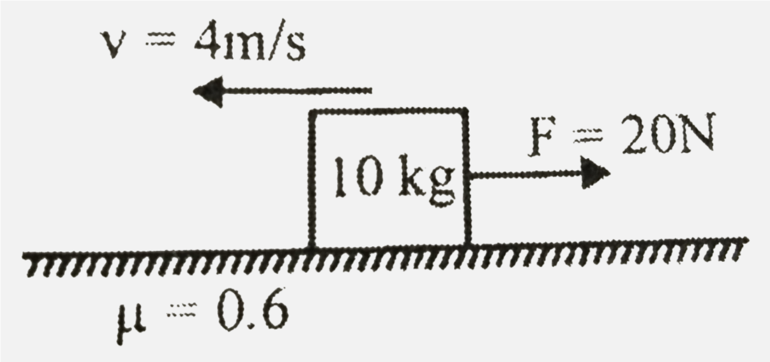
30. A block of mass 10 kg is moving on a rough surface as shown in figure. The frictional force acting on block is :-



A. 20 N

B. 60 N

C. 40 N

D. 80 N

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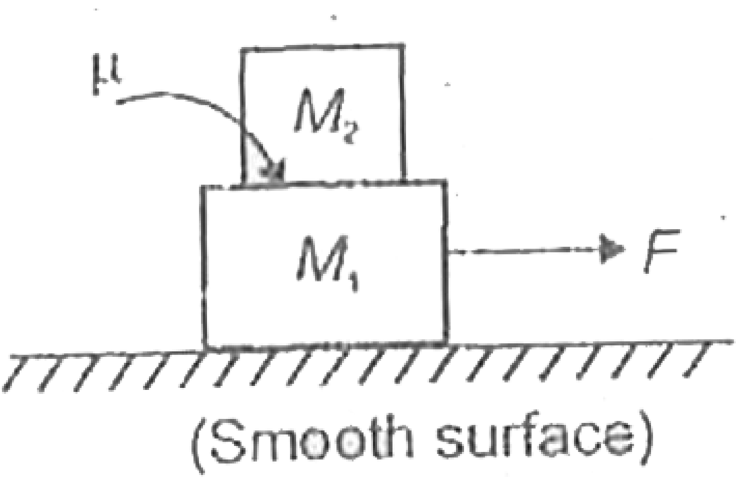
31. The maximum value of F which can be applied on the system shown in figure so that both blocks move together with same acceleration is



A. $F = \mu M_2 g$

B. $F = \mu[M_1 - M_2]g$

C. $F = \mu M_1 g$

D. $F = \mu[M_1 + M_2]g$

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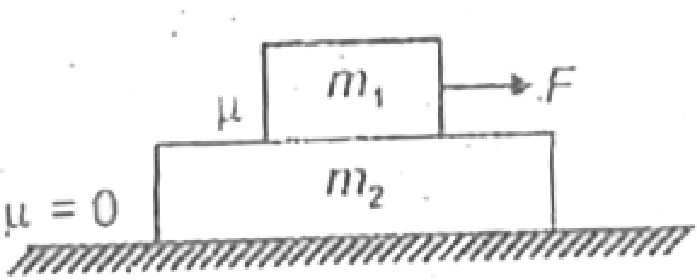
32. In the given arrangement the maximum value of F for which there is no relative motion between the blocks



A. $\mu m_1 g$

B. $\mu(m_1 + m_2)g$

C. $\mu m_1 g\left(\frac{m_1}{m_2} + 1\right)$

D. Zero

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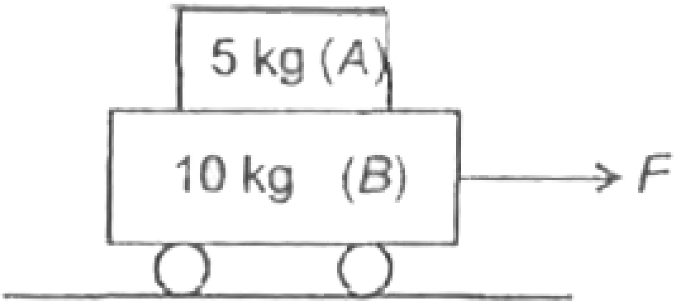
33. If acceleration of A is $2m/s^2$ which is smaller than acceleration of B then the value of frictional force applied by B on A is



A. 50 N

B. 20 N

C. 10 N

D. None of these

Answer: C

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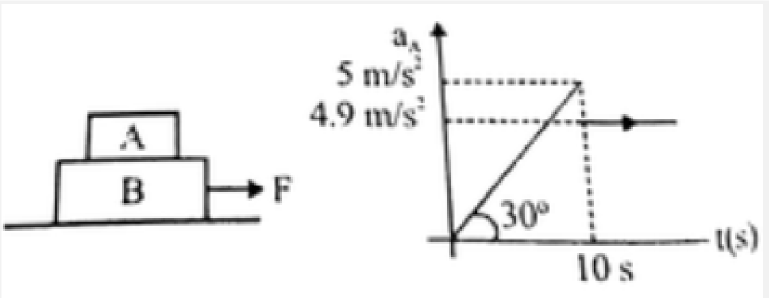
34. Acceleration of block A varies with time as shown in figure the value of coefficient of kinetic friction between block A and B is



A. 0.5

B. 0.6

C. 0.4

D. None of these

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35. Block of mass 10 kg is moving on inclined plane with constant velocity 10 m/s. The coedfficient of kinetic friction between incline plane and block is :-

A. 0.57

B. 0.75

C. 0.5

D. None of these

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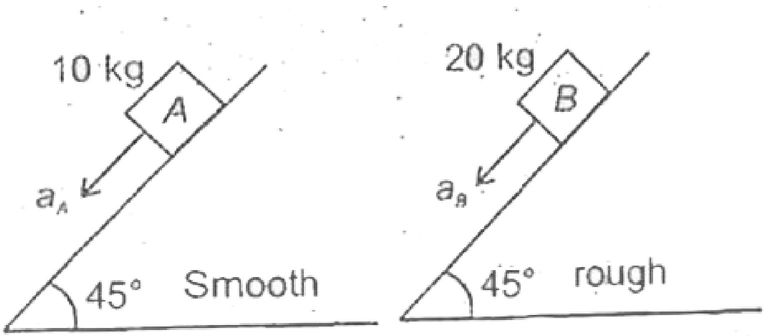
36. 

The ratio of acceleration of blocks A placed on smooth incline with block B placed on rough incline is $2:1$. The coefficient of kinetic friction between block B and incline is

A. 0.5

B. 0.75

C. 0.57

D. None of these

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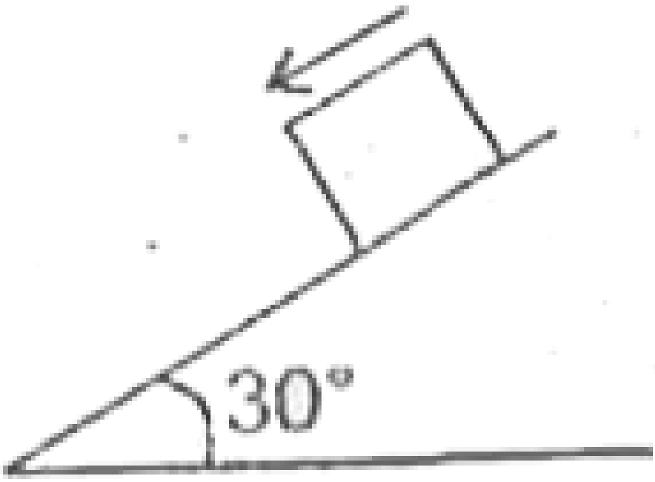
37. A block of mass 10 kg is released on rough incline plane. Block start descending with acceleration $2m/s^2$. Kinetic friction force acting on block is (take $g = 10m\,/\,s^2$)



A. 10 N

B. 30 N

C. 50 N

D. $50\sqrt{3}$ N

Answer: B

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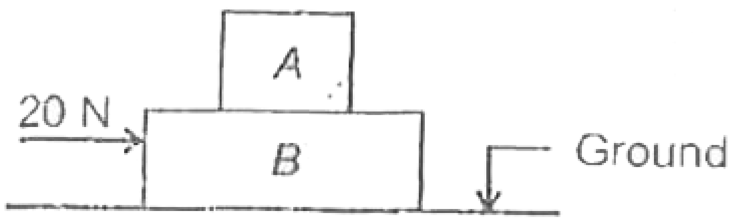
38. Blocks shown in figure moves with constant velocity 20 m/s towards right. All surfaces in contact are rough. The friction force applied by B on A is



A. 0 N

B. 20 N

C. 10 N

D. Insufficient data

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39. In the previous problem. The friction force applied by ground on block B is

A. 0 N

B. 20 N

C. 10 N

D. Insufficient data

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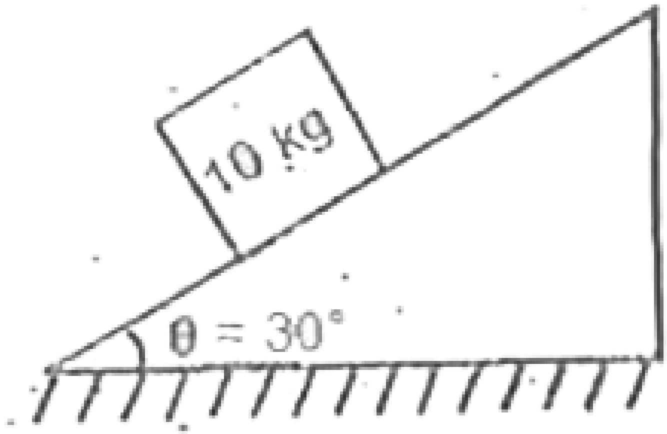
40. A block of mass 10 kg is kept on a fixed rough $(\mu = 0.8)$ inclined plane of angle of inclination 30°. The frictional force acting on the block is



A. 50 N

B. $50\sqrt{3}$ N

C. 52 N

D. 54 N

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41. A block of mass 5 kg is at rest on a rough inclined surface. If angle of inclination of plane is 60°, then force applied by it on block is

A. 50 N

B. $25\sqrt{3}$ N

C. 25 N

D. $50\sqrt{3}$ N

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42. Maximum force of friction is called

A. Limiting frictional force

B. Static frictional force

C. Kinetic frictional force

D. Rolling frictional force

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43. Static friction between two surfaces

A. Prevents the relative motion between them

B. Opposite to the direction of motion of them

C. Acts in opposite direction of applied force

D. Both (1) & (3)

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Watch Video Solution

44. Coefficient of kinetic friction and coefficient of static friction between two blocks is μ_k and μ_s respectively. In general

A. $\mu_s < \mu_k$

B. $\mu_s > \mu_k$

C. $\mu_s = \mu_k$

D. None of these

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45. The limiting value of static friction between two contact surfaces is

A. Proportional to normal force between the surface in contact

B. Independent of apparent area of contact

C. Depends on the microscopic area of contact

D. All of these

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46. A block of mass m slides down an inclined plane which makes an angle θ with the horizontal. The coefficient of friction between the block and the plane is μ. The force exerted by the block on the plane is

A. mg

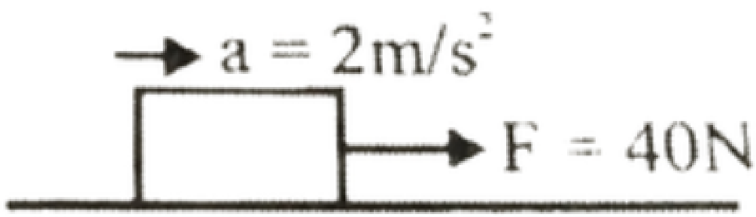
B. $mg\sin\theta$

C. $mg\cos\theta$

D. $mg\tan\theta$

Watch Video Solution

47. A block of mass 10 kg, moving with acceleration $2m/s^2$ on horizontal rough surface is shown in figure



A. 0.2

B. 0.4

C. 0.5

D. 0.1

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48. If angle of repose is ϕ, the coefficient of static friction between body and the plane is

A. $\cot \phi$

B. $\tan \phi$

C. $\sin \phi$

D. $\cos \phi$

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49. Which of the following is a self adjusting force?

A. Rolling frictional force

B. Static frictional force

C. Kinetic frictional force

D. All of these

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50. Two blocks of masses 2 kg and 4 kg are hanging with the help of massless string passing over an ideal pulley inside an elevator. The elevator is moving upward with an acceleration $\frac{g}{2}$. The tension in the string connected between the blocks will be (Take $g = 10m/s^2$).

A. 40 N

B. 60 N

C. 80 N

D. 20 N

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51. A man of mass m is standing in an elevator moving downward with an acceleration $\frac{g}{4}$. The force exerted by the bottom surface of the elevator on the man will be

A. $\frac{3mg}{4}$

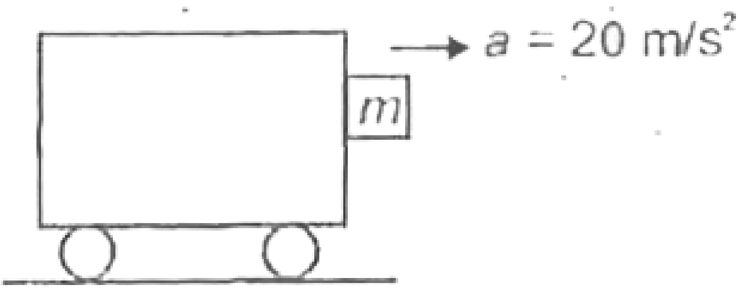
B. $\frac{mg}{4}$

C. $\frac{5mg}{4}$

D. $\frac{7mg}{4}$

Watch Video Solution

52. A vehicle is moving on a road with an acceleration $a = 20m / s^2$ as shown in figure. The frictional coefficient between the block of mass (m) and the vehicle so that block is does not fall downward is $(g = 10m / s^2)$



A. 0.5

B. 0.4

C. 2

D. 0.7

Answer: A

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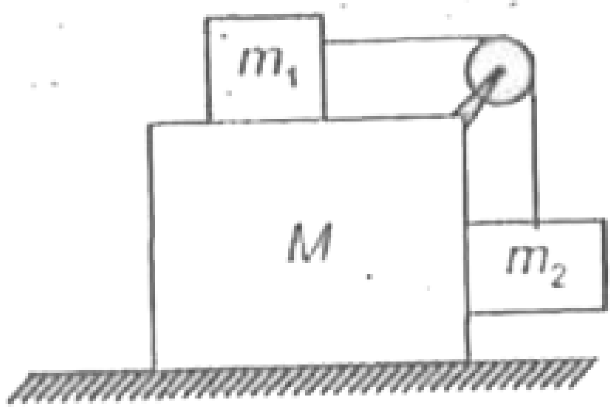
53. In the given arrangement all surfaces are smooth. What acceleration should be given to the system, for which the block m_2 doesn't slide down?



A. $\dfrac{m_2 g}{m_1}$

B. $\dfrac{m_1 g}{m_2}$

C. g

D. $\dfrac{m_2 g}{m_1 + m_2}$

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54. A block of mass m kg is kept on a weighing machine in an elevator. If the elevator is retarding upward by a ms^{-2}, the reading of weighing machine is

A. mg

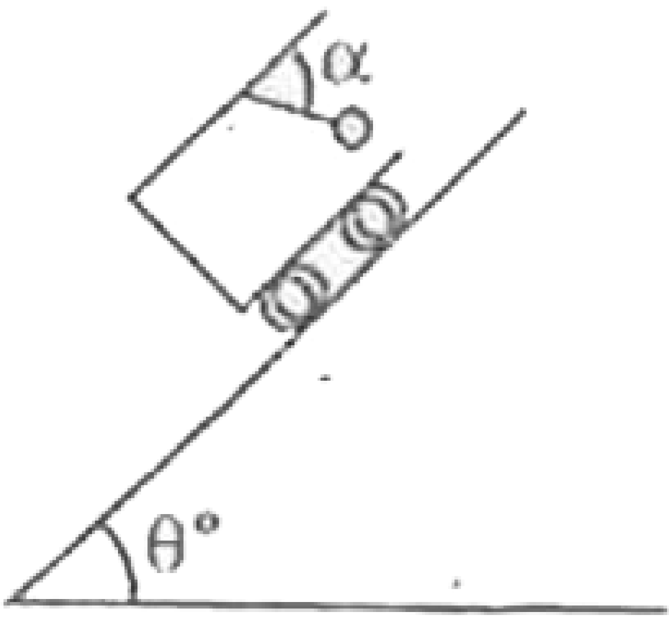
B. $m(g-a)$

C. $m\left(1-\frac{1}{g}\right)$

D. $m(g+a)$

Watch Video Solution

55. A trolley is falling freely on inclined plane as shown in the figure. The angle of string of pendulum with the ceiling of trolley is (α) equal to



A. θ°

B. $90^{\circ} - \theta^{\circ}$

C. 90°

D. 0°

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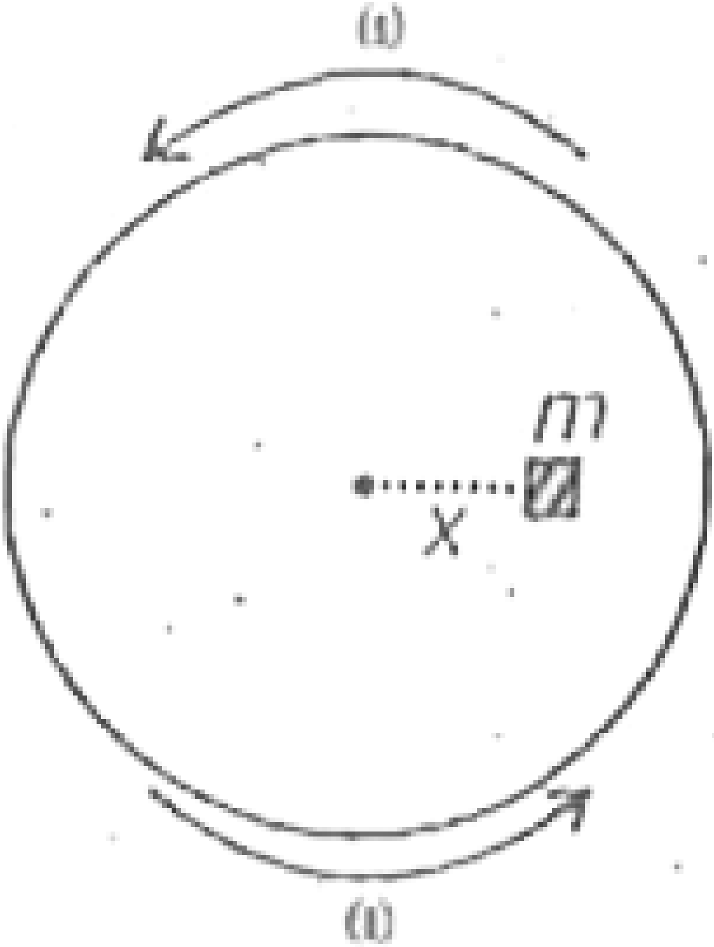
56. A block of mass m is kept on horizontal turn table at x distance from the centre. If coefficient of friction between block and surface of turn table is μ, then maximum angular speed of the table so that block does not slip



A. $\sqrt{\frac{\mu g}{x^2}}$

B. $\sqrt{\frac{\mu g}{x}}$

C. $\sqrt{\frac{\mu g}{2x}}$

D. $\sqrt{\frac{\mu x^2}{g}}$

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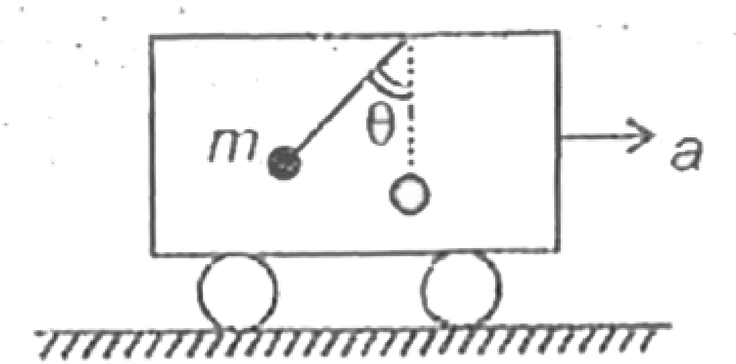
57. If trolley accelerates horizontally with acceleration a then bob is displaced backward from its initial vertical position. The angular deflection of the bob in equilibrium is



A. $\theta = \cos^{-1}\left(\frac{a}{g}\right)$

B. $\theta = \sin^{-1}\left(\frac{a}{g}\right)$

C. $\theta = \cot^{-1}\left(\frac{a}{g}\right)$

D. $\theta = \tan^{-1}\left(\frac{a}{g}\right)$

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58. Select correct statement regarding pseudo force :-

A. It is electromagnetic in origin

B. Newton's 3rd law is applicable for it

C. It is a fundamental force

D. It is used to make Newton's law applicable in noninertial frame

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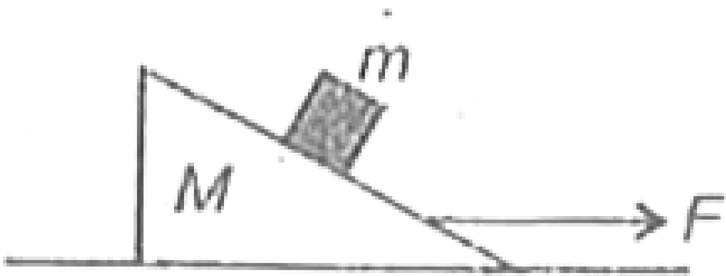
59. What force should be applied on the wedge so that block over it does not move? (All surfaces are smooth)



A. $F = (M+m)g\cot\theta$

B. $F = (M+m)g\tan\theta$

C. $F = (M+m)\cdot g\sin\theta$

D. $F = (M+m)g\cos\theta$

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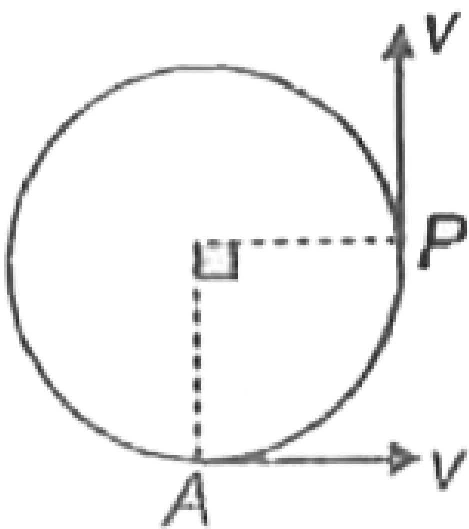
60. A particle of mass 2 kg is moving in circular path with constant speed 20 m/s. The magnitude of change in velocity when particle travels from A to P will be



A. $20\sqrt{2}m / s$

B. $40m / s$

C. $40\sqrt{2}m / s$

D. Zero

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61. A particle is in uniform circular motion, then its velocity is perpendicular to

A. Net force

B. Centripetal acceleration

C. Angular velocity

D. All of these

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62. If a particle is moving on a circular path with constant speed, then the angle between the direction of acceleration and its position vector w.r.t. centre of circle will be

A. Zero

B. $\frac{\pi}{2}$

C. π

D. 2π

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63. A particle is revolving in a circular path of radius 2 m with constant angular speed 4 rad/s. The angular acceleration of particle is

A. Zero

B. $8\pi^2 \text{rad} / s^2$

C. $16\pi^2 \text{rad} / s^2$

D. $128\pi^2 \text{rad} / s^2$

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64. A particle is moving on a circular path of radius 1 m with 2 m/s. If speed starts increasing at a rate of $2m/s^2$, then acceleration of particle is

A. $2m/s^2$

B. $4m/s^2$

C. $2\sqrt{5}m/s^2$

D. $8m/s^2$

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65. The maximum speed with which a vehicle can take safely circular turn on a horizontal flat rough road is (where symbols have their usual meanings)

A. $\mu\sqrt{rg}$

B. $\sqrt{\frac{rg}{\mu}}$

C. $\sqrt{rg}$

D. $\sqrt{rg\mu}$

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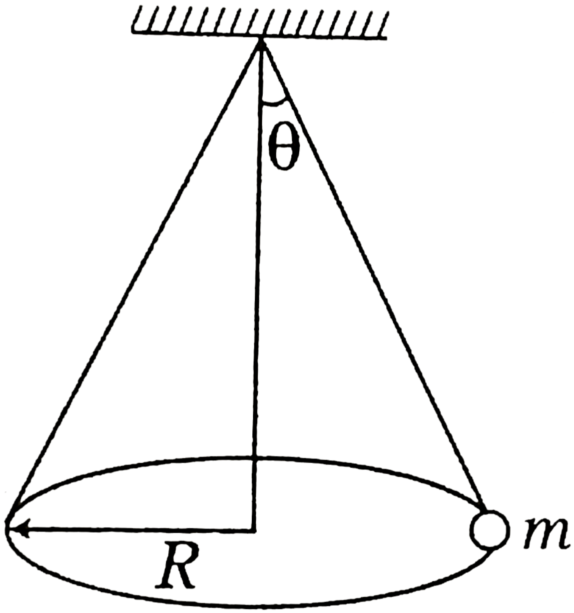
66. A conical pendulum of length L makes an angle θ with the vertical. The time period will be



A. $2\pi\sqrt{\frac{l}{g}}$

B. $2\pi\sqrt{\frac{l\cos\theta}{g}}$

C. $2\pi\sqrt{\frac{l}{g\cos\theta}}$

D. Infinite

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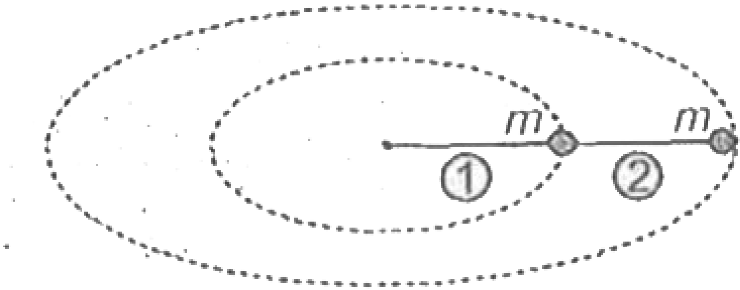
67. Two particles each of mass m are moving in horizontal circle with same angular speed. If both string are of same length then the ratio of tension in string $\frac{T_1}{T_2}$ is



A. $\frac{3}{2}$

B. 3

C. 2

D. $\frac{1}{3}$

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68. A car is moving in a horizontal level circular track with uniform speed v. If R is the radius of circular path, then the minimum coefficient of friction to avoid over turning is

A. $\frac{v^2}{Rg}$

B. $\frac{v}{\sqrt{Rg}}$

C. $v\sqrt{Rg}$

D. $\frac{\sqrt{Rg}}{v}$

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69. A motorcyclist is moving in a circular path of radius 10m and with uniform speed $36 km h^{-1}$. The angle with vertical at which motorcyclist will bend is

A. 0°

B. 90°

C. 60°

D. 45°

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Assignment (SECTION-A)

1. An athlete does not come to rest immedietly after crossing the winning line due to the

A. Inertia of rest

B. Inertia of motion

C. Inertia of direction

D. None of these

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2. When an object is at rest -

A. Force is required to keep it in rest state

B. No force is acting on it

C. A large number of forces may be acting on it which balance each other

D. It is in vacuum

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3. Newton's first law is applicable

A. In all reference frames

B. Only in inertial reference frames

C. Only in non-inertial reference frames

D. None of these

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4. From Newton's second law of motion, it can be inferred that

A. No force is required to move a body uniformly along straight line

B. Accelerated motion is always due to an external force

C. Inertial mass of a body is equal to force required per unit acceleration in the body

D. All of these

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5. When the force of constant magnitude always act perpendicular to the motion of a particle then :

A. Speed is uniform

B. Momentum is uniform

C. Velocity is uniform

D. All of these

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6. When an object is in equilibrium state, then

-

A. It must be at rest

B. No force is acting on it

C. Acceleration must be zero

D. All of these

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7. When a force of constant magnitude in a fixed direction acts on a moving object, then its path is -

A. Circular

B. Parabolic

C. Straight line

D. Either (2) or (3)

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8. An object of mass 2 kg is sliding with a constant velocity of $4ms^{-1}$ on a frictionless horizontal table. The force required to keep the object moving with the same velocity is

A. 8 N

B. 0 N

C. 2×10^4 N

D. $\frac{1}{2}$ N

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9. A 10 g bullet moving at 200 m/s stops after penetrating 5 cm of wooden plank. The average force exerted on the bullet will be

A. 2000 N

B. $-2000N$

C. 4000 N

D. $-4000N$

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10. A ball of mass 50 g is dropped from a height of 20 m. A boy on the ground hits the ball vertically upwards with a bat with an average force of 200 N, so that it attains a vertical height of 45 m. The time for which the ball remains in contact with the bat is [Take $g = 10m/s^2$]

A. $1/20^{th}$ of a second

B. $1/40^{th}$ of a second

C. $1/80^{th}$ of a second

D. $1/120^{th}$ of a second

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11. A string tied on a roof can bear a maximum tension of 50 kg wt. The minimum acceleration that can be acquired by a man of 98 kg to descend will be [take g = $9 \cdot 8\frac{m}{s^2}$]

A. $9.8m / s^2$

B. $4.9m / s^2$

C. $4.8m / s^2$

D. $5m / s^2$

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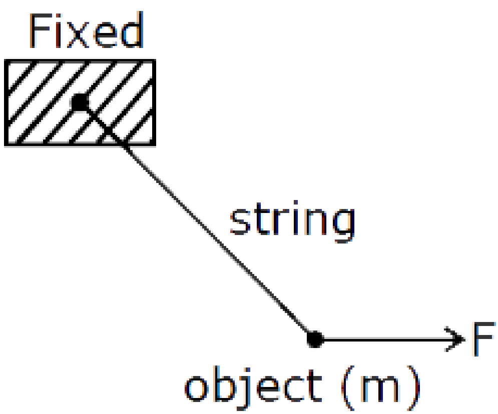
12. In the following figure, the object of mass m is held at rest by a horizontal force as shown. The force exerted by the string on the block is -



A. F

B. mg

C. $F + mg$

D. $\sqrt{F^2 + m^2 g^2}$

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13. In accordance with Newton's third law of motion -

A. Action and reaction never balance each other

B. For appearance of action and reaction, physical contact is not necessary

C. This law is applicable whether the bodies are at rest or they are in motion

D. All of these

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14. When a 4 kg rifle is fired, the 10g bullet receives an acceleration of $3 \times 10^{6} cm / s^{2}$. The magnitude of the force acting on the rifle (in newton) is

A. Zero

B. 120

C. 300

D. 3000

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15. A man of mass 50 kg carries a bag of weright 40 N on his shoulder. The force with which the floor pushes up his feet will be -

A. 882N

B. 530N

C. 90N

D. 600N

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16. 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

A. mg

B. $\frac{mg}{\cos\theta}$

C. $mg\tan\theta$

D. $mg\cos\theta$

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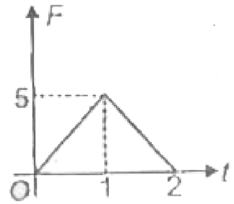
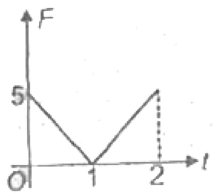
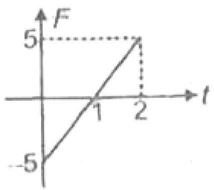
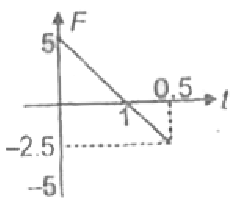
17. In which of the following graphs, the total change in momentum is zero ?

A. 

B. 

C. 

D. 

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18. A weight mg is suspended from the middle of a rope whose ends are at the same level. The rope is no longer horizontal. Find the minimum tenstion required to completely straighten the rope.

A. $\frac{Mg}{2}$

B. $Mg\cos\theta$

C. $2Mg\cos\theta$

D. Infinitely large

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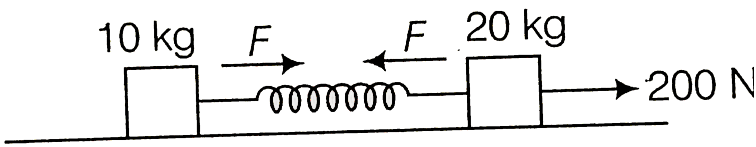
19. Two masses 10 kg and 20kg resplectivley are connected by a massless spring as shown in figure. A force of 200 N acts one the 20 kg mass.At the instant shown is figure the 10 kg mass has acceleration of 12 m/s^2.The vlalue of acceleration of 20 kg mass is



A. $12m/s^2$

B. $4m/s^2$

C. $10m/s^2$

D. Zero

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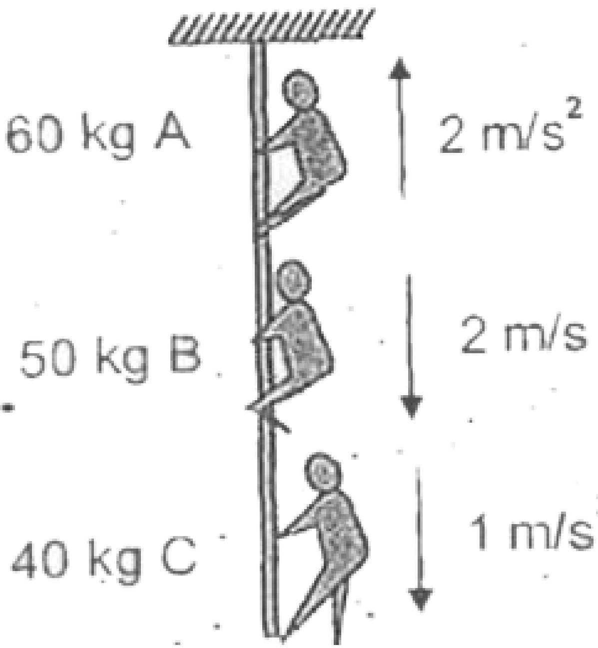
20. Tension in the rope at the rigid support is

$(g = 10m / s^2)$



A. 760N

B. 1360N

C. 1580N

D. 1620N

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21. Two bodies of masses m_1 and m_2 are connected a light string which passes over a frictionless massless pulley. If the pulley is moving upward with uniform acceleration $\frac{g}{2}$, then tension in the string will be

A. $\frac{3m_1m_2}{m_1+m_2}g$

B. $\dfrac{m_1 + m_2}{4m_1m_2}g$

C. $\dfrac{2m_1m_2}{m_1 + m_2}g$

D. $\dfrac{m_1m_2}{m_1 + m_2}g$

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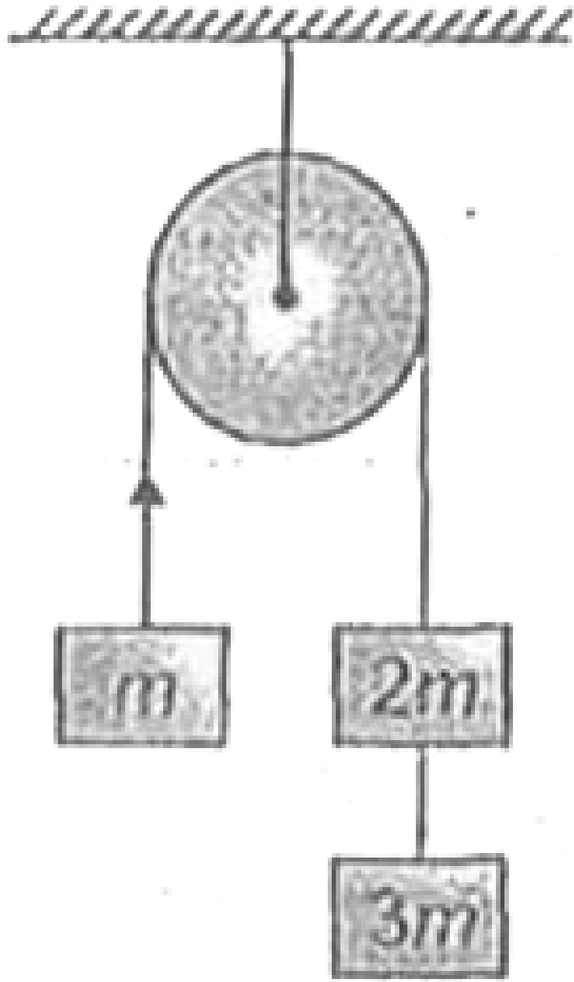
22. In the figure given below, with what acceleration does the block of mass m will move? (Pulley and strings are massless and frictionless)



A. $\dfrac{g}{3}$

B. $\frac{2g}{5}$

C. $\frac{2g}{3}$

D. $\frac{g}{2}$

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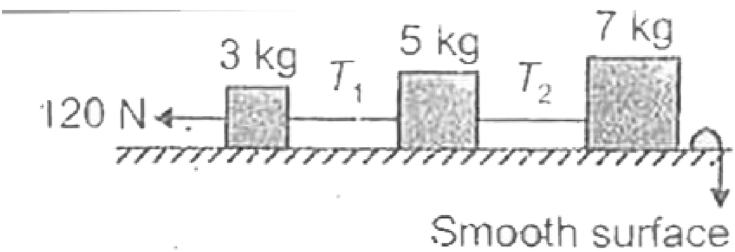
23. T_1 and T_2 in the given figure are



A. 28N, 48N

B. 48N, 28N

C. 96N, 56N

D. 56N, 96N

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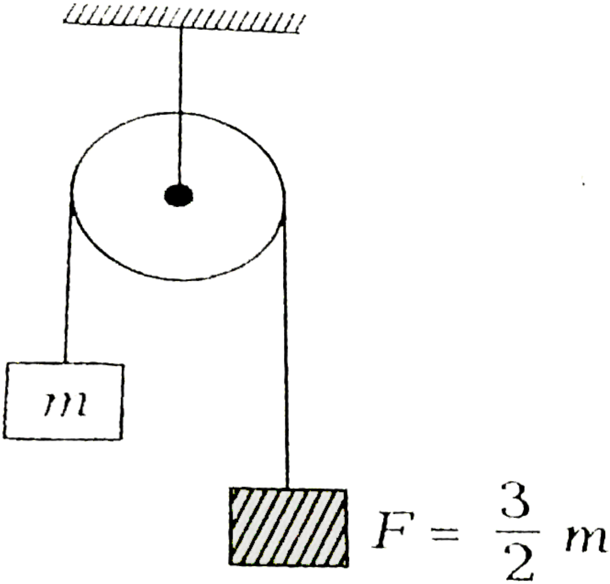
24. In the arrangement shown, the mass m will ascend with an acceleration (Pulley and rope are massless)



A. Zero

B. $\frac{g}{2}$

C. g

D. 2g

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25. A chain of mass M and length L is held vertical by fixing its upper end to a rigid support. The tension in the chain at a distance y from the rigid support is:

A. $\mathrm{Mg}\dfrac{L}{L+l}$

B. $\dfrac{Mg}{L}(L-y)$

C. Mg

D. $\frac{l}{L}Mg$

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26. A man slides down a light rope whose breaking strength in η times his weight $(\eta < 1)$. What should be his maximum acceleration so that the rope just breaks ?

A. $g(1-\eta)$

B. $g(1+\eta)$

C. $g\eta$

D. $\frac{g}{\eta}$

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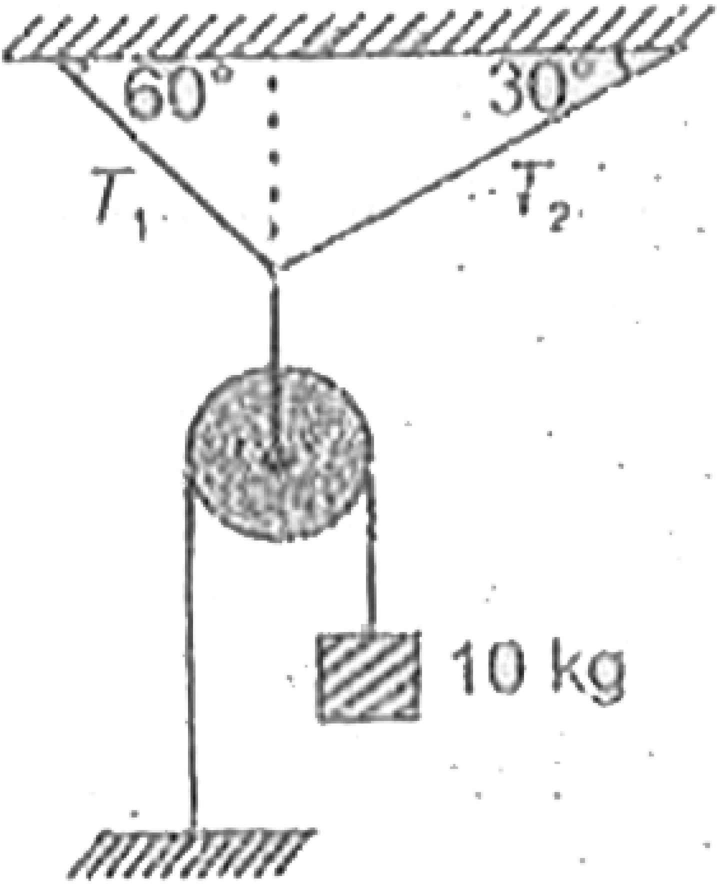
27. In the arrangement as shown, tension T_2 is

$(g = 10m/s^2)$



A. 50N

B. 100N

C. $50\sqrt{3}N$

D. $100\sqrt{3}N$

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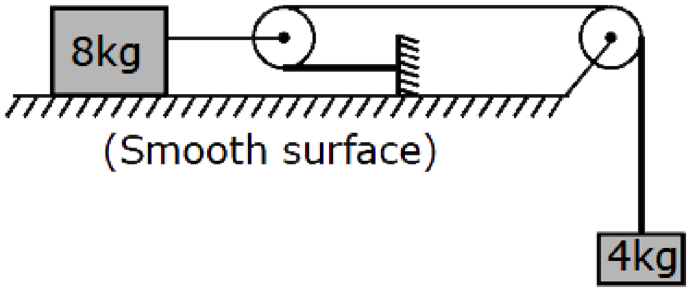
28. If pulleys shown in the diagram are smooth and massless and a_1 and a_2 are acceleration of blocks of mass 4 kg and 8 kg respectively, then -



A. $a_1 = a_2$

B. $a_1 = 2a_2$

C. $2a_1 = a_2$

D. $a_1 = 4a_2$

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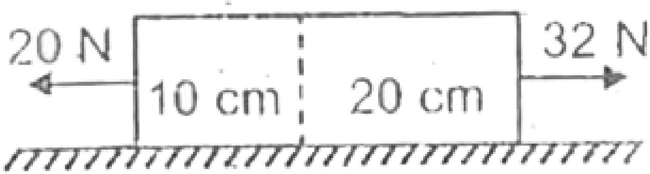
29. Figure shows a uniform rod of length 30 cm having a mass 3.0 kg. The rod is pulled by constant forces of 20N and 32N as shown. Find the force exerted by 20 cm part of the rod on the 10 cm part (all surfaces are smooth) is



A. 36N

B. 12N

C. 64N

D. 24N

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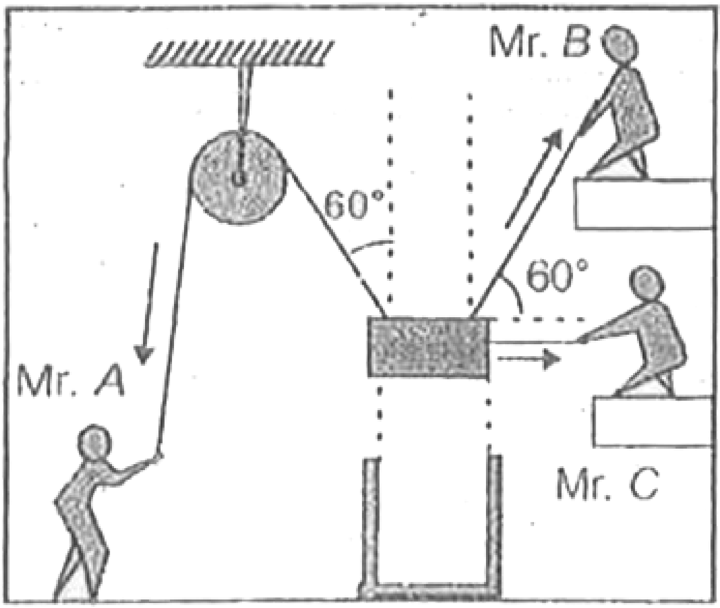
30. Mr. A, B and C are trying to put a heavy piston into a cylinder at a mechanical workshop in railway yard. If they apply forces F_1, F_2 and F_3 respectively on ropes then for which set of forces at that instant, they will be able to perform the said job?



A. $\sqrt{3}F_1 = F_2 + 2F_3$

B. $2F_1 = F_2 + F_3$

C. $2F_2 = \sqrt{3}F_1 - \frac{F_3}{2}$

D. $F_3 = 2F_1 - \sqrt{3}F_2$

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31. In a rocket, fuel burns at the rate of 2 kg/s. This fuel gets ejected from the rocket with a velocity of 80 km/s. Force exerted on the rocket is -

A. 16,000 N

B. 1,60,000 N

C. 1600 N

D. 16 N

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32. A machine gun fires a bullet of mass 65 g with a velocity of 1300 m/s. The man holding it can exert a maximum force of 169 N on the gun. The number of bullets he can fire per second will be

A. 1

B. 2

C. 3

D. 4

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33. A bullet of mass 40 g is fired from a gun of mass 10 kg. If velocity of bullet is 400 m/s. then the recoil velocity of the gun wil be

A. 1.6 m/s in the direction of bullet

B. 1.6 m/s opposite to the direction of bullet

C. 1.8 m/s in the direction of bullet

D. 1.8 m/s opposite to the direction of bullet

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34. A diwali rocket is ejecting $0.05 kg$ of gases per second at a velocity of $400 m/\sec$. The accelerating force on the rocket is

A. 20 dyne

B. 20 N

C. 200 N

D. Zero

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35. A rocket of mass 5700 kg ejects mass at a constant rate of 15 kg/s withe constant speed of 12 km/s. The acceleration of the rocket 1 minute after the blast is $\left(g = 10m / s^2\right)$

A. $34.9m / s^2$

B. $27.5m / s^2$

C. $3.50m / s^2$

D. $13.5m / s^2$

Watch Video Solution

36. A ballon has 2 g of air . A small hole is pierced into it . The air comes out with relative velocity 4 m/s . If the balloon shrinks completely in 2.5 s , the average force acting on the balloon is

A. 0.008 N

B. 0.0032 N

C. 8 N

D. 3.2 N

Watch Video Solution

37. A surface is hit elastically and normally by n bals per unit time, all the balls having the same mass m, and moving with the same velocity v. then the force acting on surface is

A. mun

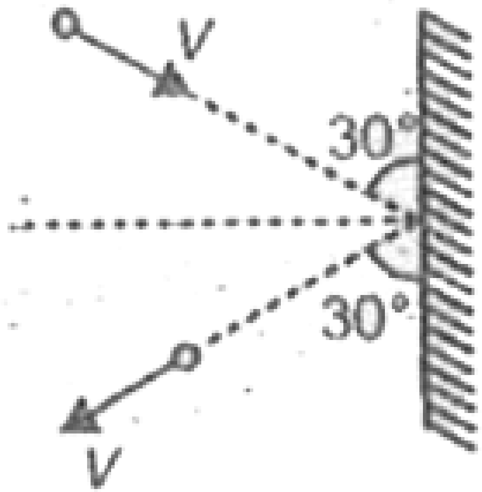
B. 2 mun

C. $\frac{1}{2}mu^2n$

D. mu^2n

Watch Video Solution

38. A particle of mass m strikes a wall with speed v at an angle 30° with the wall elastically as shown in the figure. The magnitude of impulse imparted to the ball by the wall is



A. mv

B. $\frac{mv}{2}$

C. 2mv

D. $\sqrt{3}mv$

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39. A body of mass $1kg$, initially at rest, explodes and breaks into three fragments of masses in the ratio $1:1:3$. The two pieces of equal mass fly off perpendicular to each other with a speed of $30m/s$ each. What is the velocity of the heavier fragment?

A. 5 m/s

B. 15 m/s

C. 45 m/s

D. $5\sqrt{2}$ m/s

Watch Video Solution

40. A 6 kg bomb at rest explodes into three equal pieces P, Q and R. If P flies with speed 30 m/s and Q with speed 40 m/s making an angle 90° with the direction of P. The angle between the direction of motion of P and R is about

A. 143°

B. 127°

C. 120°

D. 150°

41. A particle of mass 2m moving with velocity v strikes a stationary particle of mass 3m and sticks to it . The speed of the system will be

A. 0.8v

B. 0.2v

C. 0.6v

D. 0.4v

42. Which of the following is a self adjusting force?

A. Static friction

B. Limiting friction

C. Kinetic friction

D. Rolling friction

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43. Maximum force of friction is called

A. Limiting friction

B. Static friction

C. Sliding friction

D. Rolling friction

Watch Video Solution

44. The limiting force of friction betwwen two bodies in contact independent of

A. Nature of the surface in contact

B. The area of surfaces in contact

C. Normal reaction between the surfaces

D. The materials of the bodies

Watch Video Solution

45. "It is difficult to move a cycle along the road with its brakes on". Why?

A. Rolling friction opposes motion on road

B. Sliding friction opposes motion on road

C. Rolling friction is more than sliding friction

D. Sliding frictionis more than the rolling friction

Watch Video Solution

46. Which is a suitable method to decrease friction ?

A. Polishing

B. Lubrication

C. Ball bearing

D. All of these

Watch Video Solution

47. A cubical blocks rests on a plane of $\mu = \sqrt{3}$. The angle through which the plane be inclines to the horizontal so that the block just slides down will be

A. 30°

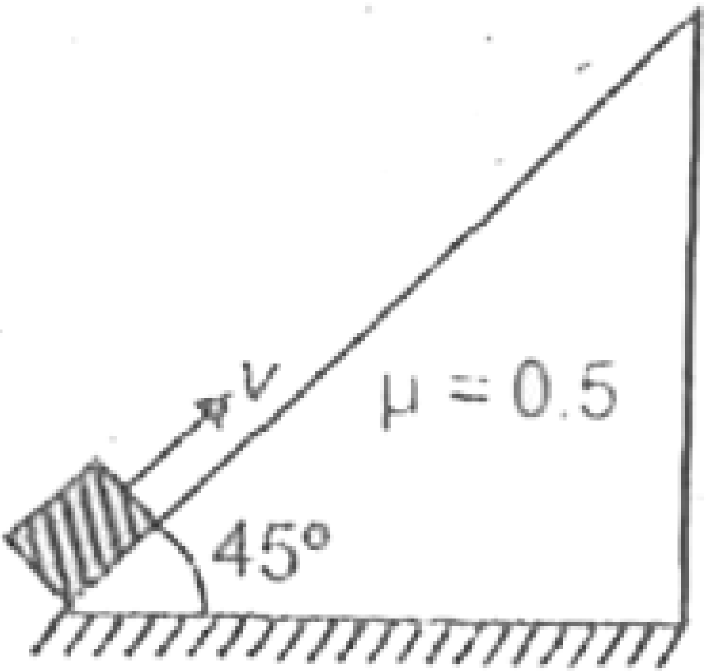
B. 45°

C. 60°

D. 75°

Watch Video Solution

48. A block of mass 1 kg is projected from the lowest point up along the inclined plane. If $g = 10ms^{-2}$, the retardation experienced by the block is



A. $\frac{15}{\sqrt{2}}ms^{-2}$

B. $\frac{5}{\sqrt{2}}ms^{-2}$

C. $\frac{10}{\sqrt{2}}ms^{-2}$

D. Zero

Watch Video Solution

49. A child weighing 25 kg slides down a rope hanging from a branch of a tall tree. If the force of friction acting against him is 200 N, the acceleration of child is $(g = 10m/s^2)$

A. $22.5m/s^2$

B. $8m/s^2$

C. $5m/s^2$

D. $2m/s^2$

Watch Video Solution

50. An object of mass 1 kg moving on a horizontal surface with initial velocity 8 m/s comes to rest after 10 s. If one wants to keep the object moving on the same surface with velocity 8 m/s the force required is

A. 0.4 N

B. 0.8 N

C. 1.2 N

D. Zero

Watch Video Solution

51. A heavy box is slid across a rough floor with an initial speed of 4 m/s. It stops moving after 8 seconds. If the average resisting force of friction is 10 N, the mass of the box (in kg) is

A. 40

B. 20

C. 5

D. 2.5

Watch Video Solution

52. If a block moving up at $\theta = 30^{\circ}$ with a velocity 5m/s, stops after 0.5 sec, then what is μ

A. 0.5

B. 0.6

C. 0.9

D. 1.1

Watch Video Solution

53. A chain is lying on a rough table with a fraction 1/n of its length hanging down from the edge of the table. if it is just on the point of sliding down from the table, then the coefficient of friction between the table and the chain is -

A. $\frac{1}{3}$

B. $\frac{1}{n-1}$

C. $\frac{1}{4}$

D. $\frac{1}{5}$

Watch Video Solution

54. A block has been placed on an inclined plane with the slope angle θ, block slides down the plane at constant speed. The coefficient of kinetic friction is equal to

A. $\sin\theta$

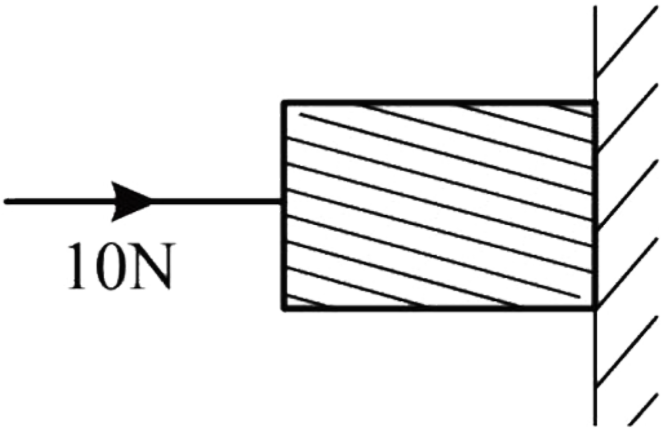
B. $\cos\theta$

C. $\tan\theta$

D. $\cot\theta$

Watch Video Solution

55. A horizontal force of 10N is necessary to just hold a block stationary against as well. The coefficient of friction between the block and the wall is 0.2. The weight of the block is



A. 20 N

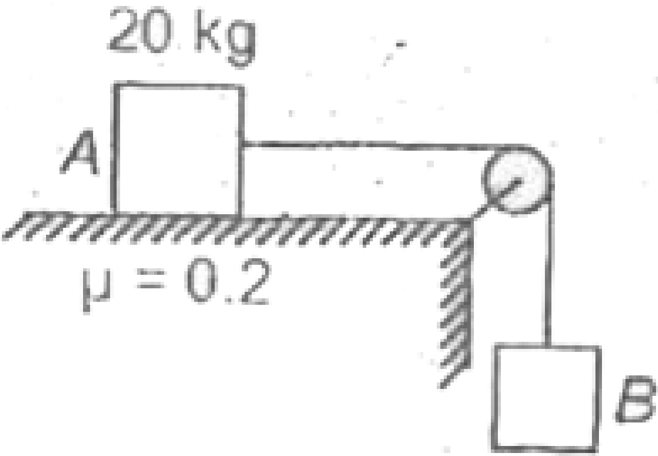
B. 50 N

C. 100 N

D. 2 N

Watch Video Solution

56. In the figure shown, the coefficient of static friction between the block A of mass 20 kg and horizontal table is 0.2. What should be the minimum mass of hanging block just beyond which blocks start moving?



A. 2 kg

B. 3 kg

C. 4 kg

D. 5 kg

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57. Two block A and B of masses 5 kg. and 3 kg. respectively rest on smooth horizontal surface with B over A. The coefficient of friction between A and B. 0.5 the maximum horizontal force that can be applied to A so that there will be motion of A and B without separation is :-

A. 1.5

B. 2.5

C. 40

D. 5

Watch Video Solution

58. A small metallic sphere of mass m is suspended from the ceiling of a car accelerating on a horizontal road with constant acceleration a. The tension in the string attached with metallic sphere is

A. mg

B. $m(g+a)$

C. $m(g-a)$

D. $m\sqrt{g^2+a^2}$

Watch Video Solution

59. A cystlist riding a bicycle a bicycle at a speed of $14\sqrt{3}$ m/s takes a turn around a circular a circular road of radius $20\sqrt{3}$ m without skidding . What is his inclination to the vertical ?

A. 30°

B. 45°

C. 60°

D. 75°

Watch Video Solution

60. A car turns a corner on a slippery road at a constant speed of 10 m /s . If the coefficient of friction is 0.5, the minimum radius of the arc in meter in which the car turns is

A. 4 m

B. 10 m

C. 15 m

D. 20 m

Watch Video Solution

61. A car is moving on a horizontal circular track of radius 0.2 km with a constant speed. If coefficient of friction between tyres of car and road is 0.45, then maximum speed of car may be [Take $g = 10m/s^2$]

A. 15 m/s

B. 30 m/s

C. 20 m/s

D. 40 m/s

Watch Video Solution

62. A boy is sitting on the horizontal platform of a joy wheel at a distance of 5 m from the center. The wheel begins to rotate and when angular speed exceeds 1 rad/s, the boy just slips. The coefficient of friction between the boy and the wheel is $\left(g = 10m/s^2\right)$

A. 0.5

B. 0.32

C. 0.71

D. 0.2

Watch Video Solution

63. A vehicle is moving on a track with constant speed as shown in figure. The apparent weight of the vehicle is

A. Maximum at A

B. Maximum at B

C. Maximum at C

D. Same at A, B and C

Watch Video Solution

64. A train is running at 20 m/s on a railway line with radius of curvature 40,000 metres. The distance between the two rails is 1.5 metres. For safe running of train the elevation of outer rail over the inner rail is

$\left(g = 10m / s^2\right)$

A. 2.0 mm

B. 1.75 mm

C. 1.50 mm

D. 1.25 mm

Watch Video Solution

65. A car is moving on a horizontal circular road of radius 0.1 km with constant speed. If coefficient of friction between tyres of car and road is 0.4, then speed of car may be $\left(g = 10m/s^2\right)$

A. 5 m/s

B. 10 m/s

C. 20 m/s

D. All of these

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Assignment (SECTION-B)

1. A projectile is fired with velocity u at an angle θ with horizontal. At the highest point of its trajectory, it splits up into three segments of masses m, m and 2m. First part falls vertically downward with zero initial velocity and second part returns via same path to the point of projection. The velocity of third part of mass 2 m just after explosion will be

A. $u \cos \theta$

B. $\frac{3}{2} u \cos \theta$

C. $2u \cos \theta$

D. $\frac{5}{2} u \cos \theta$

Watch Video Solution

2. A bomb of mass $9kg$ explodes into two pieces of masses $3kg$ and $6kg$. The velocity of mass $3kg$ is $16ms^{-1}$. The kinetic energy of mass $6kg$ is

A. 196

B. 320

C. 192

D. 620

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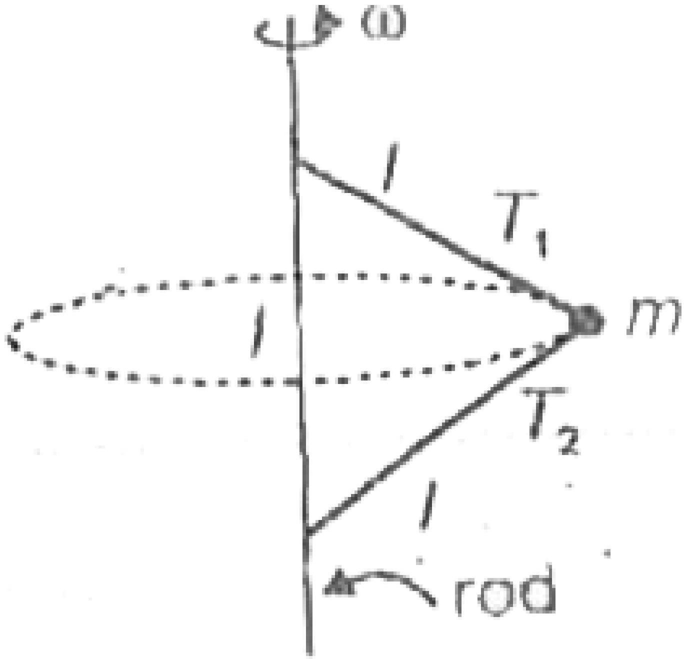
3. In the figure, a ball of mass m is tied with two strings of equal as shown. If the rod is rotated with angular velocity ω_1 when



A. $T_1 > T_2$

B. $T_2 > T_1$

C. $T_1 = T_2$

D. $T_1 = \frac{T_2}{6}$

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4. A block of weight 1 N rests on a inclined plane of inclination θ with the horizontal. The coefficient of friction between the block and the inclined plane is μ. The minimum force that has to be applied parallel to the inclined plane to make the body just move up the plane is

A. $\mu \sin \theta$

B. $\mu \cos \theta$

C. $\mu \cos \theta - \sin \theta$

D. $\mu \cos \theta + \sin \theta$

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5. If a pushing force making an angle α with horizontal is applied on a block of mass m placed on horizontal table and angle of friction is β, then minimum magnitude of force required to move the block is

A. $\dfrac{mg\sin\beta}{\cos[\alpha-\beta]}$

B. $\dfrac{mg\sin\beta}{\cos[\alpha+\beta]}$

C. $\dfrac{mg\sin\beta}{\sin[\alpha+\beta]}$

D. $\dfrac{mg\cos\beta}{\cos[\alpha-\beta]}$

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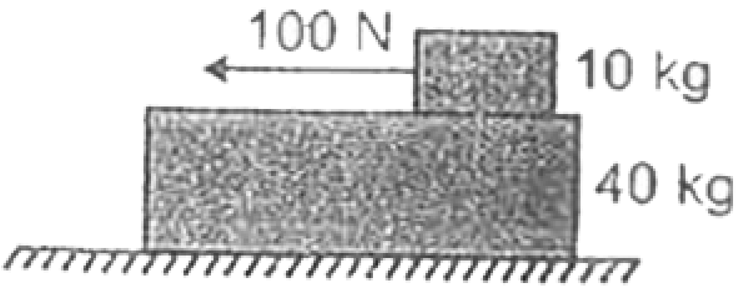
6. A 40 kg slab rests on a frictionless floor. A 10 kg block rests on top of the slab. The coefficient of friction between the block and the slab is 0.40. The 10 kg block is acted upon by a horizontal force of 100 N. If $g = 10 m / s^2$, the resulting acceleration of the slab will be



A. $1.0 m / s^2$

B. $1.47m/s^2$

C. $1.52m/s^2$

D. $6.1m/s^2$

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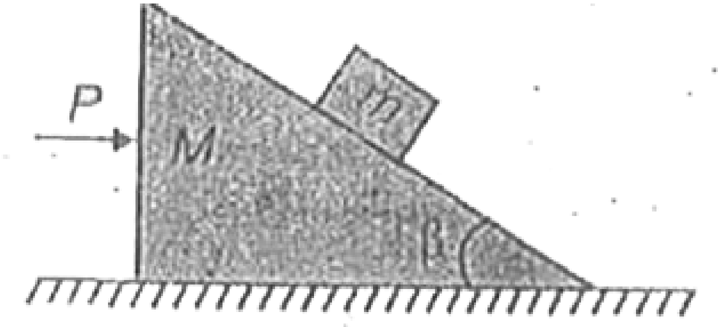
7. A block of mass m, is kept on a wedge of mass M, as shown in figure such that mass m remains stationary w.r.t. wedge. The magnitude of force P is



A. $g \tan \beta$

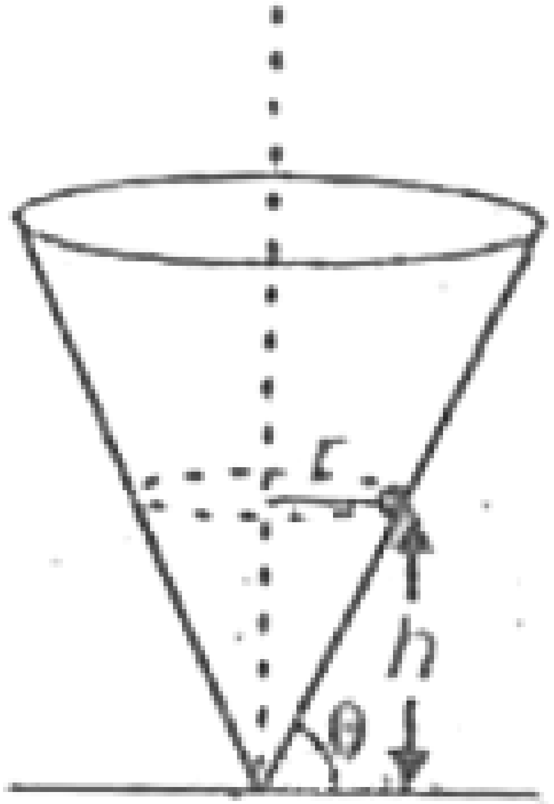
B. $mg \tan \beta$

C. $(m + M)g \tan \beta$

D. $mg \cot \beta$

Watch Video Solution

8. A particle describes a horizontal circle of radius r on the smooth surface of an inverted cone as shown. The height of plane of circle above vertex is h. The speed of particle should be



A. $\sqrt{rg}$

B. $\sqrt{2rg}$

C. $\sqrt{gh}$

D. $\sqrt{2gh}$

Watch Video Solution

9. If the string of a conical pendulum makes an angle θ with horizontal, then square of its time period is proportional to

A. $\sin\theta$

B. $\cos\theta$

C. $\tan\theta$

D. $\cot\theta$

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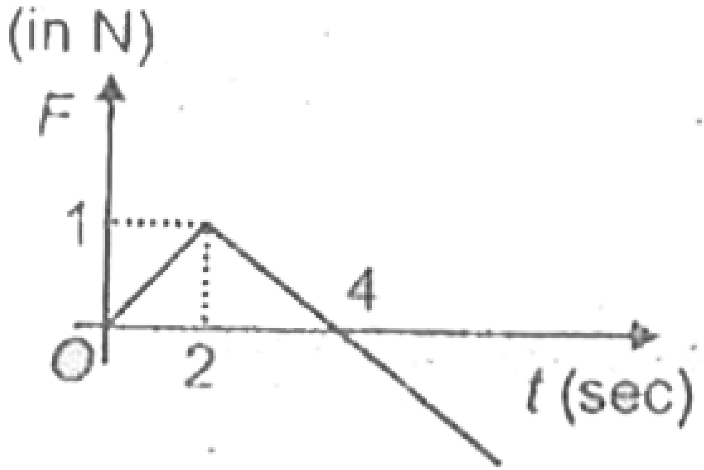
10. Force acting on a body varies with time as shown below. If initial momentum of the body is $\overrightarrow{p}$, then the time taken by the body to retain its momentum $\vec{p}$ again is



A. 8 s

B. $\left(4+2\sqrt{2}\right)s$

C. 6 s

D. Can never obtain

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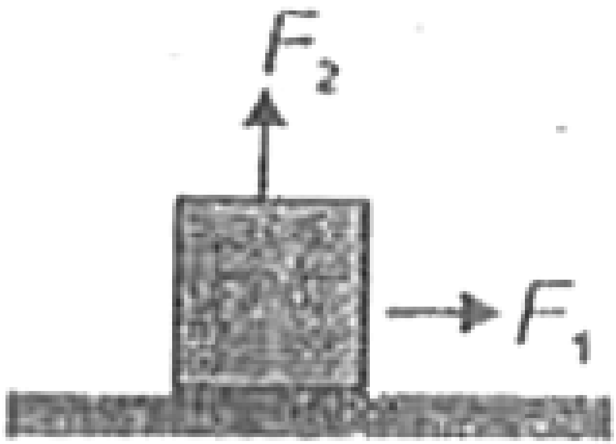
11. In the figure shown, horizontal force F_1 is applied on a block but the block does not slide. Then as the magnitude of vertical force F_2 is increased from zero the block begins to slide, the correct statement is



A. The magnitude of normal reaction on block increases

B. Static frictional force acting on the block increases

C. Maximum value of static frictional force decreases

D. All of these

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12. Arrangement of two block system is as shown. The net force acting on 1 kg and 2 kg block are (assuming the surfaces to be frictionless) respectively -

A. 4N, 8N

B. 1N, 2N

C. 2N, 4N

D. 3N, 6N

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13. A 6000kg rocket is set for vertical firing. If the exhaust speed is $1000ms^{-1}$, the amount of gas that must be ejected per second to supply the thrust needed to overcome the weight of the rocket is $(g = 10ms^{-1})$

A. 30 kg

B. 40 kg

C. 50 kg

D. 60 kg

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14. Which of the following is a self adjusting force?

A. Sliding friction

B. Dynamic friction

C. Static friction

D. Limiting friction

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15. An open carriage in a goods train is moving with a uniform velocity of 10 m/s. If the rain adds water with zero velocity at the rate of 5 kg/s, then the additional force required by the engine to maintain the same velocity of the train is

A. 0.5 N

B. 20 N

C. 50 N

D. Zero

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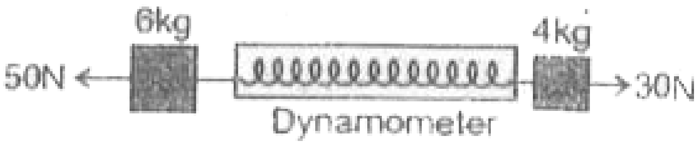
16. A dynamometer D is attached to two blocks of masses 6 kg and 4 kg as shown in the figure.

The reading of the dynamometer is



A. 18 N

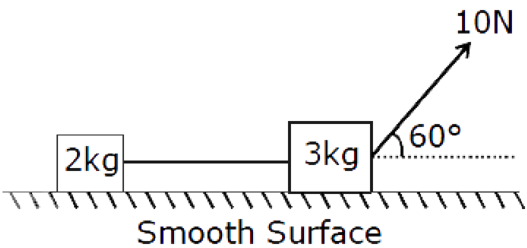
B. 28 N

C. 38 N

D. 48 N

Watch Video Solution

17. Figure shows two blocks connected by a light inextensible string as shown in figure. A force of 10 N is applied on the bigger block at 60° with horizontal, then the tension in the st ring connection the two masses is -



A. 5 N

B. 2 N

C. 1 N

D. 3 N

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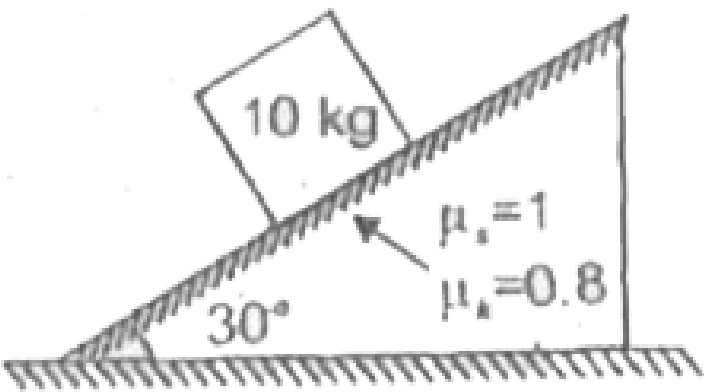
18. A block of 10 kg mass is placed on a rough inclined surface as shown in figure. The acceleration of the block will be



A. Zero

B. g

C. $\frac{g}{2}$

D. $\frac{\sqrt{3}g}{2}$

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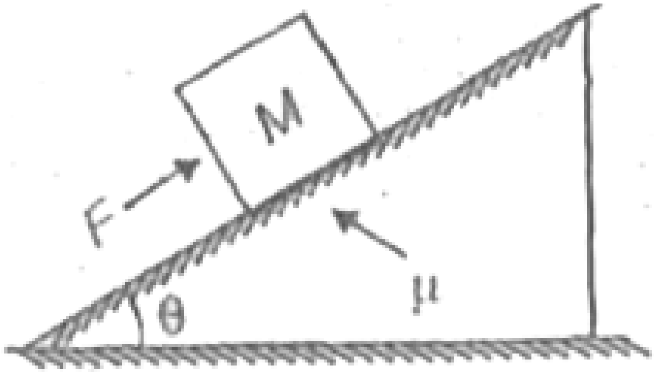
19. A block (mass = M kg) is placed on a rough inclined plane. A force F is applied parallel to the inclined (as shown in figure) such that it just starts moving upward. The value of F is



A. $Mg\sin\theta - \mu Mg\cos\theta$

B. $Mg\sin\theta + \mu Mg\cos\theta$

C. $Mg\sin\theta$

D. $\mu Mg\cos\theta$

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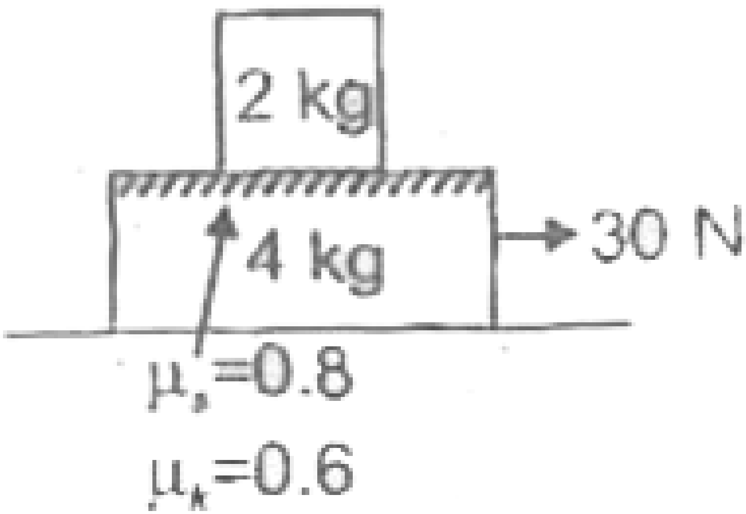
20. Figure shows two block system, 4 kg block rests on a smooth horizontal surface, upper surface of 4 kg is rough. A block of mass 2 kg is placed on its upper surface. The acceleration of upper block with respect to earth when 4 kg mass is pulled by a force of 30 N, is



A. $0m/s^2$

B. $5m/s^2$

C. $8m/s^2$

D. $2m/s^2$

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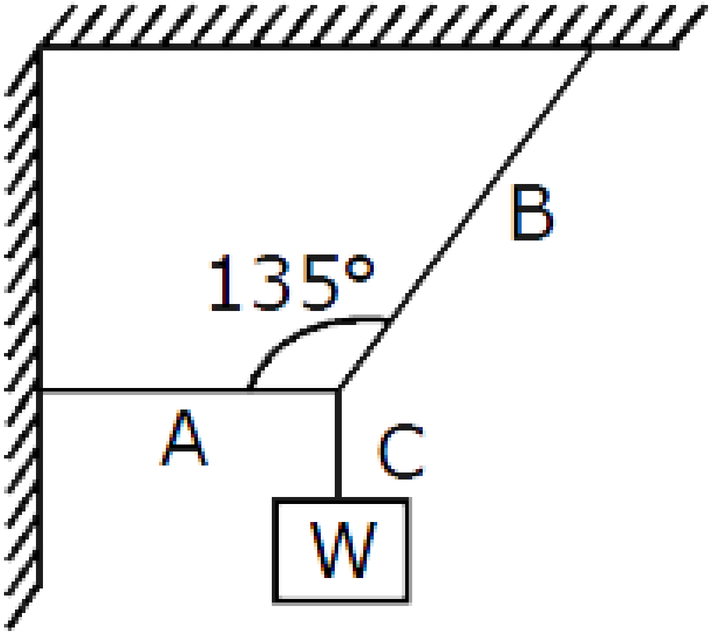
21. A block of weight W is supported by three strings as shown in figure. Which of the following relations is true for tension in the string ? (Here, T_1, T_2 and T_3 are the tension in the strings A,B and C respectively)



A. $T_1 = T_2$

B. $T_1 = T_3$

C. $T_2 = T_3$

D. $T_1 = T_2 = T_3$

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22. A car accelerates on a horizontal road due to the force exerted by

A. The engine of the car

B. The driver of the car

C. The earth as weight of the car

D. The road

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23. Which of the following quantities are independent of the choice of orientation of the co-ordinate axes?

A. Only (b)

B. Both (a) & (b)

C. Both (a) & (c)

D. Both (b) & (c)

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24. The acceleration vector of a particle in uniform circular motion averaged over the cycle is a null vector. This statement is

A. True

B. False

C. May be true

D. May be false

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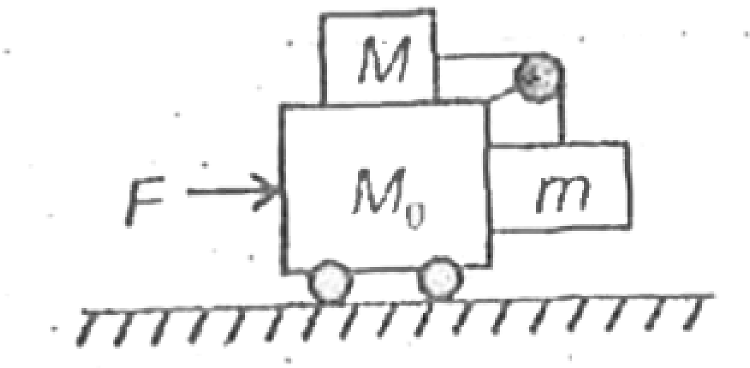
25. Two blocks of mass M and m are kept on the trolley whose all surfaces are smooth select the correct statement



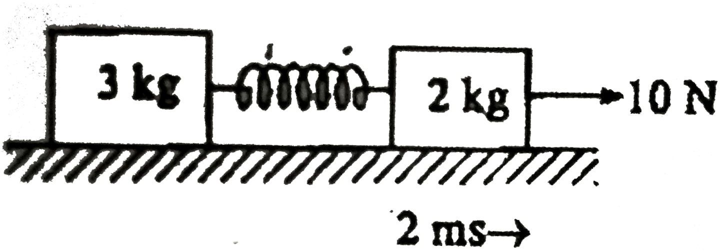
A. If $F = 0$ blocks cannot remain stationary

B. For one unique value of F, blocks will be stationary

C. Blocks cannot be stationary for any value of F because all surfaces are smooth

D. Both (1) & (2)

26. Find the acceleration of 3 kg mass when acceleration of 2 kg mass is $2ms^{-2}$ as shown in figure-2.140



A. $3m/s^2$

B. $2m/s^2$

C. $0.5m/s^2$

D. Zero

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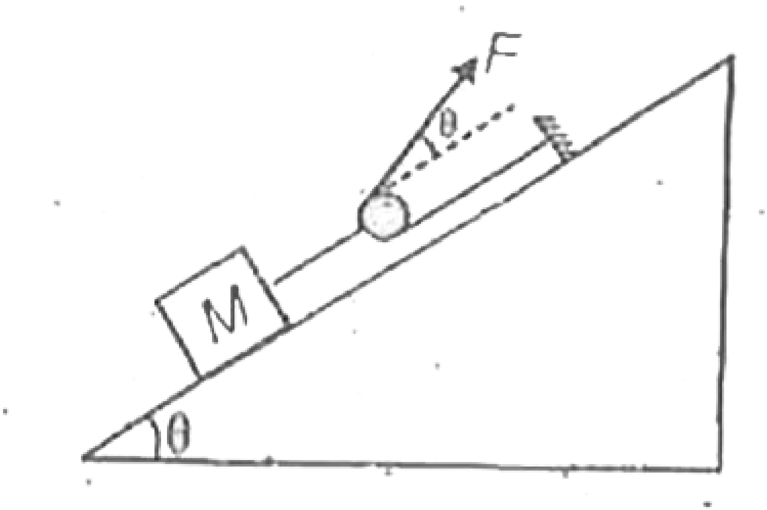
27. What is the minimum value of F needed so that block begins to move upward on frictionless incline plane as shown



A. $Mg\tan\left(\frac{\theta}{2}\right)$

B. $Mg\cot\left(\frac{\theta}{2}\right)$

C. $\dfrac{Mg\sin\theta}{(1+\sin\theta)}$

D. $Mg\sin\left(\dfrac{\theta}{2}\right)$

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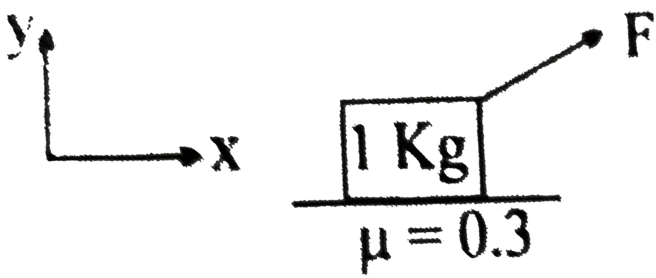
28. A force $\overline{F} = \hat{i} + 4\hat{j}$ acts on block shown.

The force of friction acting on the block is :



A. $-\hat{i}$

B. $-18\hat{i}$

C. $-2.4\hat{i}$

D. $-3\hat{i}$

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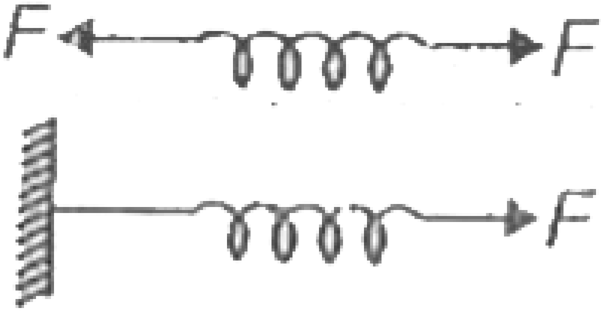
29. Figure shows tow cases. In first case a spring (spring constant K) is pulled by two equal and opposite forces F at both ends and in second case is pulled by a force F at one end. Extensions (x) in the springs will be



A. In both cases $x = \frac{2F}{K}$

B. In both cases $x = \frac{F}{K}$

C. In first case $x = \frac{2F}{K}$, in second case $x = \frac{F}{K}$

D. In first case $x = \frac{F}{K}$, In second case $x = \frac{2F}{K}$

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30. A money of mass 40 kg climbs up a rope, of breaking load 600 N hanging from a ceiling. If it climbs up the rope with the maximum possible acceleration, then the time taken by monkey to climb up is [length of rope is 10 m]

A. 2 s

B. 1 s

C. 4 s

D. 3 s

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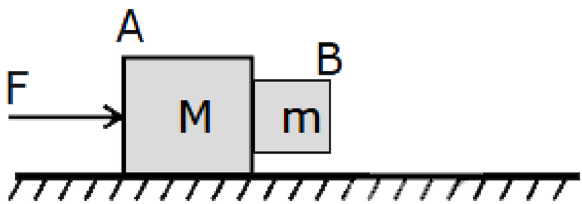
31. Coefficient of friction between A and B is μ.

The minimum force F with which A will be pushed such that B will not slip down is -



A. $\dfrac{Mg}{\mu}$

B. $\dfrac{mg}{\mu}$

C. $\dfrac{(M+m)g}{\mu}$

D. $\dfrac{(M-m)g}{\mu}$

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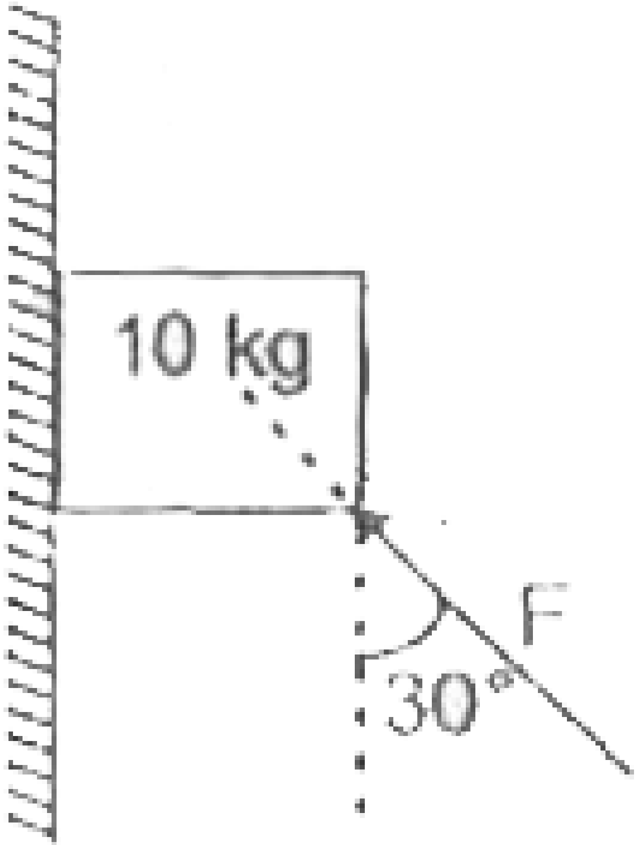
32. A block of mass 10 kg is held at rest against a rough vertical wall $[\mu = 0.5]$ under the action a force F as shown in figure. The minimum value of F required for it is $(g = 10m/s^2)$



A. 162.6 N

B. 89.7 N

C. 42.7 N

D. 95.2 N

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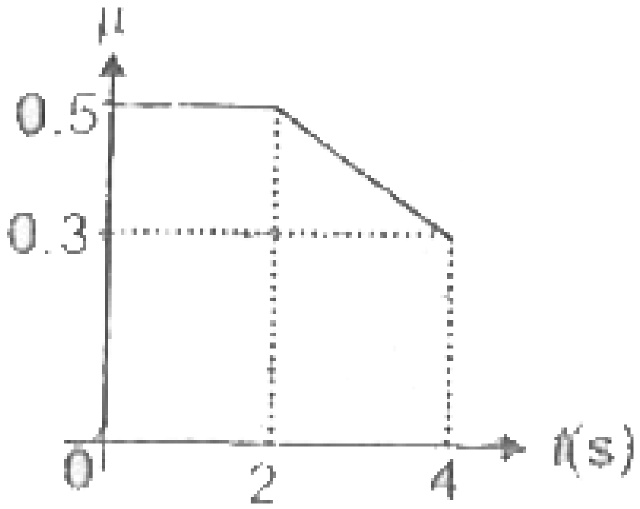
33. A block is projected with speed 20 m/s on a rough horizontal surface. The coefficient of friction (μ) between the surface varies with time (t) as shown in figure. The speed of body at the end of 4 second will be $(g = 10m/s^2)$



A. 2 m/s

B. 5 m/s

C. 7.2 m/s

D. 9.5 m/s

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34. An object starts from rest and is acted upon by a variable force F as shown in figure. If F_0 is the initial value of the force, then the position of the object, where it again comes of rest will be :-

A. $\dfrac{2F_0}{\tan\alpha}$

B. $\dfrac{F_0}{\sin\alpha}$

C. $\frac{2F_0}{\cot \alpha}$

D. $\frac{F_0}{2 \cos \alpha}$

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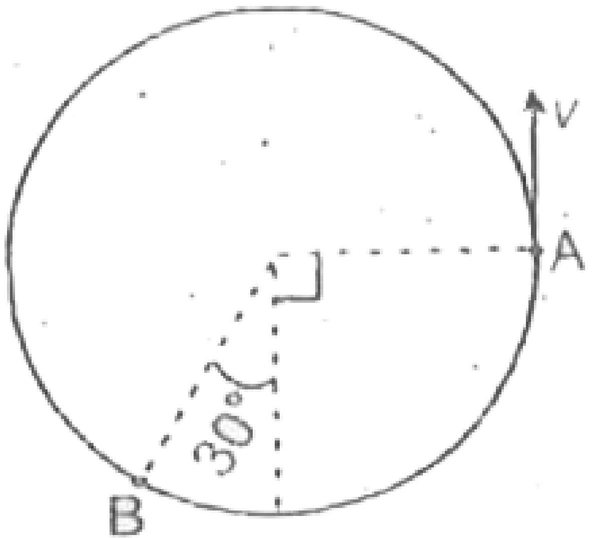
35. A particle of mass m moves with constant speed v on a circular path of radius r as shown in figure. The average force on it during its motion from A to B is



A. $\dfrac{\sqrt{3}mv^2}{2\pi r}$

B. $\dfrac{mv^2}{r}$

C. $\dfrac{2\sqrt{3}mv^2}{\pi r}$

D. $\dfrac{3\sqrt{3}mv^2}{4\pi r}$

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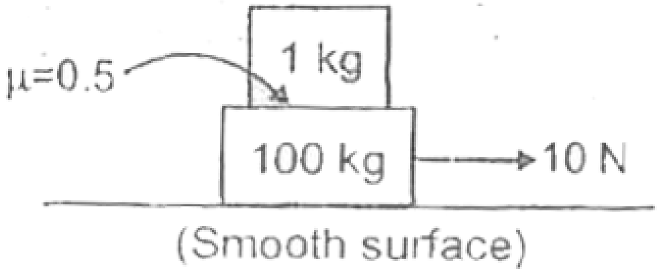
36. The frictional force acting on 1 kg block is



A. 0.1 N

B. 2 N

C. 0.5 N

D. 5 N

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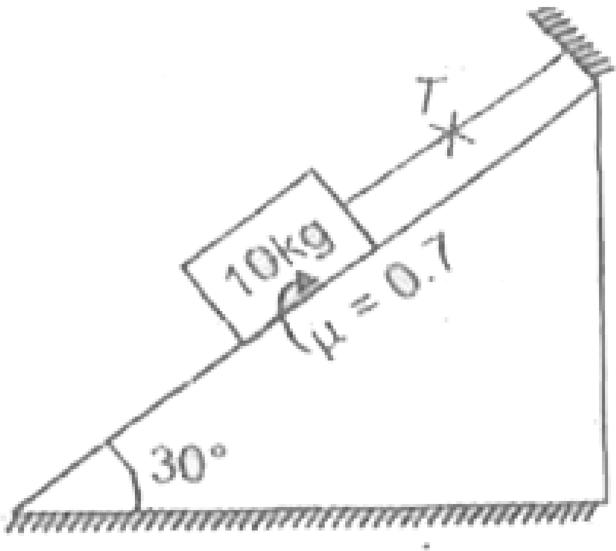
37. The tension T in the string shown in figure is



A. Zero

B. 50 N

C. $35\sqrt{3}N$

D. $\left(\sqrt{3}-1\right)50N$

Watch Video Solution

38. An object of mass 2 kg at rest at origin starts moving under the action of a force $\overrightarrow{F}=\left(3t^2\hat{i}+4t\hat{j}\right)N$ The velocity of the object at t = 2 s will be -

A. $\left(3\hat{i} + 2\hat{j}\right)m/s$

B. $\left(2\hat{i} + 4\hat{j}\right)m/s$

C. $\left(4\hat{i} + 4\hat{j}\right)m/s$

D. $\left(3\hat{i} - 4\hat{j}\right)m/s$

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39. A block of mass m is at rest on a rough inclined plane of angle of inclination θ. If coefficient of friction between the block and the inclined plane is μ, then the minimum value of force along the plane required to move the block on the plane is

A. $mg[\mu \cos \theta - \sin \theta]$

B. $mg[\sin \theta + \mu \cos \theta]$

C. $mg[\mu \cos \theta + \sin \theta]$

D. $mg[\sin \theta - \mu \cos \theta]$

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40. A block of mass m takes time t to slide down on a smooth inclined plane of angle of inclination θ and height h. If same block slids down on a rough inclined plane of same angle of inclination and same height and takes time n times of initial value, then coefficient friction between block and inclined plane is

A. $\left[1+n^2\right]\tan\theta$

B. $\left[1-\frac{1}{n^2}\right]\tan\theta$

C. $\left[1-n^2\right]\tan\theta$

D. $\left[1+\frac{1}{n^2}\right]\tan\theta$

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41. A person stands in contact against the inner wall of a rotor of radius r. The coefficient of friction between the wall and the clothing is μ and the rotor is rotating about vertical axis. The minimum angular speed of the rotor so that the person does not slip downward is

A. $\sqrt{\frac{\mu g}{r}}$

B. $\sqrt{\frac{\mu r}{g}}$

C. $\sqrt{\frac{g}{\mu r}}$

D. $\sqrt{\mu r g}$

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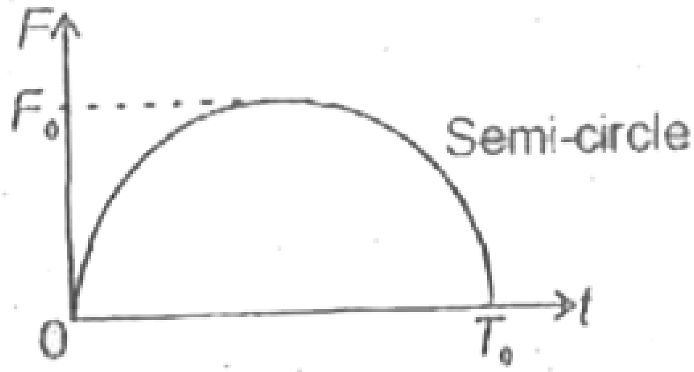
42. The magnitude of force acting on a particle moving along x-axis varies with time (t) as shown in figure. If at t = 0 the velocity of particle is v_0, then its velocity at $t = T_0$ will be



A. $v_0 + \dfrac{\pi F_0 T_0}{4m}$

B. $v_0 + \dfrac{\pi F_0}{2m}$

C. $v_0 + \dfrac{\pi T_0^2}{4m}$

D. $v_0 + \dfrac{\pi F_0 T_0}{m}$

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43. Three forces $\overrightarrow{F}_1 = \left(2\hat{i} + 4\hat{j}\right)N : \overrightarrow{F}_2 = \left(2\hat{j} - \hat{k}\right)N$ and $\overrightarrow{F}_3 = \left(\hat{k} - 4\hat{i} - 2\hat{j}\right)N$ are applied on an object of mass 1 kg at rest at origin. The position of the object at t = 2s will be

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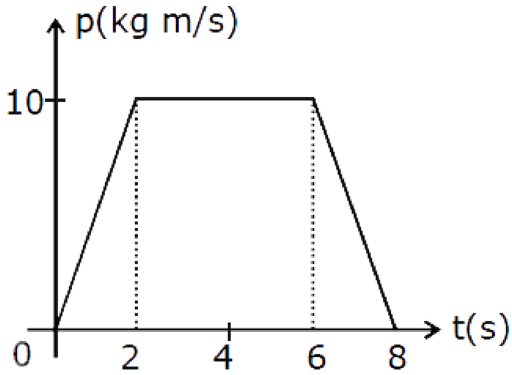
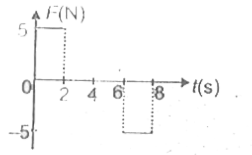
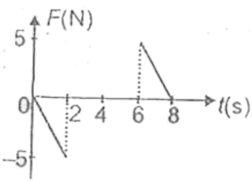
44. The momentum p of an object varies with time (t) as shown in figure. The corresponding force (F)- time (t) graph is -



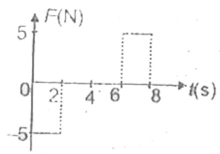
A.

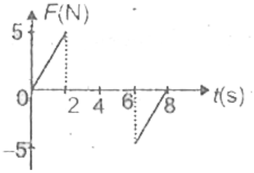


B.



C.



D. 

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Assignment (SECTION-C)

1. One end of a string of length l is connected lo a particle of mass m and the other to a small peg on a smooth horizontal table. If the particle moves in a circle with speed v, the net force on the particle directed towards the centre is (where T is the tension in the string)

A. T

B. $T + \frac{mv^2}{l}$

C. $T - \frac{mv^2}{l}$

D. Zero

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2. Suppose the charge of a proton and an electron differ slightly. One of them is -e and the other is $(e+\Delta e)$. If the net of between force and gravitational force between two hydrogen atoms placed at a distance d (much greater than atomic size) apart is zero, then Δe is of the other [Given mass of hydrogen, $m_h = 1.67 \times 10^{-27} kg$]

A. $10^{-20} C$

B. $10^{-23} C$

C. $10^{-37} C$

D. $10^{-47}C$

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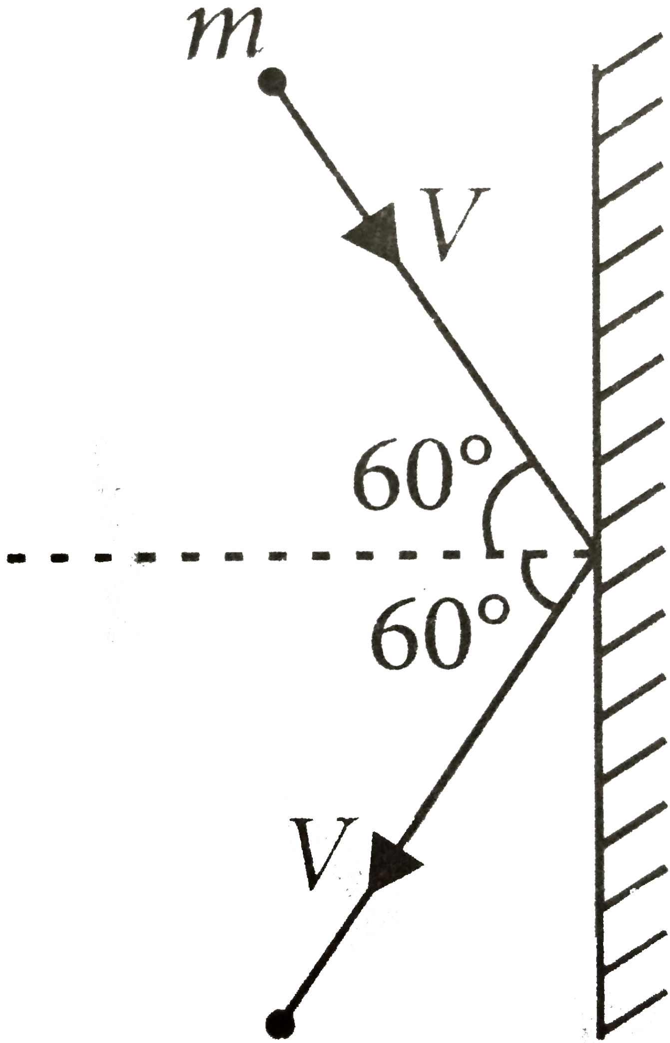
3. A rigid ball of mass m strikes a rigid wall at 60° and angles reflected without loss of speed as shown in the figure. The value of impulse imparted by the wall on the ball will be.



A. mV

B. 2mV

C. $\frac{mV}{2}$

D. $\frac{mV}{3}$

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

A. $\sqrt{\frac{g}{R^2}\frac{\mu_s+\tan\theta}{1-\mu_s\tan\theta}}$

B. $\sqrt{gR^2\frac{\mu_s+\tan\theta}{1-\mu_s\tan\theta}}$

C. $\sqrt{gR\frac{\mu_s+\tan\theta}{1-\mu_s\tan\theta}}$

D. $\sqrt{\frac{g}{R}\frac{\mu_s+\tan\theta}{1-\mu_s\tan\theta}}$

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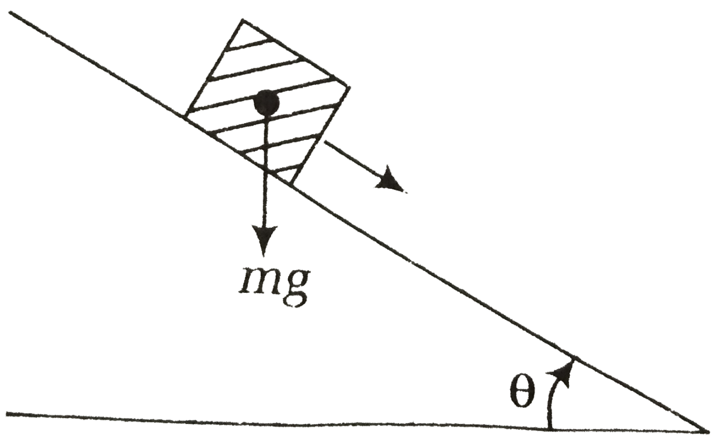
5. A plank with a box on it at one end is gradually raised about the other end. As the angle of inclination with the horizontal reaches 30° , the box starts to slip and slides 4.0 m down the plank in 4.0 s. The coefficients of static and kinetic friction between the box and the plank will be repectively.



A. 0.4 and 0.3

B. 0.6 and 0.6

C. 0.6 and 0.5

D. 0.5 and 0.6

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

A. 1

B. 2

C. 3

D. 4

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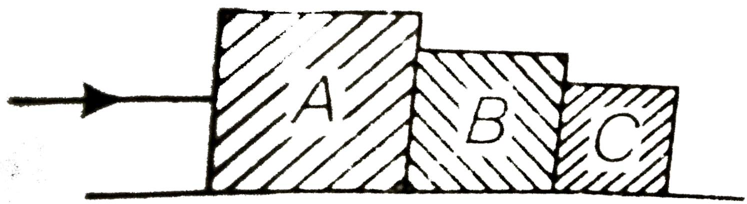
7. Three blocks A,B and C of masses 4 kg, 2kg and 1kg respectively, are in contact on a frictionless surface, as shown. If a force of 14 N is applied on the 4 kg block, then the contact force between A and B is



A. 18 N

B. 2 N

C. 6 N

D. 8 N

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8. A block A of mass m_1 rests on a horizontal table. A light string connected to it passes over a frictionless pulley at the edge of table and from its other end another block B of mass m_2 is suspended. The coefficient of knetic friction between the block and table is

μ_k . When the block A is sliding on the table, the tension in the string is.

A. $\dfrac{m_1 m_2 (1 - \mu_k) g}{(m_1 + m_2)}$

B. $\dfrac{(m_2 + m_k m_1) g}{(m_1 + m_2)}$

C. $\dfrac{(m_2 - \mu_k m_1) g}{(m_1 + m_2)}$

D. $\dfrac{m_1 m_2 (1 + \mu_k) g}{(m_1 + m_2)}$

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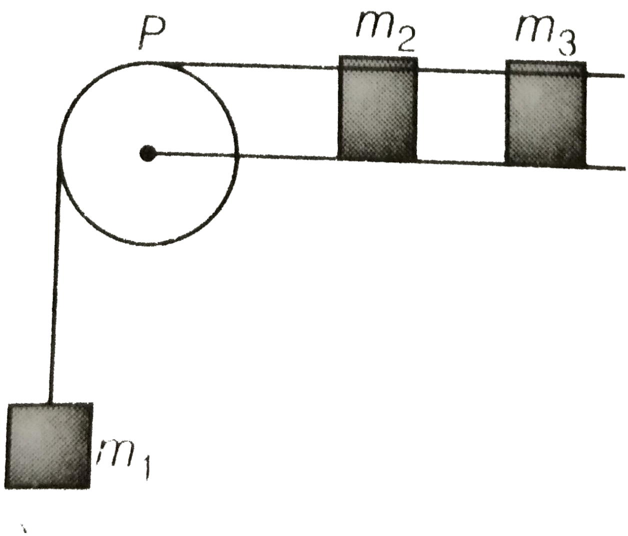
9. A system consists of three masses m_1, m_2 and m_3 connected by a string passing over a pulley P. ?The mas m_1 are on a rough horizontal table (the coefficient of friction = mu). The pulley is frictionless and of negligible mass. The downward acceleration of mass m_1 is (Assume, $m_1 = m_2 = m_3 =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



A. $\dfrac{g(1-g\mu)}{9}$

B. $\dfrac{2g\mu}{3}$

C. $\dfrac{g(1-2\mu)}{3}$

D. $\dfrac{g(1-2\mu)}{2}$

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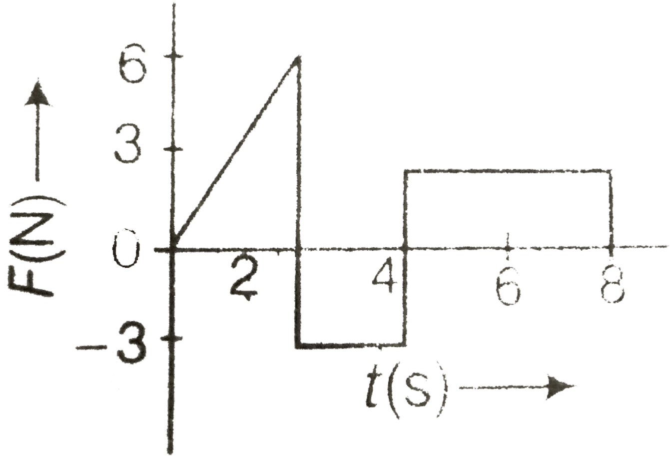
10. The force F acting on a particle of mass m is indicated by the force-time graph shown below. The change in momentum of the particle over the time interval from 0 to 8 s is



A. 24 Ns

B. 20 Ns

C. 12 Ns

D. 6 Ns

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11. A balloon with mass M is descending down with an acceleration $a(a < g)$. What mass of its contents must be removed so that it starts moving up with same acceleration a?

A. $\frac{2ma}{g+a}$

B. $\frac{2ma}{g-a}$

C. $\frac{ma}{g+a}$

D. $\frac{ma}{g-a}$

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12. The upper half of an inclined plane with inclination ϕ is perfectly smooth while the lower half is rough A body starting from rest at the will again come to rest to the bottom if the coefficient of friction for the lower half is given by

A. $\mu = \frac{2}{\tan \theta}$

B. $\mu = 2 \tan \theta$

C. $\mu = \tan \theta$

D. $\mu = \frac{1}{\tan \theta}$

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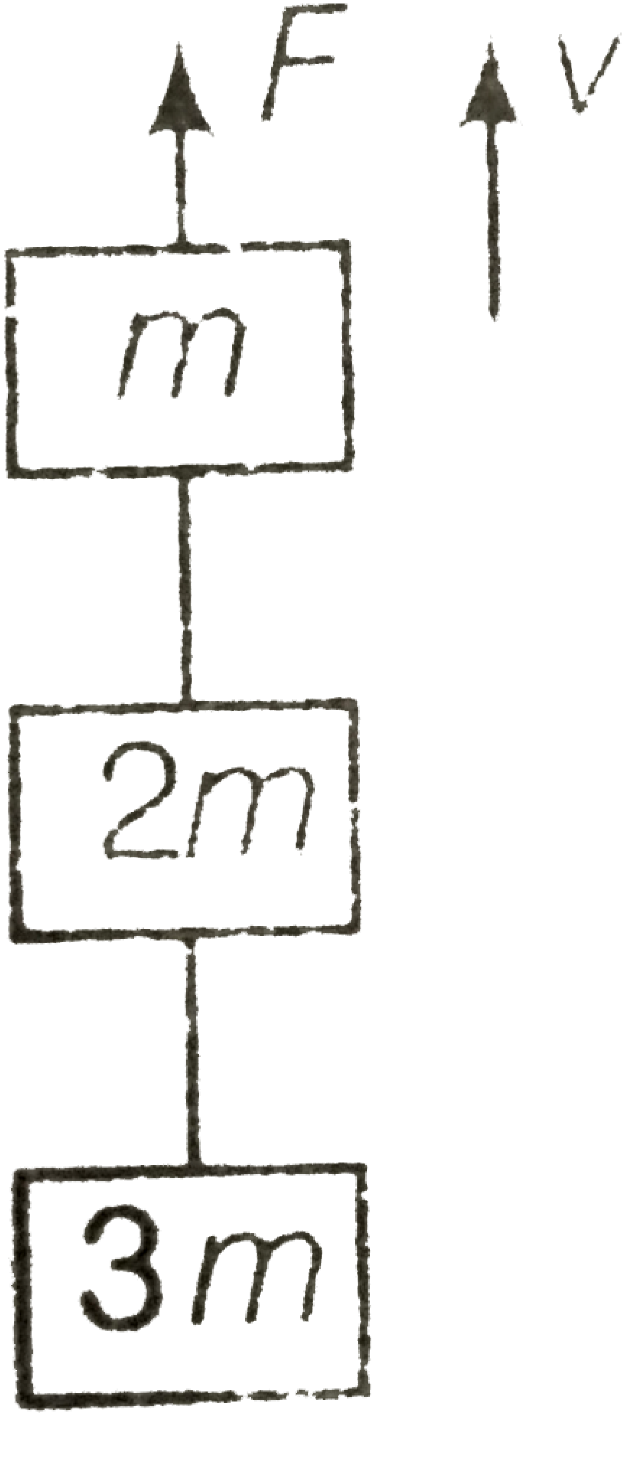
13. Three blocks with masses m,2m and 3m are connected by strings, as shown in the figure. After an upward force F is applied on block m, the masses move upward at constant speed v. What is the net force on the block of mass 2m

? (g is the acceleration due to gravity).


F
v
m
2m
3m

A. 2mg

B. 3mg

C. 6mg

D. Zero

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

A. 5 kg

B. 7 kg

C. 17 kg

D. 3 kg

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

A. $5ms^{-1}$

B. $10ms^{-1}$

C. $20ms^{-1}$

D. $30ms^{-1}$

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16. A car of mass m is moving on a level circular track of radius R. If μs represents the static friction between the road and tyres of the car, the maximum speed of the car in circular motion is given by -

A. $\sqrt{\mu_s m R g}$

B. $\sqrt{\frac{Rg}{\mu_s}}$

C. $\sqrt{\frac{mRg}{\mu_s}}$

D. $\sqrt{\mu_s R g}$

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

A. 1200 N

B. 8600 N

C. 9680 N

D. 11000 N

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18. A ball of mass m strikes a rigid walJ with speed u and rebounds with the same speed. The impulse imparted to the ball by the wall is

A. Zero

B. Mv

C. 1.5 Mv

D. 2 Mv

Watch Video Solution

19. A radioactive nucleus of mass M emits a photon of frequency v and the nucleus recoils. The recoil energy will be

A. hv

B. $Mc^2 - hv$

C. $\frac{h^2v^2}{2Mc^2}$

D. Zero

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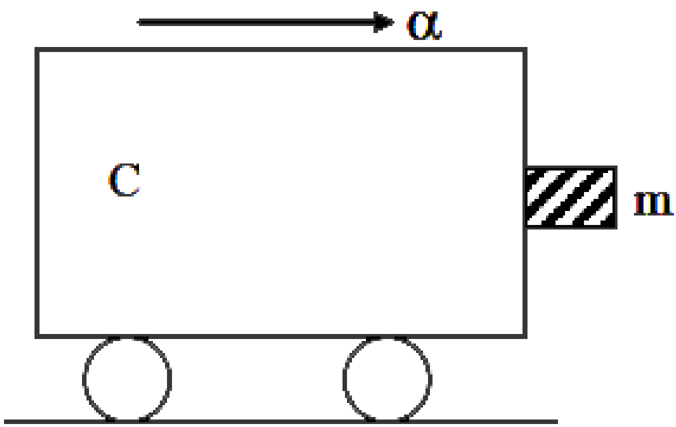
20. A block of mass m is in contact with the cart C as shown in figure -



The coefficient of static friction between the block and the cart is μ , The accelertion α of the cart that will prevent the block from failing satisfies -

A. $\alpha > \frac{mg}{\mu}$

B. $\alpha > \frac{g}{\mu m}$

C. $\alpha \geq \frac{g}{\mu}$

D. $\alpha < \frac{g}{\mu}$

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21. A gramophone record is revolving with an angular velocity ω. A coin is placed at a distance R from the centre of the record. The static coefficient of friction is μ. The coin will revolve with the record if

A. $r = \mu g \omega^2$

B. $r < \frac{\omega^2}{\mu g}$

C. $r < \frac{\mu g}{\omega^2}$

D. $r \geq \frac{\mu g}{\omega^2}$

22. A force $F = \left(6\hat{i} - 9\hat{j} + 10\hat{k}\right)$ N produces an accelertion of 1 m^{-2} in a bady .The mass of bady would be

A. 10 kg

B. 20 kg

C. $10\sqrt{2}$ kg

D. $2\sqrt{10}$ kg

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

A. $4ms^{-2}$ upwards

B. $4ms^{-2}$ downwards

C. $14ms^{-2}$ upwards

D. $30ms^{-2}$ downwards

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24. Sand is being dropped on a conveyor belt at the rate of M kg/s. The force necessary to keep the belt moving with a constant velocity of v m/s will be -

A. Zero

B. Mv newton

C. 2Mv netwton

D. $\frac{Mv}{2}$ newton

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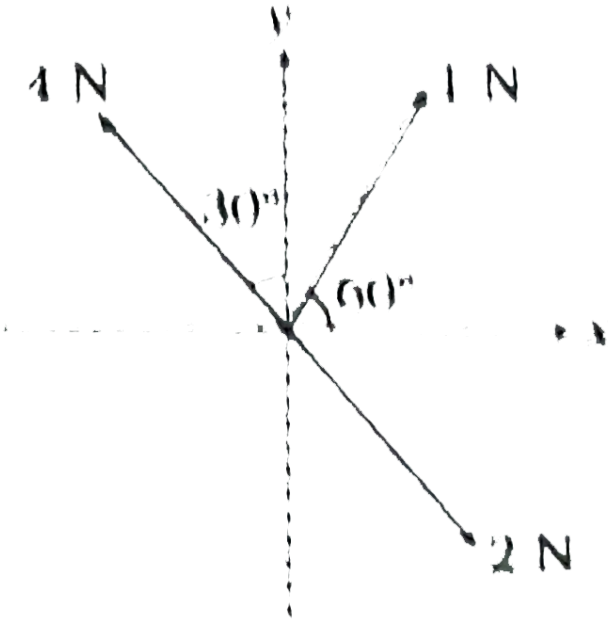
25. Three forcs acting on body are shown in the figure . To have the resultant foce only along the y-direction ,the magniude of the minimum additional force needed is



A. $\sqrt{3}N$

B. $0.5N$

C. 1.5N

D. $\frac{\sqrt{3}}{4}N$

Watch Video Solution

26. A roller coaster is designe such that riders experience "weightlessness" as they go round the top of a hill whose radius of curvature is

20m. The speed of the car at the top of the hill

is between

A. 13 m/s and 14 m/s

B. 14 m/s and 15 m/s

C. 15 m/s and 16 m/s

D. 16 m/s and 17 m/s

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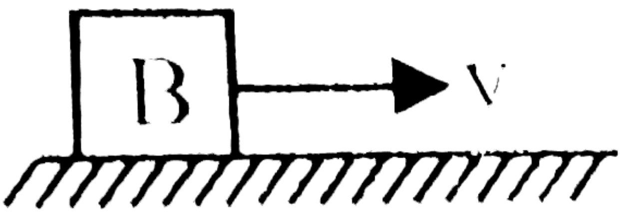
27. A block B is pushed momentarily along a horizontal surface with an initial velocity v. If μ is the coefficient of sliding friction between B and the surface, block B will come to rest after a time:-



A. $\dfrac{v^2}{g\mu}$

B. $\dfrac{v}{\mu g}$

C. $\dfrac{g\mu}{v}$

D. $\frac{g}{v}$

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


30
30

A. 48 N

B. 24 N

C. 12 N

D. 96 N

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29. A tube of length L is filled completely with an incompressible liquid of mass M and closed at both the ends. The tube is then rotated in a horizontal plane about one of its ends with a uniform angular velocity ω. The force exerted by the liquid at the other end is

A. $\frac{ML\omega^2}{2}$

B. $\frac{ML^2\omega}{2}$

C. $Ml\omega^2$

D. $\frac{ML^2\omega^2}{2}$

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

A. Zero

B. 0.4 m

C. 1.2 m

D. 0.6 m

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31. A stone is dropped from a height h. It hits the ground with a certain momentum P. If the same stone is dropped from a height 100% more than the previous height, the momentum when it hits the ground will change by -

A. 68%

B. 41%

C. 200%

D. 100%

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32. A mass m moving horizontal (along the x-axis) with velocity v collides and sticks to mass of $3m$ moving vertically upward (along the y-axis) with velocity $2v$. The final velocity of the combination is

A. $\frac{2}{3}v\hat{i} + \frac{1}{3}v\hat{j}$

B. $\frac{3}{2}v\hat{i} + \frac{1}{4}v\hat{j}$

C. $\frac{1}{4}v\hat{i} + \frac{3}{2}v\hat{j}$

D. $\frac{1}{3}v\hat{i} + \frac{2}{3}v\hat{j}$

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33. An object is moving on a plane surface with uniform velocity $10ms^{-1}$ in presence of a force 10N. The frictional force between the object and the surface is

A. 1 N

B. -10 N

C. 10 N

D. 100 N

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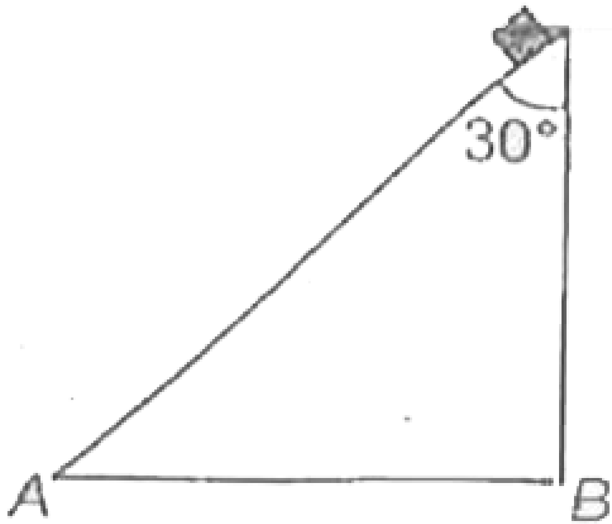
34. A body of mass M starts sliding down on the inclined plane where the critical angle is $\angle ACB = 30^\circ$ as shown in figure. The coefficient of kinetic friction will be



A. $\dfrac{Mg}{\sqrt{3}}$

B. $\sqrt{3}Mg$

C. $\sqrt{3}$

D. None of these

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35. In non-inertial frame, the second law of motion is written as (where F_p is pseudo-force while a is the acceleration of the body relative to non-inertial frame).

A. $F = ma$

B. $F = ma + F_p$

C. $F = ma - F_p$

D. $F = 2ma$

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

A. $-1.6ms^{-1}, 8N$

B. $-0.08ms^{-1}, 16N$

C. $-0.8ms^{-1}, 16N$

D. $-1.6ms^{-1}, 16N$

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37. In a rocket, fuel bums at the rate of 1 kg/s. This fuel is ejected from the rocket with a velocity of 60 km/s. This exerts a force on the rocket equal to

A. 6000 N

B. 60000 N

C. 60 N

D. 600 N

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38. A satellite in force-free sweeps stationary interplanetary dust at a rate of $d\frac{M}{dt} = \alpha v,$ where M is mass and v is the speed of satellite and α is a constant. The tangential acceleration of satellite is

A. $\frac{-\alpha v^2}{2M}$

B. $-\alpha v^2$

C. $\frac{-2\alpha v^2}{M}$

D. $\frac{-\alpha v^2}{M}$

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39. A man fires a bullet of mass 200 g at a speed of 5 m/s. The gun is of one kg mass. by what velocity the gun rebounds backwards

A. 1 m/s

B. 0.01 m/s

C. 0.1 m/s

D. 10 m/s

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40. A 10 N force is applied on a body produces an acceleration of 1 m/s^2 . The mass of the body is

A. 15 kg

B. 20 kg

C. 10 kg

D. 5 kg

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41. A force of 6 N acts on a body at rest and 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

A. 7 second

B. 5 second

C. 10 second

D. 8 second

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42. A shell in its flight, explodes into four unequal parts. Which of the following is conserved?

A. Potential energy

B. Momentum

C. Kinetic energy

D. Both (1) & (3)

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

A. $185.5kgs^{-1}$

B. $187.5kgs^{-1}$

C. $127.5kgs^{-1}$

D. $137.5kgs^{-1}$

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

A. 9 Ns

B. Zero

C. 1.8 Ns

D. 0.9 Ns

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45. A ball of mass 0.25 kg attached to the end of a string of length 1.96 m is moving in a horizontal circle. The string will break if the tension is more than 25 N . What is the maximum speed with which the ball can be moved

A. 5 m/s

B. 3 m/s

C. 14 m/s

D. 3.92 m/s

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46. A mass of 1 kg is suspended by means of a thread. The system is (i) lifted up with an acceleration of $4.9ms^2$ (ii) lowered with an acceleration of $4.9ms^{-2}$. The ratio of tension in the first and second case is

A. $1:3$

B. $1:2$

C. $3:1$

D. $2:1$

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47. If the force on a rocket moving with a velocity of 300 m/s is 345 N, then the rate of combustion of the fuel is

(a) 0.55 kg/s (b) 0.75 kg/s (c) 1.15 kg/s (d) 2.25 kg/s

A. 0.07 kg/s

B. 1.4 kg/s

C. 0.7 kg/s

D. 10.7 kg/s

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48. A 500 kg car takes a round turn of radius 50 m with a velocity of 36 km/hr . The centripetal force is

A. 1000 N

B. 750 N

C. 250 N

D. 1200 N

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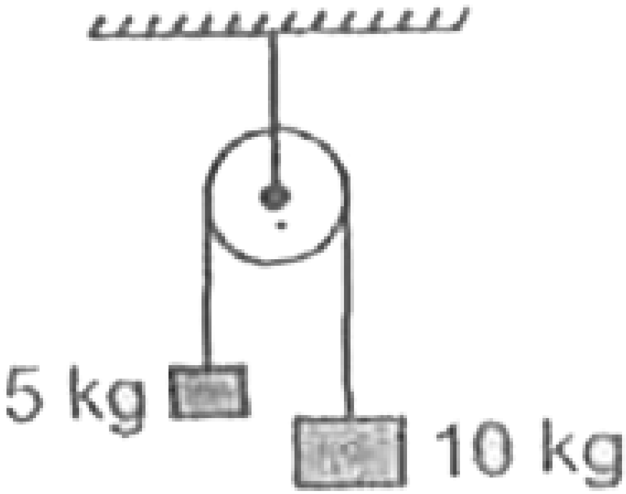
49. Two masses as shown are suspended from a massless pulley. Calculate the acceleration of the 10 kg mass when masses are left free



A. $\frac{2g}{3}$

B. $\frac{g}{3}$

C. $\frac{g}{9}$

D. $\frac{g}{7}$

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50. A mass of 1 kg is thrown up with a velocity of 100 m/s. After 5 seconds. It explodes into two parts. One parts of mass 400 g comes down with a velocity 25 m/s Calaculate the velocity of other parts:

A. $40m/s\uparrow$

B. $40m/s\downarrow$

C. $100m/s\uparrow$

D. $60m/s\uparrow$

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51. A man is slipping on a frictionless inclined plane & a bag falls down from the same height. Then the speed of both is related as:

A. $V_B > V_m$

B. $V_B < V_m$

C. $V_B = V_m$

D. V_B and V_m can't be related

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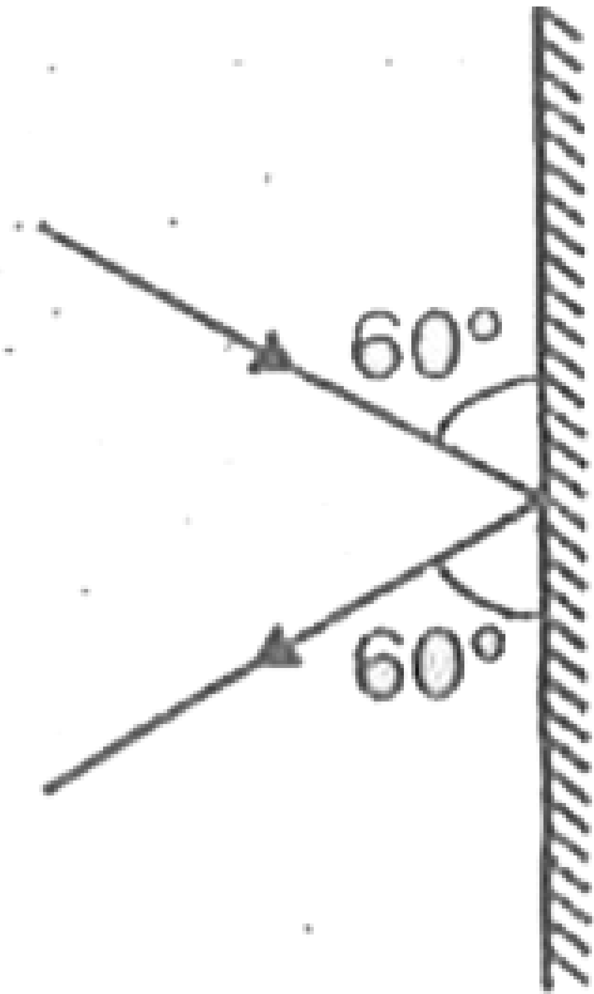
52. A body of mass 3 kg moving with velocity 10 m/s hits a wall at an angle of 60° and returns at the same angle. The impact time was 0.2 s. Calculate the force exerted on the wall.



A. $150\sqrt{3}N$

B. $50\sqrt{3}N$

C. 100 N

D. 75 N

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53. A cricketer catches a ball of mass 150 gm. in 0.1 second moving with speed $20ms^{-1}$. Then he experiences force of : -

A. 300 N

B. 30 N

C. 3 N

D. 0.3 N

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54. On the horizontal surface of a truck $(\mu = 0.6)$ a block of mass 1 kg is placed. If the truck is accelerating at the rate of $5m / \sec^2$ then friction force on the block will be

A. 5 N

B. 6 N

C. 5.88 N

D. 8 N

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55. An object of mass $3kg$ is at rest. Now a force of $\overrightarrow{F} = 6t^2\hat{i} + 4t\hat{j}$ is applied on the object, the velocity of object at $t = 3s$ is.

A. $18\hat{i} + 3\hat{j}$

B. $18\hat{i} + 6\hat{j}$

C. $3\hat{i} + 18\hat{j}$

D. $18\hat{i} + 4\hat{j}$

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56. A block of mass $10kg$ is placed on a rough horizontal surface having coefficient of friction $\mu = 0.5$. If a horizontal force of $100N$ is acting on it, then acceleration of the block will be.

A. $10m/s^2$

B. $5m/s^2$

C. $15m/s^2$

D. $0.5m/s^2$

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57. A lift of mass 1000 kg which is moving with an acceleration of $1ms^{-2}$ in upward direction , then the tension developed in string which is connected to lift is __________

A. 9800 N

B. 10,800 N

C. 11,000 N

D. 10,000 N

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

A. $5m / s^2$

B. $10m / s^2$

C. $25m / s^2$

D. $2.5m / s^2$

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59. A man weighs $80kg$. He stands on a weighing scale in a lift which is moving upwords with a uniform acceleration of $5m/s^2$. What would be the reading on the scale?

A. Zero

B. 400 N

C. 800 N

D. 1200 N

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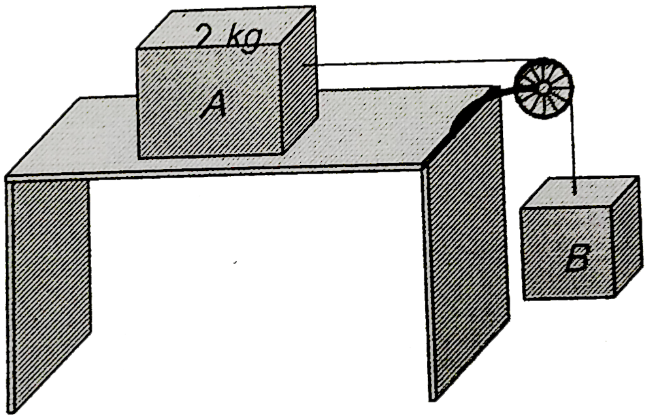
60. The coefficient of static friction, μ_s between block A of mass 2 kg and the table as shown in the figure is 0.2. What would be the maximum mass value of block B so that the two blocks do not move? The string and the pulley are assumed to be smooth and massless.$(g = 10m/s^2)$



A. 2.0 kg

B. 4.0 kg

C. 0.2 kg

D. 0.4 kg

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

A. $mg \cos \theta$

B. $mg \sin \theta$

C. mg

D. $mg / \cos \theta$

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62. A car is moving in a circular horizontal track of radius 10 m with a constant speed of $10ms^{-1}$. A plumb bob is suspended from the roof of the car by a light rigid rod. The angle made by the rod with the vertical is:

A. 0°

B. $\frac{\pi}{3}$

C. $\frac{\pi}{6}$

D. $\frac{\pi}{4}$

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63. A man of $50kg$ mass is standing in a gravity free space at a height of $10m$ above the floor. He throws a stone of $0.5kg$ mass downwards with a speed $2m/s$. When the stone reaches the floor, the distance of the man above the floor will be

A. 20 m

B. 9.9 m

C. 10.1 m

D. 10 m

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Assignment (SECTION-D) (Assertion-Reason Type Questions)

1. A : Due to inertia an object is unable to change by itself its state of rest and uniform motion.

R : An object cannot change its state unless acted upon by an unbalanced external force.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion

C. If Assertion is true statement but Reason is false

D. If both Assertion and Reason are false statements

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2. A : Acceleration of an object in uniform motion is zero.

R : No force is required to move an object uniformly

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion

C. If Assertion is true statement but Reason is false

D. If both Assertion and Reason are false statements

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3. A : Newton's second law of motion gives the measurement of force.

R : According to second law of motion, force is directly proportional to the rate of change of momentum.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion

C. If Assertion is true statement but Reason is false

D. If both Assertion and Reason are false statements

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

R : There is no time lag between action and reaction.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion

C. If Assertion is true statement but Reason is false

D. If both Assertion and Reason are false statements

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5. A : Inertia depends on the mass of an object.

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

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion

C. If Assertion is true statement but Reason is false

D. If both Assertion and Reason are false statements

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6. Assertion : In the case of free fall of the lift, the man will feel weightlessness.

Reason : In free fall, acceleration of lift is equal to acceleration due to gravity.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion

C. If Assertion is true statement but Reason is false

D. If both Assertion and Reason are false statements

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7. A : Static friction force is a self adjusting force.

R : The interatomic forces at the point of contact give rise to friction between the surfaces.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion

C. If Assertion is true statement but Reason is false

D. If both Assertion and Reason are false statements

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8. Assertion : The value of dynamic friction is less than the limiting friction.

Reason : Once the motion has started, the inertia of rest has been overcome.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion

C. If Assertion is true statement but Reason is false

D. If both Assertion and Reason are false statements

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9. A : During horizontal circular turn of a car, the centripetal force required should be less than the limiting friction between its tyres and road.

R : The centripetal force to car is provided by the frictional force between its tyres and the road.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion

C. If Assertion is true statement but Reason is false

D. If both Assertion and Reason are false statements

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10. A : A person on a frictionless surface can get away from it by blowing air out of his mouth

R : For every action there is an equal and opposite reaction.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion

C. If Assertion is true statement but Reason is false

D. If both Assertion and Reason are false statements

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11. A : It is difficult to move a cycle along a road with its brakes on.

R : Sliding friction is greater than rolling friction.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion

C. If Assertion is true statement but Reason is false

D. If both Assertion and Reason are false statements

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12. A : It makes easier to walk on slippery muddy road if we throw some sand on it.

R : On throwing sand, frictional force of the surface increases.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion

C. If Assertion is true statement but Reason is false

D. If both Assertion and Reason are false statements

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13. A : Banking of roads reduces the wear and tear of the tyres of automobiles.

R : By banking of the roads one component of the normal reaction on the automobile contributes to necessary centripetal force.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion

C. If Assertion is true statement but Reason is false

D. If both Assertion and Reason are false statements

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14. A : The centripetal and centrifugal forces never cancel each other.

R : They are action and reaction forces.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion

B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion

C. If Assertion is true statement but Reason is false

D. If both Assertion and Reason are false statements

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15. A : Work done by friction can increase the kinetic energy of the body.

R : Friction is a type of contact force and it always opposes the relative motion or tendency of relative motion.

A. If both Assertion & Reason are true and the reason is the correct explanation of the assertion
B. If both Assertion & Reason are true but the reason is not the correct explanation of the assertion
C. If Assertion is true statement but Reason is false

D. If both Assertion and Reason are false statements

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