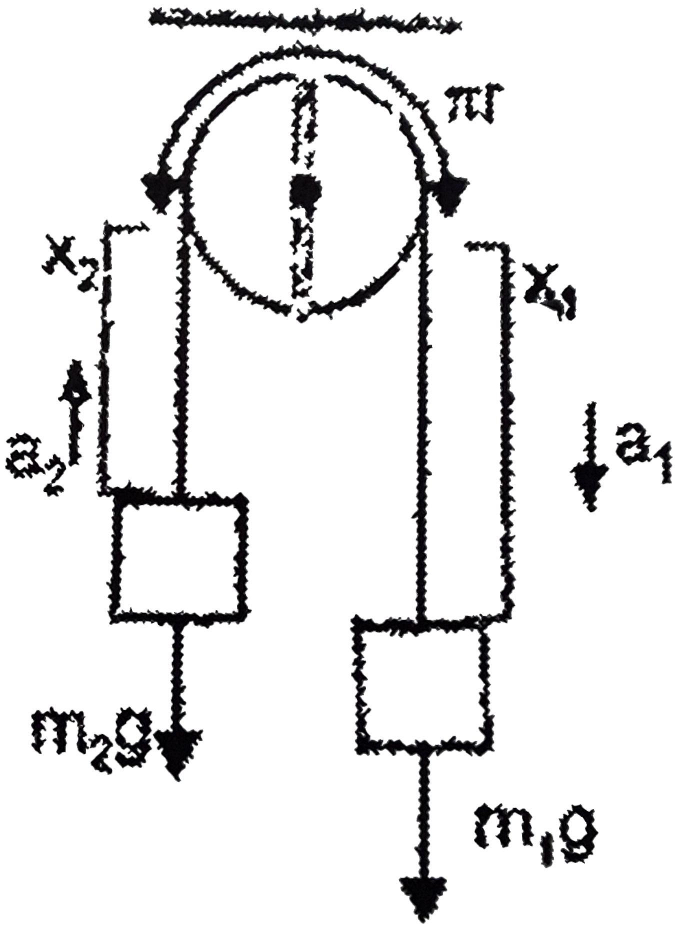
PHYSICS

BOOKS - SHREE BALAJI PHYSICS (HINGLISH)

FORCE ANALYSIS

Illustration

1. In the figure shown the masses are attached to the inextensible string. At any instant, let the positions of m_1 and m_2 be x_1 and x_2 respectively as shown in the Fig.



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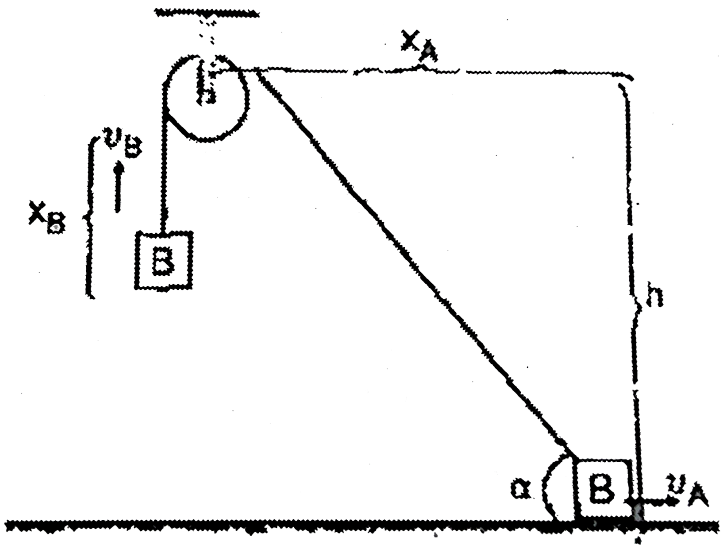
2. In the Fig. the blocks 'A' and 'B' are connected with an inextensible string. The block 'A' can slide on a smooth horizontal surface.



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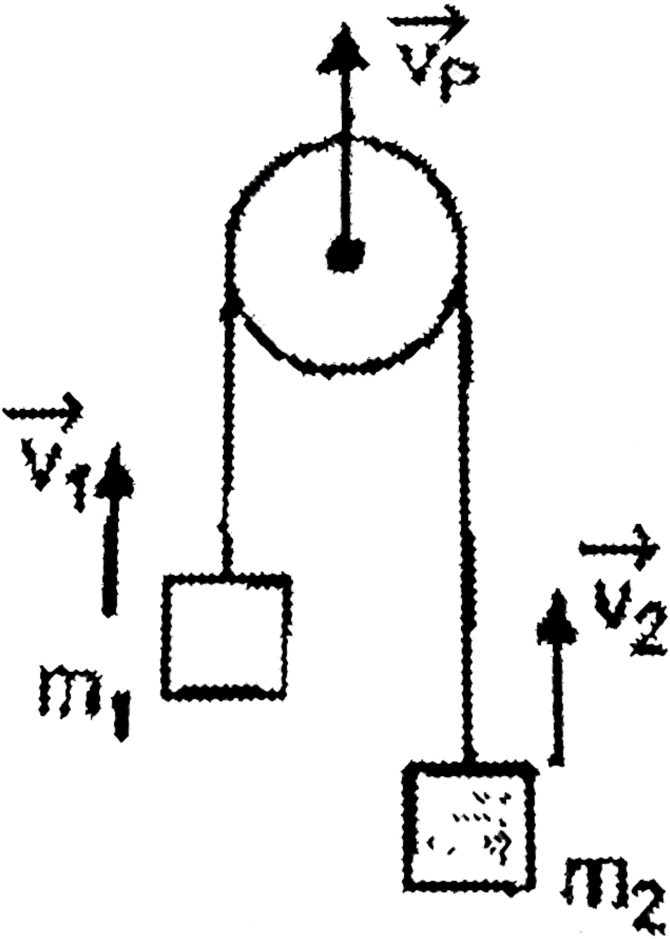
3. In the Fig. shown pulley moves with acceleration $\vec{v}_P$. Let acceleration of blocks m_1 and m_2 w.r.t. ground are $\vec{v}_1$ and



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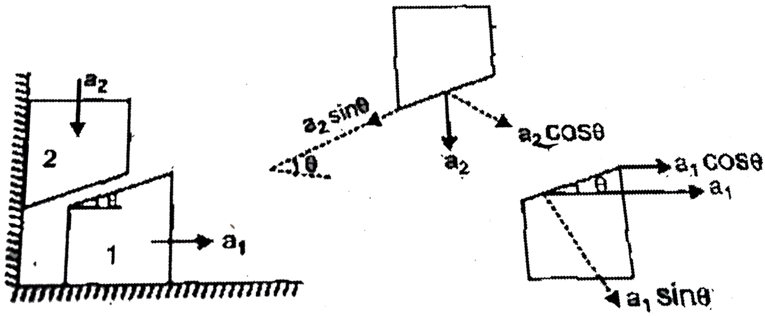
4. In the Fig. shown find relation between acceleration of wedge 1 and 2



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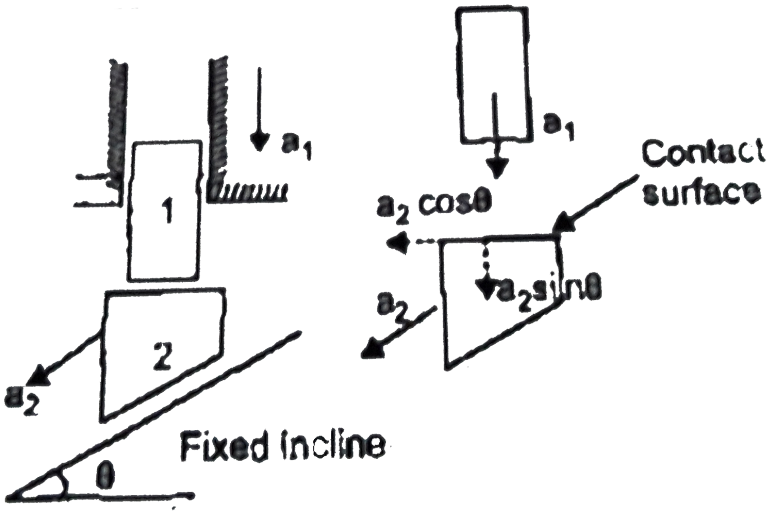
5. In the Fig. shown plank 1 and wedge 2 are free to more obtain relation between their acceleration procedure is similar to that of previous illustration. ltbr. $a_1 = a_2 \sin\theta$



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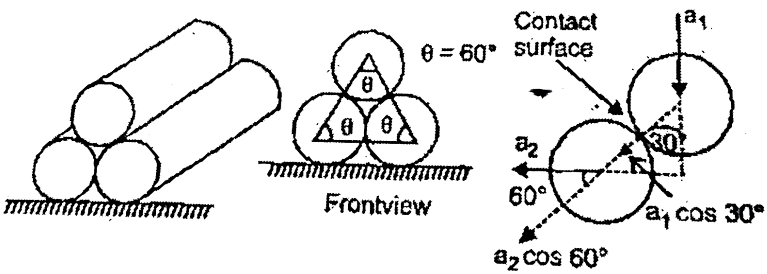
6. Fig shown three identical cylinders, cylinders are released, find relation between acceleration of cylinders.



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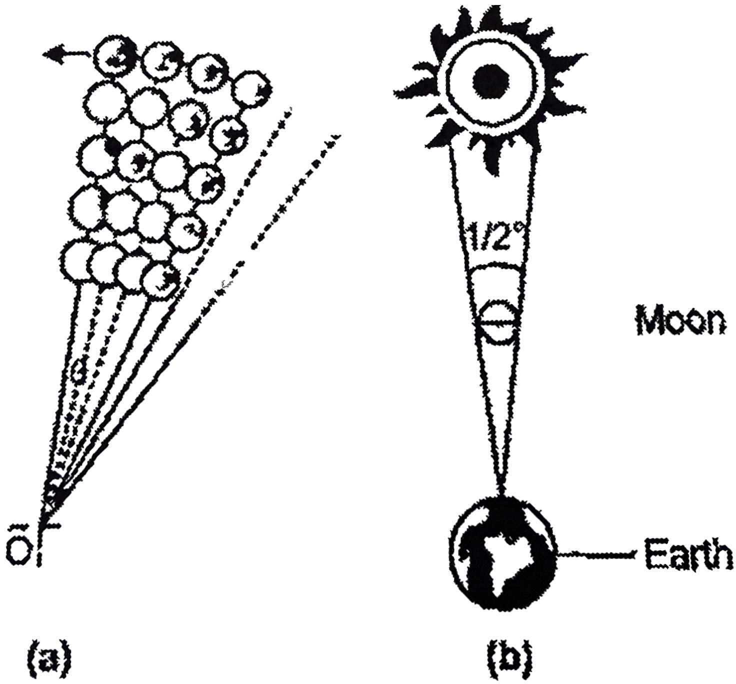
7. Diameter of moon, $D = 3.4 \times 10^6 m$

Distance from earth, $r = 3.8 \times 10^8 m.$



If we approximate its straight line diameter as an arc length, then the angle θ subtended at the earth at the earth by the moon is

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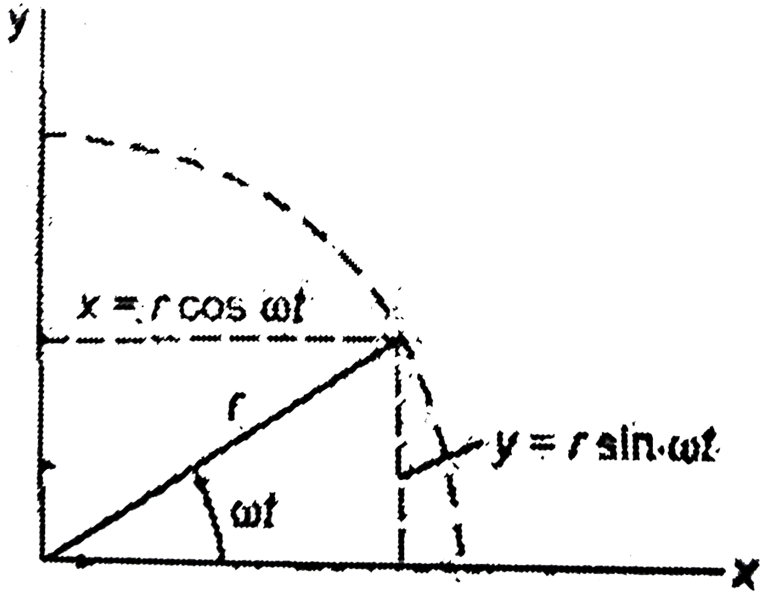
8. Consider a particle moving in the $x-y$ plane according to $r = r\left(\cos\omega t\hat{i} + \sin\omega t\hat{j}\right)$, where r and ω are constants. Find the trajectory, the velocity, and the acceleration.



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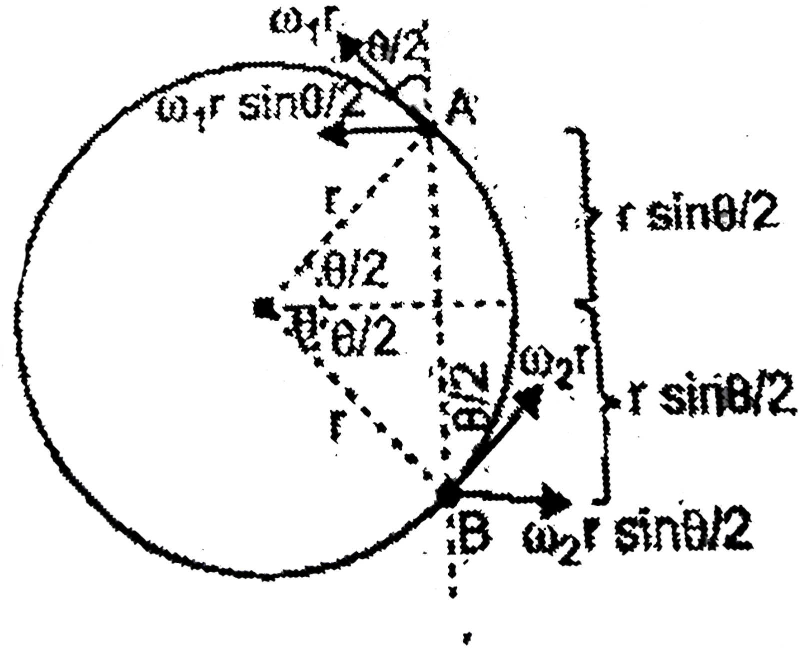
9. Two particle 'A' and 'B' are moving on the same circle with angular ω_1 and ω_2 respectively w.r.t. the centre of circle. Find the angular velocity of 'A' w.r.t. 'B' when,

(i) their sense of rotations is same,

(ii) and their sense of rotation is opposite.



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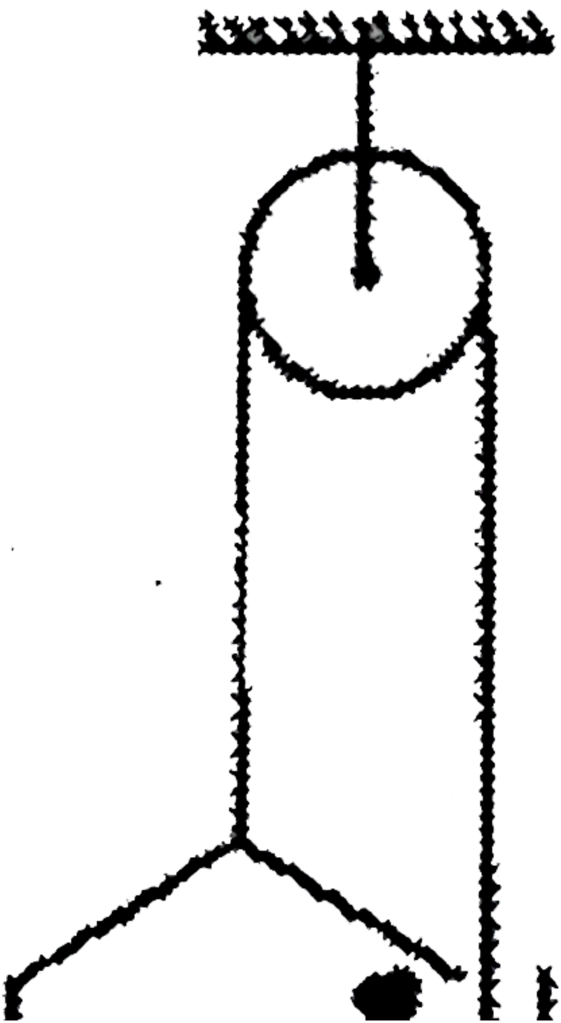
Example

1. A man of mass M stands on a.box of mass m as shown in the Fig. 2E. I (a). A rope attached to 'the box and passing over an overhead pulley allows the man to raise himself and the box by , pulling the rope downward.

(i) With what minimum force should the ' man pull the rope so as to prevent himself , from falling down.

(ii) If the man pulls the rope with a force F greater than the minimum force, then determine the acceleration of the (man + box) system.

(iii) Determine. the normal reaction between the man and the trolley.



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2. A heavy block of mass M hangs in equilibrium at the end of a rope of mass m and length l connected to a celling. Determine the tension in the rope at a distance x from the ceiling.

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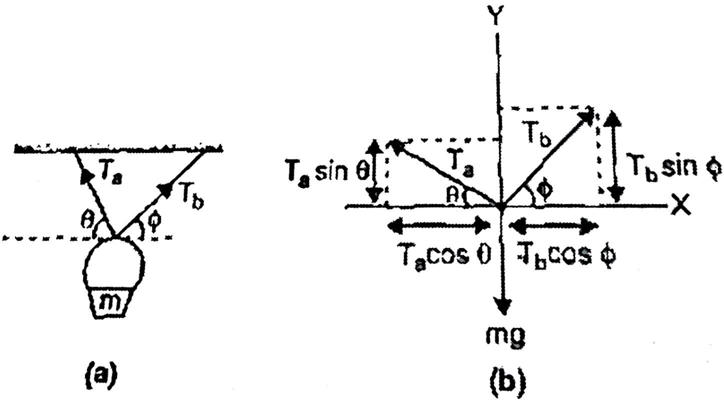
3. A bucket is suspended by two light ropes a and b as shown in fig. 2E.3 (a). Determine the tensions in the ropes a and b.



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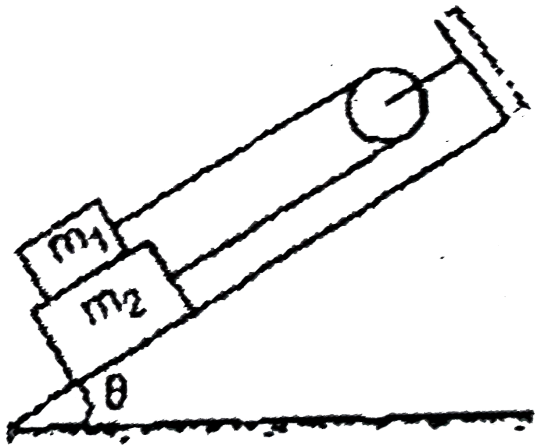
4. (a) shows a block of mass m_1 sliding on a block of mass m_2, with $m_1 > m_2$. Find

(a) the acceleration of each block,

(b) tension in the string,

(c) force exerted by m_1 on m_2

(d) force exerted by m_2 on the incline



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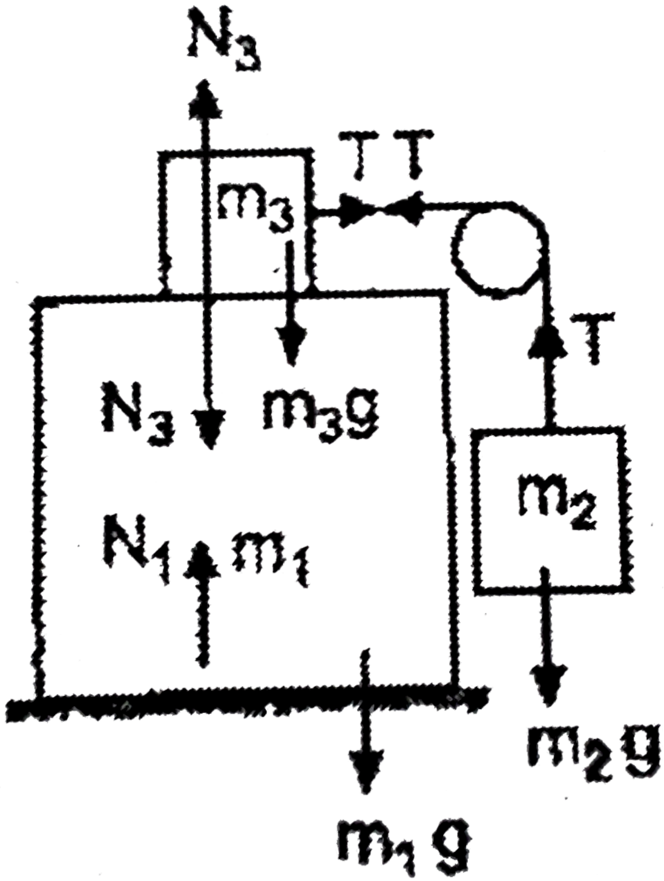
5. In the system shownin Fig. 2E.5 (a), block m_2 is being prevented from descending by pulling m_1 to the right with force F. Assuming all the surfaces to be surfaces to be frictionless, find F.



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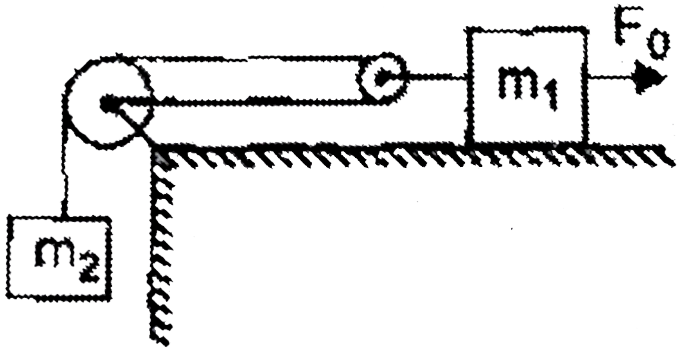
6. A block of mass m_1 on a smooth, horizontal· swface is: connected to a second mass m_2 by a light cord ovbr a light,: frictionless pulley as shown. (Neglect the mass of the cord and' of the pulley). A force of magnitude F_0

is applied to mass m_1· as shown. Neglect any friction.



(a) Find the value of force F_0 for which the sy!tem will be in equilibrium.

(b) Find the acceleration of masses andtensio~ in string if F_0 has a value which is double of that foun,d in part (a).

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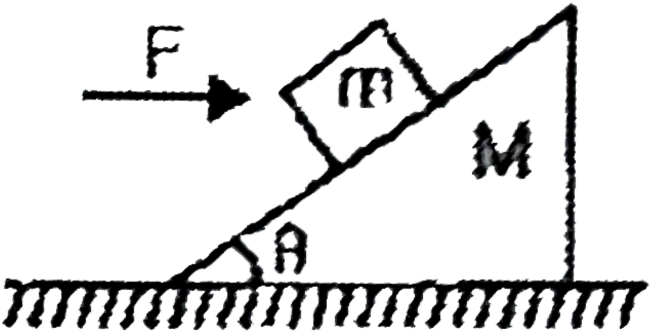
7. A small cubical block is placed on a triangular block M so that ,they touch each other along a smooth inclined contact plane as shown. The, inclined surface makes an angle θ With the horizontal. A hqrizontal force F is to be applied on the block mi so that the two bodies move without slipping against each other. Assuming the floor to be smooth also, determine the



(a) normal force with which m and M press against each other and

(b) the magnitude of external force F. Express your answer in terms of m, M, θ and g.

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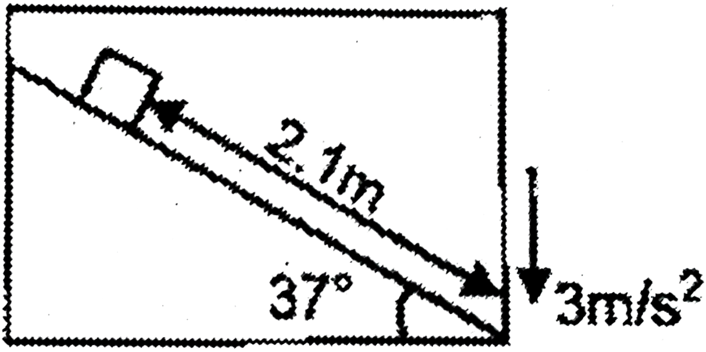
8. A block of mass 1 kg is kept on the tilted floor ofa lift moving, down with $3m/s^2$. If the block is released from rest as shown, what will be the time taken by block to reach the bottom. What is the normal reaction on the block during the motion?



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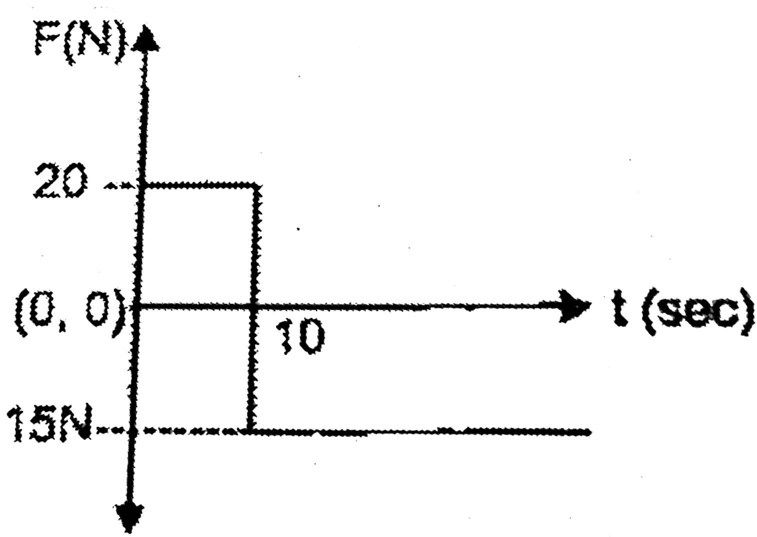
9. A particle of mass 10 kg is acted upon by a force F along the line of motion which varies as shown in the figure. The initial velocity of the particle is $10ms^{-1}$. Find the maximµm velocity attained by the particle before it comes to instantaneous rest.



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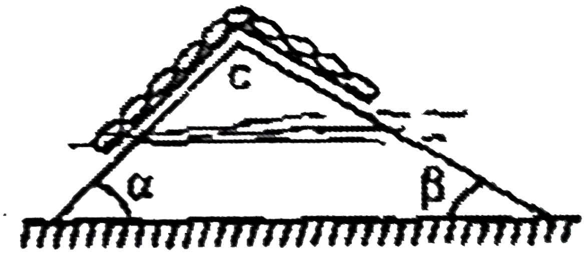
10. A homogeneous and flexible chain rests on a wedge whose side edges make-angle α and β with the horizontal [refer Fig. 2E., 10(a)]. The cehtrarparcuf the chain lies on the upper tip of the wedge. With what acceleration should the wedge be pulled to the left along the horizontal plane in order to prevent the, displacement of the chain with respect to the wedge?

[Consider all surfaces to be smooth]



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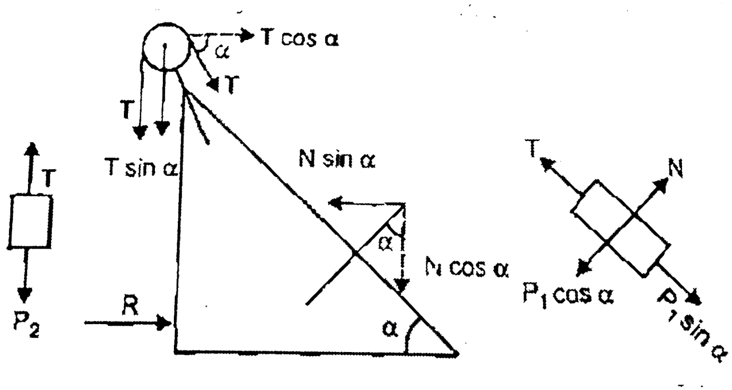
11. A body A weighting P_1 descends down inclined plane D fixed of a wedge which makes an angle α with the horizontal, and pulls a load B that weights P_2 by means of a weightless and inextensible thread passing over a fixed smooth pulley C, as shown in fig. 2E.11. Determine the horizontal compouent of the force (in Newton) which the wedge acts on the floor corner E.



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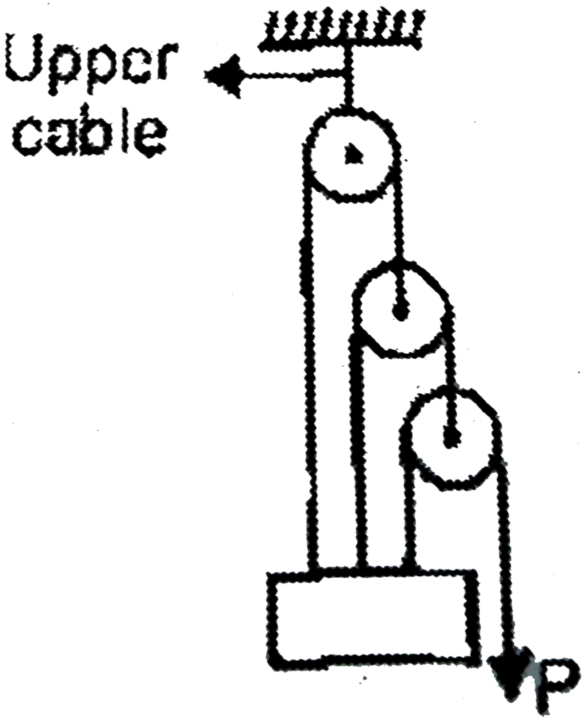
12. The pull P is is just sufficient to keep the 14 N block in equilibrium as shown. Pulleys are ideal. Find the tension (in N) in the cable connected with ceiling.



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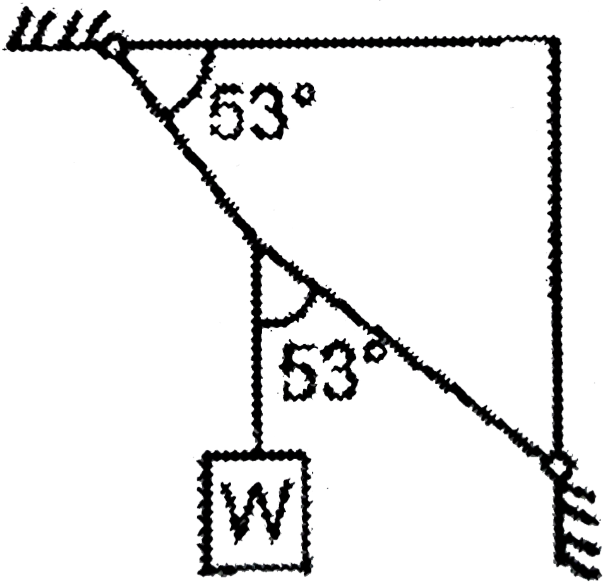
13. For the equilibrium situation shown, the cords are strong enough to with stand a maximum tension 100 N. what is the largest value of W (in N) that they can support as shown ?



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14. Two block a and B having masses $m_1 = 1kg, m_2 = 4kg$ are arranged as shown in the figure. The pulleys P and Q are light, and frictionless. All the blocks are resting on. a horizontal floor and the pulleys ate held such that strings remains just taut.

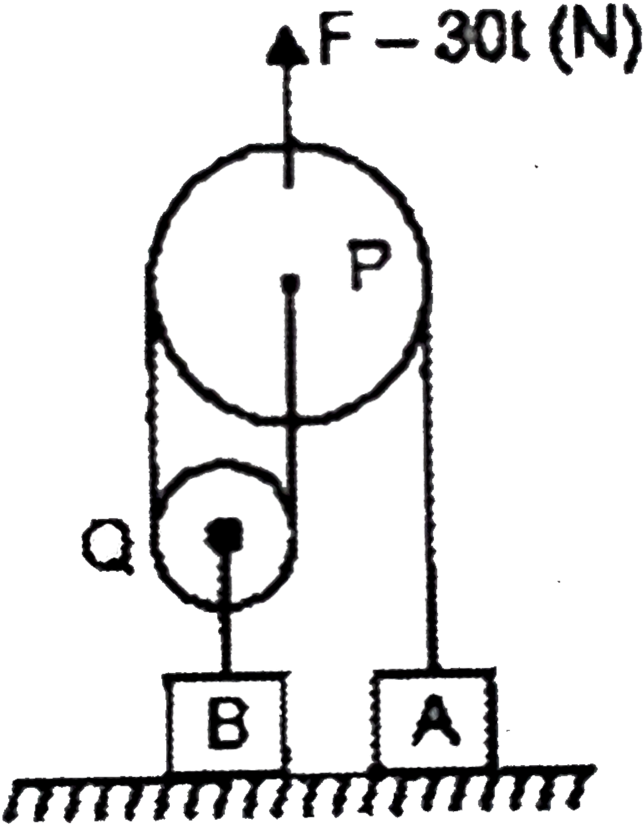
At.moment $t = 0a$ force $F = 30t(N)$ starts acting on thei ipulley p along . vertically upward direction as shown in the pulley P along vertically upward direction as shown in the figure. Calculate.

(i) the time when the blocks A and B loose contact with ground.

(ii) the. velocity of A when B looses contact with ground.

(iii) the height raised. by A upto this instant.

(iv) the work done by the force F upto this instan.



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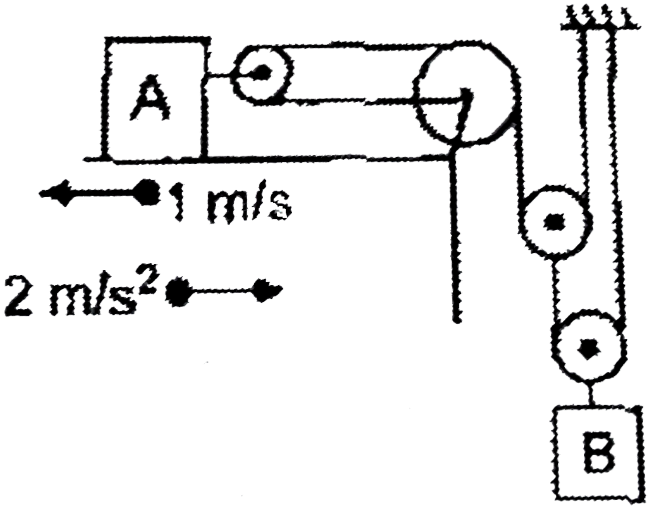
15. In the figure find the velocity and acceleration of B, if instaneous velocity and acceleration of A are as shown in the Fig.



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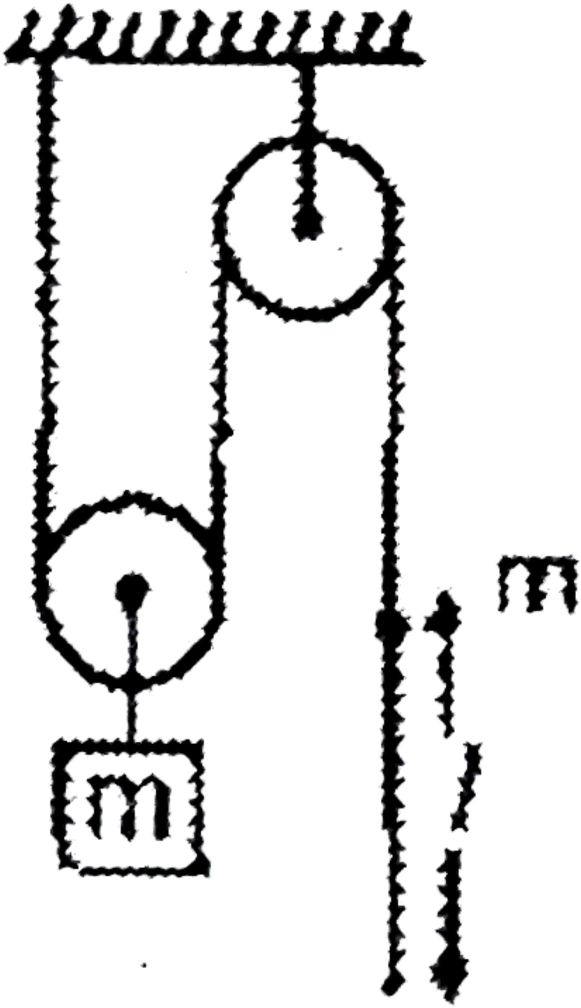
16. In the figure shown, friction force between the bend and the light string is $\frac{mg}{4}$. Find the time in which the bead loose contact with the string after the system is released from rest.



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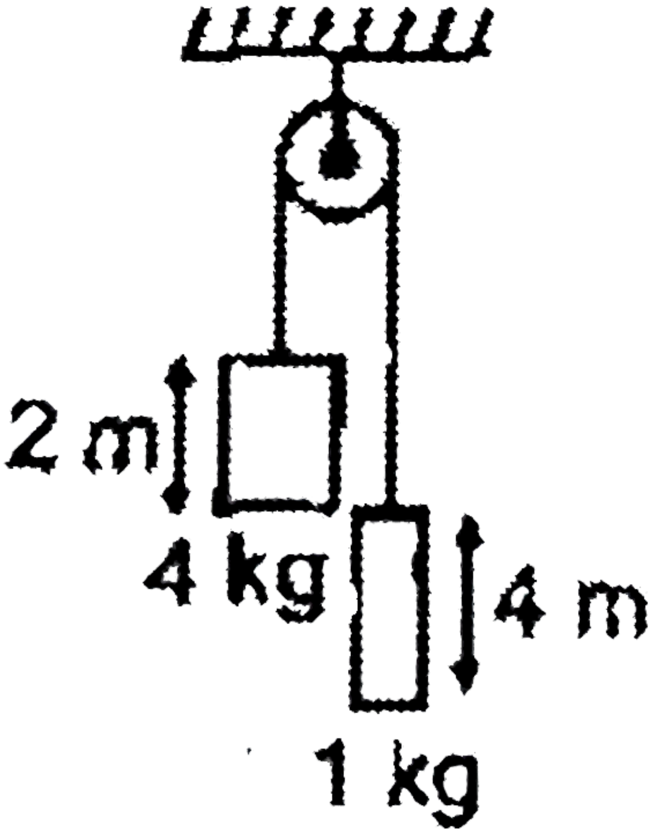
17. In Fig. shown, both blocks are released from rest. Length of 4 kg block is 2 m and of 1 kg is 4 m. Find the time they take to cross each other? Assume pulley to be light and string to be light and inelastic.



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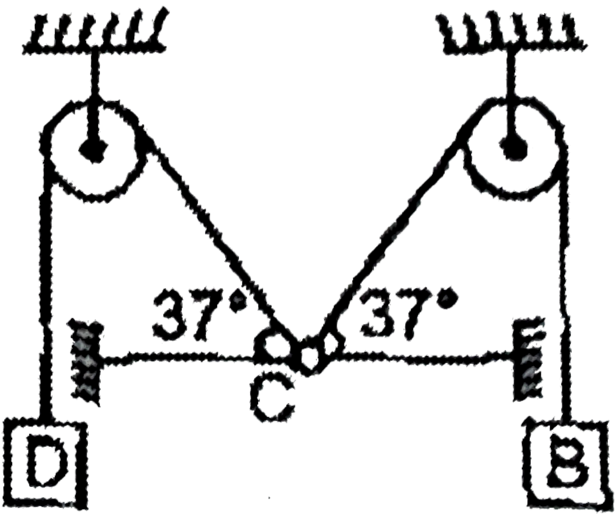
18. A bead C can move freely on a horizontal rod. The bead is connected by blocks B and D by a string as shown in the figure. IF the velocity of B is v. find the velocity of block D.



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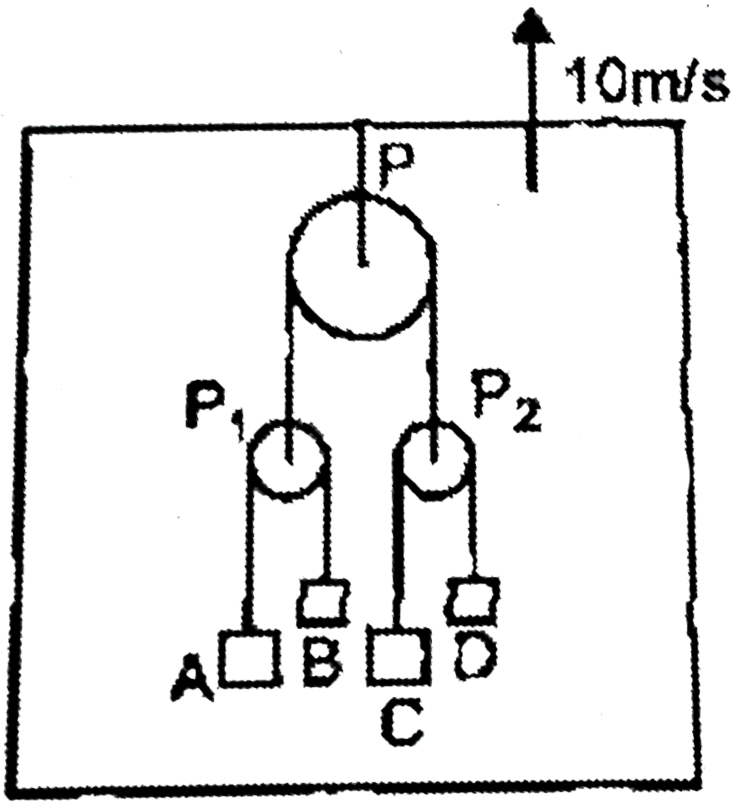
19. A lift goes up with 10 m/s. a pulley P is fixed to the ceiling of the lift. To this pulley other two pulley P_1 and P_2 are attached. P_1 moves up with velocity 30 m/s. A moves up with velocity 10 m/s. D is moving downwards with velocity 10 m/s at same instant of time. Find the velocity of B and that of C at that instant. Assume that all velocities are relative to the ground.



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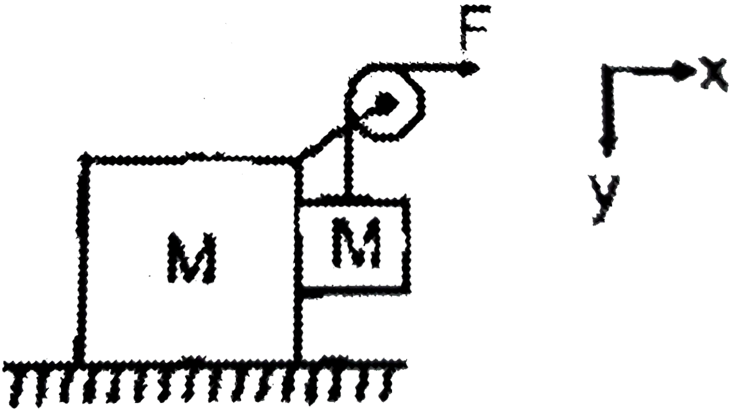
20. In the situation given all surfaces are frictionless, pulley is ideal and string is light. If $F = Mg/2$, find the acceleration of both the block in vector form.



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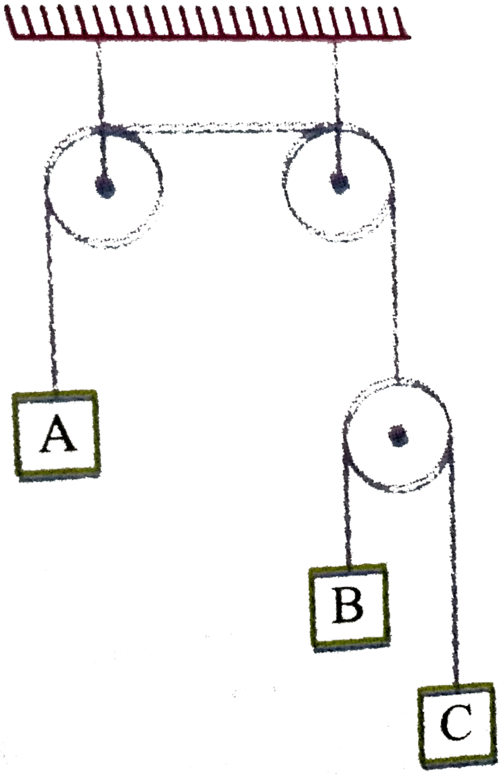
21. Three blocks shown in move vertically with constant velocities The relative velocity of w.r.t C is $100 m/s$ upward and the relative velocity of B w.r.t A is $50 m/s$ downward. All the string are ideal The velocity of C

with respect to ground is $125/x$ calculate x



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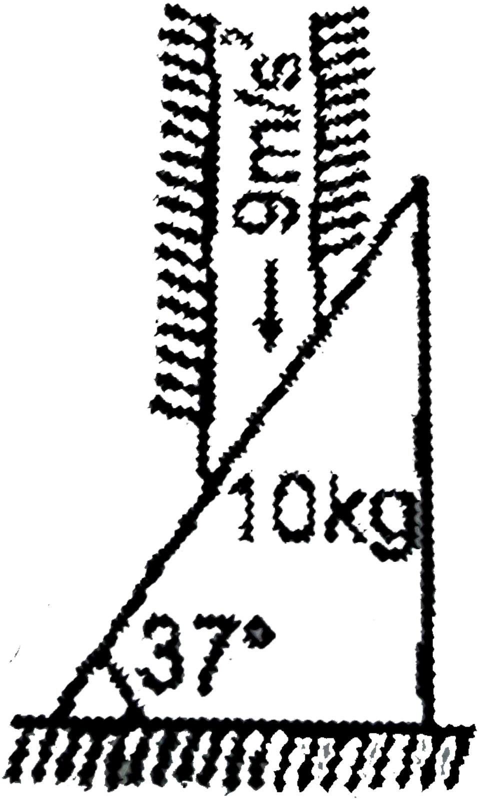
22. System is shown in figure. All the surface are smooth. Rod is move by external agent with acceleration $9m/s^2$ vertically downwards. Find the force exerted on the rod by the wedge.



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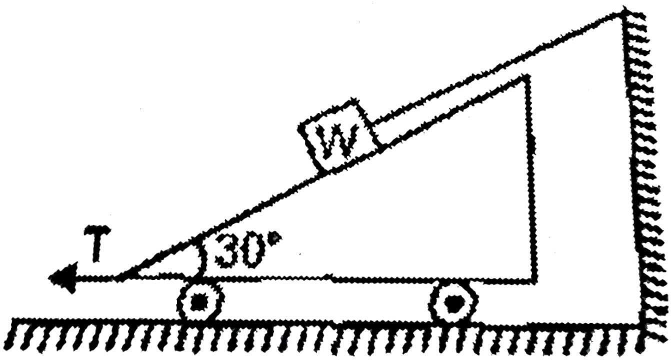
23. Find the tension to hold the car equilibrium, if there is no friction.



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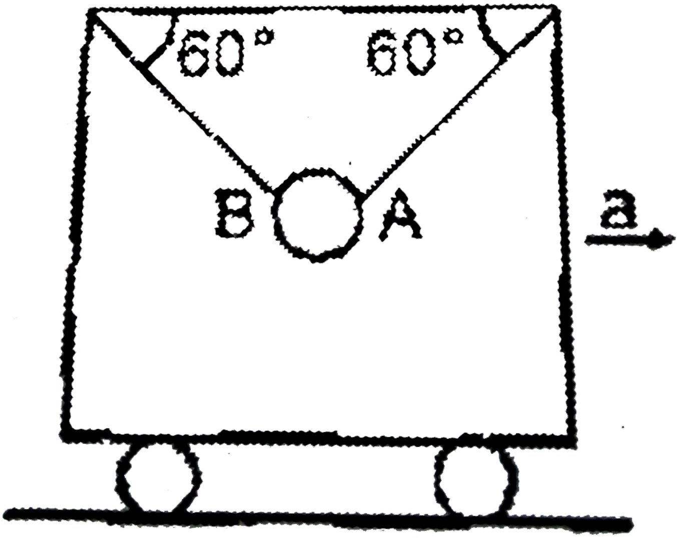
24. A steel ball is suspended from the ceiling of an accelerating carriage by means of cords A and B. Determine the acceleration a of the carriage which cause the tension in A to be twice that in B.



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25. A block of mass 10 kg is kept on ground. A vertically upward force $F = (20t)N$, where t is the time in seconds starts on it at $t = 0$.

(a) Find the time at which the normal reaction acting on the block is zero.

(b) The height of the block from ground at $t = 10$ sec.

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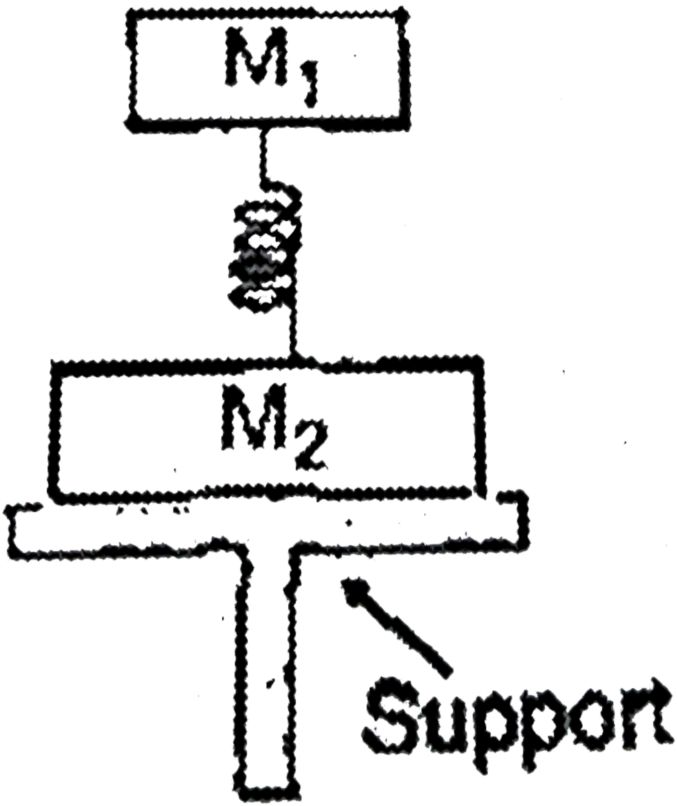
26. The system of two weights with masses m_1 and m_2 are connected with weightless spring as shown. The system is resting on the support S. the support S is quickly removed. Find the accelerations of each of the weights right after the support S is removed.



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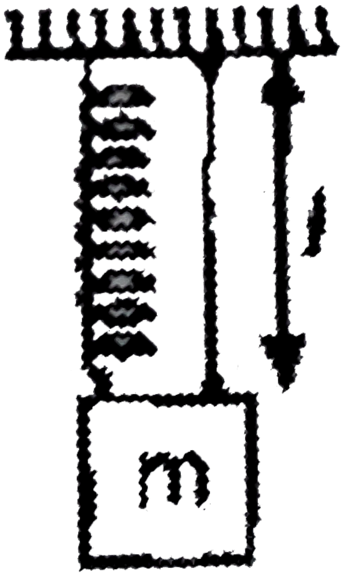
27. An object of mass m is suspended in equilibrium using a string of length l and a spring of constant $K(< 2mg/l)$ and unstretched length $1/2$. Find the tension in the string. What happens if $K > 2mg/l$?



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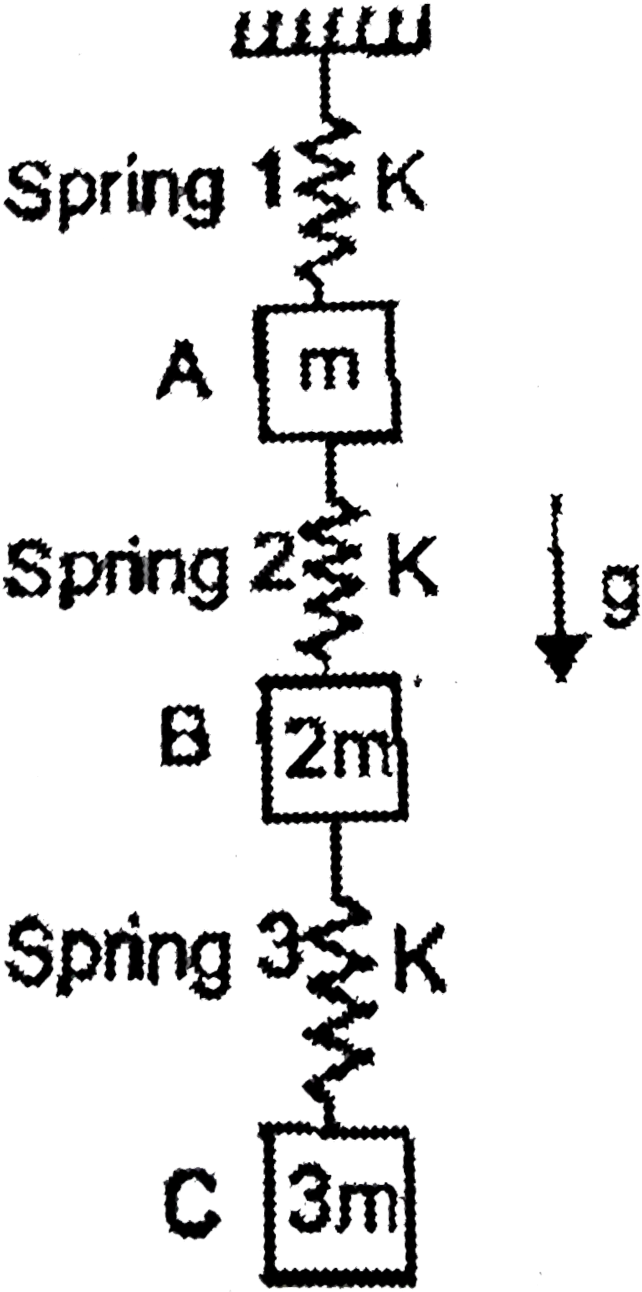
28. The system shown in the Fig. is in equilibrium. Find the initial acceleration of A, B and C just after the spring 2 is cut.



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29. The mass in the fig. can slide on a frictionless surface. The mass is pulled out by a distance x. The spring constants are k_1 and k_2 respectively. Find the force pulling back on the mass and orce on the wall.

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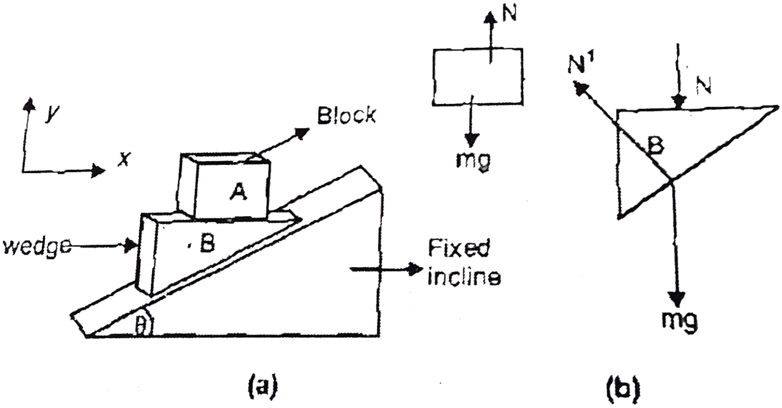
30. Block A of mass m is placed over a wedge of same mass m. Both the block and wedge are placed on a fixed inclined plane. Assuming all surfaces to be smooth calculate the displacement of the block A in ground frame in $1s$.



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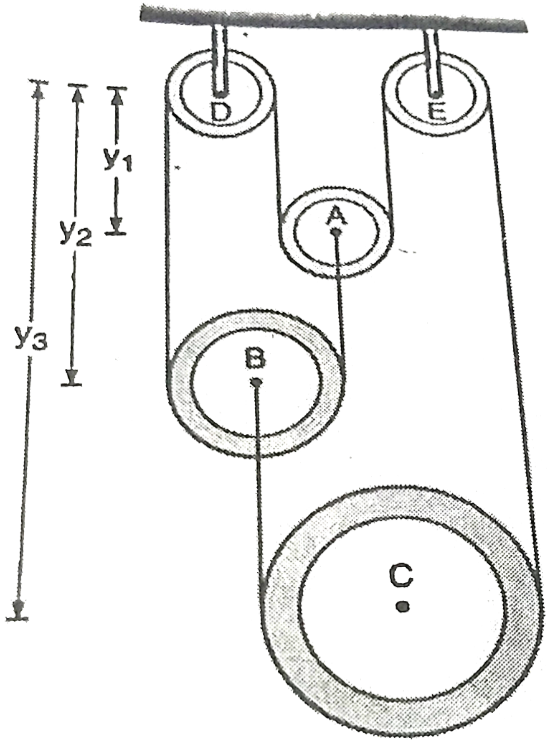
31. In the pulley system shown in figure the movable pulleys A, B and C are of 1 kg each D and E are fixed pulleys. The strings are light and inextensible find the accelerations of the pulleys and tension in the string.



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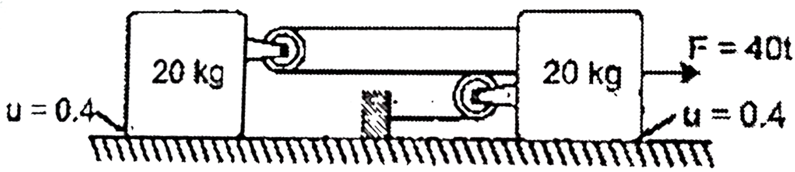
32. Two identical blocks each having a mass of 20 kg are connected to each other by a light inextensible string as shown and as placed over a rough surface. Pulley are connected to the blocks.

Find acceleration of the blocks after one second after the application of the time varying force of 40 t N, where t is in second.



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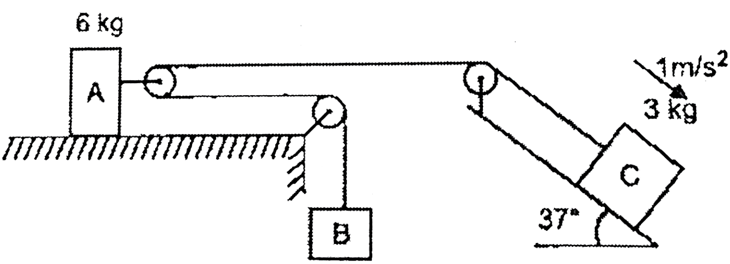
33. Three blocks A, B, & C are arranged as shown. Pulley and strings are ideal. All surfaces are frictionless. If block C is observed moving down along the incline at $1m/s^2$. Find mass of block B, tension in string and accelerations of A. B as the system is released from rest.



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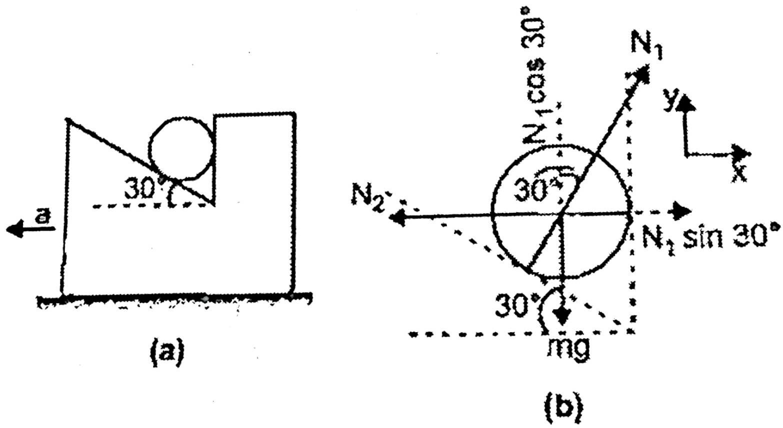
34. The system shown in the Fig. is given an acceleration 'a' towards left. Assuming all the surfaces to be frictionless, find the force on the sphere.



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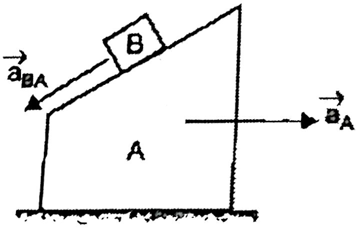
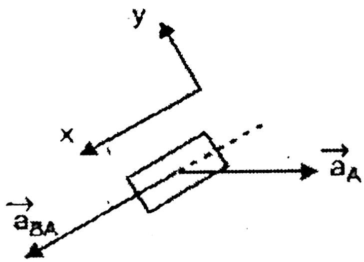
35. The block B starts from rest and slides on the wedge A which can move on a horizontal surface, Neglecting friction, determine (a) the acceleration of wedge, (b) the acceleration of the block relative to the wedge.





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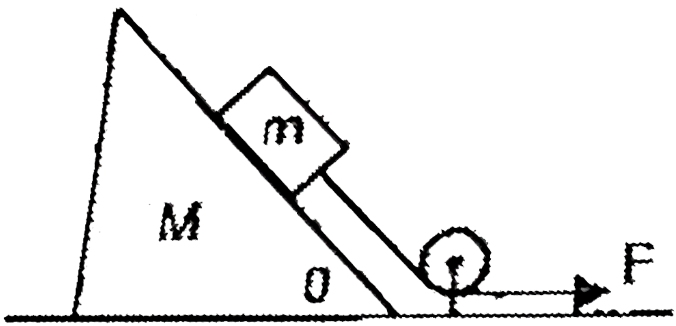
36. In the Fig. shown, mass 'm' is being pulled on the incline of a wedge of mass M. All the surface are smooth. Find the acceleration of the wedge.



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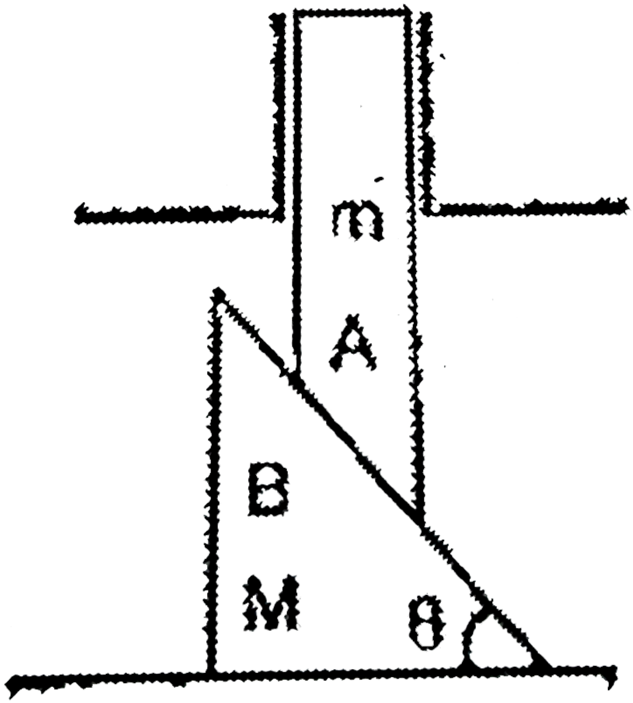
37. A rod 'A' constrained to move in vertical direction rests on a wedge B, as shown in the Fig. Find the accelerations of rod A and wedge B instantaneously after system is released from rest, neglecting friction at all the contact surfaces.



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38. A block weighing 20 N rests on a horizontal surface. The: coefficient of static friction between block and surface is 0.40 and the coefficient of kinetic friction is 0.20.

(a) How large is the friction force exerted on the block?

(b) How great will the friction force be if a horizontal force of 5 N is exerted on the block?

(c) What is the minimum force that will start the block in motion?

(d) What is the minimum force that will keep the block in motion once it has been started?

(e) If the horizontal force is 10 N, what is the friction force?

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39. A wedge of mass M makes an angle θ with the horizontal. The wedge is placed on horizontal frictionless surface. A small block of mass m is placed on the inclined surface of wedge. What horizontal force F must be applied to the wedge so that the force of friction between the block and wedge is zero ?

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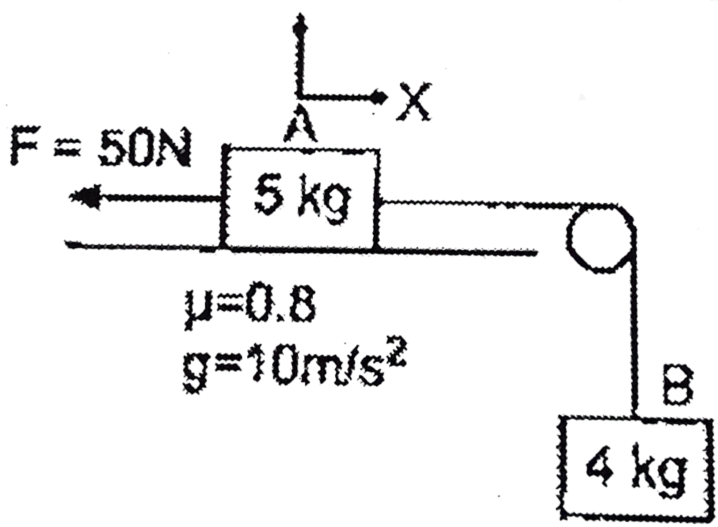
40. Find the acceleration of the block and magnitude and direction of frictional force between block A and table, if block A is pulled towards Left with a force of 50 N.



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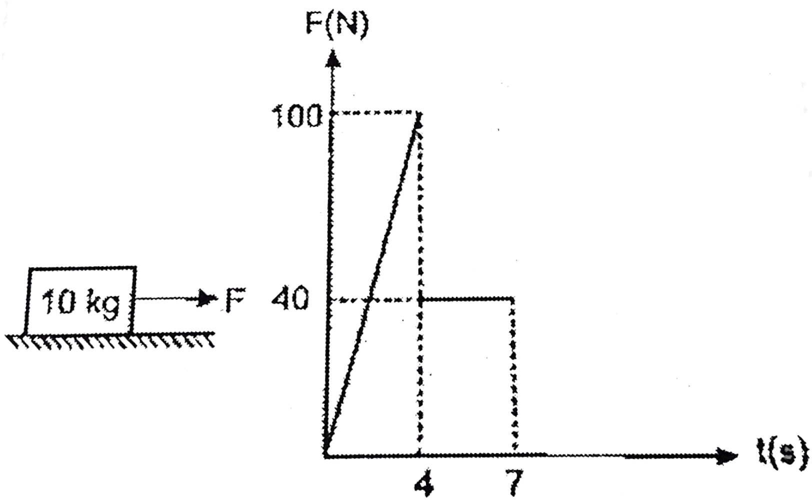
41. The 10 kg block is resting on the horizontal surface when the force 'F is applied to it for 7 second. The variation of 'F with time is shown. Calculate the maximum velocity reached by the block and the total time 't' during which the block is in motion. The coefficient of static and kinetic friction are both, 0.50.



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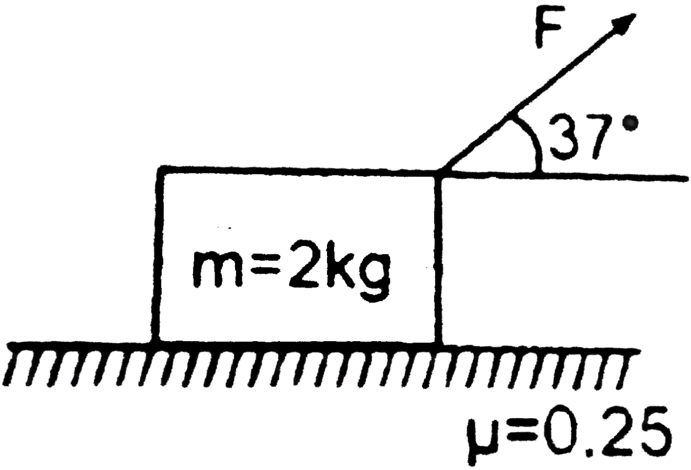
42. A force $F = 20N$ is applied to a block (at rest) as shown in figure. After the block has moved a distance of $8m$ to the right, the direction of horizontal component of the force F is reversed. Find the velocity with which block arrives at its starting point.



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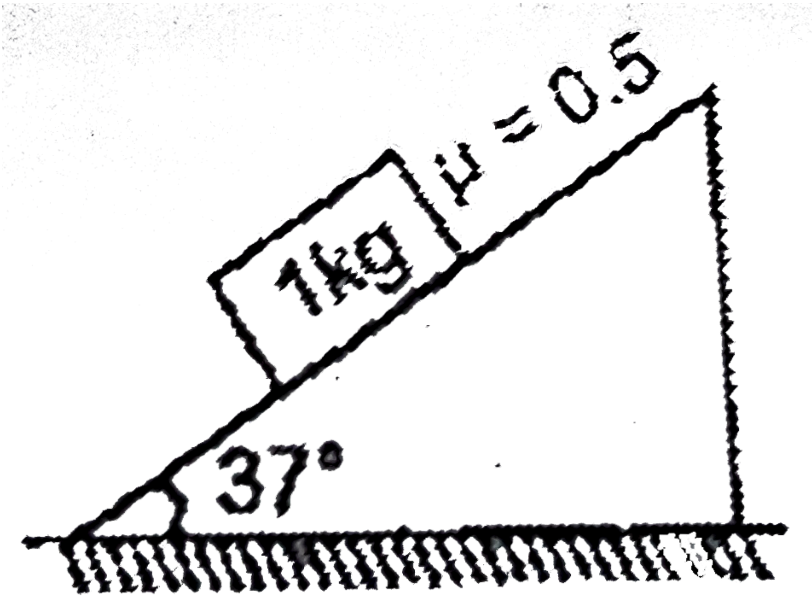
43. Find the contact force on the 1 kg block.



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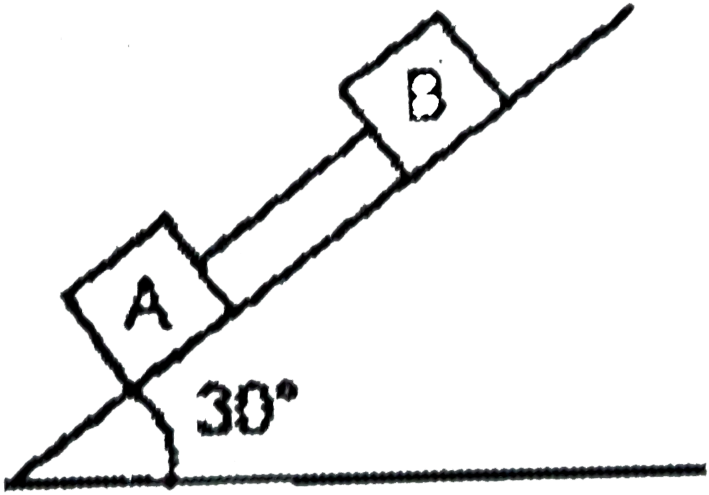
44. Blocks A and Bin the Fig. 2E.46 .(a) are connected With a string of negligible mass. The masses are placed on an inclined plane of inclination 30° as shown inFig. 2E.46 (a) . If A and B each have mass m and $\mu_A = 0$ and $\mu_R = \sqrt{\frac{2}{3}}$, where μ_A and μ_B are the coefficient of friction between plane and the bodies respectively, calculate the acceleration of the system and tension in the string.



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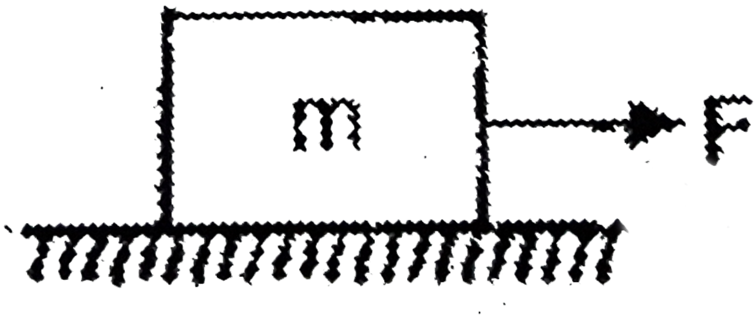
45. In the Fig. shown a time dependent force F expressed as $F = kt$ is applied on a block of mass 5 kg. Coefficient of static and kinetic friction is $\mu_s = 0.4$ and $\mu_k = 0.3$. Motion begins when $t = 2$ sec draw a acceleration vs time graph for block. $(m = 5kg, \mu_s = 0.4, \mu_k = 0.3)$



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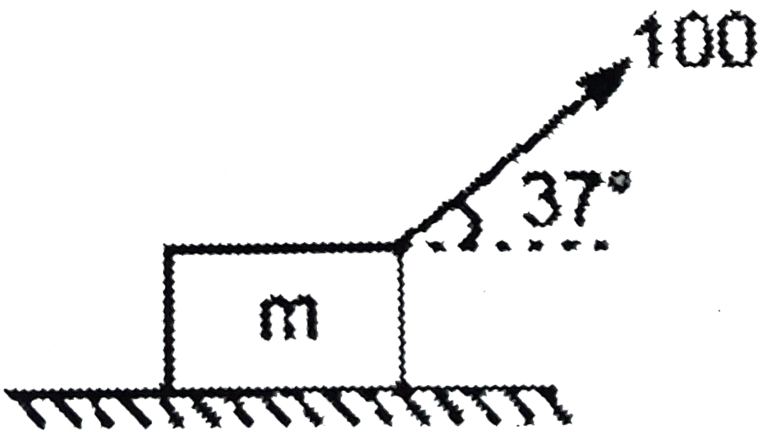
46. $m = 20kg, \mu_s = 0.5$, find friction on block.



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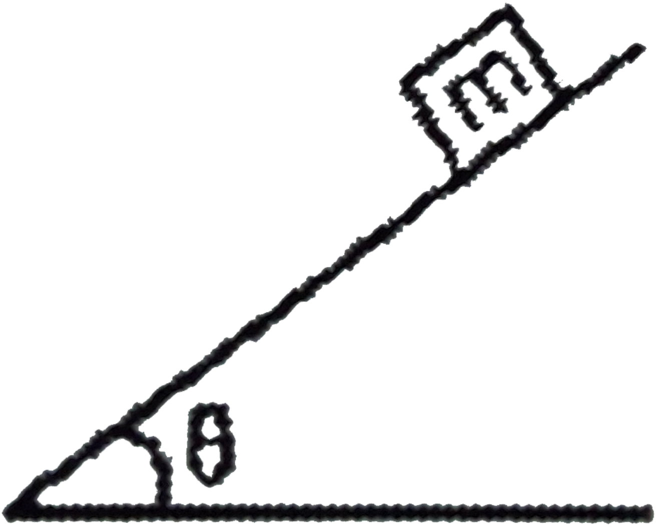
47. Find θ at which slipping will start. μ_s is coefficient of static friction.

(Angle of repose)



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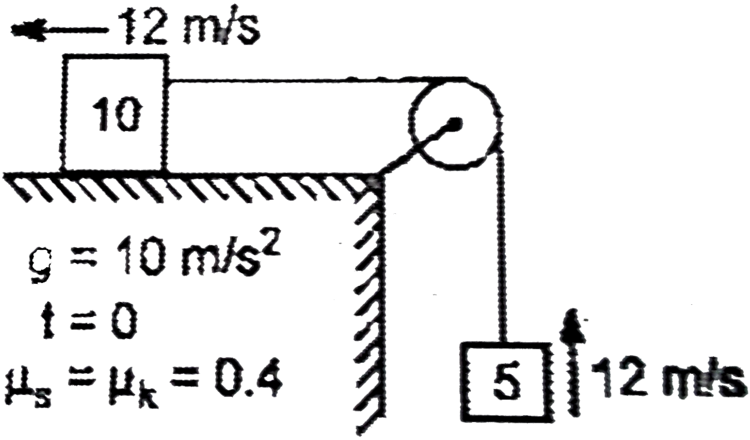
48. Blocks are given velocities as shown at $t = 0$, find velocity and position of 10 kg block at $t = 1$ and $t = 4$.



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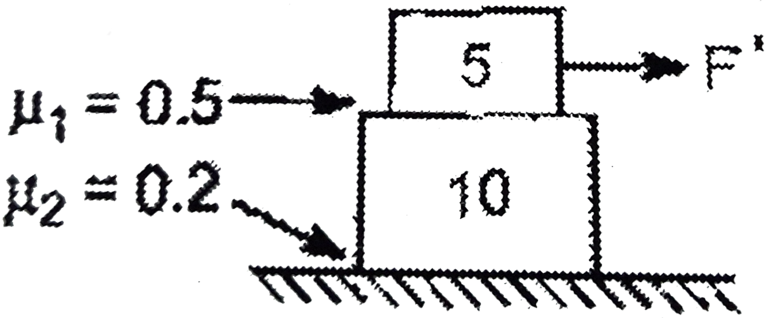
49. Find acceleration of blocks $F = 40N$



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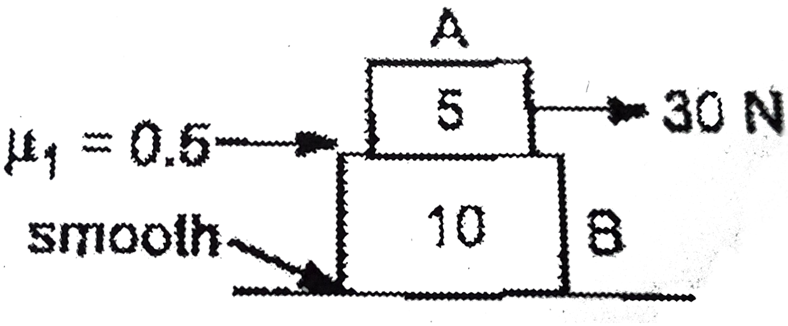
50. Find Force acting on object B.



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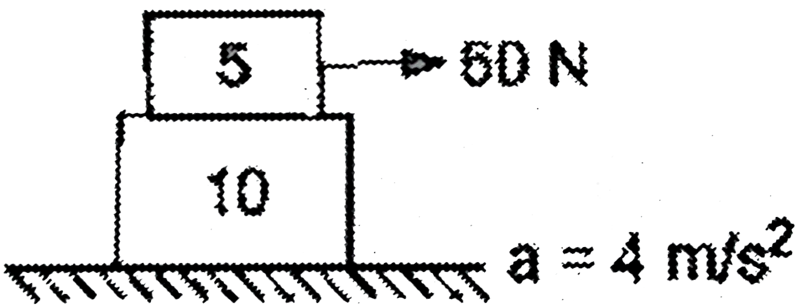
51. If a force of 60N is applied on the upper block will the two blocks move together with an acceleration of $4\frac{m}{s^2}$. If not, find their acceleration.



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52. Find maximum force for which they can move together

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53. Coefficient of friction between 5 kg and 10 kg block is 0.5. If friction between them is 20 N. What is the value of force being applied on 5 kg. The floor is frictionless

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54. An object is given a quick push up an inclined plane. It slides up and then comes back down. It is known that the ratio of the ascent time (t_{up}) to the descent time (t_{dawn}) is equal to the coefficient of kinetic friction (μ). Find the angle θ that the inclined plane makes with the horizontal Find also the range of μ for which the situation described is possible. Assume. that the coefficints of static and kinetic friction are equal.

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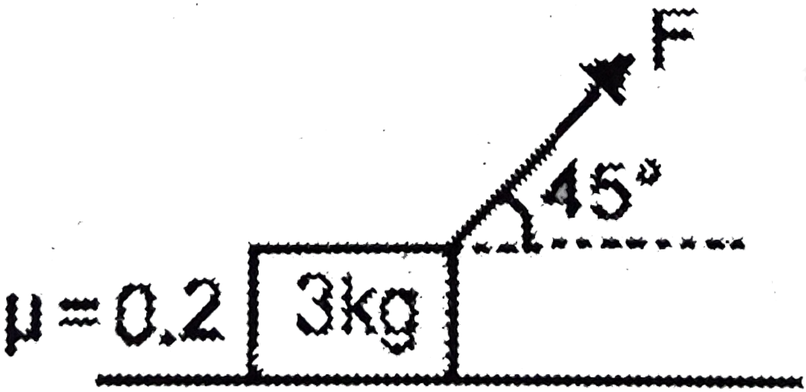
55. A time varying for $F = 10\sqrt{2}t$ starts acting on the 3 kg block lept on a rough horizontal surface $(\mu = 0.2)$ at $t = 0$. Find

(a) the moment of time when the blocks leaves the surface

the moment of time when the horizontal motion begins.



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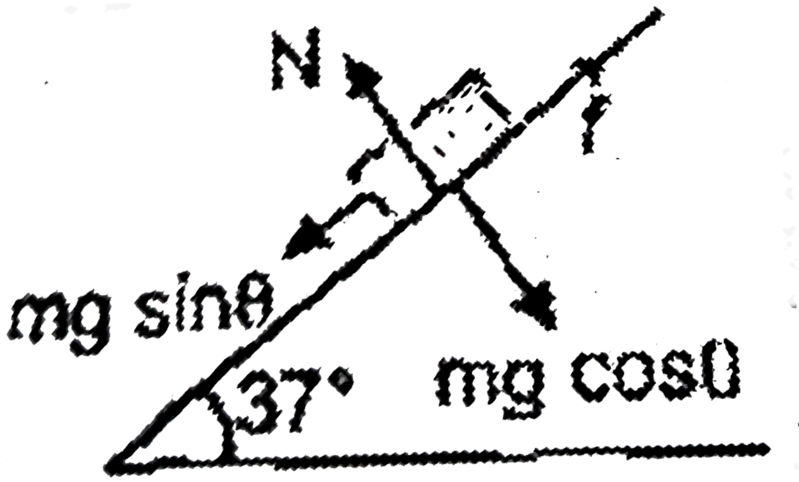
56. A block of mass 3 kg slides on a rough fixed inclined plane of 37° angle having coefficient of friction 0.5. find the resultant force exerted by plane on the block.



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57. A car has headlight which can illuminate a horizontal straight road in front upto a distance l. If coefficient of friction between tyres & road is μ. Find the maximum safe speed of the car during a night drive neglect the reaction time of the driver.

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58. A block of mass 2 kg is placed on the floor $(\mu = 0.4)$. A horizontal force of 7 N is applied on the block. The force of friction between the block & floor is f_s. Find the f_s.

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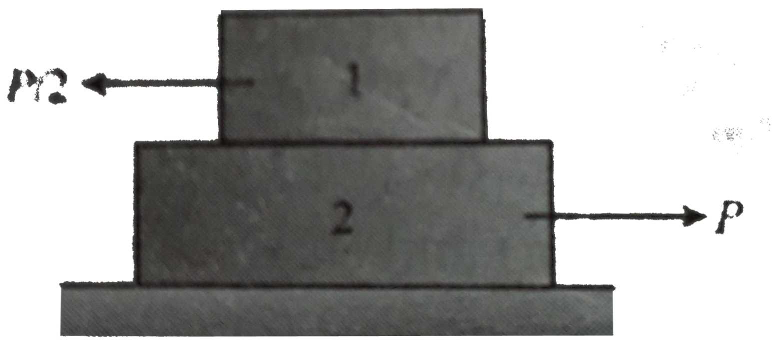
59. In Fig block 1 is placed on top of block 2 .Both of then have a mass of $1kg$ The coefficient of friction between block 1 and 2 are $\mu_s = 0.75$ and $\mu_k = 0.60$ The table is frictionless A force $p/2$ is applied on block 1 in the left and force P on block 2 to the right .Find the minimum value of p such that sliding accore between the two blocks



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60. A block of mass m rests on a rough floor . The coefficient of friction between the block and the floor is μ

a. Two boys apply force P at an angle θ to the horizontal. One of them pushes the block , the other one pulls. Which one would reqire less efferts to cause impending motion of the block?

b. What is the minimum force required to move the block by pulling it ?

c. Shown that the block is pushes at a certain angle θ_0 it cannot be moved fro whatever the value of P be

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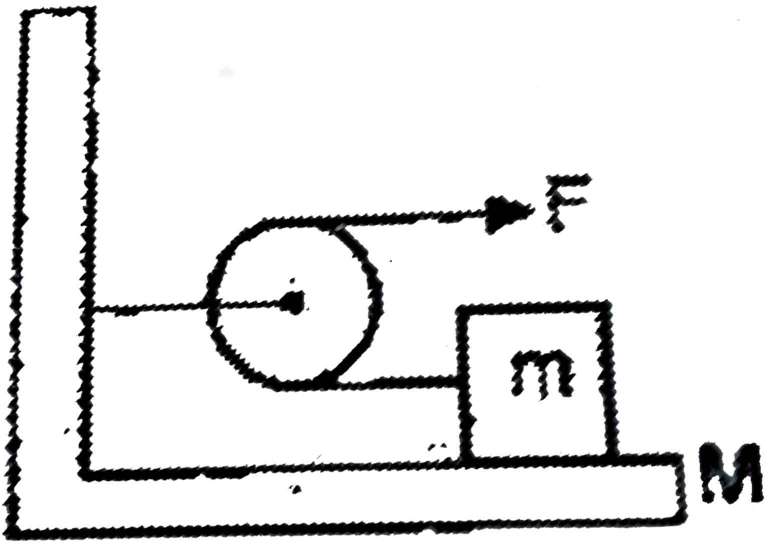
61. A block of mass m rests on a bracket of mass M. The coefficients of friction between block and bracket are μ_s and μ_k . The bracket rests on a frictionless surface. What is the maximum force F that can be applied if the block is not to slide on the bracket?



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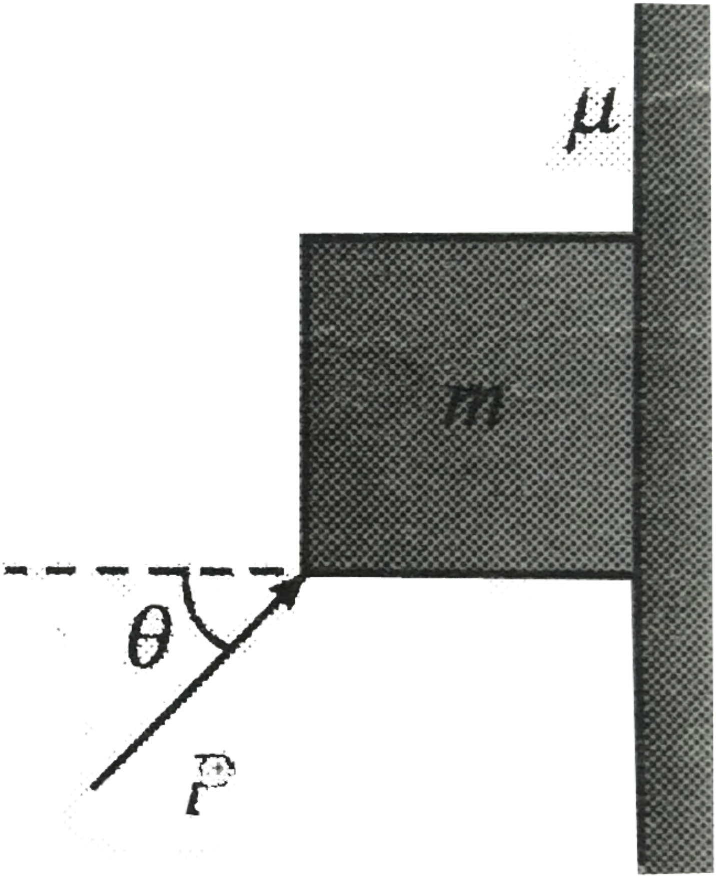
62. A block of mass m is supported on a rough wall by applying a force in figure Coefficient of static friction between block and wall is μ

For what range of value of p , the block remain in static equilibrium ?



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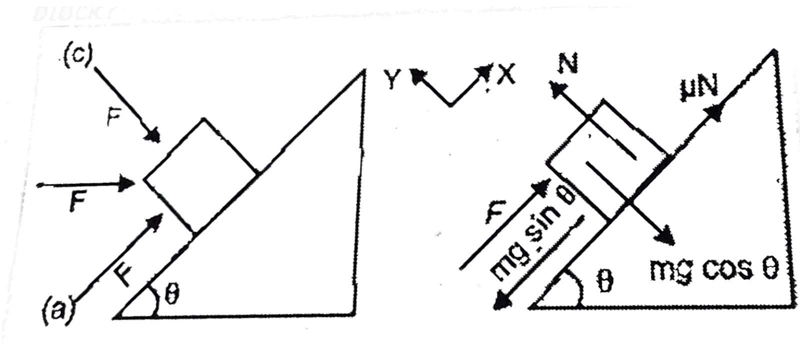
63. A block is kept on a rought incline whose angle of inclination is greater than angle of repose.

(a) Find the minimum and maximum force F applied parallel to incline that will keep it in equilibrium.

(b) What is the required force if it is applied normal to the incline?

(c) What is the range of F if it is applied horizontally on the block?



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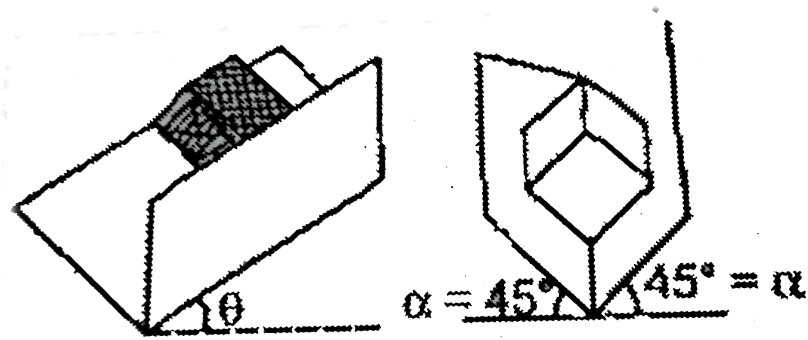
64. A wooden block slides down the right angle channel as shown in Fig. The channel is inclined at an angle θ w.r.t. the horizontal . The angle α is 45°, i.e., the channel is oriented symmetrically with the vertical. IF the coefficient of friction between the block and the channel is μ_k, find the

acceleration of the block.



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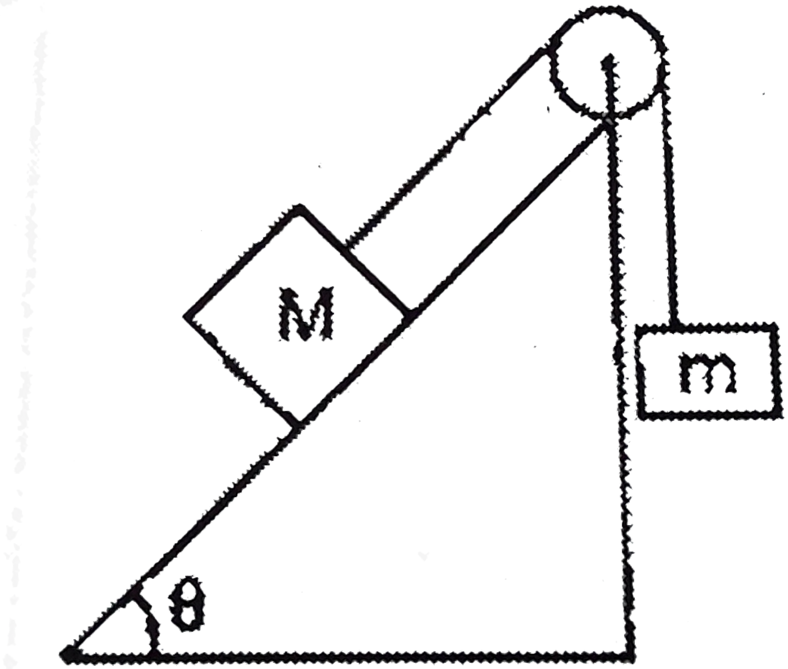
65. Two blocks of mass 'm' and 'M, are connect to the ends of a string passing over a pulley. 'M' lies on the plane inclined at an angle θ with the horizontal and 'm' is hanging vertically as shown in Fig. The coefficient of static friction between 'M' and the incline is μ_s. Find the minimum and maximum value of 'm' so that the system is at rest.



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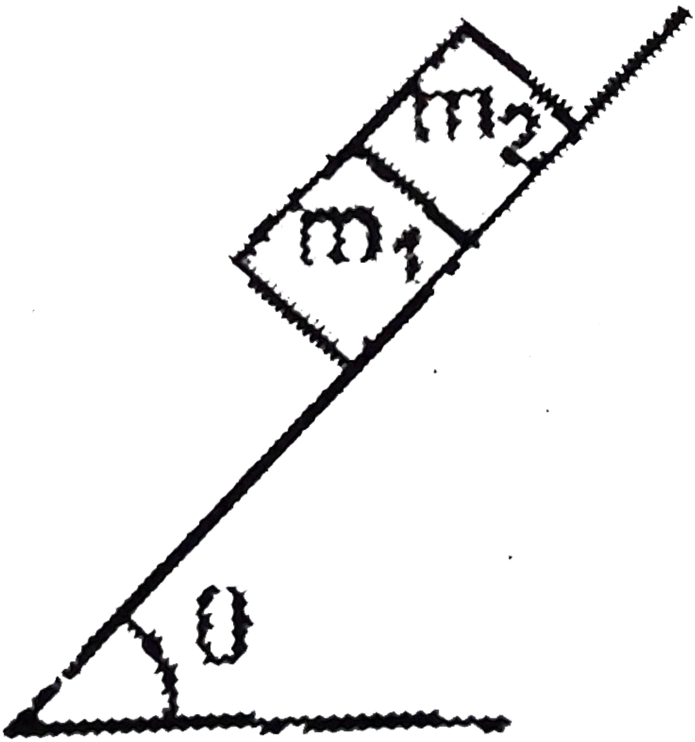
66. Two blocks are kept an incline in contact with each other. Masses of blocks are m_1 and m_2 and coefficients of friction are μ_1 and μ_2 respectively. The angle of inclination is θ. Determine

(a) acceleration of block, and

(b) force F with which the blocks press against each other



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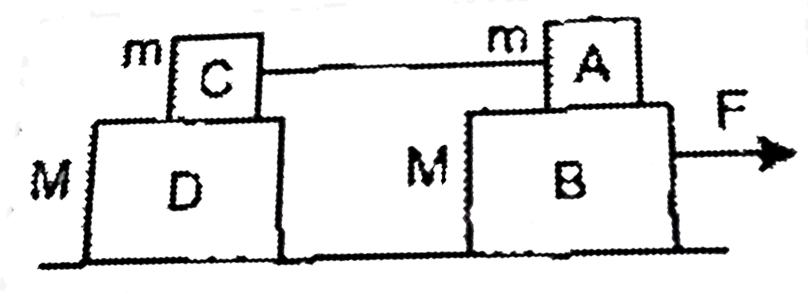
67. Four blocks are arranged on a smooth horizontal surface as shown. The masses of the blocks are given (see the diagram). The coefficient of static friction between the top and the bottom blocks is μ_s. What is the maximum value of the horizontal force F, applied to one of the bottom blocks as show, thilt makes all four blocks move with the same acceleration ?



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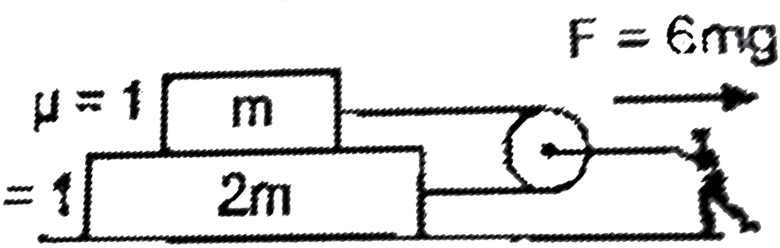
68. A block of mass m rests on top of a block of mass 2m which Is kept on a table. The coefficient of kinetic friction between all surfaces is $\mu = 1A$ massless string is connected to each mass and wraps halfway around a massless pulley, as shown. Assume that you pull on the pulley with a force of 6 mg. What Is the acceleration of your hand ?



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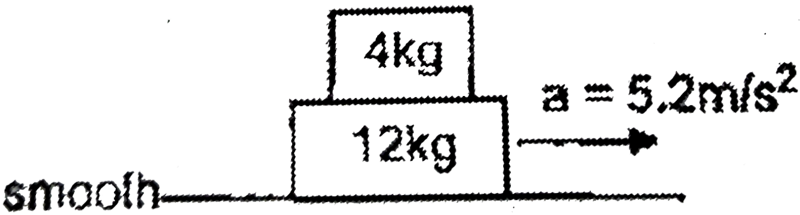
69. A 4 kg block Is placed on top of a long .12 kg block, which is accelerating along a smooth horizontal table at $a = 5.2m/s^2$ under application of an external constant force. Let minimum, coefficient of friction between the two blocks which will prevent the 4 kg block from sliding is μ, and coefficient of friction between blocks Is only half of this minimum value. of, (i.e., $\mu/2$). Find the amount of heat (in joules) generated due to sliding between the two blocks during the time in which. 12 kg block moves 10 m starting from rest



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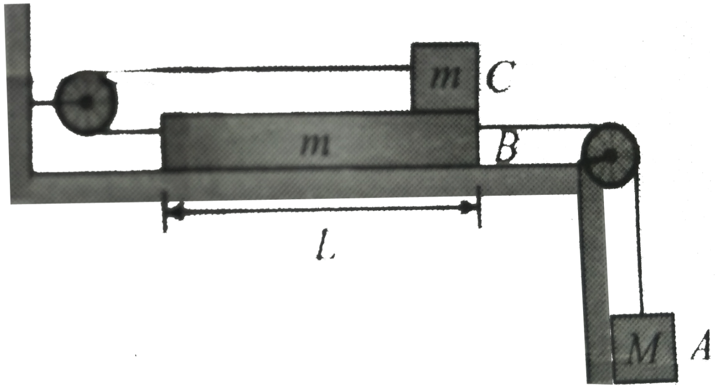
70. Given the setup shown in Fig Block A, B and C have masses $m_A = M$ and $m_B = m_C = m$. The strings are assumed maseless and unstreichable, and the pulleys frictionless .There is no friction between block B and the support table, but there is friction between blocks B and C, denoted by a given coefficient μ



a . In terms the given find (i) the acceleration of block A and B

b. Suppose the system is released from rest with block C near the right end of block B as shown in the above figure. If the the length L of block B is given, what is the speed of block C as it reached the left end of block B ? Tear the size of C as small

c. If the mass of block A is less then some critical value, the blocks will not accelerate when released from rest. Write down as expression for that critical mass.

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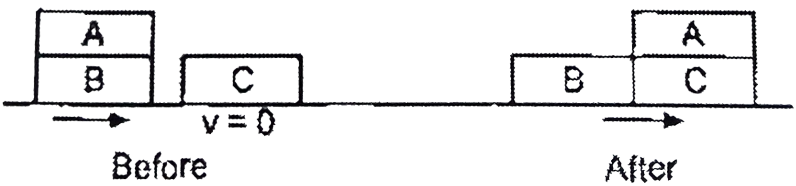
71. Board A is placed on board B as shown. Both boards slide, without moving with respect to each other, along a frictionless horizontal surface at a speed 6 m/ s. Board B hits a resulting board C "head·on". After the collision, board B and C stick together and board A slides on top of board C and stops its motion relative to C in the position shown on the diagram. What is the length (in m) of each board? All three boards have the same mass, size and shape. The coefficient of kinetic friction between boards A and C and between board A & B is 0.3



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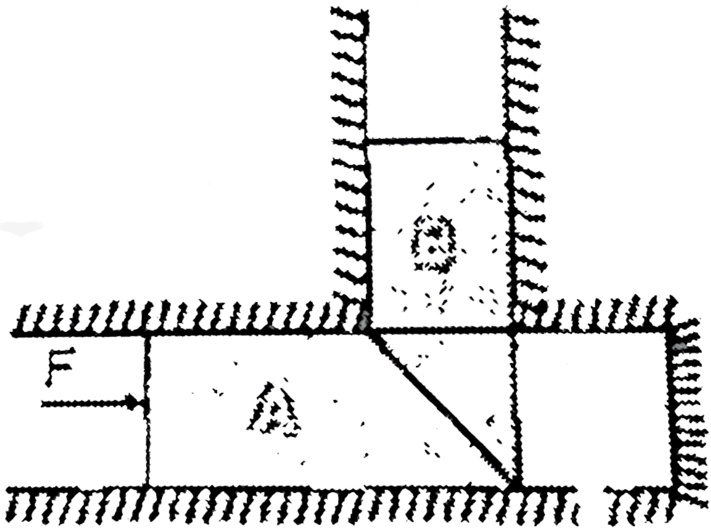
72. A side view of a simplified form of vertical latch B is as shown. The lower member A can be pushed forward in its horizontal channel. The sides of the channels are smooth, but at the inteifaces of A and B, which are at 45° with the horizontal, there exists a static coefficient of friction

$\mu = 0.4$. What is the' minimum force F (in N) that must be applied horizontally to A to start motion of the latch B if it has a mass $m = 0.6$ kg question



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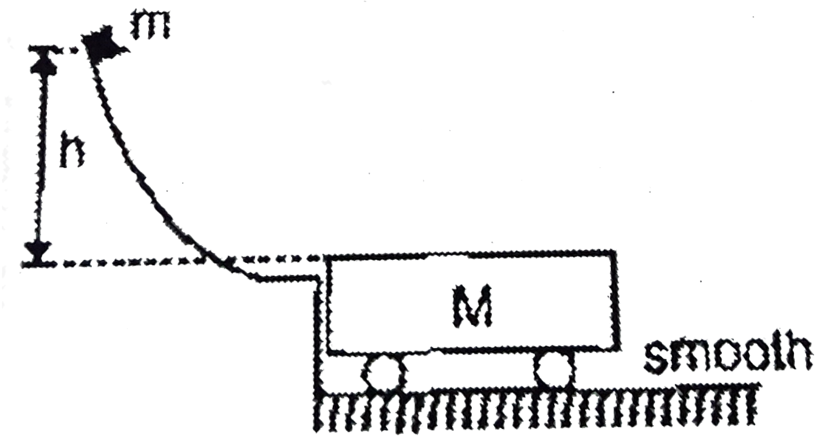
73. A carriage of mass M and length l is joined to the end of a slope as shown in the Fig 2E.81 (a). A block of mass m is released from the slope from height h. It slides till end of the carriage (The friction between the body and the slope and also friction between carriage and horizontal floor is negligible) Coefficient of friction between block and carriage is μ.

Find ,minimum h in the given terms.



A. $\mu\left(1+\frac{M}{m}\right)l$

B. $2\mu\left(1+\frac{m}{M}\right)l$

C. $\mu\left(2+\frac{m}{M}\right)l$

D. $\mu\left(1+\frac{m}{M}\right)l$

Answer: d

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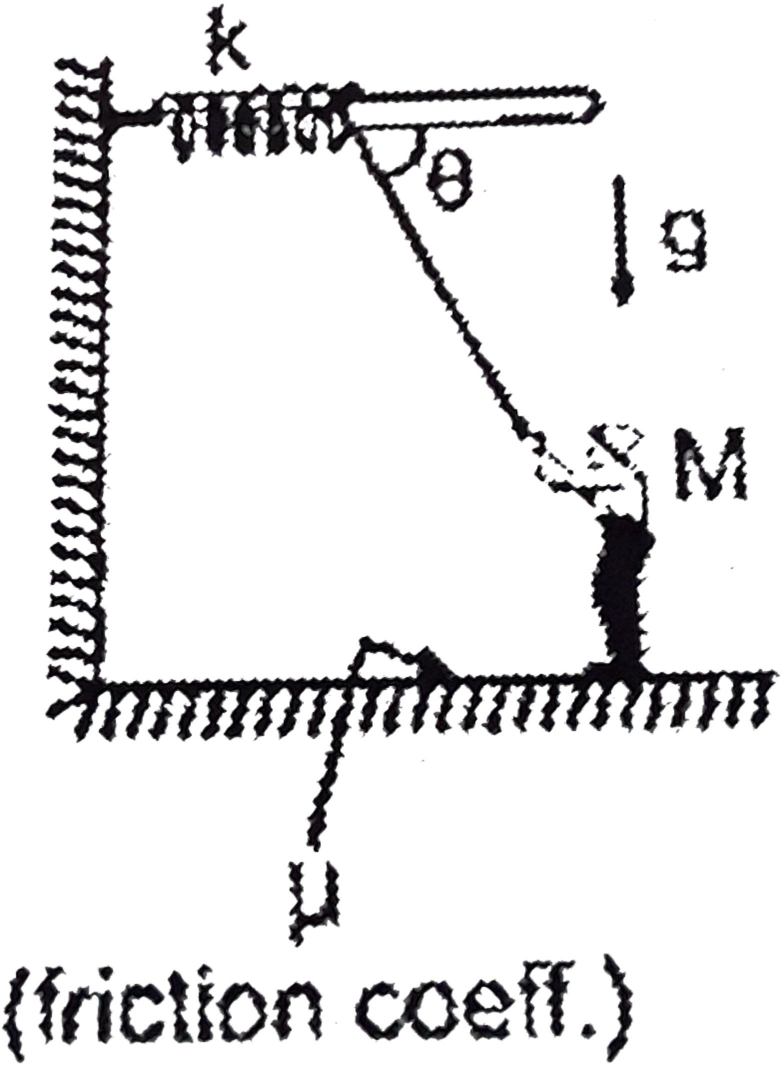
74. A man with mass M has its string'.attached to one end. of a spring which can move without friction along a horizontal, overhead fixed rod. The other end of the spring is fixed to a, wall. The spring constant is k. The string is massless and inextensible and it maintains a constant angle θ with the, overhead rod, even when the man moves. There is friction, iwith coefficient μ between the man and the ground. What is, the maximum distance (in m) that the man moving slowly can stretch the spring beyond its natural length?



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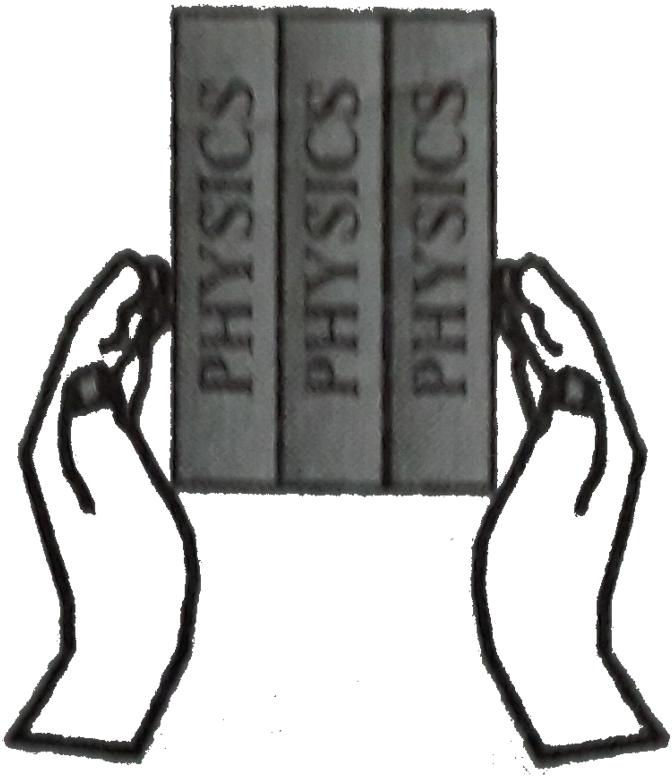
75. Find minimum normal force to be each hand to hold there identical books in verticle position Each books has mass m and the value of coefficient of friction between the books as well as between hand and the book is μ



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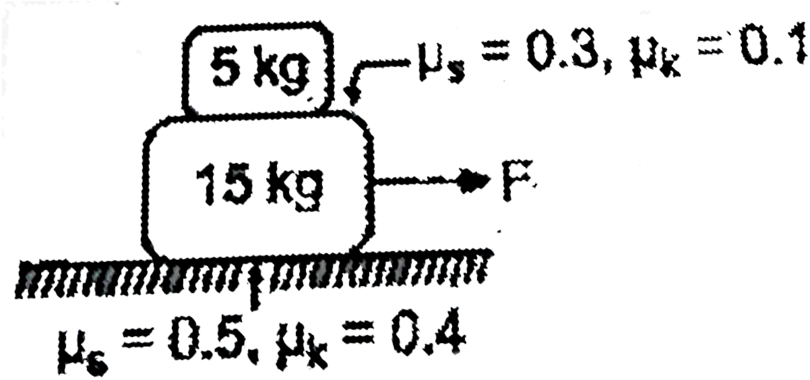
76. In the Fig. 2E.86 (a) shown a constant force Fis applied on lower block just large enough to make this block sliding outi from between the upper block and the table. Determine the force F at this instant and acceleration of each block. Take $g = 10m/s^2$.



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77. A stone is thrown horizontally with the velocity $v_x = 15m/s$. Determine the normal and tangential accelerations of the stone in I second after begins to move.

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78. A balloon starts rising from the surface of the earth with vertical component of velocity v_0. The balloon gathers a horizontal velocity $v_x = ay$, where a is a constant and y is the height from the surface of the earth, due to a horizontal wind. Determine

(a) the equation of trajectory of the balloon.

(b) the tangential, normal and total acceleration of the balloon as function of y.

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79. A ball of mass m is suspended from a rope of length L. It describes a horizontal circle of radius r with speed v. the rope makes an angle θ with vertical given by $\sin\theta = r/2$. Determine (a) the tension in the rope and (b) the speed of the ball. (c) time period of ball.

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80. A car is moving along a banked road laid out as a circle of radius r . (a) What should be the banking angle θ so that the car travelling at speed v needs no frictional force from tyres to negotiate the turn ? (b) The coefficient of friction between tyres and road are $\mu_s = 0.9$ and $\mu_k = 0.8$. At what maximum speed can a car enter the curve without sliding toward the top edge of the banked turn ?

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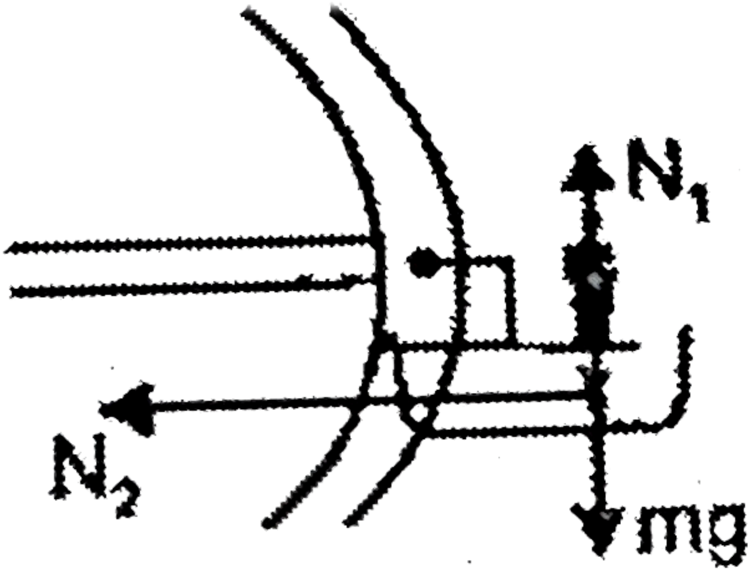
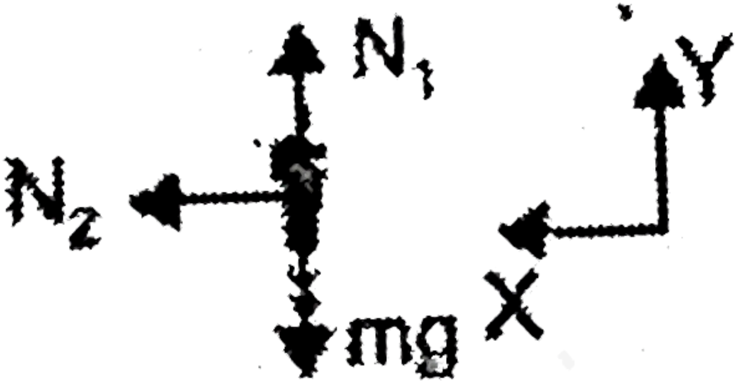
81. A $50kg$ woman is on a large swing (generally seen in fairs) of radius 9 m that rotates in a vertical circle at $6 \text{reve} / \text{ min}$. What is the magnitude of her weight when she has moved halfway up ?





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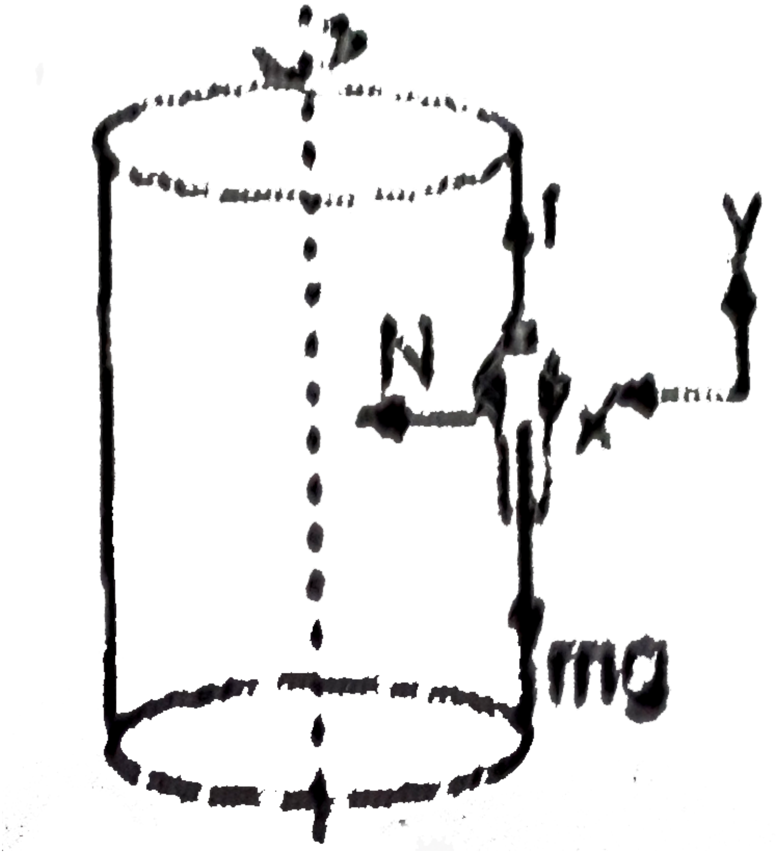
82. In amusement parks there is a device called rotor where people stand on a platform inside a large cylinder that rotates about a vertical axis.

When the rotor reaches a certain angular velocity, the platform drops away. Find the minimum coefficient of friction for the people not to a slide down. Take the radius to be $2m$ and the period to be $2s$.



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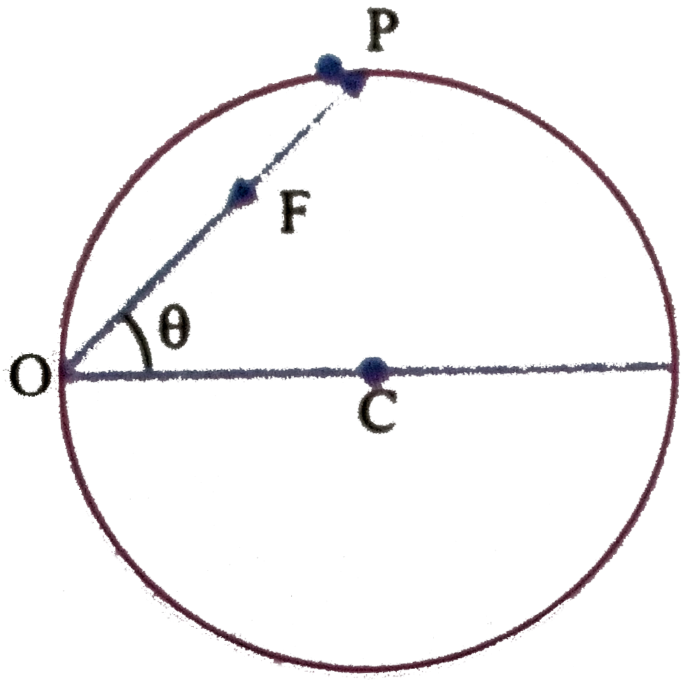
83. A particle $'P'$ is moving on a circular path under the action of only one force action always toward the fixed point $'O'$ on the circumference.

Find the ratio of $\frac{d^2\theta}{dt^2}$ & $\left(\frac{d\theta}{dt}\right)^2$



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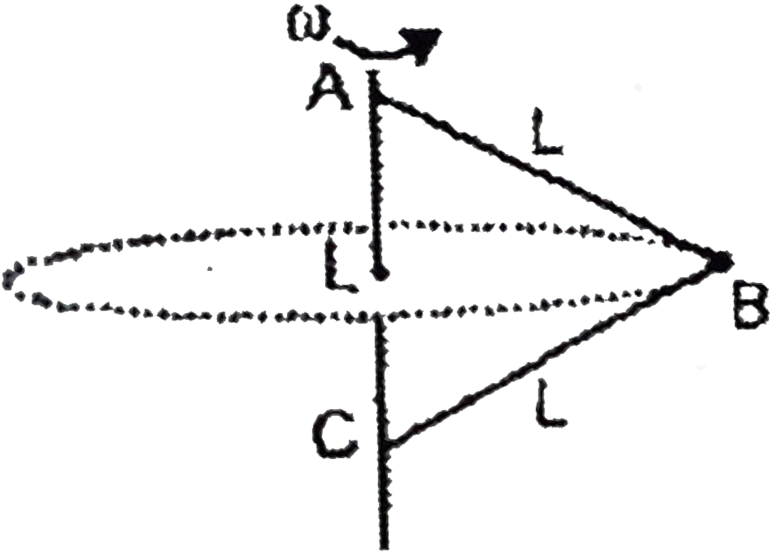
84. A car is moving in a circular path of radius $50m$, on a plat rough horizontal ground. The mass of the car is $1000kg$. At a certain moment the speed of the car is $5m/s$, the driver is increasing speed at the rate of $1m/s^2$. Find the value of static friction on tyres at this moment, in

Newtons.



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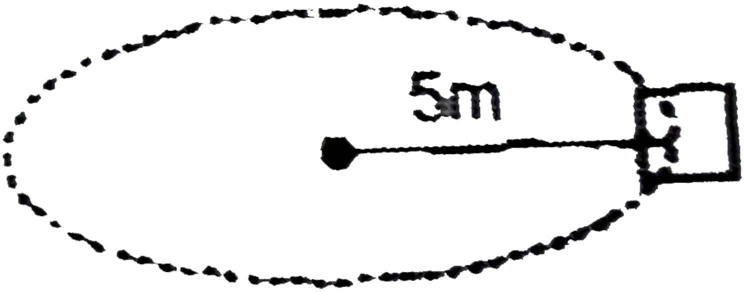
85. A block of mass $25kg$ rests on a horizontal floor $(\mu = 0.2)$. It is attached by a $5m$ long horizontal rope to a peg fixed on floor. The block is pushed along the ground with an initial velocity of $10m/s$ so that it moves in a circle around the peg. Find



(a) Tangential acceleration of the block.

(b) Speed of the block at time t.

(c) Time when tension in rope becomes zero.

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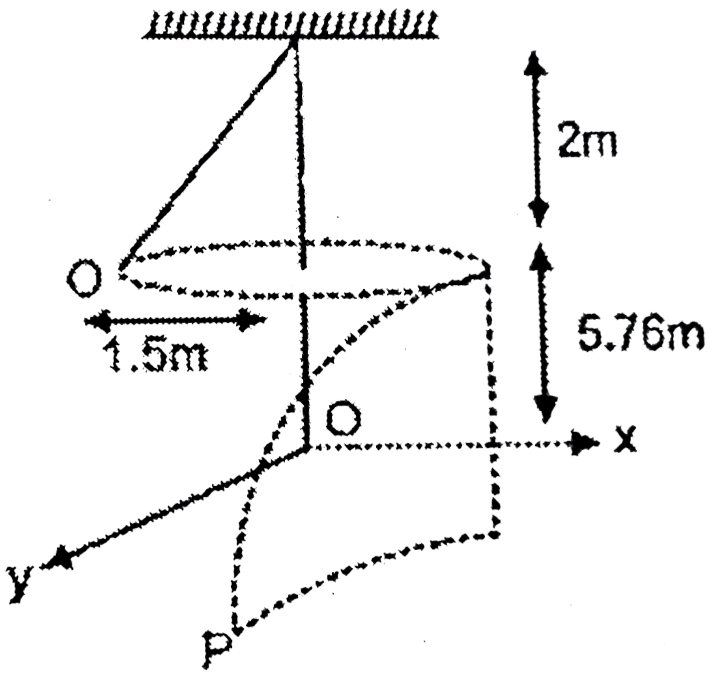
86. A particle suspended from the ceiling by inextensible light string is moving along a horizontal circle of radius 1.5 m as shown. The string traces a cone of height 2 m. The string breaks and the particle finally hits the floor (which is zy plane 5.76 m below the circle) at point P. Find the distance OP.



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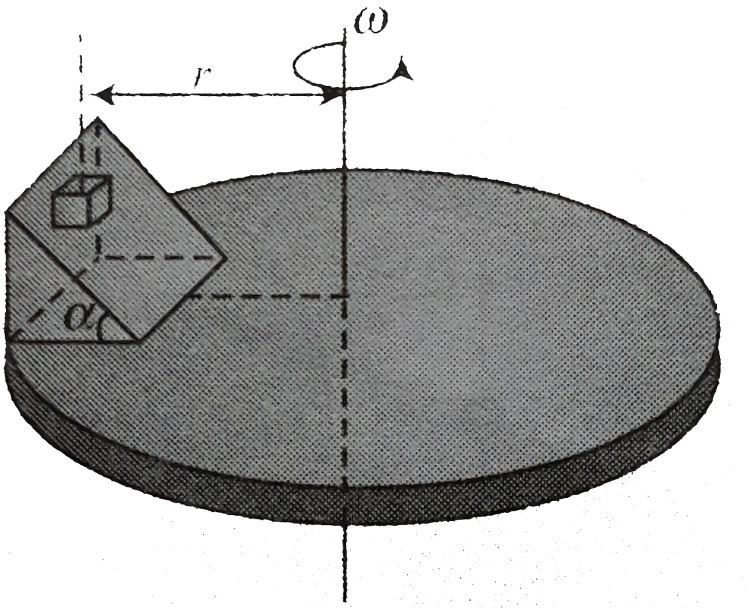
87. An inclined plane of angule a is fixed onto a horizontal turntable with its line of greater slope in same plane as a diameter of forntable .A small block is placed on the inclined plane a distance r from the axis the coefficient of fraction between the block and the inclined plane is μ The turntable along with incline plane spins about its axis with constant minimum angular velocity ω



a. Find an capression for the minimum angular velocity ω to prevent the block from sliding down the plane in term of g, r, μ and the plane ω

b. Now a block of mass but having coefficient friction (with inclined plane) 2μ is kept instead of the original block . find the radius of friction force acting between block and incline now to the friction force active in part (a)

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88. A circular race track is banked at 45° and has a radius of 40 m. at what speed does a car have no tendency to slip? If the coefficient of friction between the wheels and the track is $\frac{1}{2}$, find the maximum speed at which the car can travel round the track without skidding.

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89. A stone is launched upward at 45° with speed v_0. A bee follow the trajectory of the stone at a constant speed equal to the initial speed of the stone.

(a) Find the radius of curvature at the top point of the trajectory.

(b) What is the acceleration of the bee at the top point of the trajectory? For the stone, neglect the air resistance.

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90. A rock is launched upward at 45°. A bee moves along the trajectory of the rock at a constant speed equal to the initial speed of the rock. What is the magnitude of acceleration (in m/s^2) of the bee at the top point of the trajectory? For the rock, neglect the air resistance.

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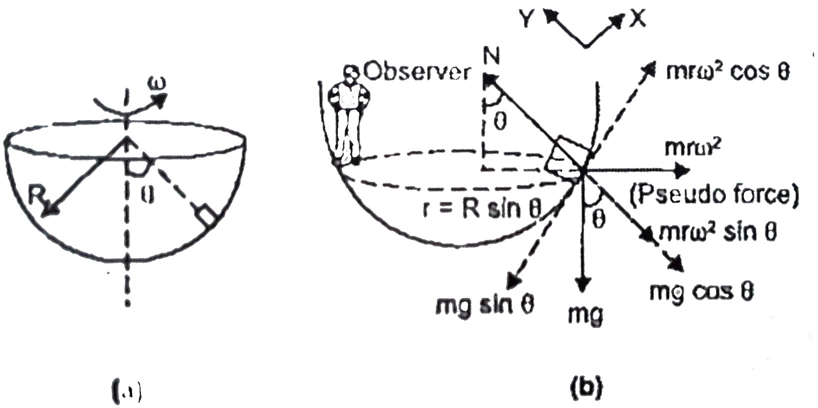
91. A block is kept inside a hemispherical bowl rotating with angular velocity ω. Inner surface of bowl is rough, coefficient of friction is μ. The block is kept at a position where radius makes an angle θ with the vertical. What is the range of the angular speed for which the block will stay at the given position?



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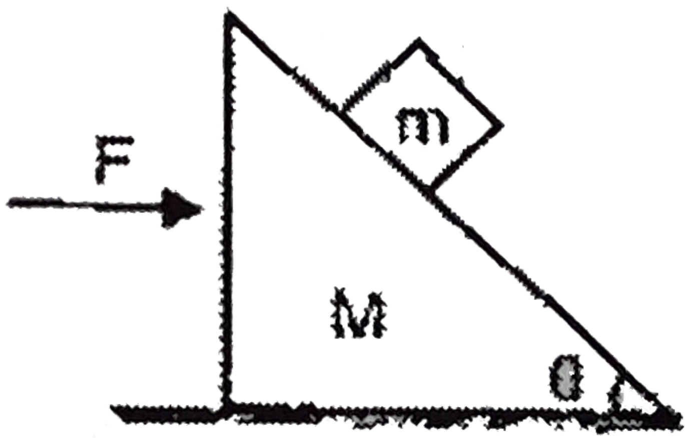
92. A wedge with mass M rests on a frictionless horizontal surface A block with mass m is placed on the wedge. There is no friction between the block and the wedge. A horizontal force f is applied to the wedge. What magnitude F must have if the block is to remain at constant height above the table top?



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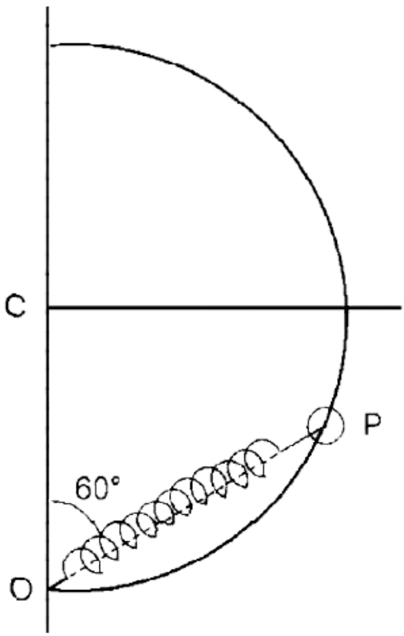
93. A smooth semicircular wire-track of radius R is fixed in a vertical plane. One end of a massless spring of natural length $3R/4$ is attached to the lowest point O of the wire-track. A small ring of mass m, which can slide on the track, is attached to the other end of the spring. The ring is held staionary at point P such that the spring makes an angle of 60° with the vertical. The spring constant $K = mg/R$. Consider the instant when the ring is released, and (i) draw the free body diagram of the ring, (ii) determine the tangential acceleration of the ring and the normal reaction.



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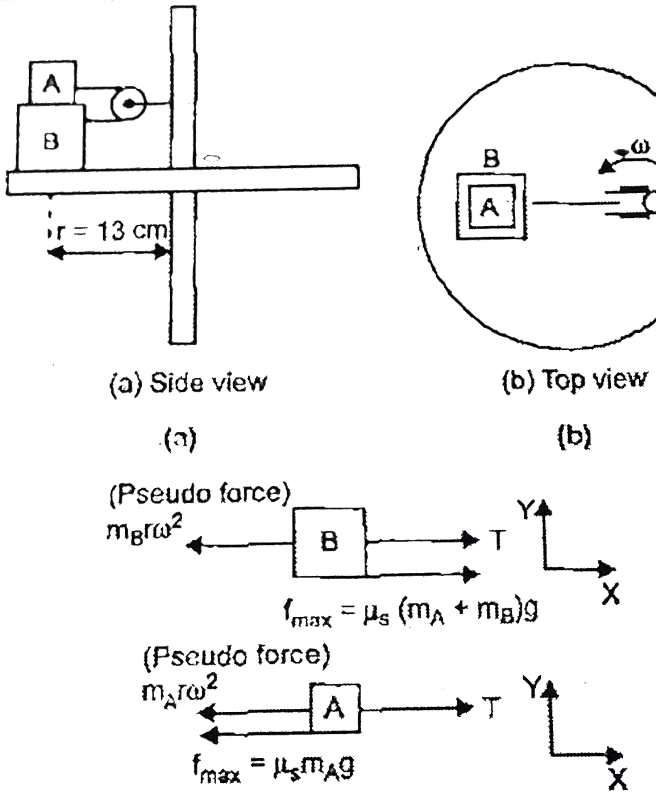
94. A small bead of mass m is given an initial velocity of magnitude v_0 on a horizontal circular wire. If the coefficient of kinetic friction is μ_k, determine the distance travelled before the collar comes to rest.

Watch Video Solution

95. In Fig. shown two blocks are kept on a rough table, where $m_A = 0.9kg, m_B = 1.7kg, r = 13cm, \mu_s = 0.1.$ Consider friction between all the contact surface, pulley is frictionless. Determine the angular speed of the turn-rable for which the blocks just begin to slide



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level 1

1. A cyclist moves with uniform velocity down a rough inclined plane of inclination α. Total mass of cycle & cyclist is m. Then the magnitude and direction of force acting on the cycle from inclined plane is :

A. $mg\cos\alpha$ perpendicularly into the inclined plane

B. $mg\cos\alpha$ perpendiculary outward of the inclined plane

C. mg perpendicularly outward of the inclined plane

D. mg vertical upwards

Answer: d

Watch Video Solution

2. A block of mass 5 kg is dropped from top of a building. Then the mamiitude of force applied by the block on the earth whne falling is :

A. 5 g N upwards

B. 5g N downwards

C. 5g N downwards

D. None of these

Answer: a

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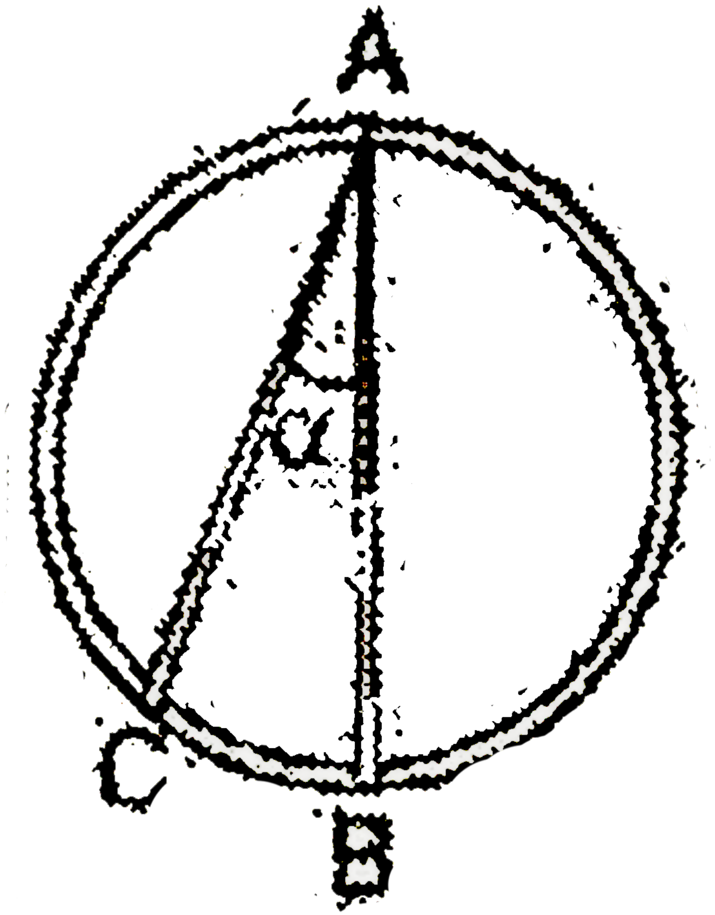
3. In a vertical disc two grooves are made as shown in figure. AB is a diameter. Two balls are dropped at A one in each groove, simultaneously.

Then:



A. Time to each at C is less than that to reach at B

B. Time to reach at C is greater than that to reach at B

C. Time to reach at C equal to that to reach at B

D. The different in time to reach at C and to reach at B may be positive negative or zero depending on α.

Answer: c

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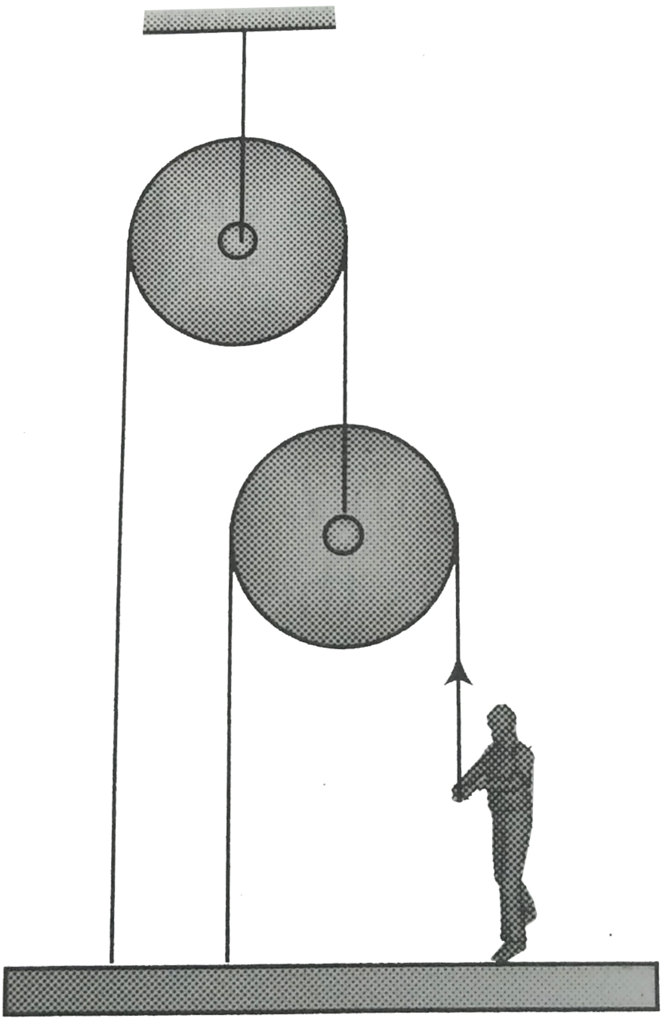
4. In the given diagram, with what force must the man pull the rope to hold the plank in position? Weight of the man is 60 kg. Neglect the weight of plank, rope and pulley.



A. 100 N

B. 150 N

C. 125 N

D. None of these

Answer: b

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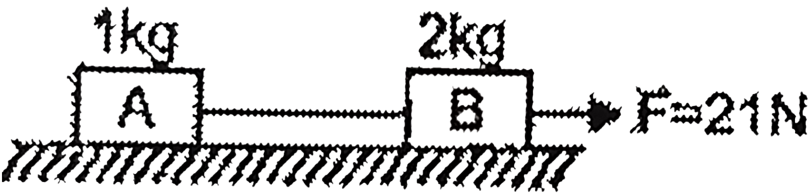
5. In the situation shown in figure the magnitude of total external force acting on the block a is (all the surfaces are smooth)



A. 21 N

B. 14 N

C. 7 N

D. Zero

Answer: c

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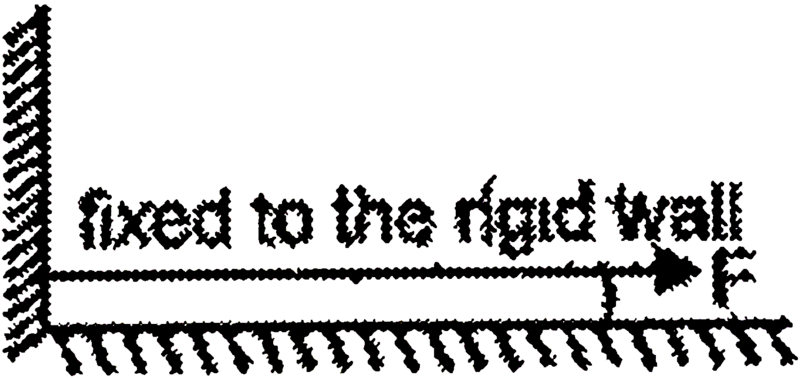
6. In the figure a rope of mass m and length l is such that its one end is fixed to rigid wall and the other is applied with a horizontal force F as shown below, then tension at the middle of the string is:



A. F

B. 2F

C. Zero

D. $F/2$

Answer: a

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7. The sum of all electromagnetic force between different particles of a system of charged particles is zero :

A. Only if all the particles are negatively charged

B. Only if half the particles are positively charged & half are negatively charged

C. Only if all the particles are positively charged

D. Irrespective of the signs of the charges

Answer: d

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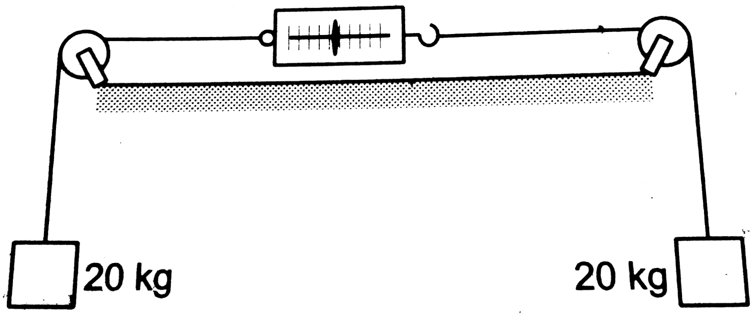
8. Figure shows a light spring balance connected to two blocks of mass 20 kg each. The graduations in the balance measure the tension in the spring. (A). What is the reading of the balance? (b).Will the reading change if the balance is heavy, say 2.0 kg? (c). What will happen if the spring is light but the blocks the unequal masses?



A. 40 kg

B. Zero kg

C. 20 kg

D. Depends on mass of spring balance

Answer: c

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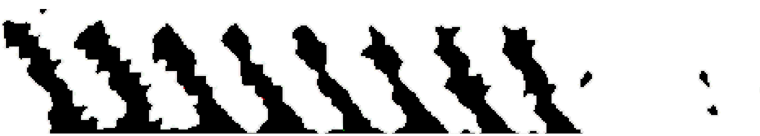
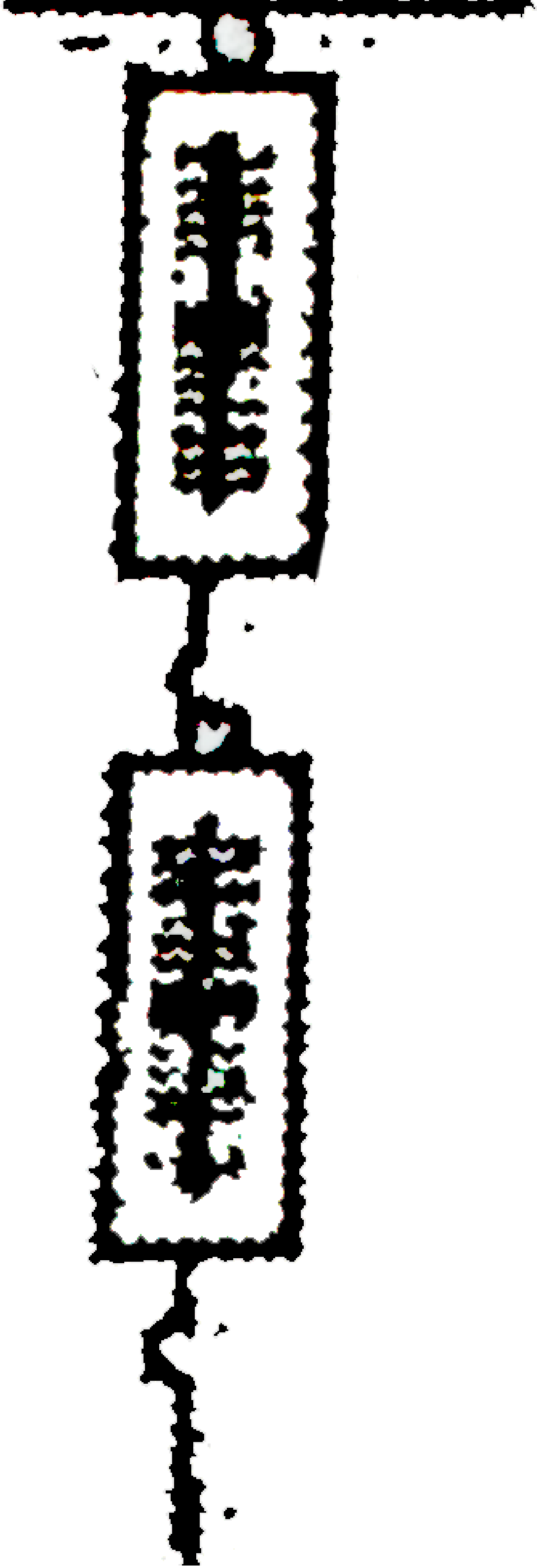
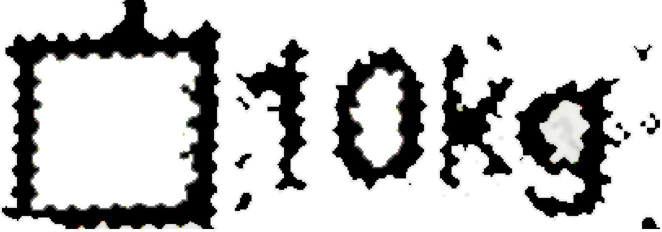
9. A block of mass 10 kg is suspended through two light spring balance as

shown below:







A. Both the scales will read 5 kg

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

C. Both the scales will read 10 kg

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

Answer: c

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10. A force F_1 acts on a particle so as to accelerate it from rest to a velocity v. The force F_1 is then replaced by F_2 which decelerates it to rest

A. F_1 must be unequal to F_2

B. F_1 may be equal to F_2

C. F_1 must be equal to F_2

D. None of these

Answer: a

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11. Two objects A and B are thrown upward simultaneously with the same speed. The mass of A is greater than the mass of B. Suppose their exerts a constant and equal force of resistance on the two bodies.

A. A will go higher than B

B. B will go higher than A

C. The two bodies will reach the same height

D. Any of the above three may happen depending on the speed with which the objects are thrown

Answer: a

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12. A smooth wedge A is fitted in a chamber hanging from a fixed ceiling near the earth's surface.A block B placed at the top of the wedge takes a time T to slide down the length of the wedge. If the block is placed at the top of the wedge and the cable supporting the chamber is broken at the same instant, the block will

A. Take a time shorter than T to slide down the wedge

B. Remain at the top of the wedge

C. Take a time longer than T to slide down the wedge

D. Jump off the wedge

Answer: b

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13. In an imaginary atmosphere, the air exerts a small force F on any particle in the direction of the particle's motion. A particle of mass m projected upward takes time t_1 and reaching the maximum height and t_2 in the return journey to the original point. Then

A. $t_1 > t_2$

B. $t_1 = t_2$

C. $t_1 < t_2$

D. The relation between $t_1 \& t_2$ depends on the mass of the particle.

Answer: a

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14. A person standing oin the floor of an elevator drops as coin. The coin reaches the floor of the elevator in a time t_1 if the elevator is stationary and in the t_2 if it is moving uniformly. Then

A. $t_1 < t_2$

B. $t_1 > t_2$

C. $t_1 = t_2$

D. $t_1 < t_2$ or $t_1 > t_2$ depending on whether the lift is going up or down.

Answer: c

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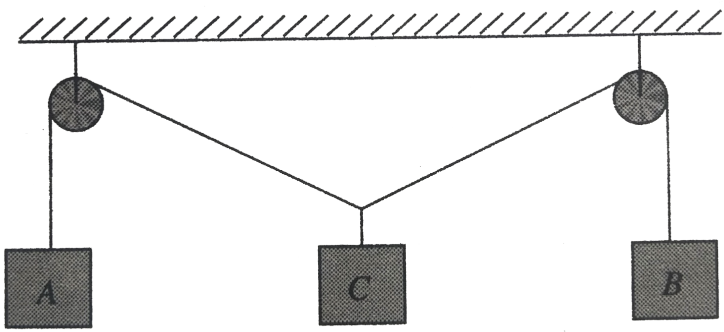
15. Three blocks A,B, and C are suspended as shown in fig. Mass of each of blocks A and B is m. If the system is in equilibrium, and mass of C is M then



A. $M < 2m$

B. $M > 2m$

C. $M = 2m$

D. $M < 2m$

Answer: a

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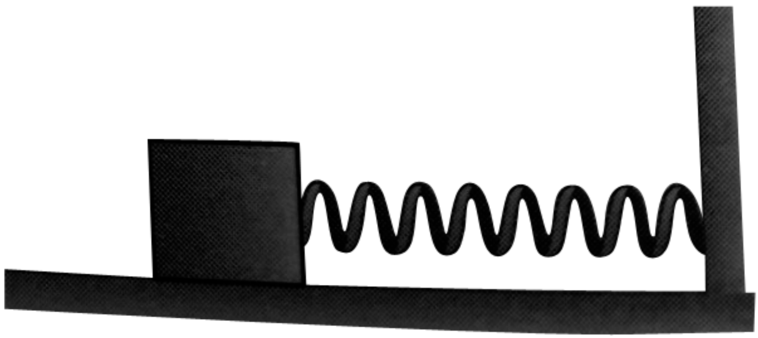
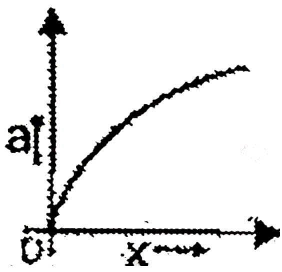
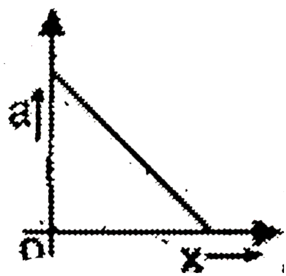
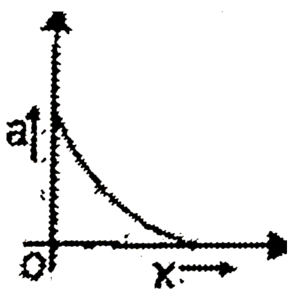


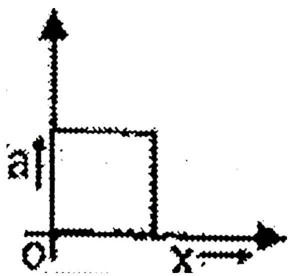
16.

An ideal spring is compressed and placed horizontally between a vertical fixed wall and a block free to slide over a smooth horizontal table to as shown in the figure. The system is released from rest. The graph which represents the relation between the magnitude of acceleration a of the block and the distance x travelled by it (as long as the spring is compressed) is

A. 

B. 

C. 

D. 

Answer: b

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17. A steel ball is placed on the surface of water in a deep tank. Water exerts a resistive force which is proportional to the velocity of the ball. The steel sinks into the water:

A. With decreasing acceleration and finaly attains a constant velocity

B. with constant acceleration equal to the gravitational acceleration

C. with constant acceleration less than the gravitational acceleration

D. with acceleration decreasing initially and reversing after a finite time

Answer: a

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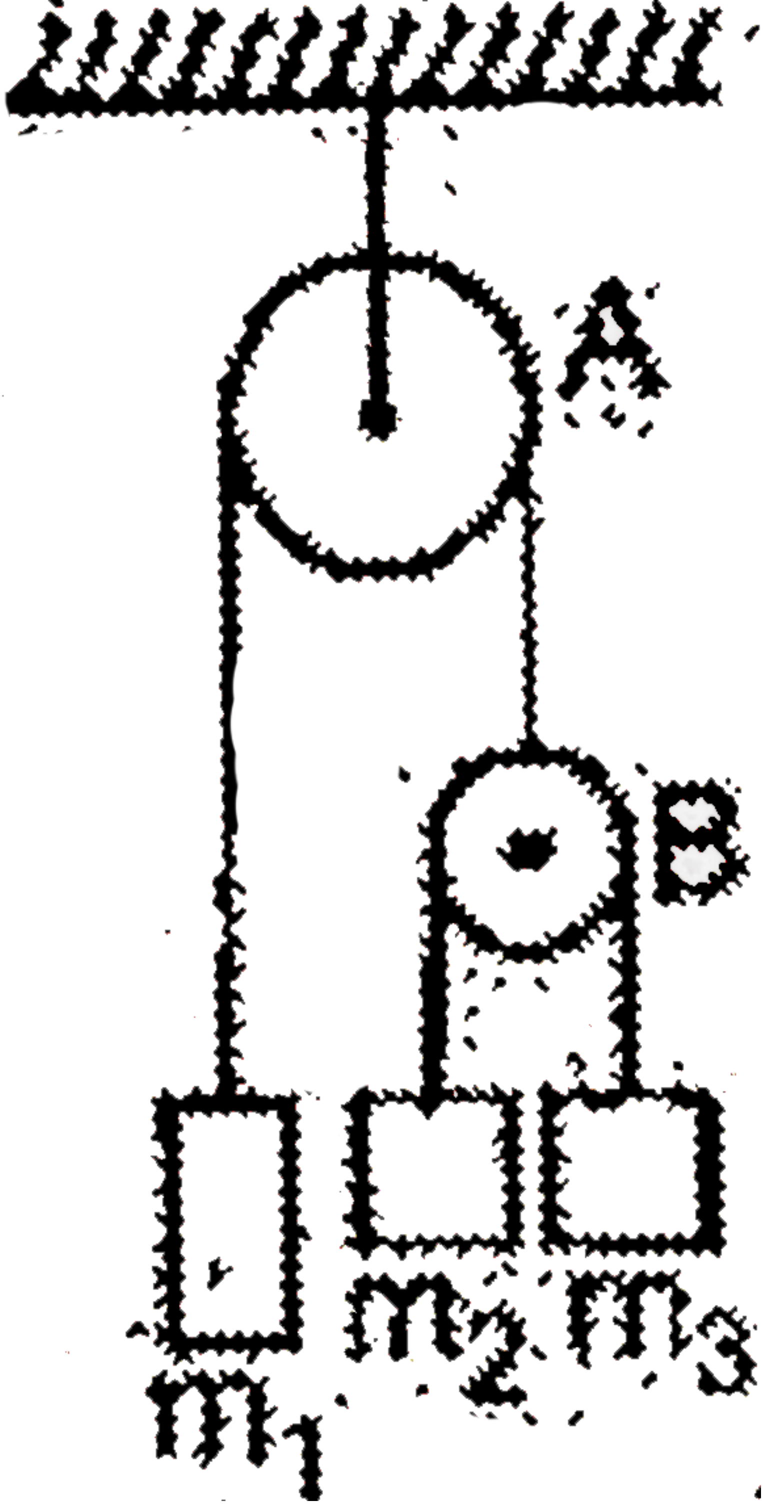
18. In the arrangement shown below pulleys are mass less and frictionless and threads are in responsible block of mass m_1 will remain at rest if :



A
B
m1
m2
m3

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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19. A fireman want to slide down a rope. The breaking load the rope is $3/4^{th}$ of the weight of the man. With what minimum acceleration should the fireman slide down ?

A. $g/6$

B. $g/4$

C. $g/3$

D. $g/2$

Answer: b

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20. An empty plastic box of mass m is found to accelerate up at the rate of g/6 when placed deep inside water. How much sand should be put inside the box so that it may accelerate down at the rate of g/6?

A. $2M/5$

B. $M/5$

C. $2M/3$

D. $6M/7$

Answer: a

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21. A metal sphere is hung by a string fixed to a wall. The forces acting on the sphere are shown in figure. Which of the following statement is/are wrong ?

A. $T^2 = N^2 + W^2$

B. $T = N + W$

C. $\overrightarrow{N} + \overrightarrow{T} + \overrightarrow{W} = 0$

D. $N = W \tan \theta$

Answer: b

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22. A force $\overrightarrow{F} = \overrightarrow{v} \times \overrightarrow{A}$ is exerted on a particle in addition to the force of gravity, where $\overrightarrow{v}$ is the veocity of the particle and $\overrightarrow{A}$ is a constant vector in the horizontal direction. With what minimum speed a particle of mass m be projected so that it continues to move undeflected with a constant velocity?

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

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

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

D. mg

Answer: b

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23. A particle of small m is joined to a very heavy body by a light string passing over a light pulley. Both bodies are free to move. The total downward force on the pulley is

A. $2mg$

B. $4mg$

C. mg

D. $> > mg$

Answer: b

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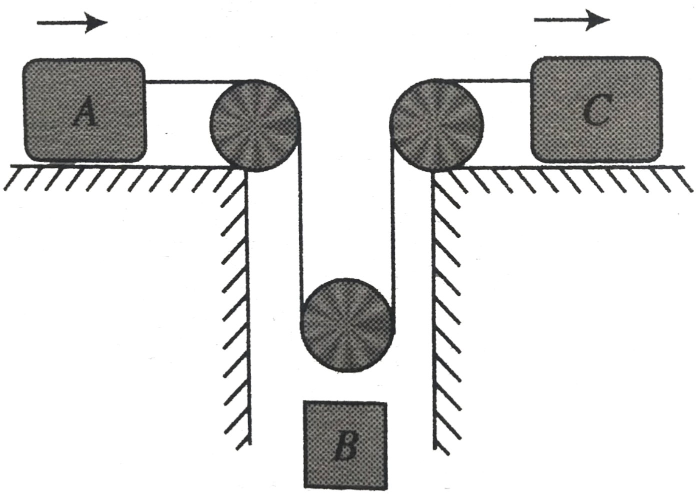
24. Block A and C starts from rest and move to the right with acceleration $a_A = 12tms^{-2}$ and $a_C = 3ms^{-2}$. Here t is in second. The time when block B again comes to rest is



A. $1s$

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

C. $2s$

D. $\frac{1}{2}s$

Answer: d

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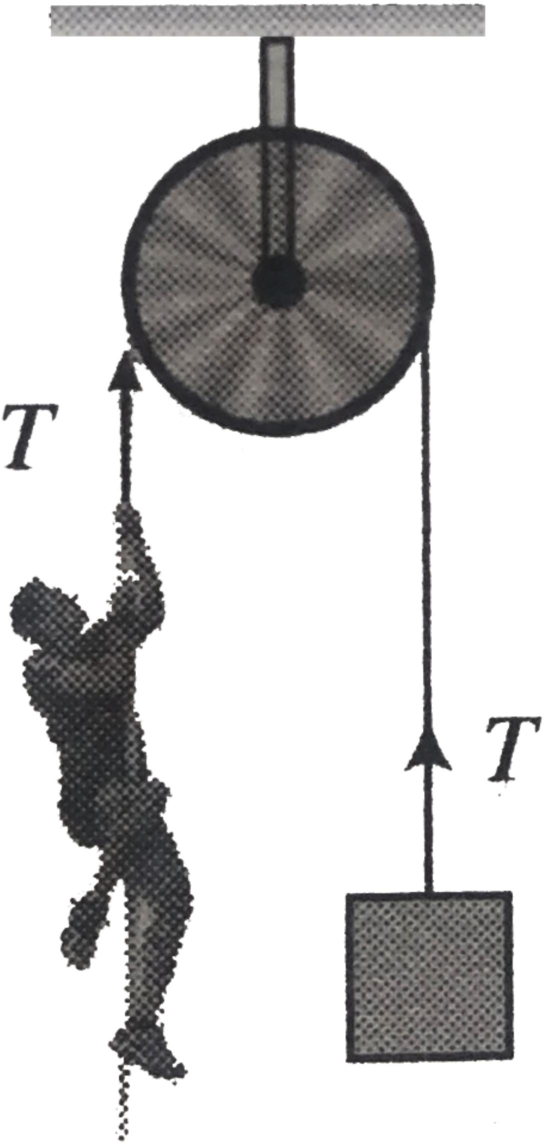
25. In order to raise a mass of 100 kg, a man of mass 60 kg fastens a rope to it and passes the rope over a smooth pulley. He climbs the rope with acceleration $5g/4$ relative to the rope. The tension in the rope is (take

$g = 10ms^{-2}$)



A. $92.8N$

B. $12.18N$

C. $1432N$

D. $642N$

Answer: b

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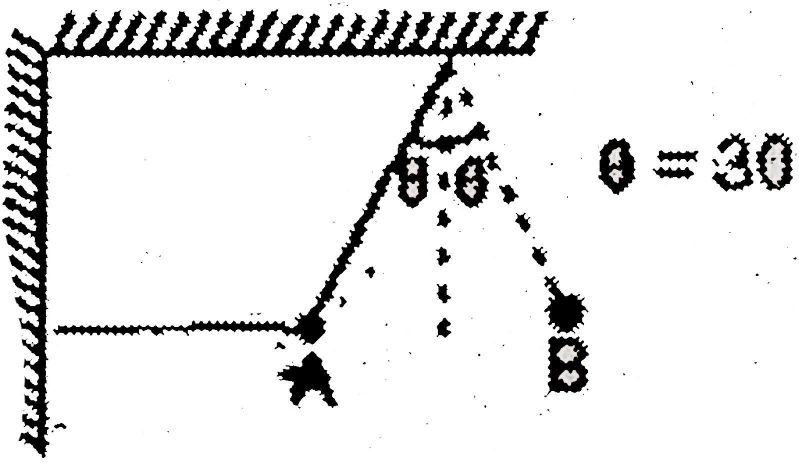
26. A ball is held at rest in position A by two light cords. The horizontal cord is now cut and the ball swings to the position B. What is the ratio of the tension in the cord in position B to that in position A?



A. $3/4$

B. $1/2$

C. 3

D. 1

Answer: a

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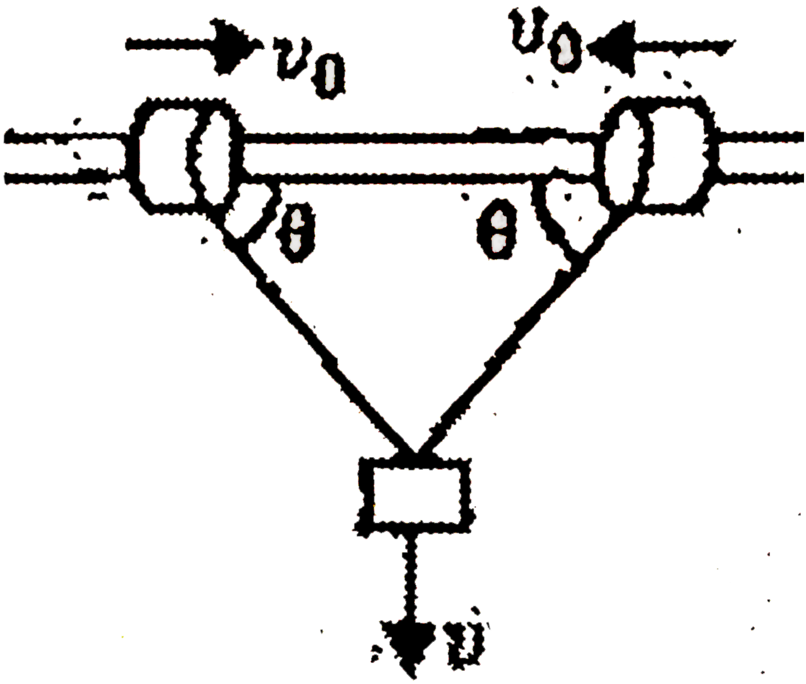
27. In the shown figure two beads slide along a smooth horizontal rod as shown in figure. The relation between v and v_0 in the shown position will be



A. $v = v_0 \cot \theta$

B. $v = v_0 \sin \theta$

C. $v = v_0 \tan \theta$

D. $v = v_0 \cos \theta$

Answer: a

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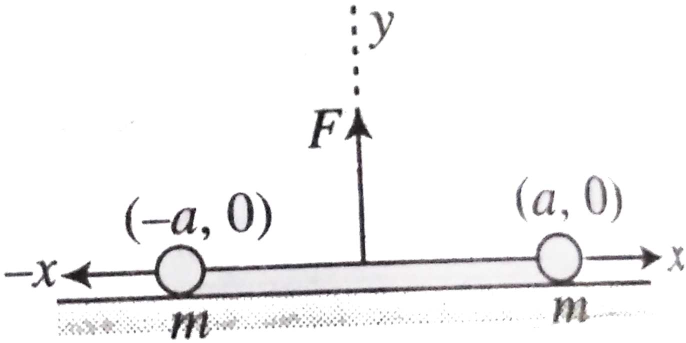
28. Two masses each equal to m are lying on x-axis at $(-a, 0)(+a, 0)$ respectively as shown in figure They are connected by a light string A force F is applied at the origin along vertical direction As a result the masses move toward each other without loosing contact with ground What is the acceleration of each mass? Assume the instantanceous position of the masses as$(-x, 0)$and $(x, 0)$



A. $\frac{F}{m}\frac{\sqrt{a^2 - x^2}}{x}$

B. $\frac{Fx}{2m\sqrt{a^2 - x^2}}$

C. $\frac{F}{m}\frac{x}{\sqrt{a^2 - x^2}}$

D. $\frac{F}{m}\sqrt{\frac{a^2 - x^2}{x}}$

Answer: b

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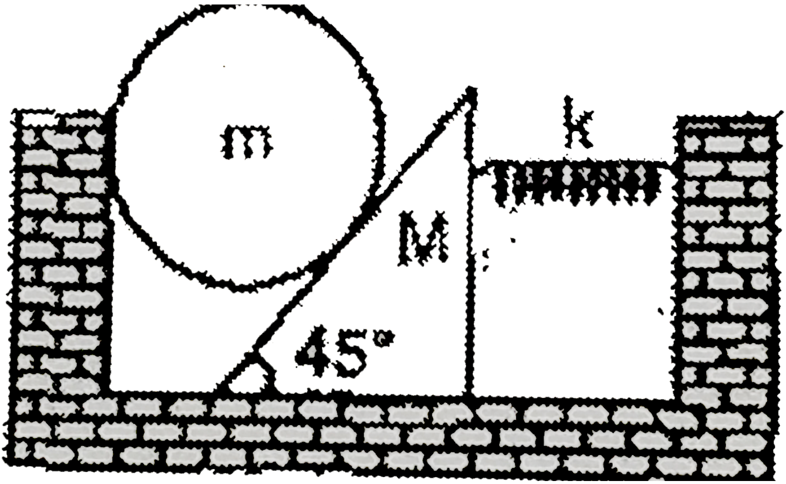
29. All surfaces shown in figure are smooth. System is released with the spring instretched. In equilibrium, compression in the spring will be



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

B. $\frac{(M+m)g}{\sqrt{2}k}$

C. $\frac{mg}{\sqrt{2}k}$

D. $\frac{mg}{k}$

Answer: d

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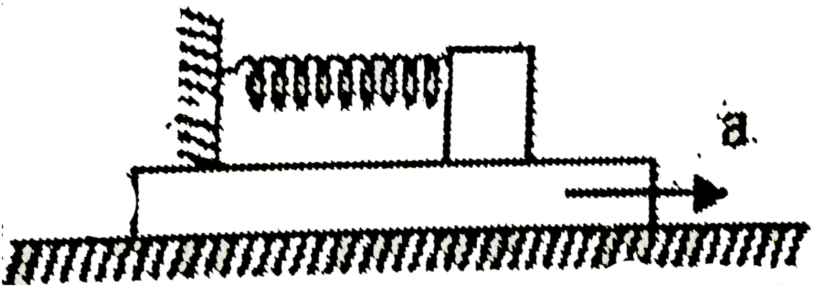
30. Find the maximum compression in the spring, if the lower block is shifted to rightwards with acceleration 'a'. All the surfaces are smooth :



A. $\frac{ma}{2k}$

B. $\frac{2ma}{k}$

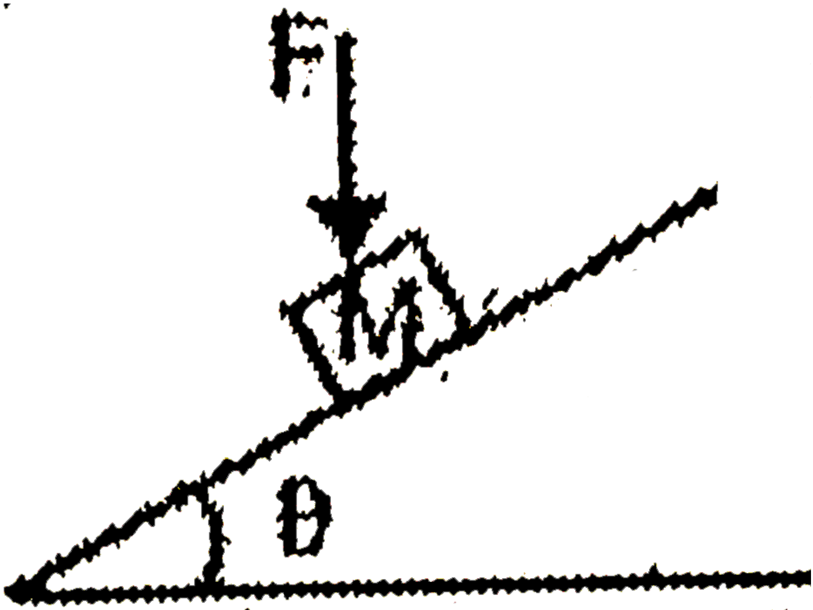
C. $\frac{ma}{k}$

D. $\frac{4ma}{k}$

Answer: b

Watch Video Solution

31. A block of mass M is sliding down the plane. Coefficient of static friction is μ_s and kinetic friction is μ_k. Then friction force acting on the block is :



A. $(F + Mg)\sin\theta$

B. $\mu_k(F + Mg)\cos\theta$

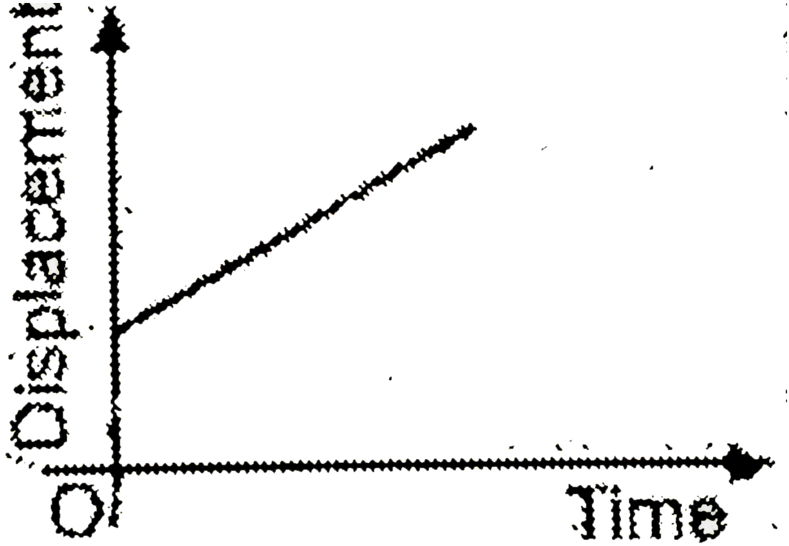
C. $\mu_s Mg\cos\theta$

D. $(Mg + F)\sin\theta$

Answer: b

Watch Video Solution

32. The displacement time curve of a particle is shown in the figure. The external force acting on the particle is :



A. Acting at the beginning part of motion

B. Zero

C. Not zero

D. None of these

Answer: b

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33. A block of mass 'M' is slipping down on a rough inclined of inclination α with horizontal with a constant velocity. The magnitude and direction of total reaction from the inclined plane on the block is :

A. $Mg\sin\alpha$ down the inclined

B. less than $Mg\sin\alpha$ down the inclined

C. Mg upwards

D. Mg down wards

Answer: c

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34. A block of mass 0.1 is held against a wall applying a horizontal force of 5N on block. If the coefficient of friction between the block and the wall is 0.5, the magnitude of the frictional force acting on the block is:

A. $2.5N$

B. $0.98N$

C. $4.9N$

D. $0.49N$

Answer: b

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35. A body of mass M is kept n a rough horizontal surfasce (friction coefficient $=\mu$). A person is trying to pull he body by applying a horizontal force but the body is not moving. The force by the surface on A is F, where

A. $F=mg$

B. $Mg\leq F\leq Mg\sqrt{1+\mu^2}$

C. $F=\mu Mg$

D. $Mg\geq F\geq Mg\sqrt{1-\mu^2}$

Answer: c

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36. A spring of force constant k is cut inot two places such that one piece is double the length of the other. Then the long piece will have a force-constant of :

A. $\frac{2}{3}k$

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

C. $3k$

D. $6k$

Answer: b

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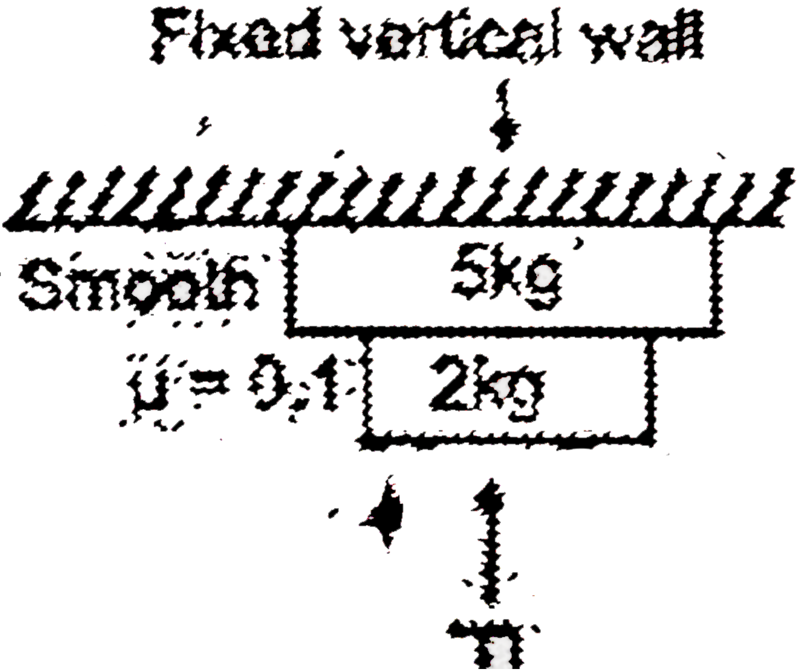
37. In the arrangement shown in figure the wall is smooth and friction coefficient between the blocks is $\mu = 0.1$. A horizontal force $F = 1000N$ is applied on the $2kg$ block. The wrong statement is :



A. The normal interaction force between the blocks is $1000N$.

B. The friction force between the blocks is zero.

C. Both the blocks accelerate downward with acceleration gm/s^2

D. Both the blocks remain at rest

Answer: b

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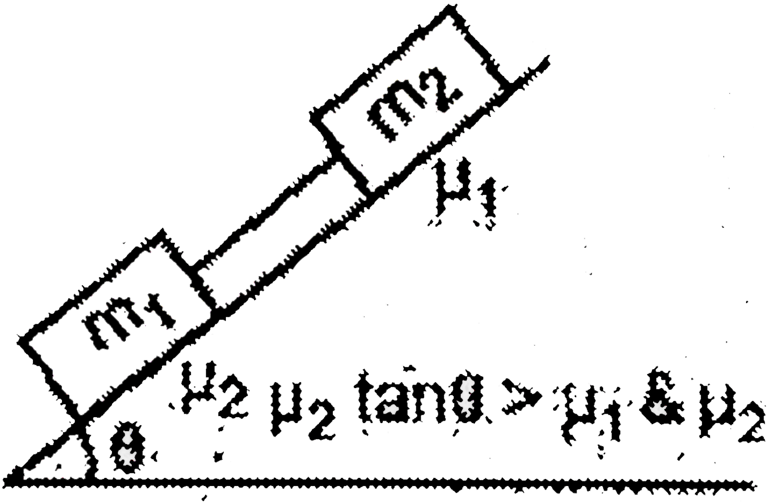
38. Two blocks are kept on an inclined plane and tied to each other with a mass-less string. Coefficient of friction between m_1 and inclined plane is μ_1 & that betweeb m_2 & the inclined is μ_2. Then :



A. The tension in the string in zero if $\mu_1 > \mu_2$

B. The tension in the string is zero if $\mu_1 < \mu_2$

C. Tension in the string is always zero irrespective of $\mu_1 \& \mu_2$

D. None of these

Answer: d

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39. A block kept on an inclined surface, just begins to slide if the inclination is 30°. The block is replaced by another block B and it is just begins to slide if the inclination is 40°, then :

A. Mass of $A >$ mass of B

B. Mass of $A <$ mass of B

C. Mass of $A =$ mass of B

D. All the three are possible

Answer: d

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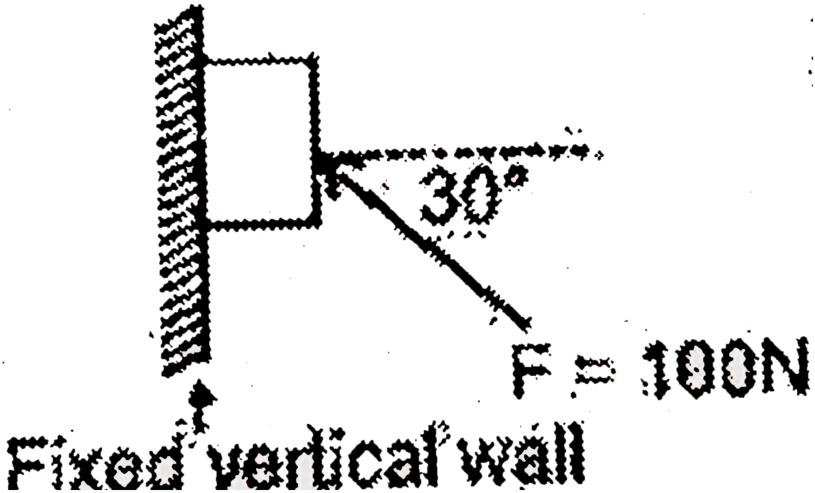
40. A force of $100N$ is applied on a block of mass 3kg as shown below. The coefficient of friction between wall and the block is $1/4$. The friction force acting on the block is :



A. 15 N downwards

B. 25 N upwards

C. 20 N downwards

D. 20 N upwards

Answer: c

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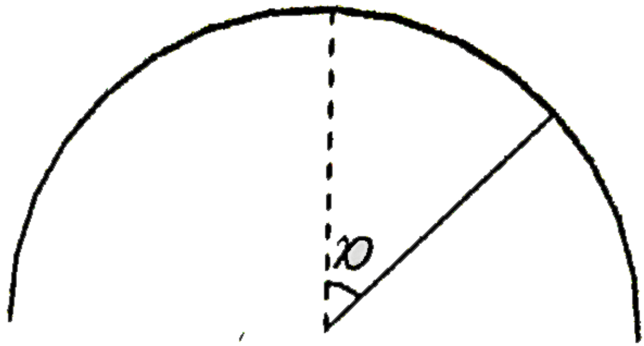
41. An insect crawls up a hemispherical surface very slowly (see the figure). The coefficient of friction between the insect and the surface is 1/3. If the line joining the centre of the hemispherical surface to the insect makes an angle α with the vertical, the maximum possible value of α is given by



A. $\cot\alpha = 3$

B. $\tan\alpha = 3$

C. $\sec\alpha = 3$

D. $\cos ec\alpha = 3$

Answer: a

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42. A block of mass 2kg is held at rest against a rough vertical wall by passing a horizontal (normal) force of $45N$. Coefficient of friction between wall and the block is equal to 0.5. Now a horizontal force of $15N$ (tangential to wall) is also applied on the block. Then the block will :

A. Move horizontally with acceleration of $5m/s^2$

B. Start to move with an acceleration of magnitude $1.25m/s^2$

C. Remain stationary

D. Start to move horizontally with acceleration greater than $5m/s^2$

Answer: b

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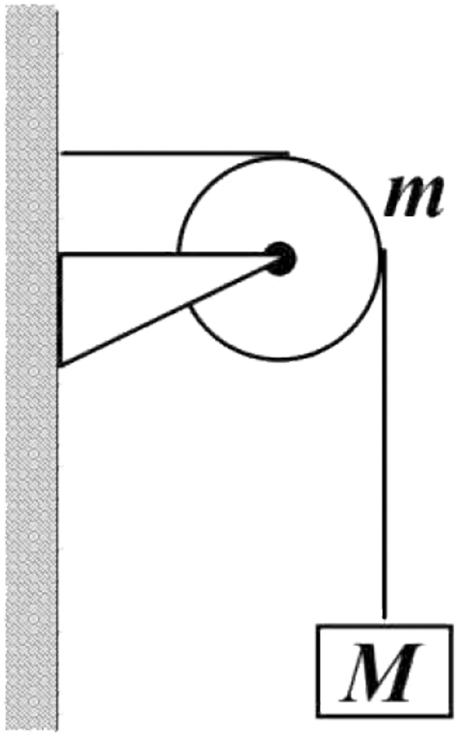
43. A string of negligible mass going over a clamped pulley of mass m supports a block of mass M as shown in the figure. The force on the pulley by the clamp is given by



A. $\sqrt{3}Mg$

B. $\sqrt{2}mg$

C. $\left(\sqrt{M+m}^{2}+m^{2}\right)g$

D. $\left(\sqrt{(M+m)^{2}+M_{2}g}\right.$

Answer: d

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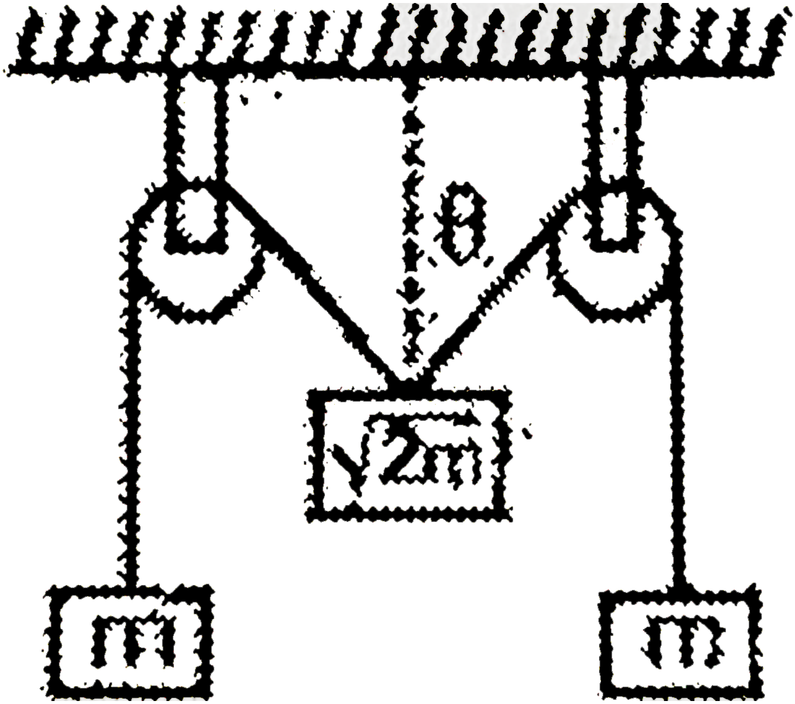
44. The pulleys and strings shown in the figure are smooth and of negligible mass. For the system to remain in equilibrium, the angle θ

should be :



A. Zero

B. 30°

C. 45°

D. 60°

Answer: c

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45. The force F_1 required to just moving a body up an inclined plane is double the force F_2 required to just prevent the body from sliding down the plane. The coefficient of friction is μ. The inclination θ of the plane is :

A. $\tan^{-1}\mu$

B. $\frac{\tan^{-1}\mu}{2}$

C. $\tan^{-1}2\mu$

D. $\tan^{-1}3\mu$

Answer: d

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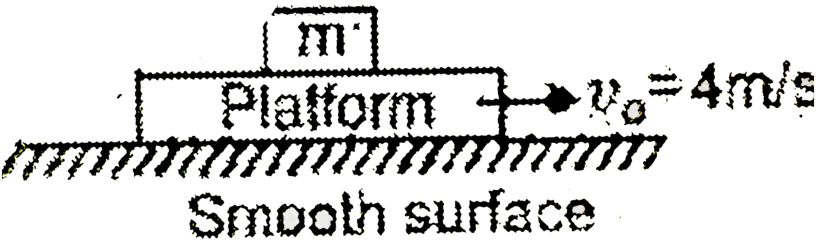
46. A stationary body of msas m is slowly lowered onto a rough massive platform moving at a constant velocity $v_0 = 4m/s$. The distance the body will slide with respect to the platform $\mu = 0.2$ is :



A. 4 m

B. 6 m

C. 12 m

D. 8 m

Answer: a

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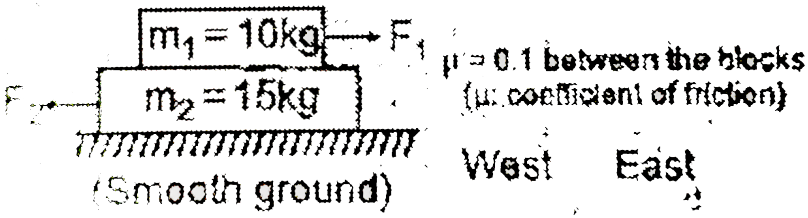
47. In the diagram shown the ground is amooth and F_1 & F_2 are both horizontal forces. The mass of the upper block is 10 kg while that of lower block is $15kg$. The correct statement is :



A. m_1 experiences frictional force towards west only if $F_1 > F_2$

B. If $F_1 \neq F_2$ then it is possible to keep the system in equilibrium for certain suitable values of $F_1 \& F_2$

C. If the system is to remain in equilibrium then F_1 must be equal to F_2 & $F_2 < 10N$

D. If $\frac{F_1}{m_1} = \frac{F_2}{m_2}$ then frictional force between the blocks is zero

Answer: c

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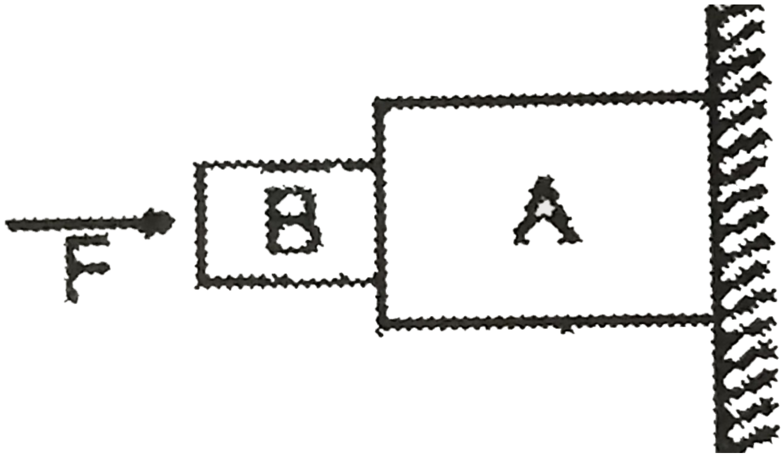
48. Consider the system as shown. The wall is smooth, but the surface of block A & B in contact is rough. The friction force on B due to A equilibrium is :



A. Zero

B. Upwards

C. Downwards

D. The system cannot remain in equilibrium

Answer: d

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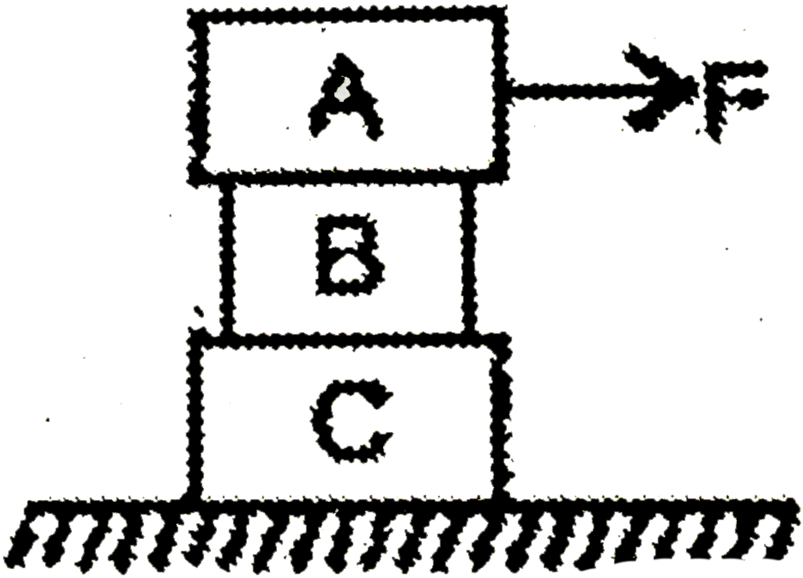
49. Given $m_A = 30kg$, $m_B = 10kg$, $m_C = 20kg$. Between a & B $\mu_1 = 0.3$, between B & C $\mu_2 = 0.2$ & between C & ground $\mu_3 = 0.1$. The least horizontal force F to start motion of ant part of the system of three blocks resting upon one another as shown below is :

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



A. 90 N

B. 80 N

C. 60 N

D. 150 N

Answer: c

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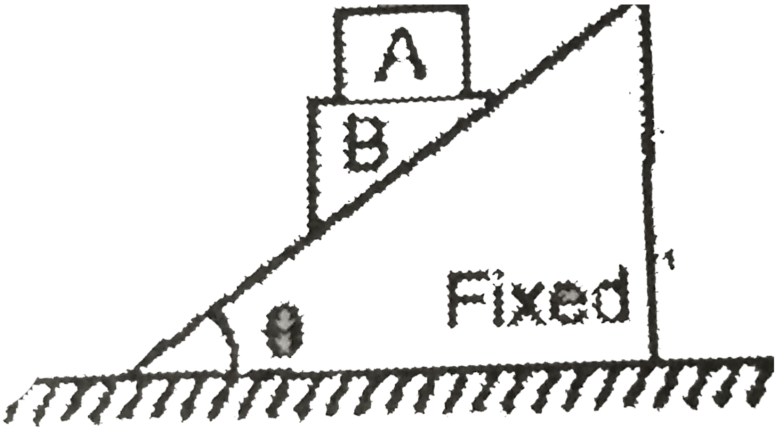
50. The coefficient of friction between the block A of mass m & block B of mass $2m$ is μ. There is no friction between block B & the inclined plane. If the system of blocks A & B is released from rest & there is no slipping between A & B then :



A. $2\theta < \sin^{-1}(2\mu)$

B. $\theta < \tan^{-1}(\mu)$

C. $2\theta < \cos^{-1}(2\mu)$

D. $2\theta < \tan^{-1}(\mu/2)$

Answer: b

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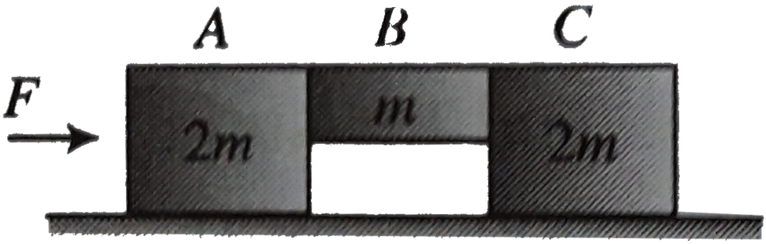
51. A system is pushed by a force F as shown in figure All surfaces are smooth except between B and C is μ. Minimum value fo F to prevent block B from down ward slipping is



A. $\left(\frac{5}{2\mu}\right)mg$

B. $\left(\frac{5}{2}\right)\mu mg$

C. $\left(\frac{3}{2\mu}\right)mg$

D. $\left(\frac{3}{2}\right)\mu mg$

Answer: a

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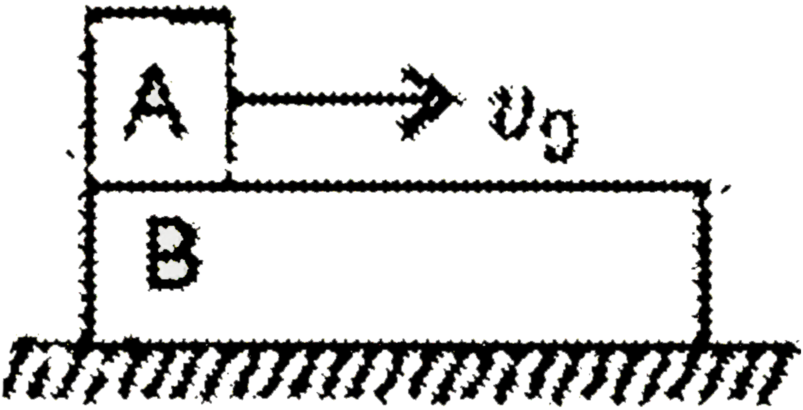
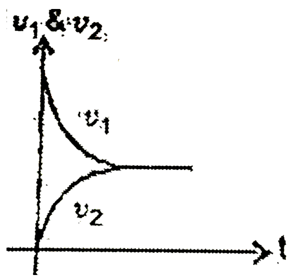
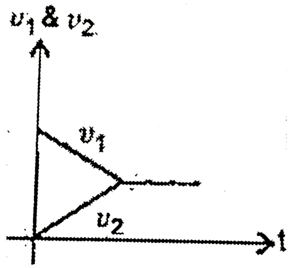
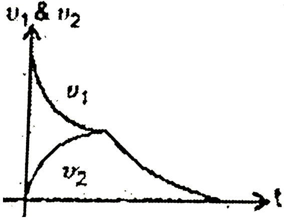
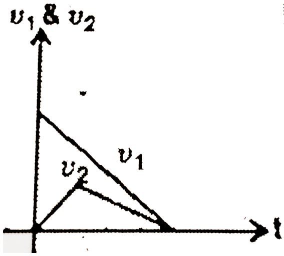
52. A block A is placed over a long rough plank B same mass as shown below. The plank is placed over a smooth horizontal surface. At time $t = 0$, block A is given a velocity v_0 in horizontal direction. Let v_1 and v_2 be the velocity of A & B at time 't'. Then choose the correct graph between v_1 or v_2 and t.



A. 

B. 

C. 

D. 

Answer: b

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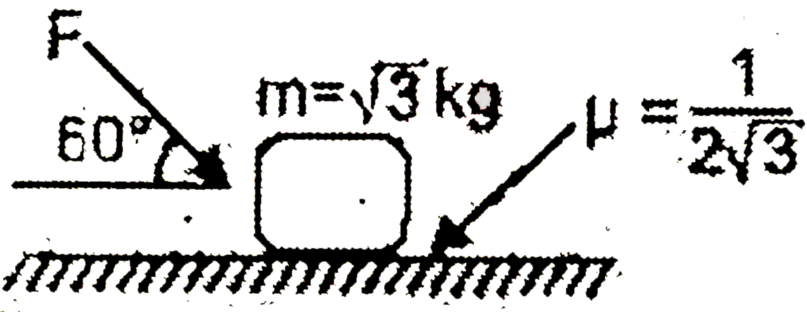
53. What is the maximum value of the force F such that the block shown in the arrangement, does not move question:



A. 20 N

B. 10 N

C. 12 N

D. 15 N

Answer: a

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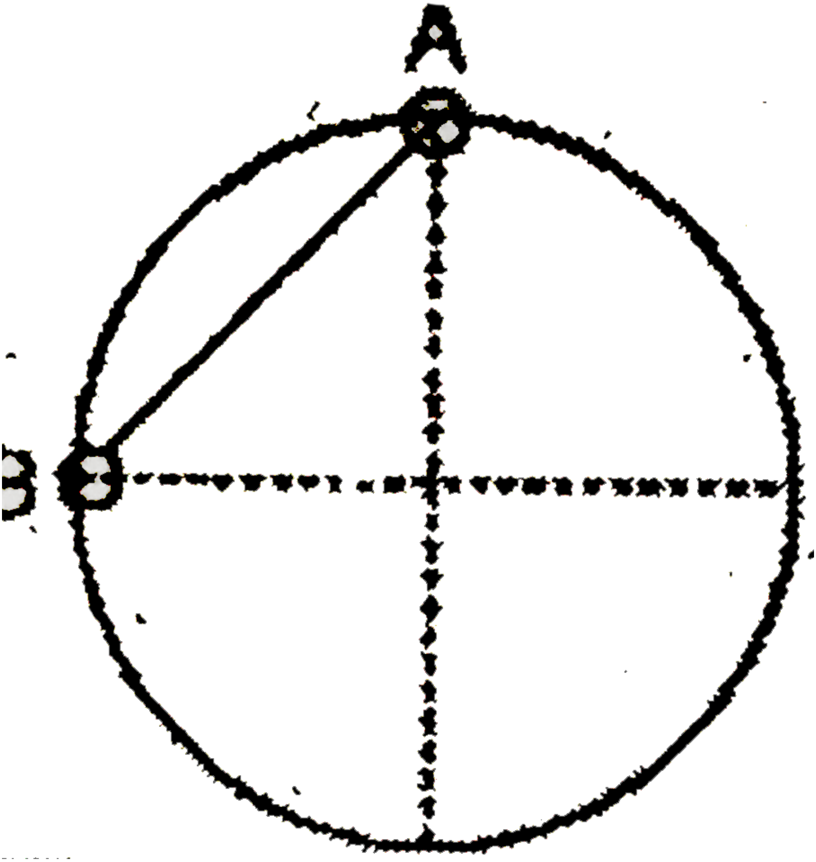
54. Two beads A & B of equal mass m are connected by a light inextensible to move on a connected to move on a frictionless ring in vertical plane. The beads are released from rest as shown. The tension in the cord just after the release is:



A. $\sqrt{2}mg$

B. $\dfrac{mg}{2}$

C. $\dfrac{mg}{4}$

D. $\dfrac{mg}{\sqrt{2}}$

Answer: d

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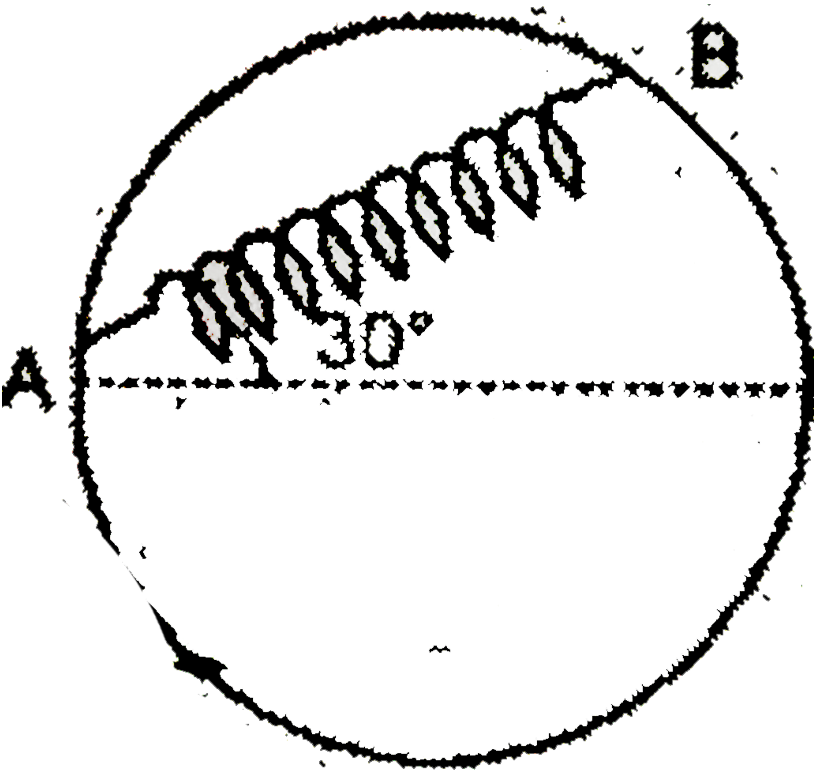
55. A bead of mass 'm' is attached to one end of a spring of natural length R & spring constant $k = \frac{(\sqrt{3}+1)}{R}$. The other end of the spring is fixed at point A on a smooth vertical ring of radius R as shown. The normal reaction at B just after it is released to move is



A. $\sqrt{3}mg$

B. $3\sqrt{3}mg$

C. $\frac{mg}{2}$

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

Answer: d

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56. In the above question 55 tangential acceleration of the bead just after it is released is ?

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

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

C. $\frac{g}{4}$

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

Answer: a

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57. If you want to pile up sand onto a circular area of radius R. The greatest height of the sand pile that can be created without spilling the sand onto the surrounding. Area, if μ is the coefficient of friction between sand particle is:

A. $\mu^2 R$

B. μR

C. R

D. $\frac{R}{\mu}$

Answer: b

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58. A mass of mass $60kg$ is pulling a mass M by an inextensible light rope passing through a smooth and massless pulley as shown in figure. The coefficient of friction between the mass and ground is $\mu = 1/2$ find the maximum value of M that can be pulled on the ground

A. 26 kg

B. 46 kg

C. 51 kg

D. 32 kg

Answer: d

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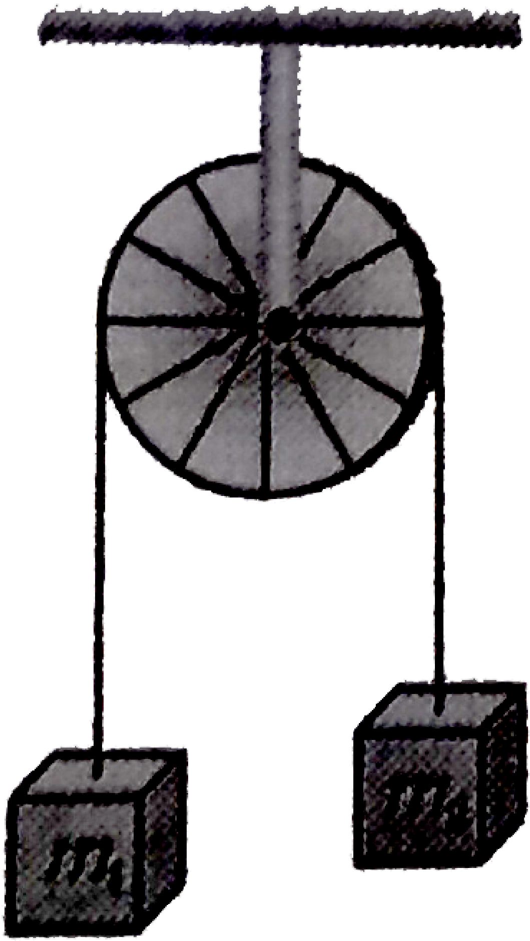
59. Two masses m_1 and m_2 are attached to a string which passes over a frictionless smooth pulley. When $m_1 = 10kg, m_2 = 6kg$, the acceleration of masses is



A. $\dfrac{f-(m_2-m_1)g}{m_1+m_2}$

B. $\dfrac{(m_1+m_2)g-f}{m_1-m_2}$

C. $\dfrac{(m_2-m_1)g-f}{m_1+m_2}$

D. $\dfrac{m_2g-f}{m_1+m_2}$

Answer: c

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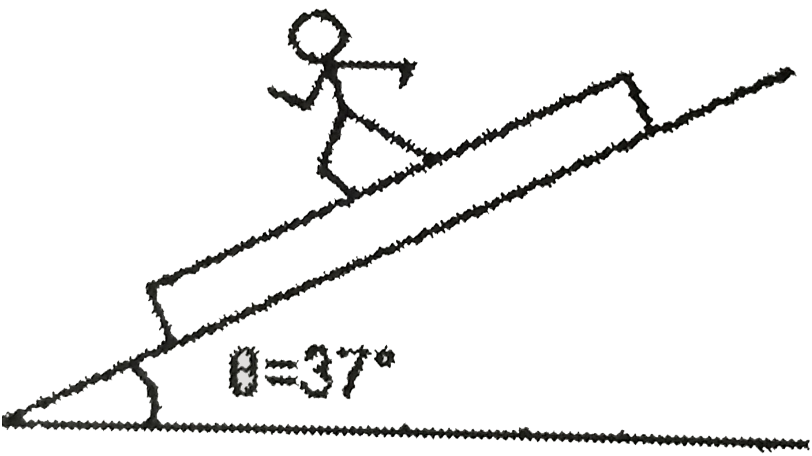
60. A plank of mass 3m is placed on a rough inclined plane and a man of mass m walks down the board. If the coefficient of friction between the board and inclined plane is $\mu = 0.5$, the minimum acceleration of does not slide is:



A. $8m/s^2$

B. $4m/s^2$

C. $6m/s^2$

D. $3m / s^2$

Answer: a

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61. A small block slides without friction down an iclined plane starting form rest. Let S_n be the distance traveled from time $t = n - 1$ to $t = n$. Then $\frac{S_n}{S_{n+1}}$ is:

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

B. $\frac{2n+1}{2n-1}$

C. $\frac{2n-1}{2n+1}$

D. $\frac{2n}{2n+1}$

Answer: c

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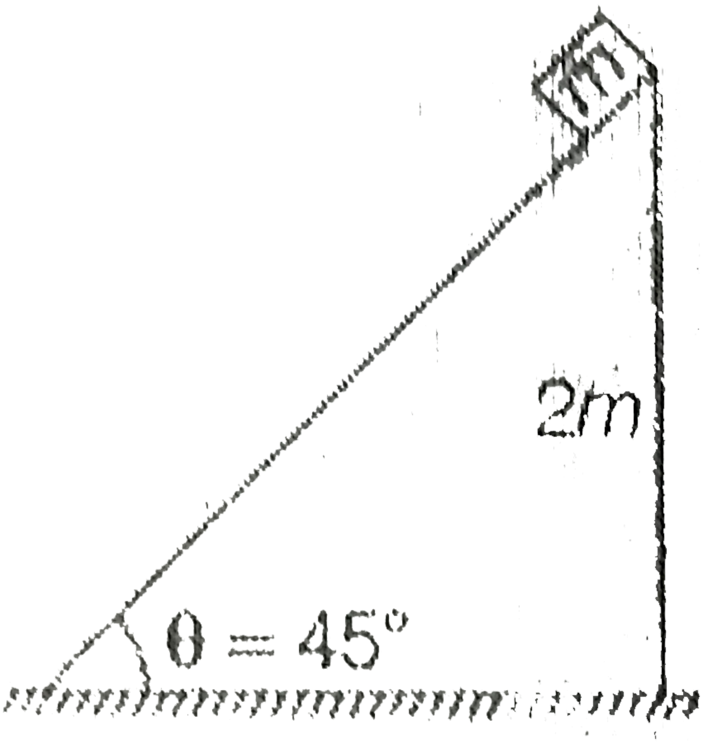
62. A wedge of mass 2m and a cube of mass m are shown in figure. Between cube and wedge, there is no friction. The minimum coefficient of friction between wedge and ground so that wedge does not move is



A. 0.20

B. 0.25

C. 0.10

D. 0.50

Answer: a

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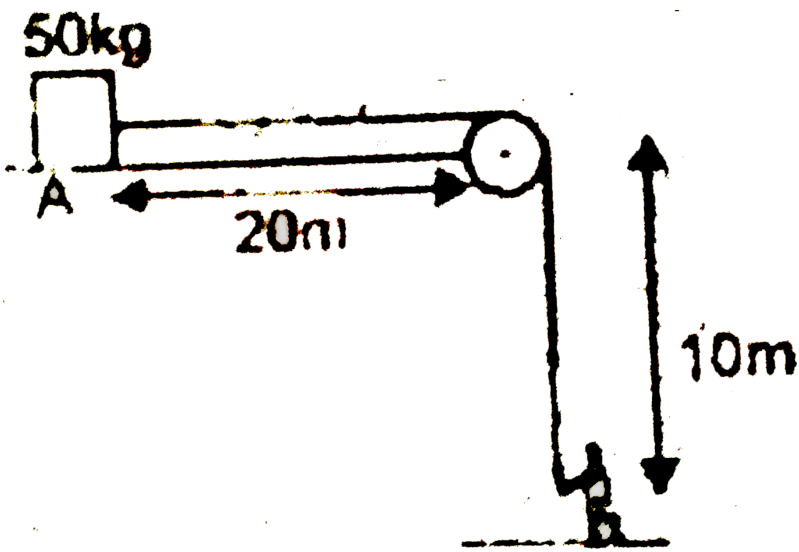
63. The figure shows a block 'A' resting on a rough horizontal surface with $\mu = 0.2$. A man of mass 50 kg standing on the ground surface starts climbing the hanging ideal string. The maximum possible tension in the string is 1000N. The minimum time taken by the man to reach upto the pulley:



A. $\sqrt{2.5}$

B. 1

C. $\sqrt{2}$

D. none of these

Answer: c

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64. In the above question 63 distance between the man and the block 'A', when man reaches the pulley is:

A. 10 m

B. 2 m

C. 20 m

D. None of these

Answer: b

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65. The force acting on the block is given by $F = 5 - 2t$. The frictional force acting on the block after time $t = 2$ seconds will be: $(\mu = 0.2)$

A. 2 N

B. 3 N

C. 1 N

D. Zero

Answer: a

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66. The acceleration of small block m with respect to ground is (all the surface are smooth):

A. g

B. $g/2$

C. Zero

D. $\sqrt{2}g$

Answer: a

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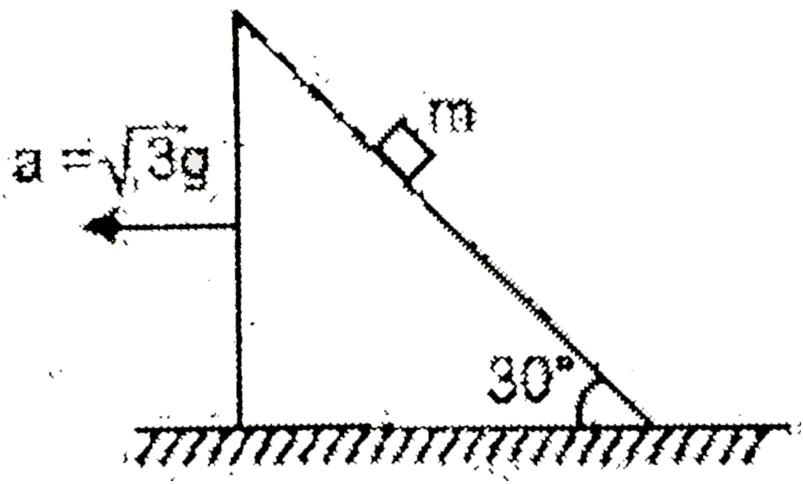
67. In the above question 66, if the same acceleration is twoards right the frictinal force exerted by wedge on the block will be: (Coefficient of friction between wedge & block $= \sqrt{3}/2$)



A. mg

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

C. 2mg

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

Answer: a

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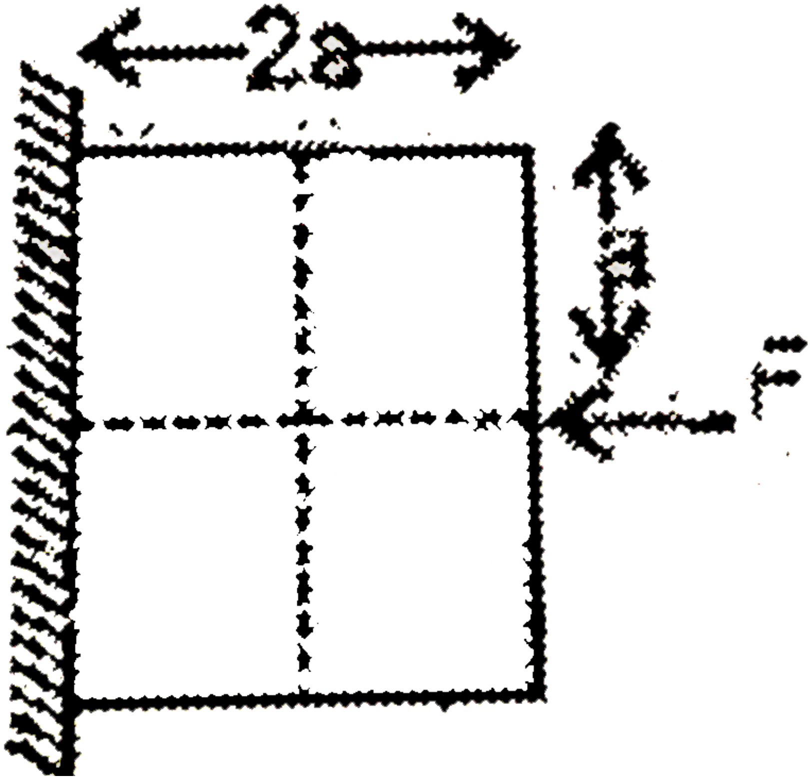
68. A block of mass 'm' is held stationary against a rough wall by applying a force F as shown. Which one of the following statement is incorrect ?



A. Friction force $f = mg$

B. Normal reaction $N = F$

C. F will not produce a torque

D. N will not produce any torque

Answer: d

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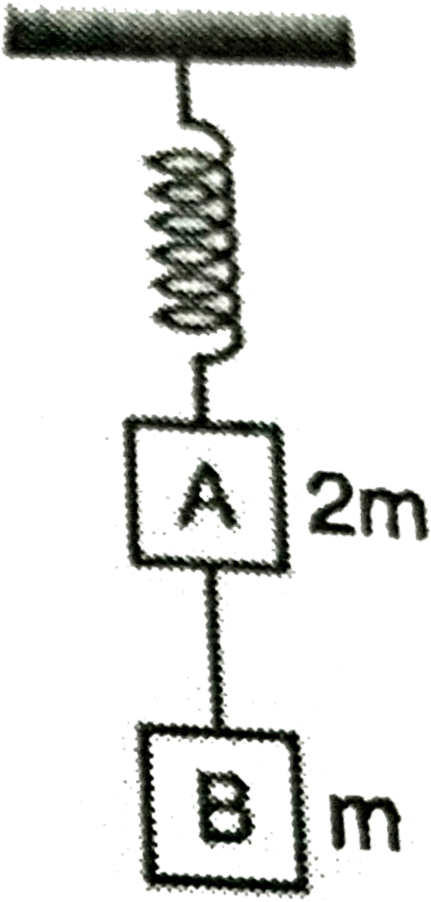
69. Two blocks A and B of masses 2m and m, respectively, are connected by a massless and inextensible string. The whole system is suspended by a massless spring as shown in the fig The magnitudes of acceleration of A and B immediately after the string is cut, are respectively:



A. g, $g/2$

B. $g/2$,g

C. g,g

D. $g/2$, $g/2$

Answer: b

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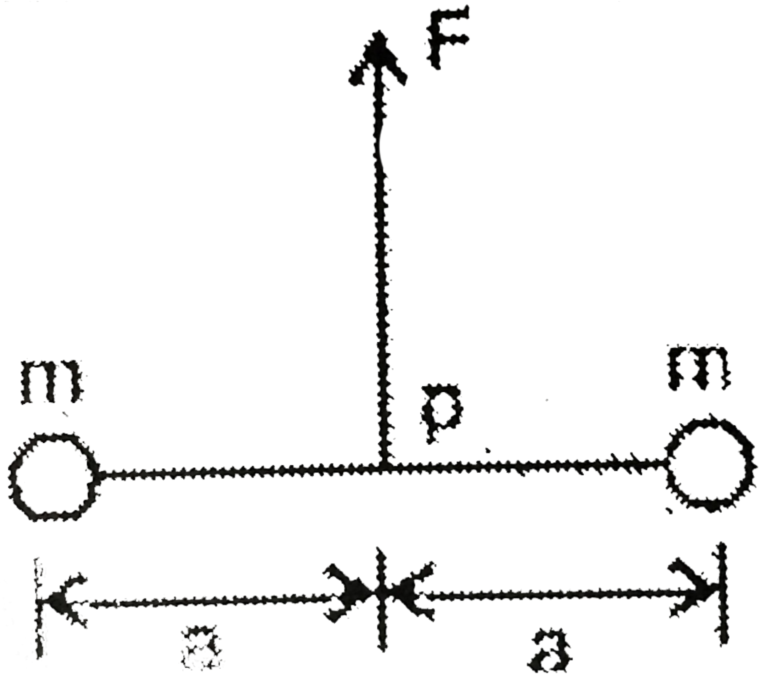
70. Two particles of mass m each are tied at the ends of a light string of length $2a$. The whole system is kept on a frictionless horizontal surface with the string held tight so that, each mass is at a distance 'a' from the center P (as shown in the figure). Now, the mid-point of the string is pulled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



A. $\frac{F}{2m}\frac{a}{\sqrt{a^2-x^2}}$

B. $\frac{F}{2m}\frac{x}{\sqrt{a^2-x^2}}$

C. $\frac{F}{2m}\frac{x}{a}$

D. $\frac{F}{2m}\frac{\sqrt{a^2-x^2}}{x}$

Answer: b

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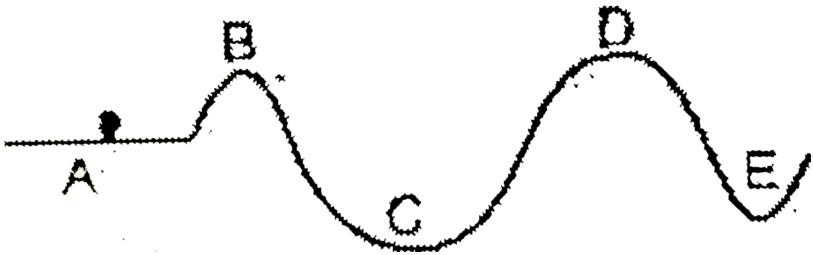
71. A particle moves along on a road with constant speed at all points as shown in figure. The normal reaction of the road on the particle is :



A. Same at all points

B. Maximum at point B

C. Maximum at point C

D. Maximum at point E

Answer: d

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72. A particle of mass m rotates with a uniform angular speed ω. It is viewed from a frame rotating about the Z-axis with a uniform angular speed ω_0. The centrifugal force on the particler is

A. $m\omega^2 a$

B. $m\omega_0^2 a$

C. $m\left(\frac{\omega+\omega_0}{2}\right)^2 a$

D. $m\omega\omega_0 a$

Answer: b

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73. A particle of mass m_1 is fastened to one end of a massless string and another particle of mass m_2 is fastened to the middle point of the same string. The other end of the string being fastened to a fixed point on a smooth horizontal table. The particles are then projected, so that the two particles and the string are always in the same straight line and describe horizontal circles. Then, the ratio of rotations in the two parts of the string is :

A. $m_1/(m_1+m_2)$

B. $(m_1 + m_2) / m_1$

C. $(2m_1 + m_2) / 2m_1$

D. $2m_1 / (m_1 + m_2)$

Answer: c

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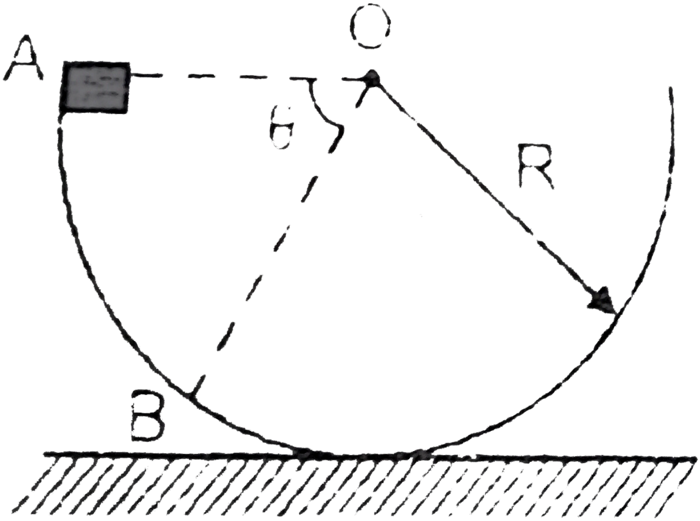
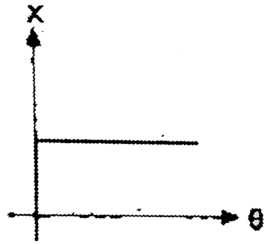
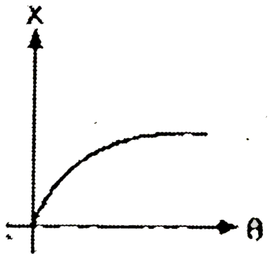
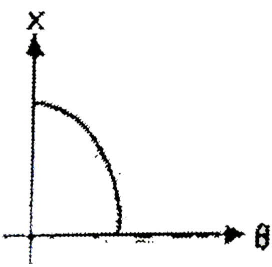
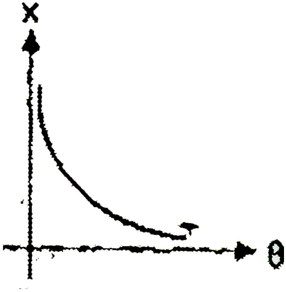
74. A small block of mass m is released from rest from point A inside a smooth hemisphere bowl of radius R, which is fixed on group such that OA is horizontal. The ratio (x) of magnitude of centripetal force and normal reaction on the block at any point B varies with θ as :



A. 

B. 

C. 

D. 

Answer: a

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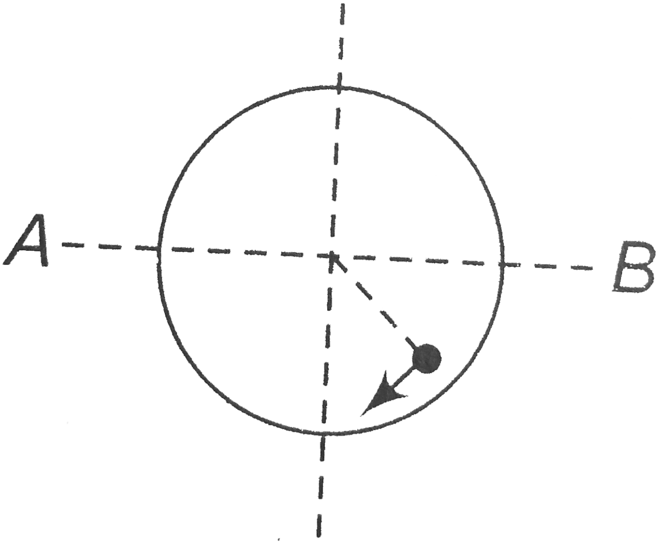
75. A partical of mass m oscillates along the horizontal diameter AB inside a smooth spherical AB inside a smooth sperical shell of radius R. At any instate $K.E.$ of the partical is K. Then force applied by partical on the on the shell at this instant is:



A. $\frac{K}{R}$

B. $\frac{2K}{R}$

C. $\frac{3K}{R}$

D. $\frac{K}{2R}$

Answer: c

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76. A particle of mass m is moving in a circular path of constant radius r such that its centripetal acceleration a_c is varying with time t as $a_c = k^2 r t^2$, where k is a constant. The power delivered to the particle by the forces acting on it is :

A. $2\pi m k^2 r^2 t$

B. $m k^2 r^2 t$

C. $(m k^4 r^2 t^5) / 3$

D. Zero

Answer: b

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77. A long horizontal rod has a bead which can slide along its length and is initially placed at a distance L from one end A of the rod. The rod is set in angular motion about A with a constant angular acceleration, α. If the coefficient of friction between the rod and bead is μ, and gravity is neglected, then the time after which the bead starts slipping is :

A. $\sqrt{\frac{\mu}{\alpha}}$

B. $\frac{\mu}{\sqrt{\alpha}}$

C. $\frac{1}{\sqrt{\mu\alpha}}$

D. infinitesimal

Answer: d

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78. In gravity free space, a particle is in constant with the inner surface of a hallow cylinder and moves in a circular path along the surface. There is some friction between the particles and the surface. The retardation of the particle is :

A. Zero

B. Independent of tha velocity

C. Proportional to its velocity

D. Proportional to the square of its velocity

Answer: d

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79. A curved section of a road is banked for a speed v. If there is no friction between the road and the tyres then.

A. a car moving with speed v does not slip on the road

B. a car is more likely to slip on the road at speeds higher than v, than at speeds lower than v

C. a car is more likely to slip on the road at speeds lower than v, than at speeds higher thab v.

D. a car can remain stationary on the road without slipping.

Answer: a

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80. In a circular motion of a particle the tangential acceleration of the particle is given by $a_t = 2tm/s^2$. The radius of the circle described is $4m$. The particle is initially at rest. Time after which total acceleration of the particle makes 45° with radial acceleration is :

A. 1 sec

B. 2 sec

C. 3 sec

D. 4 sec

Answer: b

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81. A particle travels along the arc of a circle of radius r. Its speed depends on the distance travelled l as $v = a\sqrt{l}$ where 'a' is a constant.

The angle α between the vectors of net acceleration and the velocity of the particle is

A. $\alpha = \tan^{-1}(2l / r)$

B. $\alpha = \cos^{-1}(2l / r)$

C. $\alpha = \sin^{-1}(2l / r)$

D. $\alpha = \cot^{-1}(2l / r)$

Answer: a

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82. A particle of mass m is attached to one end of string of length l while the other end is fixed to point $h(h < l)$ above a horizontal table. The particle is made to revolve in a circle on the table so as to make p revolutions per second. The maximum value of p, if the particle is to be in contact with the table, is : $(l > h)$

A. $2\pi\sqrt{gh}$

B. $\sqrt{g/h}$

C. $2\pi\sqrt{h/g}$

D. $\frac{1}{2\pi}\sqrt{h/g}$

Answer: d

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83. A stone is thrown horizontally with a velocity of $10m/s$ at $h=0$. The radius of curvature of the stone's trajectory at $t=3s$ is : [Take $g=10m/s^2$]

A. $10\sqrt{10}m$

B. $100m$

C. $100\sqrt{10}m$

D. $1000m$

Answer: c

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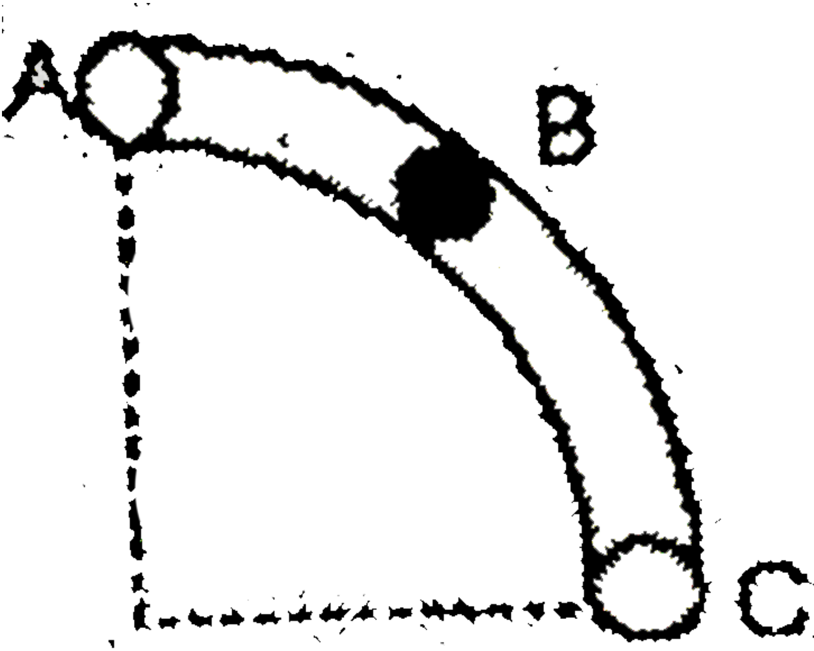
84. The narrow tube AC forms a quarter circles in a vertical plane. A ball B has an area of cross-section slighly smaller than that of the tube and can move without friction through it. B is placed at A and displaced slightly. During the motion from A to C it will :



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85. a particle is moving in a circle of radius R in such a way that at any instant the normal and the tangential component of its acceleration are equal. If its speed at $t = 0$ is v_0 then time it takes to complete the first revolution is $\frac{R}{\alpha v_0}\left(1 - e^{-\beta\pi}\right)$. Find the value of $(\alpha + \beta)$.

A. R/u_0

B. u_0/R

C. $\frac{R}{u_0}(1 - e^{-2\pi})$

D. $\frac{R}{u_0}e^{-2\pi}$

Answer: c

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86. A particle P is moving in a circle of radius r with a uniform speed u. C is the centre of the circle and AB is diameter. The angular velocity of P about A and V are in the ratio :

A. $1:2$

B. $2:1$

C. $1:3$

D. $3:1$

Answer: a

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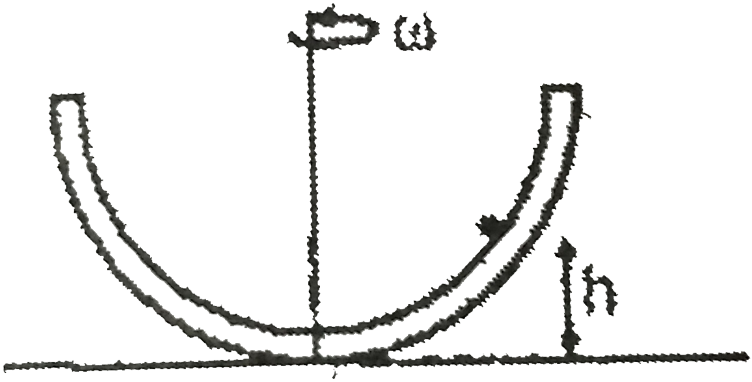
87. A small body of mass m can slide without friction along a through bent which is in the form of a semi-circular arc of radius R. At what height h will the body be at rest with respect to the trough, if the trough rotates with uniform angular velocity ω about a vertical axis:



A. R

B. $R - \frac{2g}{\omega^2}$

C. $R + \frac{2g}{\omega^2}$

D. $R - \frac{g}{\omega^2}$

Answer: d

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88. A car moves along a horizontal circular road of radius r with constant speed v. The coefficient of friction between the wheels and the road is μ. Which of the following statement is not true ?

A. The car slips if $v > \sqrt{\mu r g}$

B. The car slips if $\mu < \left(v^2 / rg\right)$

C. The car slips if $\mu > \left(v^2 / rg\right)$

D. The car slips at a lower speed if it moves with some tangential acceleration, then if it moves at constant speed

Answer: c

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89. A smooth hollow cone whose vertical angle is 2α with its axis vertical and vertex downwards revolves about its axis η time per seconds. A particle is placed on the inner surface of cone so that it rotates with same speed. The radius of rotation for the particle is :

A. $g \cot \alpha / 4\pi^2 \eta^2$

B. $g \sin \alpha / 4\pi^2 \eta^2$

C. $4\pi^2 \eta^2 / g$

D. $g / 4\pi^2 \eta^2 \sin \alpha$

Answer: a

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90. A particle is kept fixed on a turntable rotating uniformly. As seen from the ground the particle goes in a circle, its speed is $20 cm / s$ & acceleration is $20 cm / s^2$. The particle is now shifted to a new position to make the radius half of the original value. The new values of the speed & acceleration will be:

A. $10 cm / s, 10 cm / s^2$

B. $10 cm / s, 80 cm / s^2$

C. $40 cm / s, 10 cm / s^2$

D. $40cm/s, 40cm/s^2$

Answer: a

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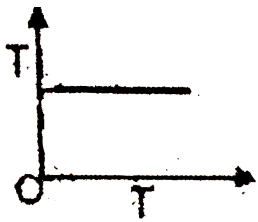
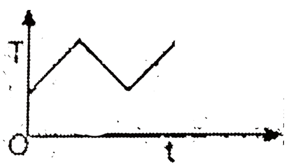
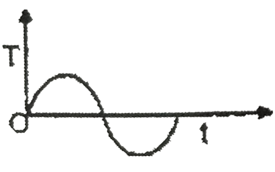
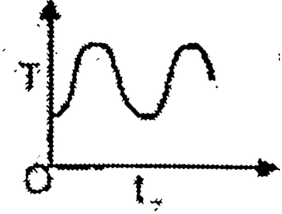
91. A particle of mass m is suspended from a fixed O by a string of length L. At $t=0$, it is displaced from its equilibrium position and released. The graph which shows the variation of the tension T in the string with time t is :

A. 

B. 

C. 

D. 

Answer: d

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92. A rod of length L is pivoted at one end and is rotated with as uniform angular velocity in a horizontal plane. Let T_1 and T_2 be the tensions at the points L//4 and 3L//4 away from the pivoted ends.

A. $T_1 > T_2$

B. $T_2 > T_1$

C. $T_1 = T_2$

D. The relation between T_1 & T_2 depends on whether the rod rotates clockwise or anticlockwise

Answer: a

Watch Video Solution

93. The driver of a car-travelling at speed V suddenly sees a wall at a distance r directly infront of him. To avoid collision. He should :

A. apply the brakes

B. turn the car simply away from the wall

C. do any of the above options

D. none of these

Answer: a

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94. A body is undergoing uniform circular motion then which of the following quantity is constant

A. velocity

B. acceleration

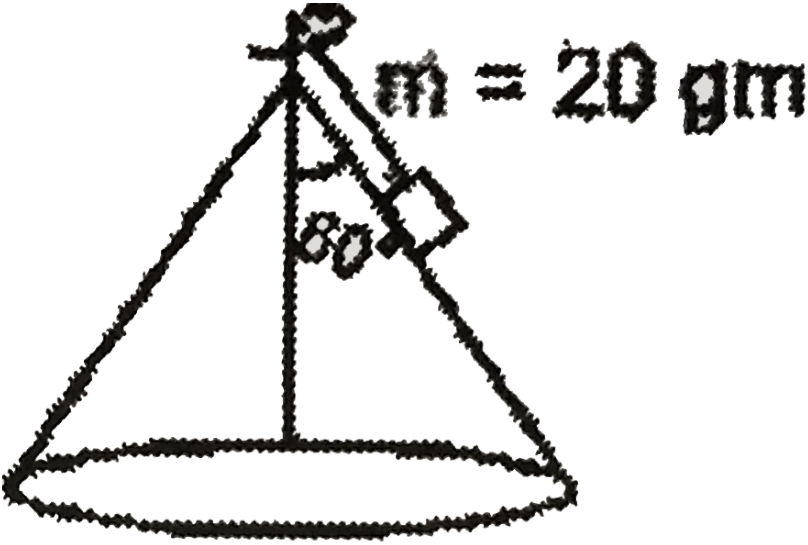
C. force

D. kinetic energy

Answer: d

Watch Video Solution

95. A particle is resting on an inverted cone as shown. It is attached to cone by a thread of length 20 cm. String remains parallel to slope of cone. The cone is givenangular acceleration of $0.5 rad / \sec^2$ then at what time does mass leave contact with surface (assuming sufficient friction) :



A. $20 \sec$

B. $10 \sec$

C. $40 \sec$

D. $5 \sec$

Answer: a

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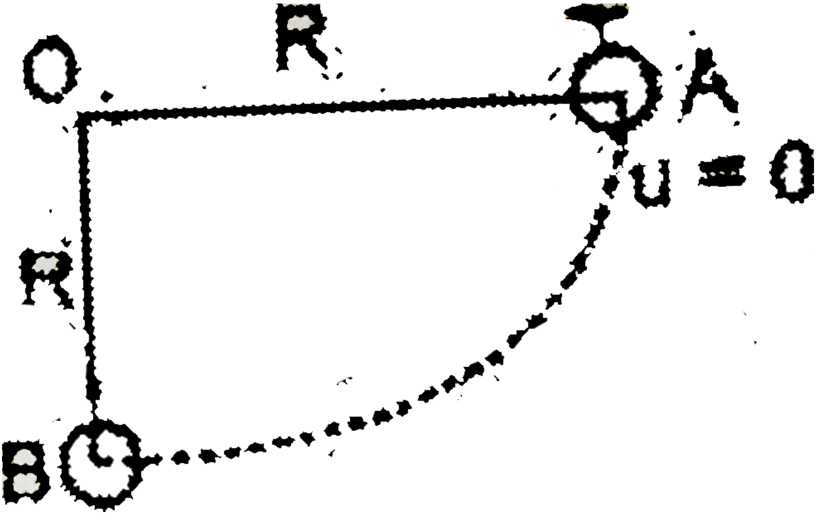
96. A particle initially at rest is released from A as shown in figures. The approximate variation of direction of resultant acceleration as particle moves from A to B is :



A. clockwise

B. anticlockwise

C. direction does not changes

D. none of these

Answer: a

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97. Repeat above Question 3, if the charge is negative and the angle made by the boundary with the velocity is $\theta = \frac{\pi}{6}$.

A. $\cos^{-1}\left(\frac{1}{\sqrt{3}}\right)$

B. $\sin^{-1}\left(\frac{1}{\sqrt{3}}\right)$

C. $\frac{\pi}{2} - \sin^{-1}\left(\frac{1}{\sqrt{3}}\right)$

D. $\frac{\pi}{2} - \cos^{-1}\left(\frac{1}{\sqrt{3}}\right)$

Answer: a

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98. Two similar trains are moving along the equational line with same speed but in opposite direction. Then :

A. they will exert equal force on rails

B. they will not exert any force as they are on equatorial line

C. one of them will exert zero force.

D. both exert different forces

Answer: d

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99. Two balls of mass m and 2m are attached with strings of length 2L and L respectively. They are released from horizontal position. Find ratio of tensions in the string when the acceleration of both is only in vertical direction :

A. $3:5$

B. $4:5$

C. $2:5$

D. $1:2$

Answer: d

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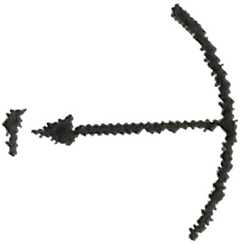
100. Indicate the direction of frictional force on a car which is moving along the curved path with non zero tangential acceleration, in anti-clock direction:



A.

B.

C. 

D. 

Answer: c

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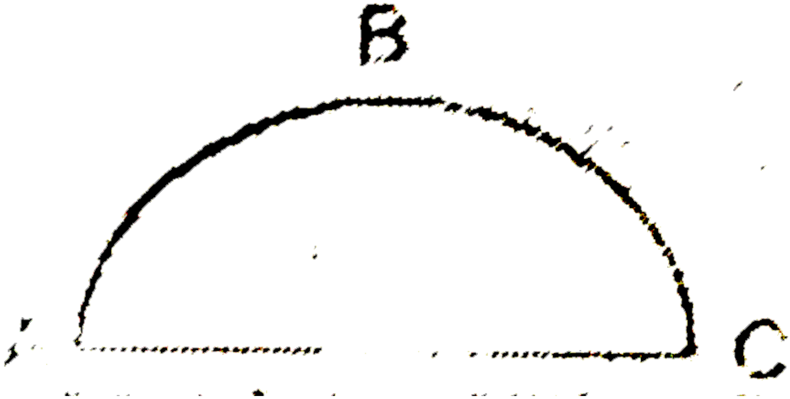
101. If a particle starts from a along the curved circular path shown in figure with tangential acceleration 'a'. Then acceleration at B in magnitude is :



A. $2a\sqrt{1+\pi^2}$

B. $a\sqrt{1+\pi^2}$

C. $a\sqrt{\pi^2-1}$

D. $a\pi\sqrt{1+\pi^2}$

Answer: b

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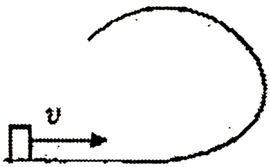
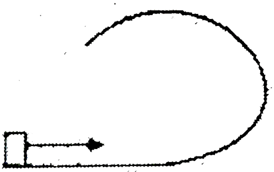
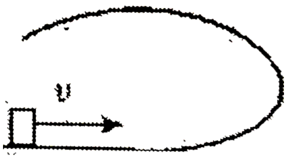
102. A small block is shot into each of the four tracks as shown below. Each of the tracks rises to the same height. The speed with which the block enters the tracks is the same in all cases. At the highest point of the track, the normal reaction is maximum in :

A. 

B. 

C. 

D. 

Answer: a

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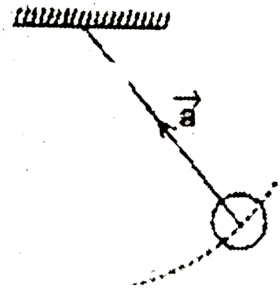
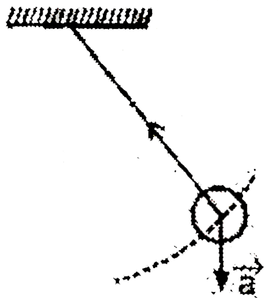
103. A simple pendulum is oscillating without damping. When the displacement of the bob is less then maximum, its acceleration vector $\vec{a}$ is correctly shown in :

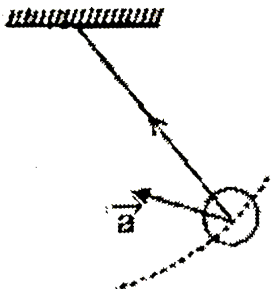
A.

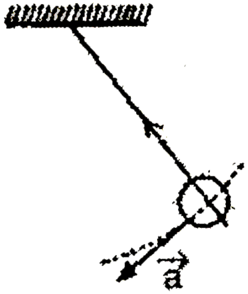


B.



C.



D. 

Answer: c

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Level-2

1. A particle stays at rest as seen in a frame. We can concude that :

A. Resultant force on the particle is zero

B. The frame may be inertial but the resultant force on the particle is zero

C. The frame is inertial

D. The frame may be non-inertial but there is a non-zero resultant force

Answer: b,d

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2. A particle is found to be at rest when seen from a frame S_1 and moving with a constant velocity when seen from another frame S_2. Select the possible options :

A. Both the frames are non-inertial

B. S_1 is inertial and S_2 is non-inertial

C. Both the frames are inertial

D. S_1 is non-inertial and S_2 is inertial

Answer: a,c

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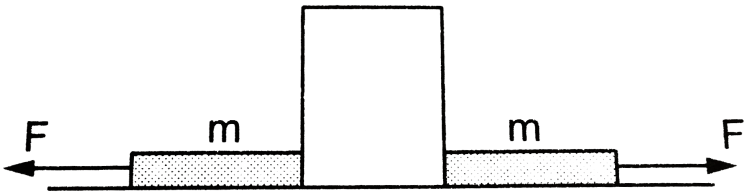
3. Figure shows a heavy block kept on a frictionless surface and being pulled on the left rope is withdrawn but the force on the right end continues to act. Let F_1 and F_2 be the magnitude of the forces by the right rope and the left rope on the block respectively.



A. $F_1 = F_2 = F + mg$ for $t < 0$

B. $F_1 = F, F_2 = F$ for $t > 0$

C. $F_1 = F_2 = F$ for $t < 0$

D. $F_1 < F, F_2 = F$ for $t > 0$

Answer: c

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4. The force exerted by the floor of an elevator on the foot of a person standing there is more than the weight of the person if the elevator is :

A. going up and speeding up

B. going down and slowing down

C. going up and slowing down

D. going down and speeding up

Answer: a,b

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5. If the tension in the cable supporting an elevator is equal to the weight of the elevator, the elevator may be :

A. going down with increasing speed

B. going up with uniform speed

C. going up with increasing speed

D. going down with uniform speed

Answer: b,d

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6. A particle is observed from two frames S_1 and S_2. The frame S_2 moves with respect to S_1 with an acceleration a. Let F_1 and F_2 be the pseudo forces on the particle when seen from S_1 and S_2 respectively. Which of the following are not possible ?

A. $F_1 \neq 0, F_2 = 0$

B. $F_1 \neq 0, F_2 \neq 0$

C. $F_1 = 0, F_2 \neq 0$

D. $F_1 = 0, F_2 = 0$

Answer: d

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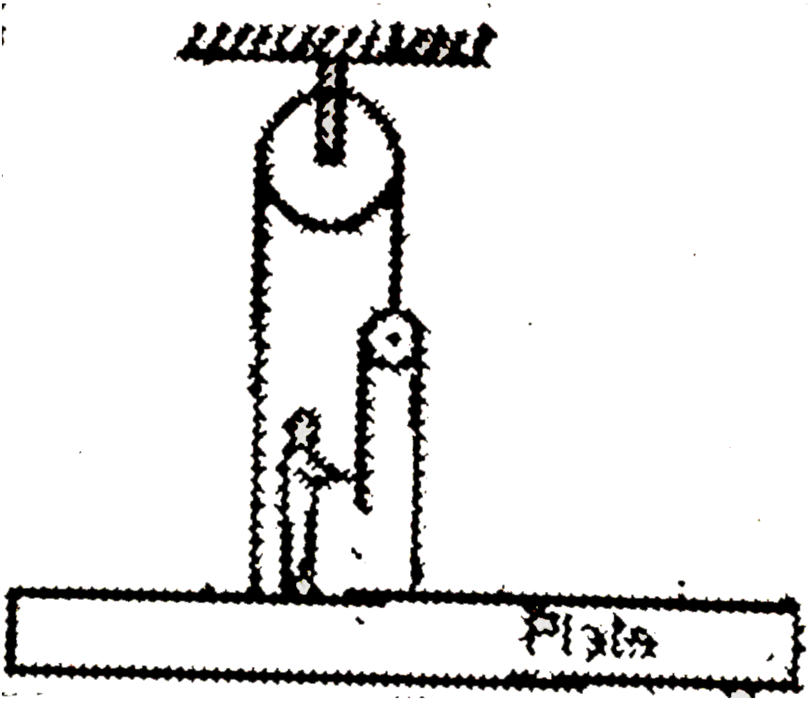
7. In the arrangement shown pulley and thread are mass less. Mass of plate is 20 kg and that of boy is 30 kg.

Then :



A. If normal reacton on the boy is equal to weight of the boy then the force applied on the rope by the boy is (150 g/7) newton

B. If the boy applies no force on the string then the normal reaction on him is 30 g

C. If the system is in equilibrium then the boy is applying 125 newton force on the rope

D. None of the above

Answer: a,c

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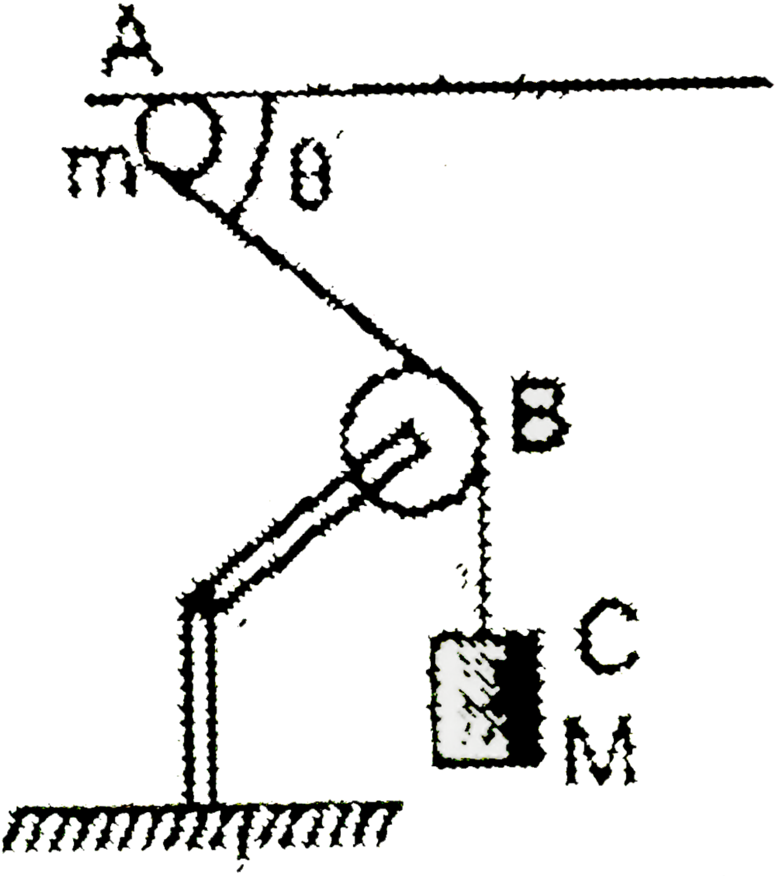
8. A smooth ring of mass m can slide on a fixed horizontal rod. A string tied to the ring pases over a fixed pulley B and carries a block C of mass

2m as shown below. As the ring starts sliding



A. The acceleration of the ring is $\dfrac{2g\cos\theta}{1+2\cos^2\theta}$

B. The acceleration of the block is $\dfrac{2g}{1+2\cos^2\theta}$

C. The tension in the string is $\dfrac{2mg}{1+2\cos^2\theta}$

D. If the block descends with velocity v then the ring slides with velocity $v\cos\theta$

Answer: a,c

Watch Video Solution

9. A block of mass m is kept on an inclined plane of mass $2m$ and inclination α to horizontal. If the whole system is accelerated such that the block does not slip on the wedge then :

A. The normal reaction acting on $2m$ due to m is $mg\sec\theta$

B. For the block m to remain at rest with respect to wedge a force $F = 3mg\tan\alpha$ must be applied on $2m$

C. The normal reaction acting on $2m$ due to m is $mg\sec\theta$

D. Pseudo force acting on m with respect to ground is $mg\tan\alpha$ towards west.

Answer: a,b,c

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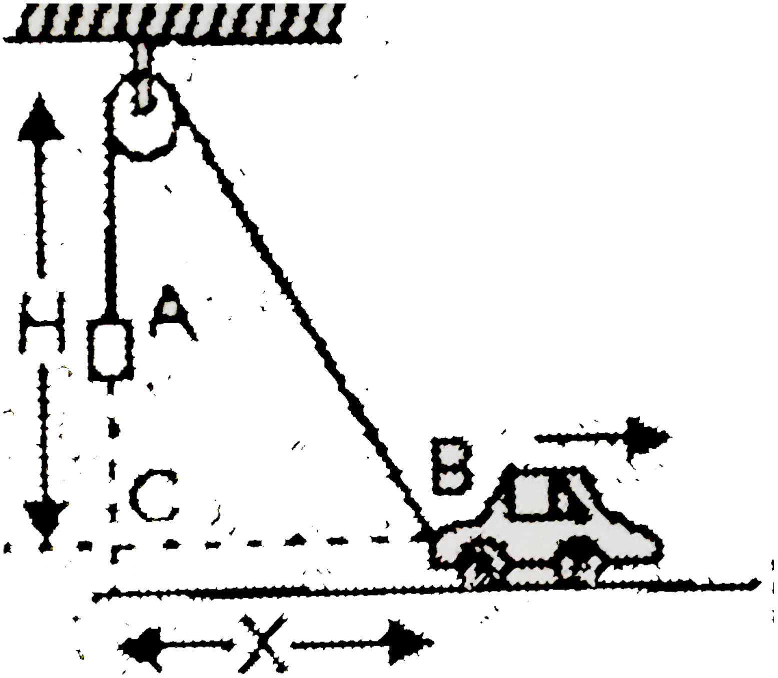
10. The car in the given figure moves with constant velocity v. When $x = 0$ end A and B were coincident at C. Then which of the following sentences is/are correct :



A. The velocity of the block is $\frac{xv}{\sqrt{H^2 + x^2}}$

B. Acceleration of the block is $\frac{H^2 v^2}{(H^2 + x^2)^{3/2}}$

C. Acceleration of block A is zero

D. Velocity of the block is v

Answer: a,b

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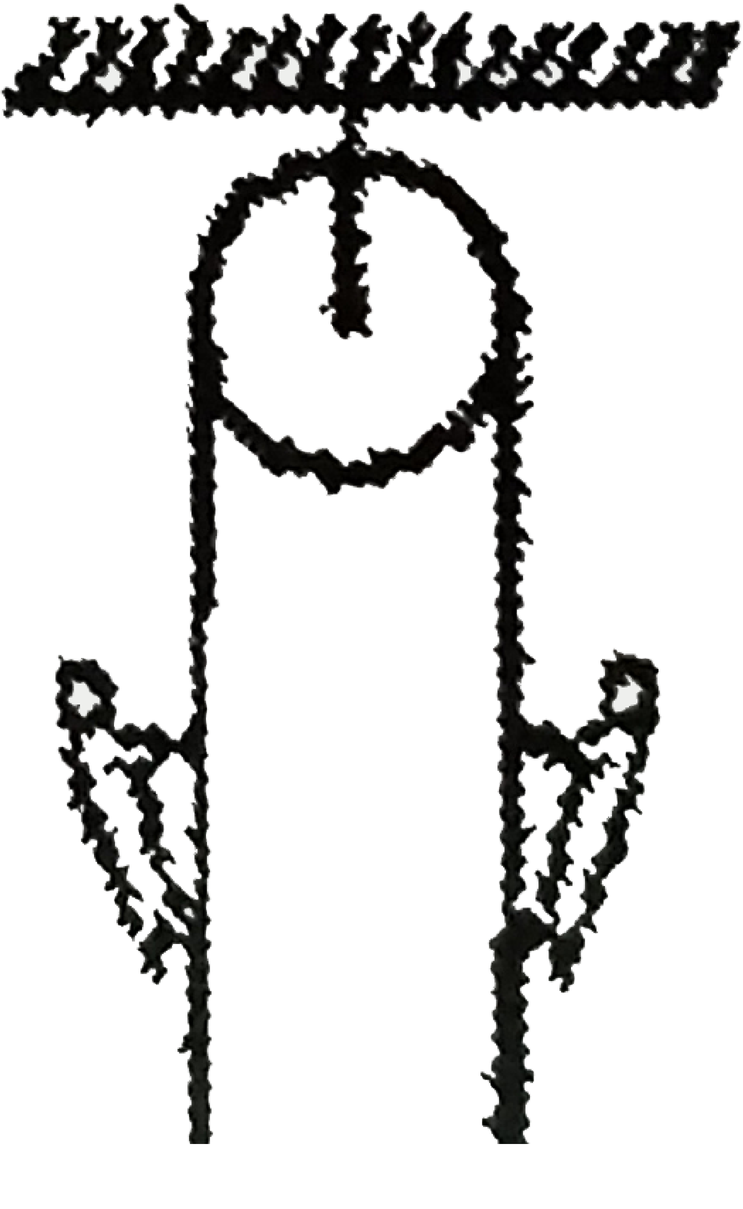
11. Two men of unequal hold to the two sections of a light rope passing over a smooth light pulley. Which of the following are possible ?



A. The heavier man is stationary while the lighter man moves with some acceleration

B. The lighter man is stationary while the heavier man move with some acceleration

C. The ligher man is stationary while the heavier man move with some acceleration

D. The two men move with acceleration of the same magnitude in opposite directions.

Answer: a,c,d

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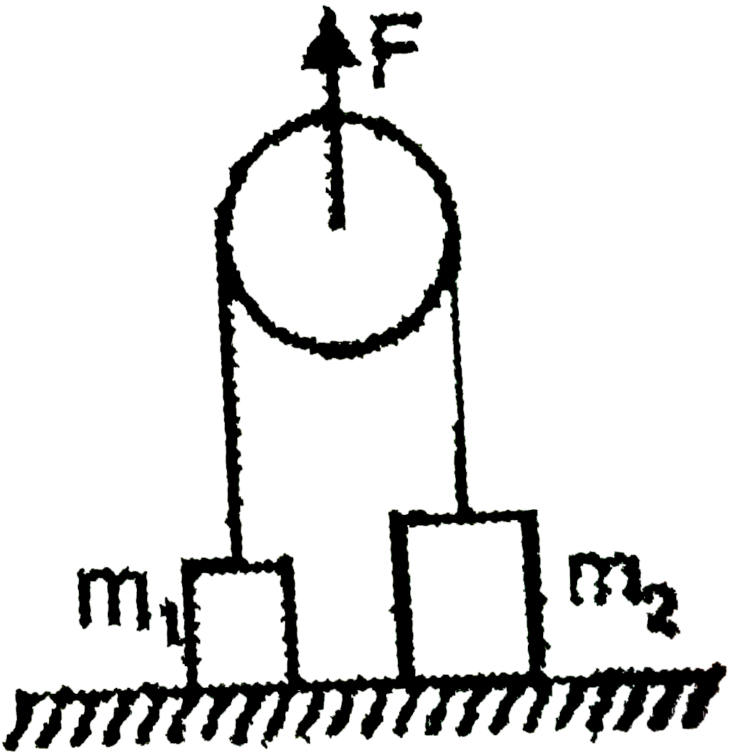
12. In the situation shown in figure $F = 500$ newton applied on the pulley $m_1 = 50kg$ and $m_2 = 10kg$ and pulley and strings are massless and frictionless. Then the acceleration of the pulley is : $\left[g = 10m/s^2\right]$



A. $15m/s^2$

B. $27.5m/s^2$

C. $40m/s^2$

D. $7.5m/s^2$

Answer: b

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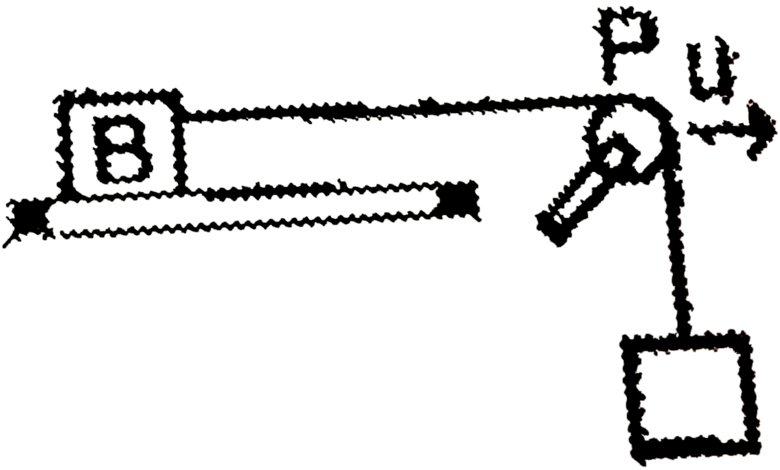
13. In the figure, the pulley P moves to the right with a constant speed u. The downward speed of A is v_A, and the speed of B to the right is v_B :



A. $v_B = u + u_A$

B. $v_B + u = v_A$

C. $v_A = v_B$

D. The two blocks have acceleration of the same magnitude

Answer: a,d

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14. A man pushes against a rigid fixed vertical wall. Which of the following is (are) the most accurate statement(s) related to the situation ?

A. Whatever forc ethe man exerts on the wall, the wall also exertes an equal and opposite force on the man

B. The maximum force, which the man can exert on the wall is the maximum frictional froce which exists between his feet and the floor

C. The man can never exerts a force on the wall which exceeds his weight

D. The man cannot be in equilibrium since. He is exerting a net force on the wall.

Answer: a,b

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15. A block of mass m is placed on a smooth wedge of inclination θ & mass M. The whole system is slip on the wedge. Then the normal reaction on the wedge acting from the ground :

A. $(M+m)g$

B. $(M+m\sin\theta)g$

C. Mg

D. $\left(\frac{M+m\sin\theta}{M+m}\right)g\cos\theta$

Answer: a

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16. A block of mass m is placed on a smooth wedge of inclination. The whole system is accelerated horizontally so that block does not slip on the wedge Find the i) Acceleration of the wedge.ii) Force to be applied on the wedge.iii) Force exerted by the wedge on the block .

A. $mg / \cos\theta$

B. $mg\cos\theta$

C. mg

D. $mg\tan\theta$

Answer: a

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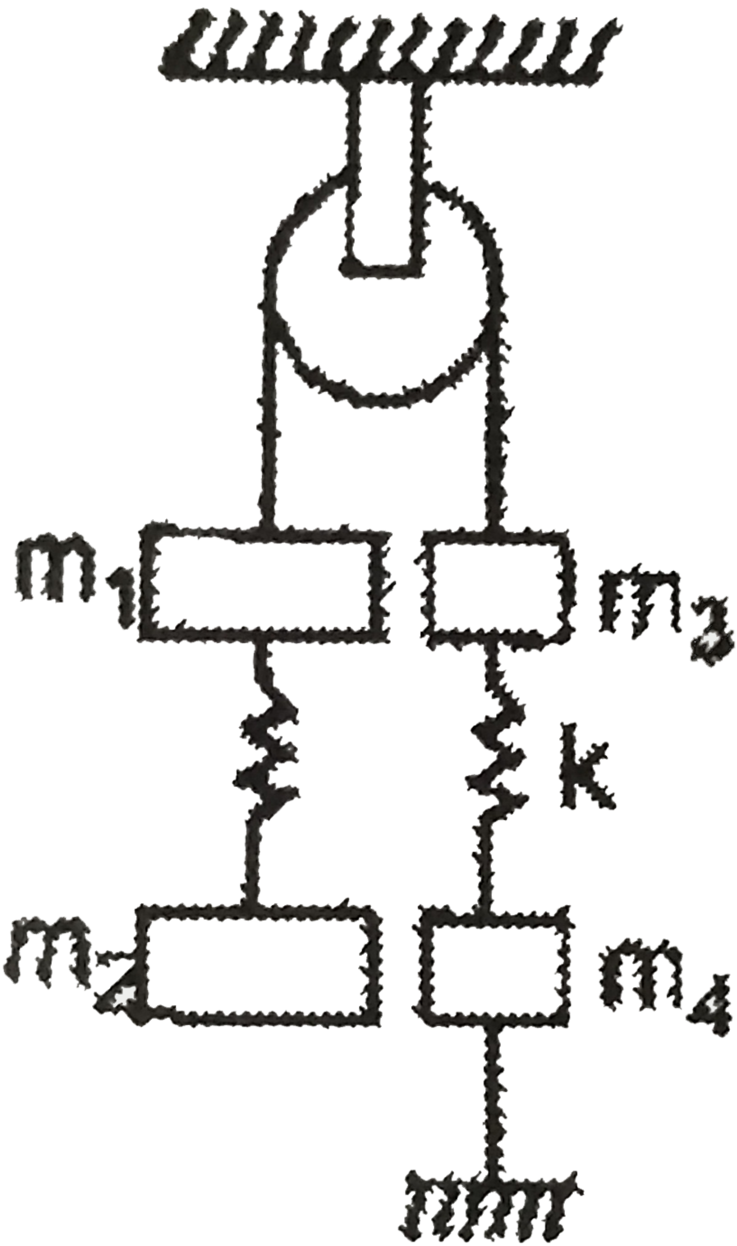
17. In arrangement shown below, the thread pulley and spring are all massless and there is no friction anywhere. The system is in equilibrium. If thread connecting m_4 is cut then just after thread is cut :



A. acceleration of $m_4 = 0$

B. acceleration of $m_1 = m_2 = m_3 = m_4 = 0$

C. acceleration of $m_1 = m_2 = m_3 = 0$

D. acceleration of $m_4 = \frac{[(m_1 + m_2) - (m_3 + m_4)]g}{m_4}$

Answer: c,d

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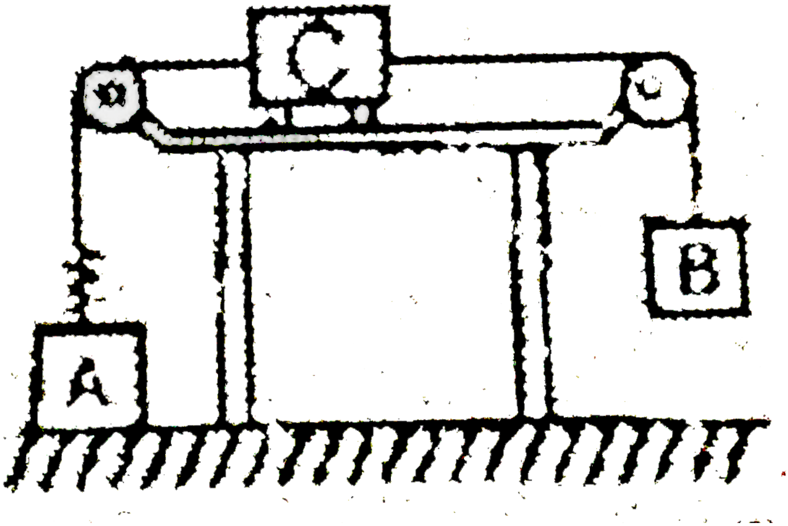
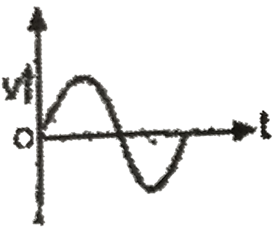
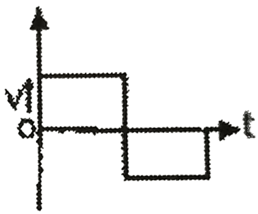
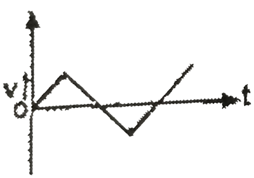
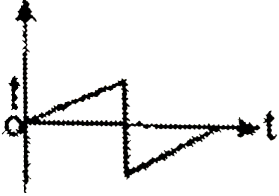
18. A trolley C can run on a smooth horizontal table. Two, much smaller but equal masses A and B are hung by string which pass over smooth pulleys : The string are long enough that when C is in equilibrium. A and B both are just on the ground. The trolley is pulled slow to one side and released as shown below. The graph of its velocity v against 't' will be as :



A. 

B. 

C. 

D. 

Answer: c

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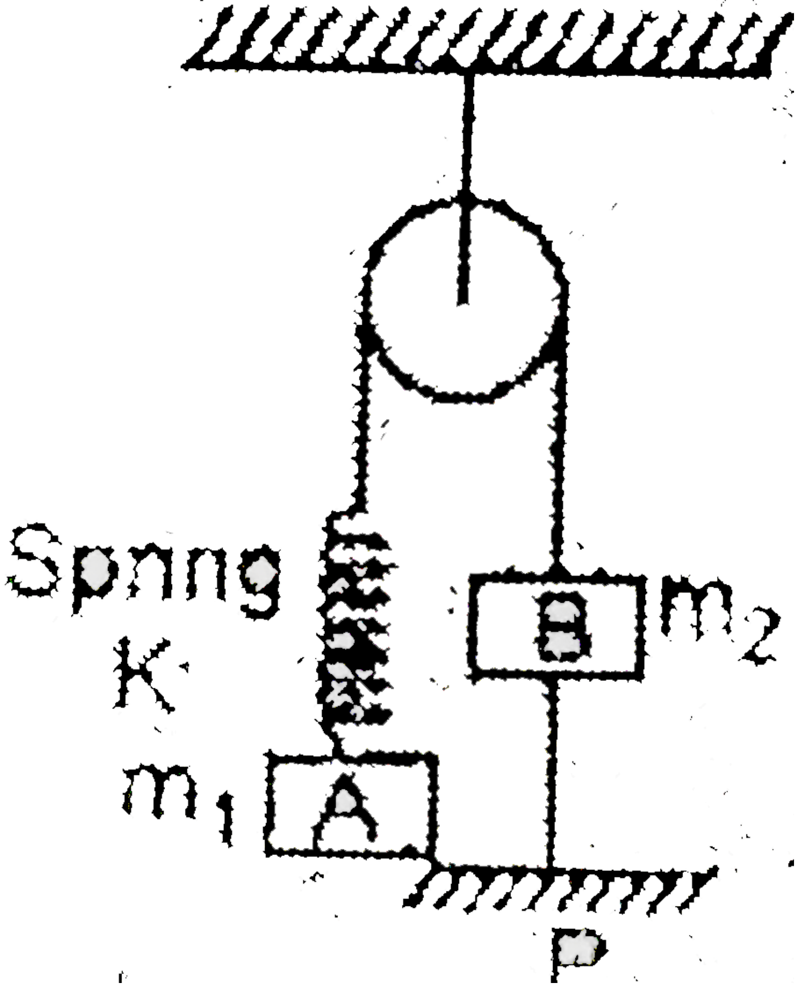
19. In the system shown in figure $m_1 > m_2$. System is held at rest by thread BP. Just after the thread BP is burnt :



A. Magnitude of acceleration of both blocks will be equal to

$$\left(\frac{m_1 - m_2}{m_1 + 2m_2}\right)g$$

B. Acceleration of m_1 will be equal to zero

C. Acceleration of m_2 will be upwards

D. Magnitudes of acceleration of two blocks will be non-zero and unequal

Answer: b,c

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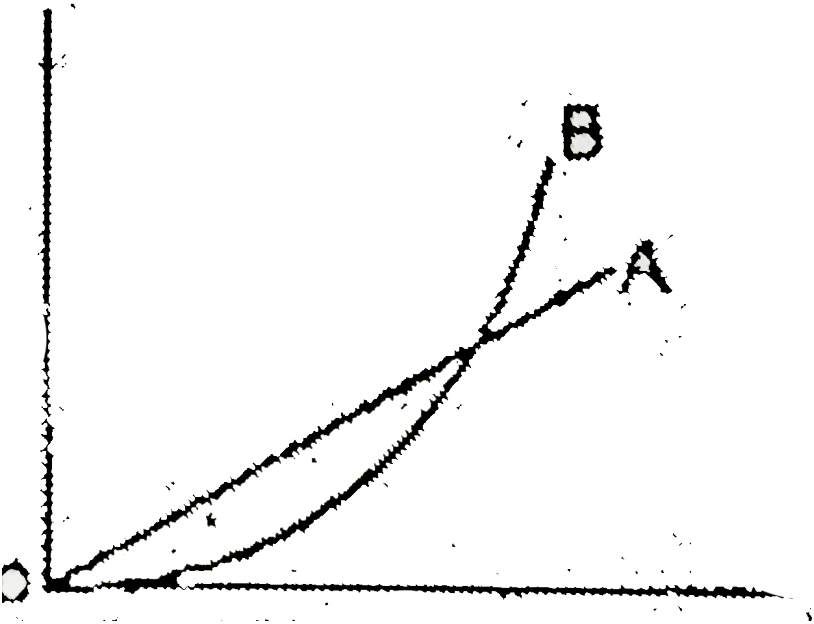
20. A particle is resting over a smooth horizontal floor. At $t = 0$, a horizontal force starts acting on it. Magnitude of the force increases with the time according to law $F = at$, where 'a' is a constant. For figure which of the following statement is/are correct ?



A. Curve B indicates velocity against time

B. Curve B indicates velocity against acceleration

C. Curve A indicates acceleration against time

D. None of these

Answer: a,b,c

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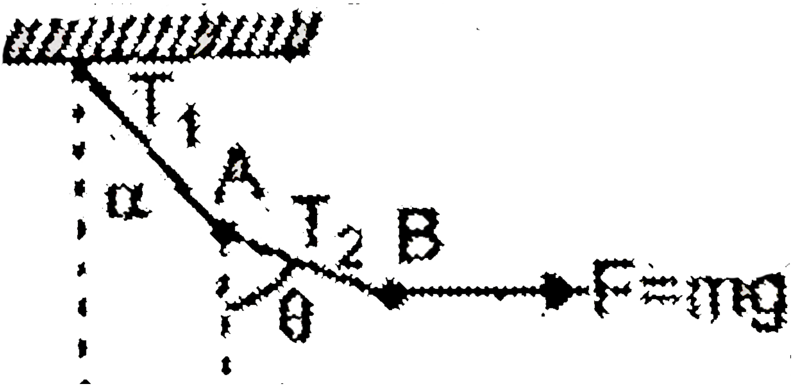
21. Two particle A & B each of mass m are in equilibrium in a vertical plane under action of a horizontal force $F = mg$ on particle B, as shown in figure Then :



A. $2T_1 = 5T_2$

B. $T_1\sqrt{2} = T_2\sqrt{5}$

C. $\tan\theta = 2\tan\alpha$

D. None of these

Answer: a,b

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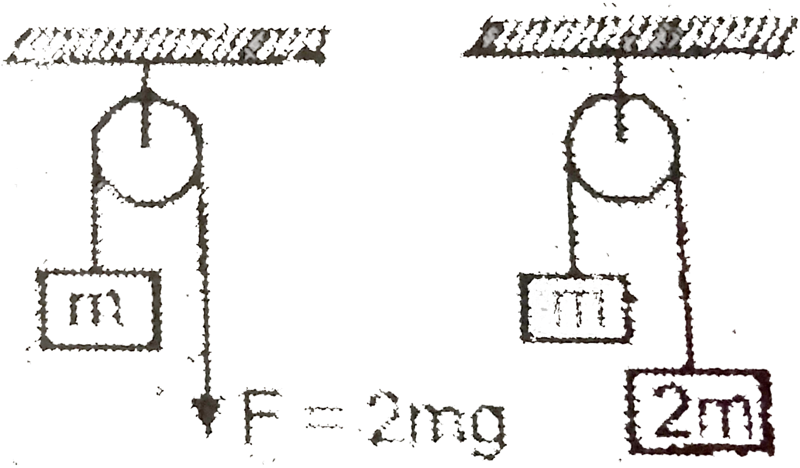
22. The magnitude of difference in accelerations of block of mass m in both the cases shown below is



A. g

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

C. zero

D. $g/31$

Answer: b,c

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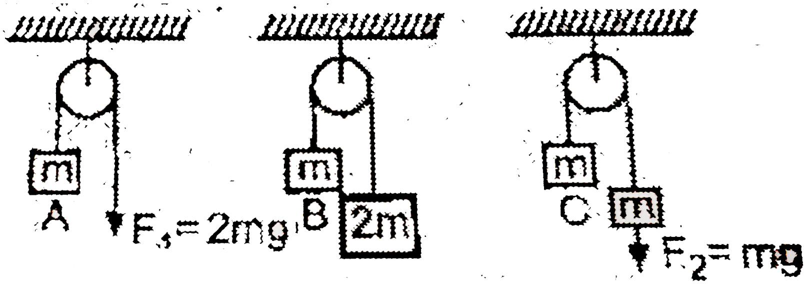
23. In the figure the block A,B and C of mass m each, have acceleration $a_1, a_2 \& a_3$ respectively. $F_1 \& F_2$ are external forces of magnitude 2 mg and mg respectively :



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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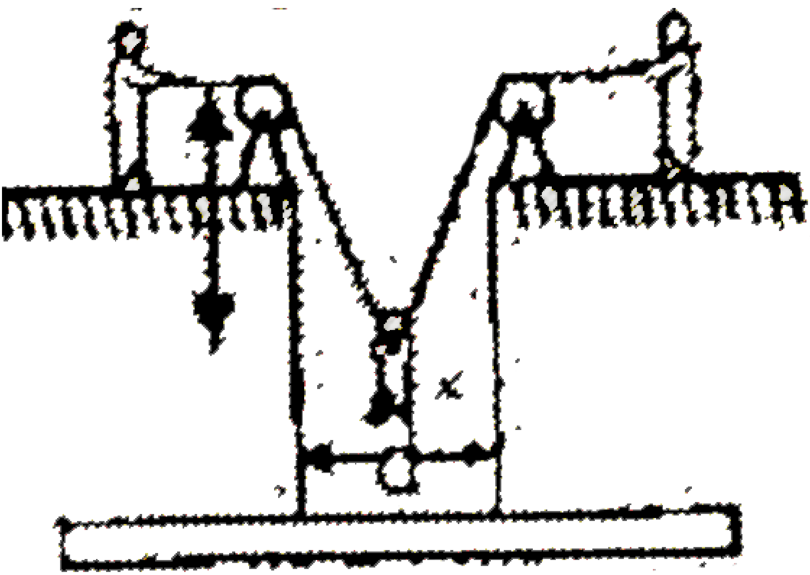
24. A man has fallen into a ditch of width d and two of his friends are slowly pulling him out using a light rope and two fixed pulleys as shown in figure. Indicate the correct statements : (assume both the friends apply equal forces of equal magnitude)



A. The force exerted by both the friends decreases as the man move up

B. The force applied by each friend is $\frac{mg}{4h}\sqrt{d^2+4h^2}$ when the man is at depth of h

C. The force exerted by both the friends increases as the man moves up

D. The force applied by each friend is $\frac{mg}{h}\sqrt{d^2+h^2}$

Answer: b,c

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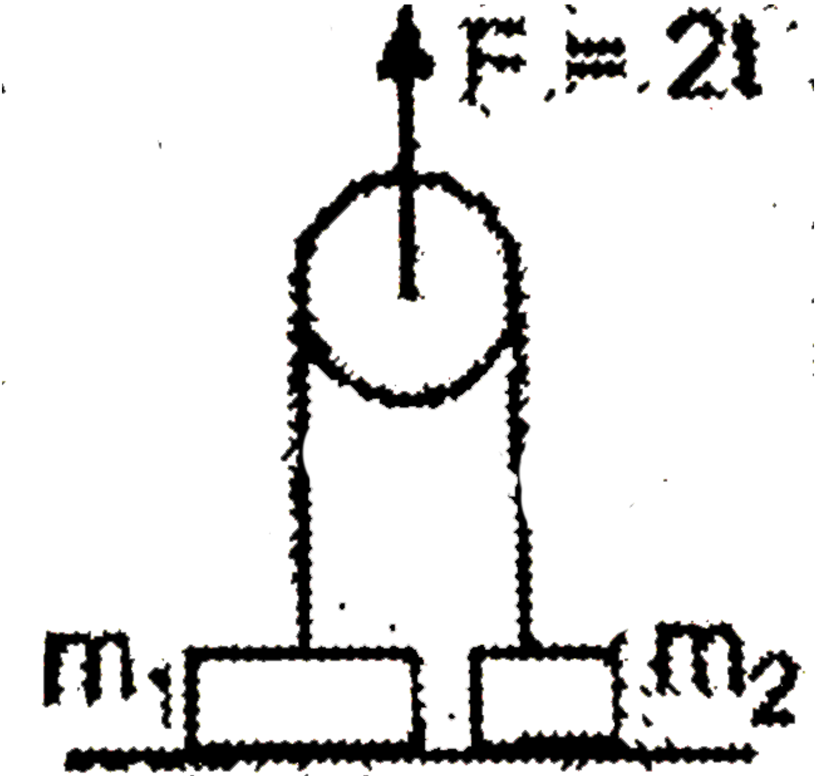
25. In the figure shown $m_1 = 1kg, m_2 = 2kg$, pulley is ideal. At $t = 0$, both masses touches the ground and string is taut. A force $F = 2t$ is applied to pulley (t is in second) then $\left(g = 10 m / s^2\right)$:



A. m_2 is lifted off the ground at $t = 20$ sec

B. acceleration of pulley when m_2 is about to lift off is $5 m / s^2$

C. m_1 is lifted off the ground at $t = 0$ sec

D. both blocks are lifted off simultaneously

Answer: a,b,c

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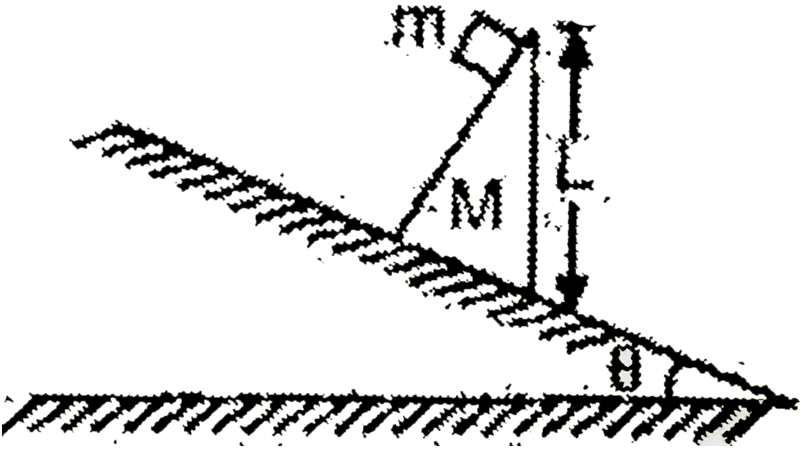
26. In the following figure all surfaces are smooth. The system is released from rest , then :



A. acceleration of wedge is greater then $g \tan \theta$

B. acceleration of m is $g\sqrt{1+2\cos^2\theta}$

C. acceleration of m is g

D. acceleration of wedge is $g \sin \theta$

Answer: c,d

Watch Video Solution

27. The above question 26, the normal force acting, betweent :

A. wedge and incline plane is $Mg \cos \theta$

B. m and wedge is zero

C. m and wedge is zero

D. m and wedge is $mg \sin \theta$

Answer: a,b

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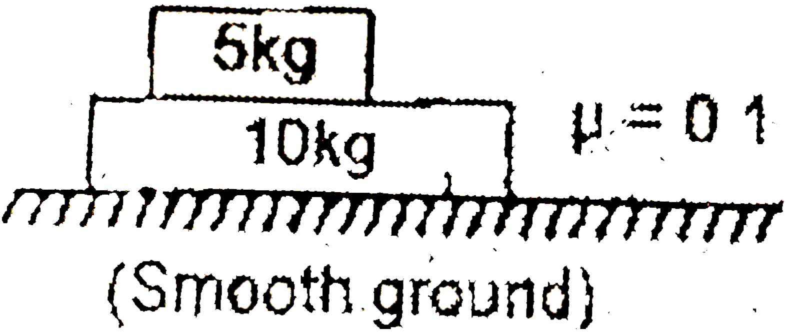
28. In the figure shown $m_1 = 5kg, m_2 = 10kg$ & friction coefficient between $m_1 \& m_2$ is $\mu = 0.1$ and ground is frictionless then :



A. If a horizontal force $F = 20N$ is applied on m_1 then the friction force acting on m_2 is 5 N in the direction of F

B. Maximum amount of horizontal force that can be applied to m_2 such that there is no relative motion between blocks is 15 N

C. If a horizontal force $F = 20N$ is applied on m_2 then friction force acting on m_1 is 20/3 N in the direction of applied force

D. Maximum amount of horizontal force that can be applied to m_1 such that there is no relative motion between blocks is 8 N

Answer: b,d

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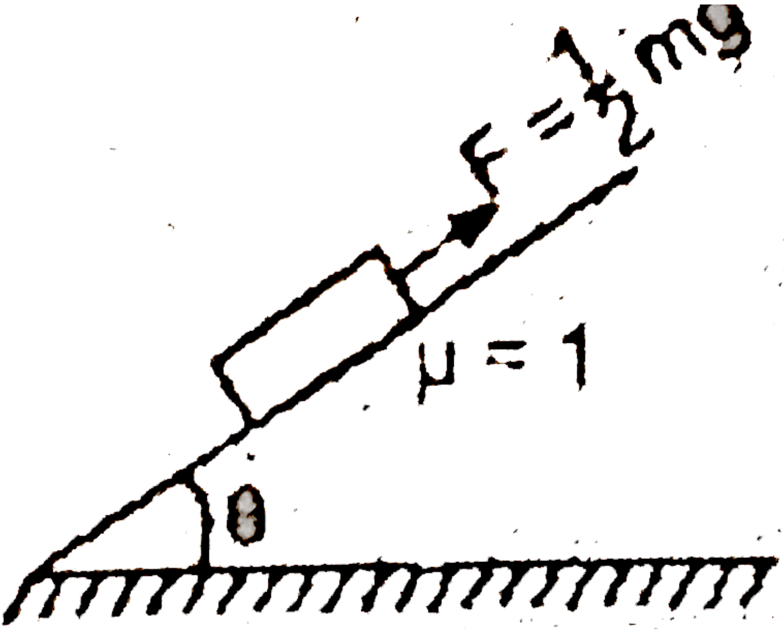
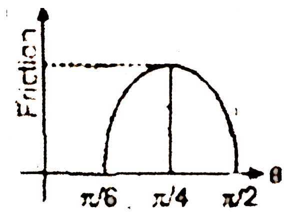
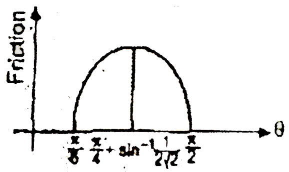
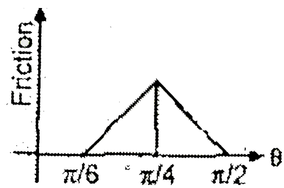
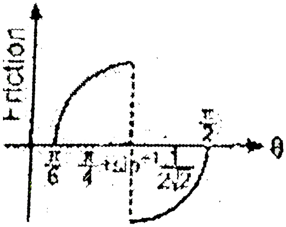
29. A block of mass 0.1 kg is kept on an inclined plane whose angle of inclination can be varied from $\theta = 30^\circ$ to $\theta = 90^\circ$. The coefficient of friction between the block & the inclined plane is $\mu = 1$. A force of constant magnitude $\frac{1}{2}mg$ newton always acts on the block directed up the inclined plane and parallel to it. Then :



A. 

B. 

C. 

D. 

Answer: b

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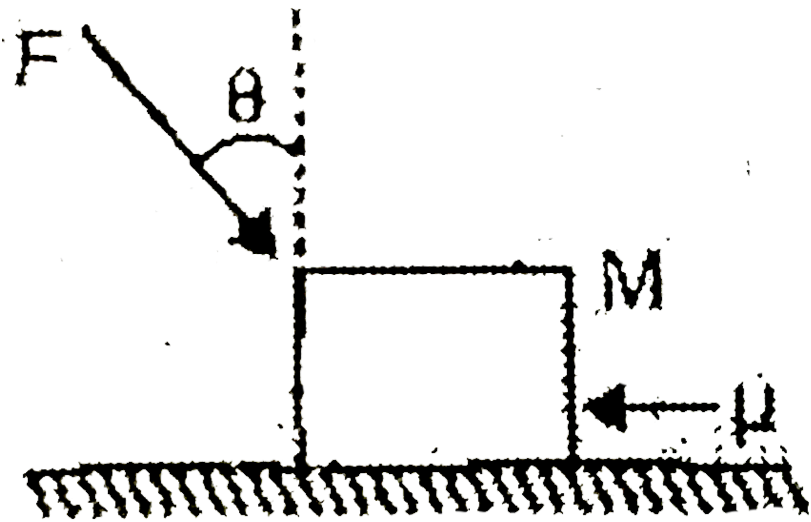
30. In the situatiobn shown in the figure the friction coefficient between M and the horizontal surface is μ. The force F is applied at an angle θ with vertical. The correct statements are :



A. If $\theta > \tan^{-1}$ the block cannot be pushed forward for any value of F

B. If $\theta < \tan^{-1}\mu$ the block cannot be pushed forward for any value of F

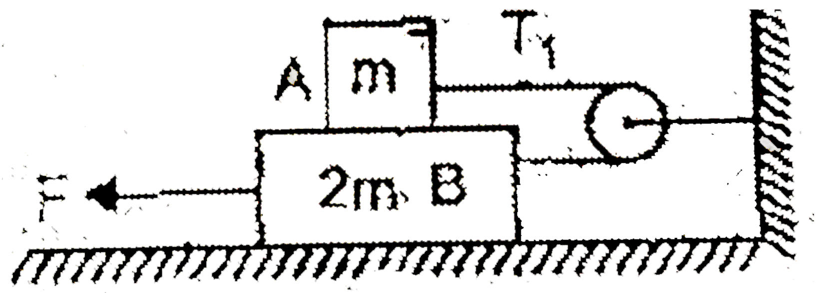
C. As θ decreases the magnitude of force needed to just push the block M forward increases

D. None of these

Answer: a,c

Watch Video Solution

31. In the arrangement shown, coefficient of friciton for all the surfaces is μ and blocks are moving with constant speeds, then :



A. $T_1 = \mu mg$

B. $F = 3\mu mg$

C. $T_1 = 2\mu mg$

D. $F = 5\mu mg$

Answer: a,d

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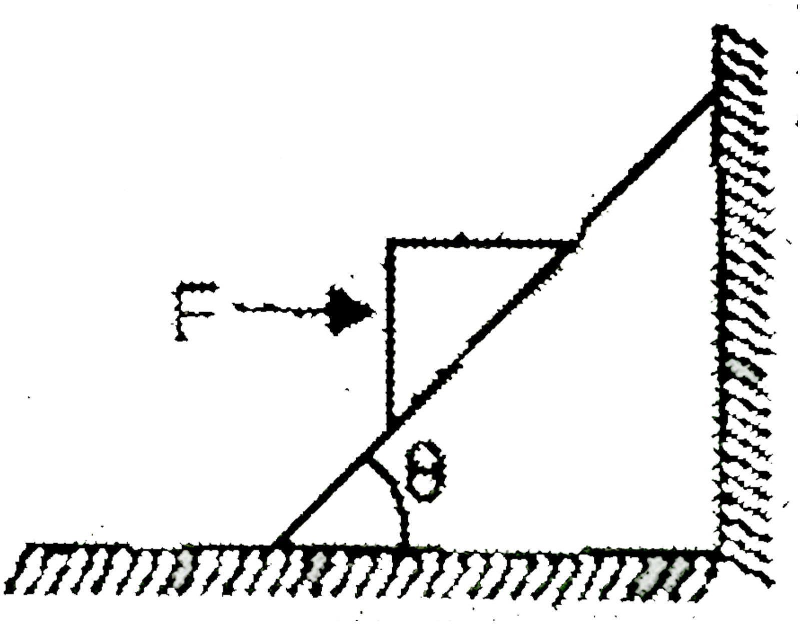
32. A triangular block mass m rests on a fixed rough inclined plane having friction coefficient μ with the block. A horizontal force F is applied to it as shown in figure below, then the correct statement is :



A. Friction force is zero when $F\cos\theta = mg\sin\theta$

B. The value of limiting friction is $\mu(mg\sin\theta + F\cos\theta)$

C. Normal reaction on the block is $F\sin\theta + mg\cos\theta$

D. The value of limiting friction is $\mu(mg\sin\theta - F\cos\theta)$

Answer: a,c

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33. A body is moving down a long inclined plane of inclination 45° with horizontal. The coefficient of friciton between the body and the plane varies as $\mu = x/2$, where x is the distance moved down the plane. Initially $x = 0 \& v = 0$

A. When $x = 2$ the velocity of the body is $\sqrt{g\sqrt{2}}m/s$

B. The velocity of the body increases all the time

C. At an instant when $v \neq 0$ the instantaneous acceleration of the body down the plane is $\dfrac{g(2-x)}{2\sqrt{2}}$

D. The body first accelerates and then, decelerates.

Answer: a,c,d

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34. Suppose $F, F_N \& f$ are the magnitudes of the contact force, normal force and the frictional force exerted by one surface on the other, kept in contact, if none of these is zero :

A. $F > f$

B. $F_N > f$

C. $F > F_N$

D. $(F_N - f) < (F_N + f)$

Answer: a,c,d

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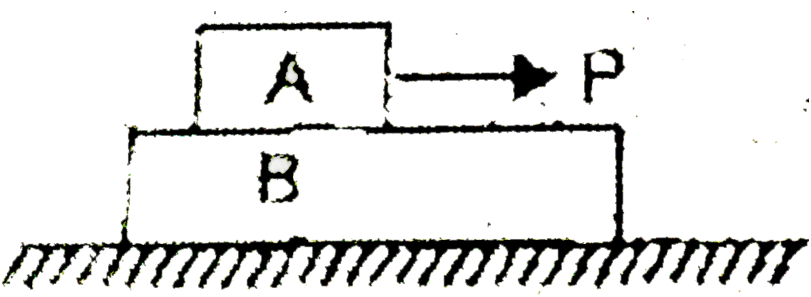
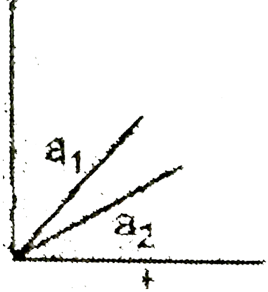
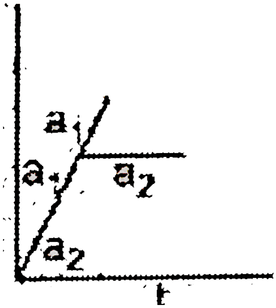
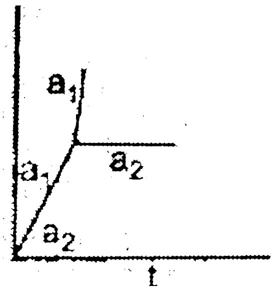
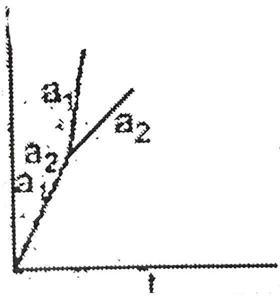
35. Block A is placed on block B. There is friction between the blocks, while the ground is smooth. A horizontal force P, increasing linearly with time, begins to act on A. The accelerations $a_1 \& a_2$ of A and B respectively. Are plotted against time (t). Time correct graph is :



A. 

B. 

C. 

D. 

Answer: c

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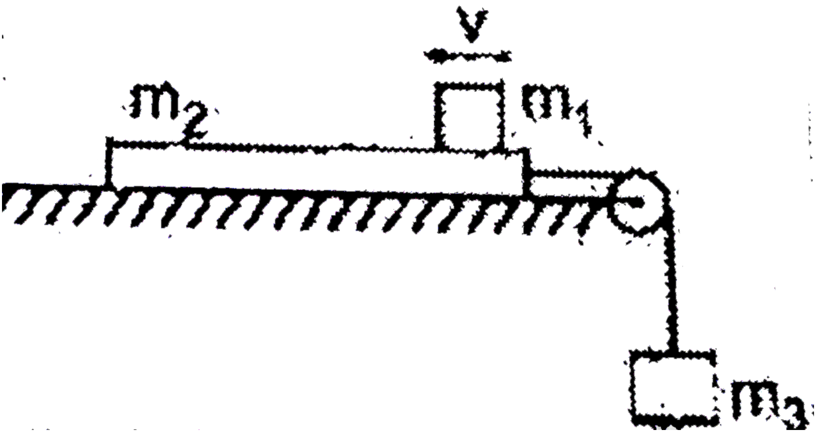
36. In the shown diagram $m_1 = m_2 = 4kg$ and $m_3 = 2kg$. Coefficient of friction between m_1 and m_2 is 0.5. The mass m_1 is given a velocity v and it just stops at the other end of the mass m_1 in 1 sec. Let a_1 and a_2 and a_3 be the acceleration m_1, m_2 and m_3 respectively, then :



A. for $t < 1\,\text{sec}$, $a_1 = 5m/s^2$, $a_2 = a_3 = \frac{1}{3}m/s^2$

B. for $t < 1\,\text{sec}$, $a_1 = 5m/s^2$, $a_2 = a_3 = 0$

C. the value of v is $5m/s$

D. for $t > 1\,\text{sec}$, $a_1 = a_2 = a_3 = 2m/s^2$

Answer: a,c,d

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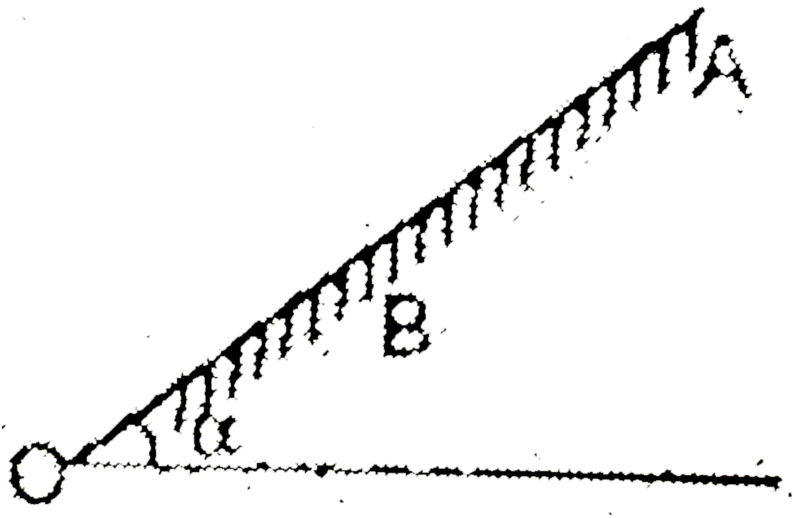
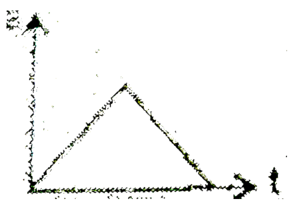
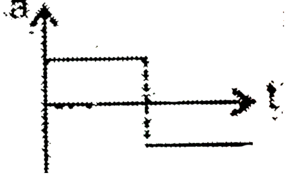
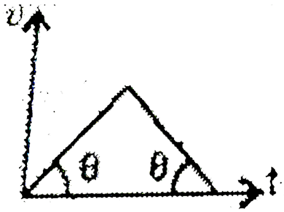
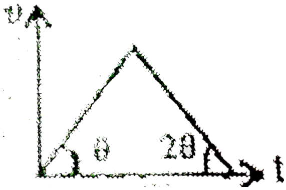
37. O is a point at the bottom of a rough plane inclined at an angle α to horizontal Coefficient of friciton between AB is $\frac{\tan\alpha}{2}$ and between BO is $\frac{3\tan\alpha}{2} B$ is the middle point of AO, A block if released from rest at A, then which of the following graphs are correct :



A. 

B. 

C. 

D. 

Answer: b,c

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38. In above question 37 :

A. velocity of block at O will be maximum

B. velocity of block at O will be zero

C. velocity of block at B will be maximum

D. average velocity of the block is zero

Answer: a,c

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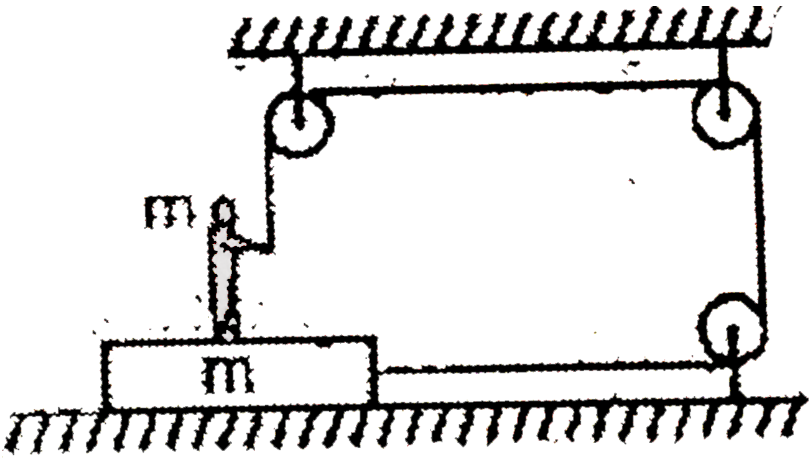
39. The friction coefficient between the plank and floor is μ. The man applies, the maximum possible force on the string and the system remains at rest. Then :



A. friction force between plank and surface is $\frac{2\mu mg}{1+\mu}$

B. frictional force on man is zero

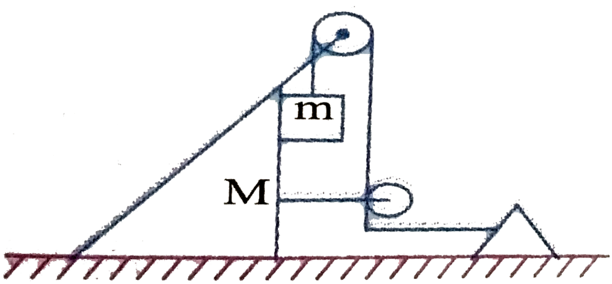
C. tension in the string is $\frac{2\mu mg}{1+\mu}$

D. net force on man is zero

Answer: a,b,c,d

View Text Solution

40. In the figure shown, friction exists between wedge and block and also between wedge and floor. The system is in equilibrium in the shown position.



A. frictional froce between wedge and surface is $\mu(M+m)g$

B. frictional force between wedge and surface is mg

C. frictional force between wedge and block is μmg

D. minimum coefficient of friction required to hold the system in equilibrium is $\frac{m}{M+m}$

Answer: c,d

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41. A block is projected with velocity v_0 up the inclined plane from its bottom at $t=0$. The plane makes an angle θ with the horizontal. If the coefficient of friction between the block and the incline is $\mu=\tan\alpha(\alpha>\theta)$ then fricitonal force applied by the plane on the block for $t>\frac{v_0}{g[\sin\theta+\tan\alpha\cos\theta]}$ will be :

A. $\tan\alpha mg\cos\theta$

B. zero

C. $mg\sin\theta$

D. $\tan\alpha mg\sin\theta$

Answer: c

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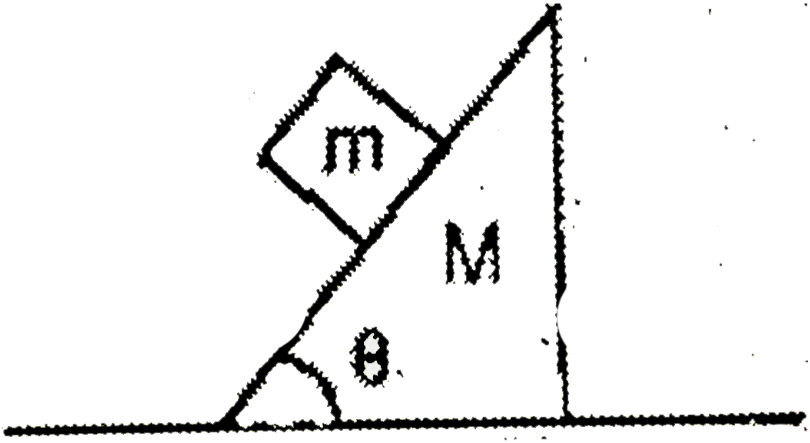
42. In the shown diagram friction exits at each contact surface with coefficient μ and the blocks are at rest. Then :



A. frictional froce between wedge and surface is $mg\sin\theta\cos\theta$

B. normal force by the surface is $(M+m)g$

C. friction force on m kg is $mg\sin\theta$

D. net force of m is zero

Answer: a,c,d

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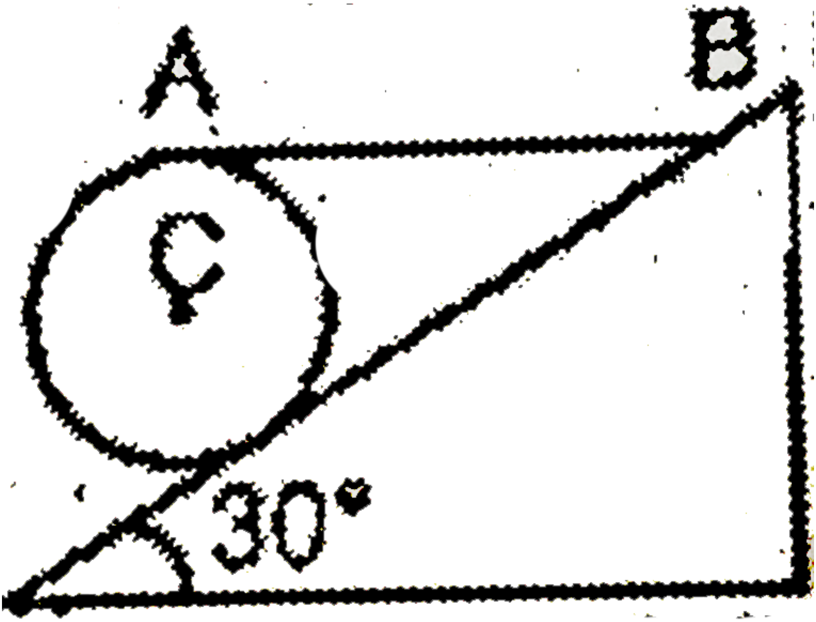
43. A sphere of weight $W = 100N$ is kept stationary on a rough inclined plane by a horizontal string AB as shown in figure. Then :



A. tension in th string is 100 N

B. normal reaction on the sphere by the plane is 100 N

C. tension in the string is $\frac{100}{2+\sqrt{3}}N$

D. fore of friction on the sphere I $\frac{100}{2+\sqrt{3}}N$

Answer: a,c,d

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

A. Its velocity remains constant

B. Its speed remains constant

C. Its acceleration remains constant

D. Its tangential remains constant

Answer: b,d

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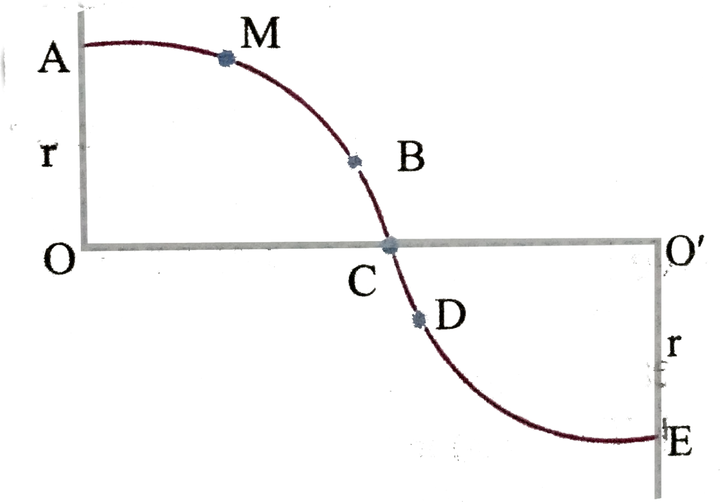
45. $ABCDE$ is a smooth iron track in the vertical plane. The sections ABC and CDE are quarter circles. Points B and D are very close to C. M is a small magnet of mass m. The force of attraction between M and the track is F, which is constant and always normal to the track. M starts from rest at A, then:



A. If M is not to leave the track at C then $F \geq 2mg$

B. At B, the normal reaction of the track is $F - 2mg$

C. At D, the normal reaction of the track is $F + 2mg$

D. The normal reaction of the track is equal to F at some point between A and C

Answer: a,b,c,d

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46. A particle is moving along a circular path. The angular velocity, linear velocity, angular acceleration and centripetal acceleration of the particle at any instant are $\vec{\omega}$, $\vec{v}$, $\vec{a}$, $\vec{a}_c$ respectively. Which of the following relations are correct ?

A. $\vec{\omega} \perp \vec{v}$

B. $\vec{\omega} \perp \vec{a}$

C. $\vec{\omega} \perp \vec{a}_c$

D. $\vec{v} \perp \vec{a}_c$

Answer: a,c,d

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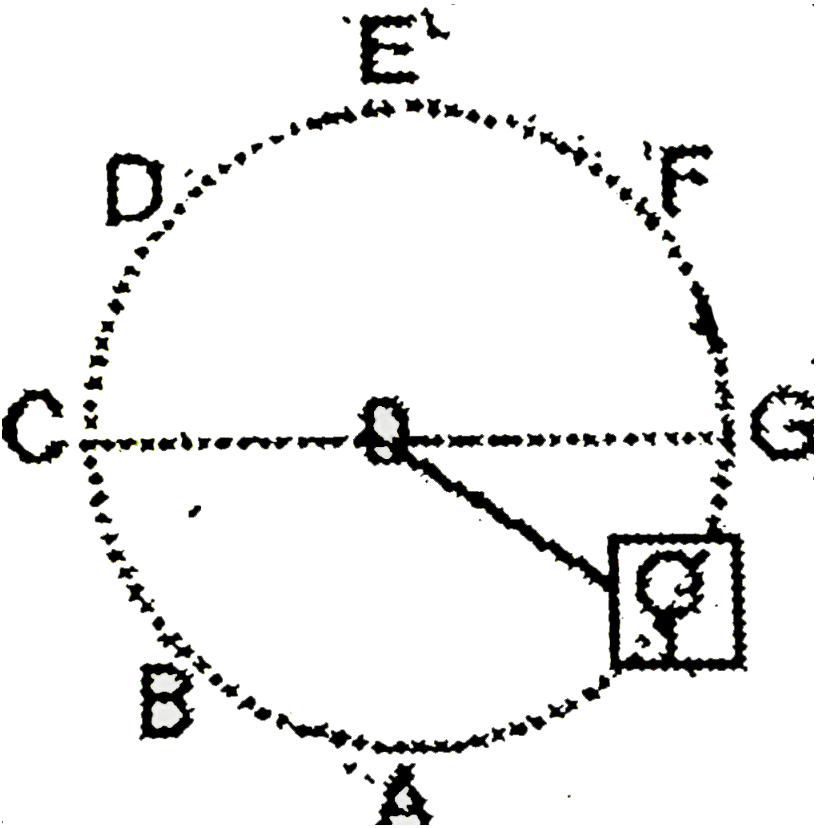
47. Suppose a machine consists of a cage at the end of one arm The arm is hinged at O as shown in figure such that the cage revolves along a vertical circle of radius r at constant linear speed $v = \sqrt{gr}$. The cage is so attached that the man of weight W, standing on a weighing machine inside the cage, remains always vertical. Then :



A. The reading of his weight on the machine is equal to W at all positions

B. The weight reading at A is greater than the weight reading at E by 2W

C. The weight reading at G issame as that at C

D. The ratio of weight reading at E to that at $A = 0$

Answer: b,c,d

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48. A smooth circular rod of radius r is banked for a speed $v = 40km/hr$. A car of mass m attempts to go on the circular road. The friction coefficient between the type and the road is negligible, The correct statements are :

A. The car cannot make a turn without skidding

B. If the car turns at a speed less than 40 km/hr, it slips down

C. If the car turns at the correct speed of 40 km/hr, the force by the road on the car is equal to mv^2 / r

D. If the car turns at the correct speed of 40 km/hr, the force by the road on the car is greater than mg as well as greater than mv^2 / r

Answer: b,d

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49. A body moves on a horizontal circular road of radius r, with a tangential acceleration a_t. The coefficient of friction between the body and the road surface Is μ. It begins to slip when its speed is v.

(i) $v^2 = \mu r g$

(ii) $\mu g = \left(\frac{v^4}{r^{92}}\right) + a_t\Big)$

(iii) $\mu^2 g^2 = \left(\frac{v^4}{r^2 + a_t^2}\right.$

(iv) The force of friction makes an angle $\tan^{-1}\left(v^2 / a_t r\right)$ with the direction of motion at the point of slipping.

A. $v^2 = \mu r g$

B. $\mu g = \frac{v^2}{r} + a_t$

C. $\mu^2 g^2 = \frac{u^4}{r^2} + a_t^2$

D. The force of friction makes an angle $\tan^{-1}(v^2 / a_t r)$ with the direction of motion at the point of slipping.

Answer: c,d

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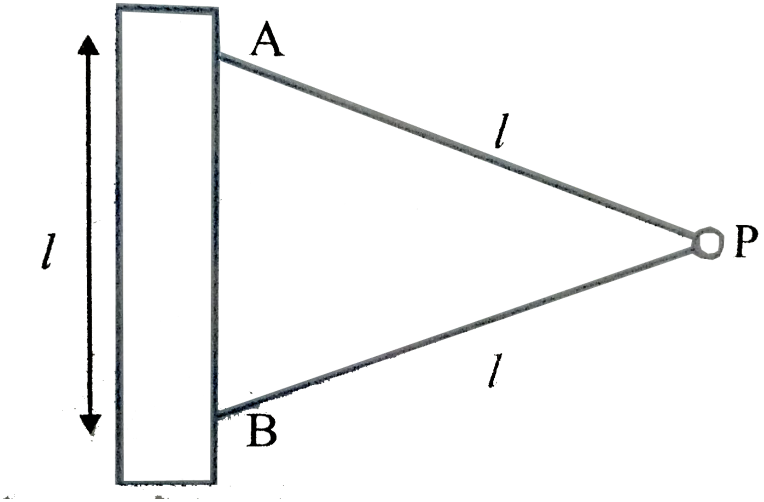
50. A particle P of mass m is attached to a vertical axis by two strings AP and BP of legth l each. The separation $AB = l$, rotates around the axis with an angular velocity ω. The tension in the two string are T_1 and

T_2. Then



A. $T_1 = T_2$

B. $T_1 + T_2 = m\omega^2 L$

C. $T_1 - T_2 = 2mg$

D. $T_1 - T_2 = 2mg$

Answer: b,c,d

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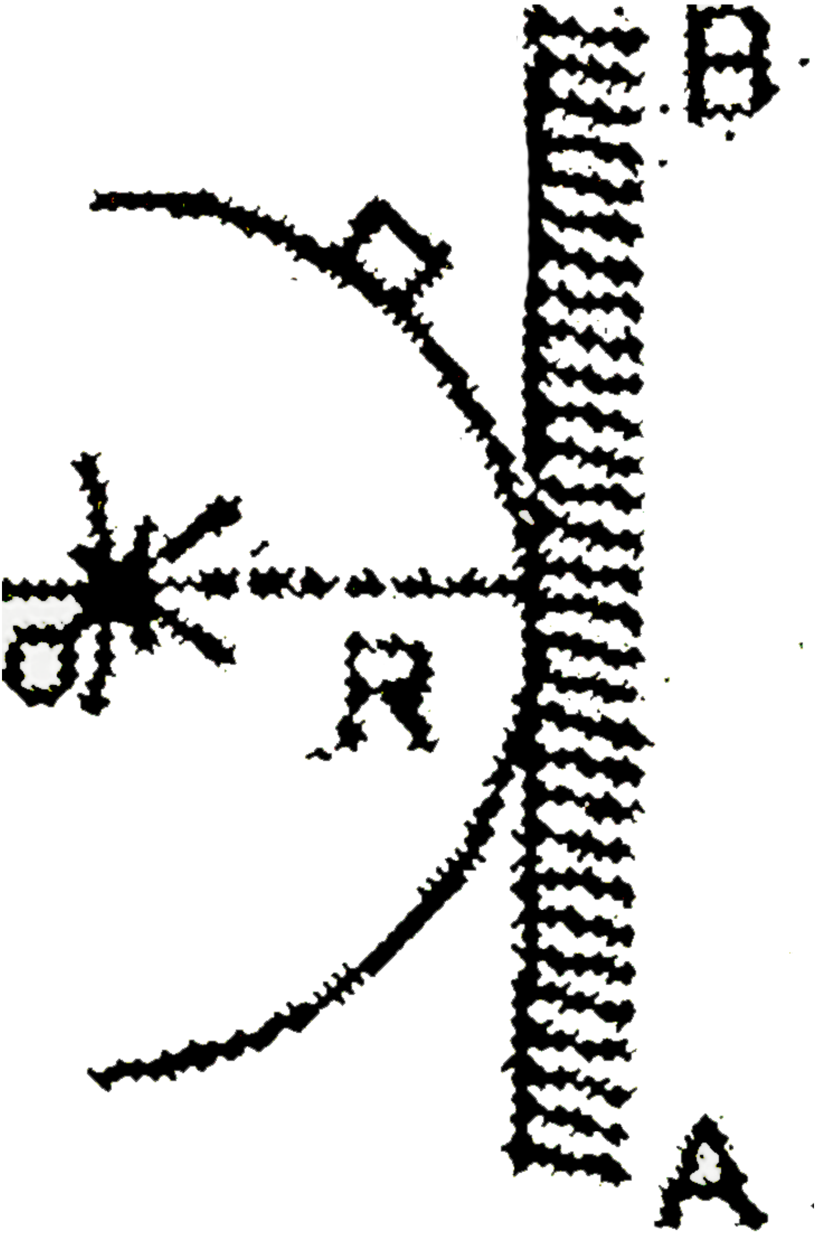
51. As shown below AB represents an infinite wall tangential to a horizontal semi-circular track. O is a point source of light on the ground at the centre of the circle. A block moves along the circular track with a speed v starting from the point where the wall touches the circle. If the velocity and acceleration of shadow along the length of the wall is respectively V and a, then :



A. $V = v\cos\left(\frac{vt}{R}\right)$

B. $V = v\sec^2\left(\frac{vt}{R}\right)$

C. $a = \left(\frac{v^2}{R}\right)\sec^2\left(\frac{vt}{R}\right)\tan\left(\frac{vt}{R}\right)$

D. $a = \left(\frac{2v^2}{R}\right)\sec^2\left(\frac{vt}{R}\right)\tan\left(\frac{vt}{R}\right)$

Answer: b,d

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52. A curved section of a road is banked for a speed v. If there is no friction between the road and the tyres then.

A. a car moving with speed v will not slip on road

B. a car is more likely to slip on the road at speed higher v, then at speeds lower than v

C. a car is move likely to slip on the road at speed lower than v, than at speeds higher than v

D. a car cannot remain stationary on road and will start slipping

Answer: a,d

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53. A tube of length 'L' is filled completely with an in compressiblem liquid of mass 'M' and closed at both ends. The tube is then rotated in a horizontal plane about one of it's ends with a uniform angular velocity $'\omega'$. Then which of following statements are true :

A. The force exerted by liquid at the other end is $\frac{1}{2}M\omega^2 L$

B. Ratio of force at middle and point of the tube will be $4:1$

C. The force between liquid layers linearly with the distance along the lenghth of tube

D. Force is constant

Answer: a,b

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54. A particle of mass m describe circular path of radius 'r' and its radial or normal or centripetal acceleration depends on time 't' as $a_R = Kt^2$. K is $+ve$ constant Then :

A. at any time 't' force acting on particle is $m\sqrt{kr + k^2t^4}$

B. Power developd at any time t is mkrt

C. Power developed at any time t is $mk^{3/2}/r^{3/2}t$

D. Tangential acceleration is also varying

Answer: a,b

Watch Video Solution

55. A particle of mass 'm' describes circular path of radius 'r' such that its kinetic energy is given by $K = \text{as}^2$. 's' is the distance travelled, 'a' is constant :

A. Power developed at distance s is proportional to s^2

B. Tangential acceleration is proportional to s

C. Radial acceleration is proportional to s^3

D. None of these

Answer: a,b

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56. Three particles describes circular path of radii r_1, r_2 and r_3 with constant speed such that all the particles take same time to complete the revolution. If $\omega_1, \omega_2, \omega_3$ be the angular velocity v_1, v_2, v_3 be linear velocities and a_1, a_2, a_3 be linear acceleration than :

A. $\omega_1 : \omega_2 : \omega_3 = 1 : 1 : 1$

B. $v_1 : v_2 : v_3 = r_1 : r_2 : r_3$

C. $a_1 : a_2 : a_3 = 1 : 1 : 1$

D. $a_1 : a_2 : a_3 = r_1 : r_2 : r_3$

Answer: a,b,d

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57. A particle of mass m describes a circular path of radius 'r' such that speed $V = \alpha\sqrt{S}$ (S is distance traveled). Then power is proportional to :

A. S

B. $\sqrt{S}$

C. $S^{3/2}$

D. None of these

Answer: b

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58. A ring of radius 'r' and mass per unit length 'm' rotates with an angular velocity $'\omega'$ in free space then :

A. Tension in ring is zero

B. Tension will vary at all points

C. Tension is constant throughout ring

D. Tension in string is $m\omega^2 r^2$

Answer: c,d

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59. A body moves on a horizontal circular road of radius of r, with a tangential acceleration a_T. Coefficient of friction between the body and road surface is μ. It begin to slip when it's speed is v, then :

A. $v^2 = \mu r g$

B. $ug = \dfrac{v^2}{r} + a_T$

C. $\mu^2 g^2 = \dfrac{v^4}{r^2} + a_T^2$

D. The force of friction makes an angle $\tan^{-1}\left(\dfrac{v^2}{a_T \times r}\right)$ with direction of motion at point of slipping.

Answer: b,c

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60. A simple pendulum has a bob of mass m and swings with an angular amplitude ϕ. The tension in thread is T. At a certain time the string makes an angle θ with the vertical $(\theta \leq \phi)$

A. $T = mg\cos\theta$ for all value of θ

B. $T = mg\cos\theta$ for only $\theta = \phi$

C. $T = mg, \text{ for} \theta = \cos^{-1}\left[\frac{1}{3}(2\cos\phi + 1)\right]$

D. T will be larger for smaller values of θ

Answer: b,c,d

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61. A particle of mass m moves along a circle of 'R'. The modulus of the average vector of force acting on the particle over the distance equal to a quarter of the circle is :

A. zero if the particle moves with uniform speed v

B. $\frac{\sqrt{2}mv^2}{\pi R}$ if the particle moves with uniform speed v

C. $\frac{\sqrt{2}mv^2}{\pi R}$ if the particle moves with uniform speed v

D. ma if particle moves with constant tangential acceleration 'a', the initial velocity being equal to zero

Answer: c

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62. A particle 'A' moves along a circle of radius R = 50 cm, so that its radius vetor 'r' relative to the point O rotates with the constant angular velocity $\omega = 0.4 rad / s$. Then :

A. linear velocity of particle is $0.2m/s$

B. linear velocity of particle is $0.4m/s$

C. magnitude of net acceleration is $0.08m/s^2$

D. acceleration of particle is zero

Answer: a,c

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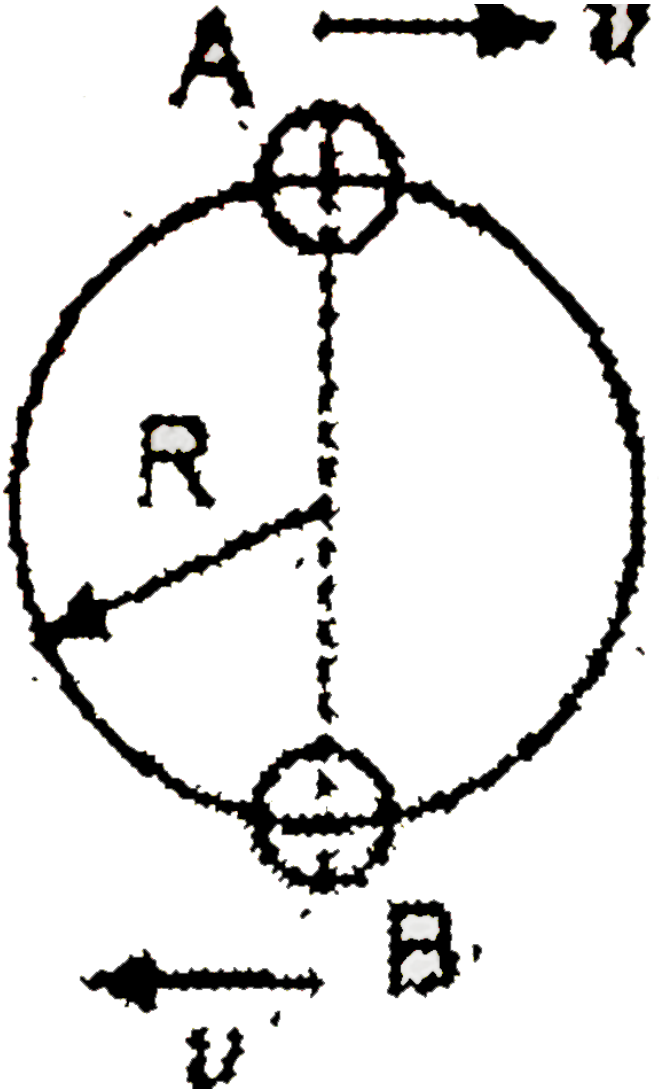
63. Two bodies are moving with constant speed v clockwise and are initially diagonally opposite. The particle B now acheives a tangential acceleration of a m/s^2. Then :



A. then collide after time $\sqrt{\frac{\pi R}{a}}$

B. they collide after time $\sqrt{\frac{2\pi R}{a}}$

C. relative velocity just before collision is $\sqrt{\pi a R}$

D. relative velocity just before collision is $\sqrt{\pi a R}$

Answer: b,d

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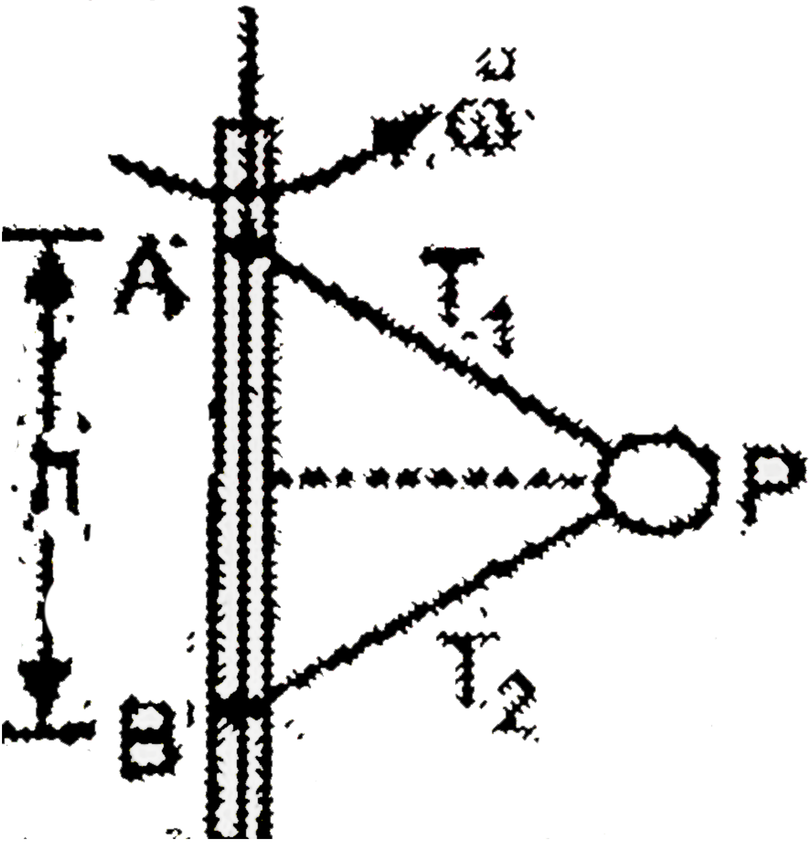
64. A particle P is attached by means of two equal strings to two points A and B is same vertical line and describes horizontal circle with uniform angular speed $2\sqrt{\frac{2g}{h}}$ where AB = h



A. $T_1 > T_2$

B. $T_1 : T_2 = 5 : 3$

C. $T_1 : T_2 = \sqrt{5} : \sqrt{3}$

D. $T_1 = T_2$

Answer: a,b

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65. A particle is acted upon by constant magnitude force perpendicular to ot which is always perpendicular to velocity of particle. The motion is taking place in a plane it follows that :

A. Velocity is constant

B. acceleration is constant

C. kinetic energy is constant

D. it moves in circular path

Answer: c,d

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66. A particle of mass m moves in a conservative force field along x axis where the potential energy U varies with position coordinate x as $U = U_0(1 - \cos ax), U_0$ and a being positive constants. Which of the following statement is true regarding its motion. Its total energy is U_0 and starts from $x = 0$

A. the acceleration is constant

B. it's speed is maximum at the initial position

C. It's maximum x coordinate is $\frac{\pi}{2a}$

D. It's maximum kinetic energy is U_0

Answer: b,c,d

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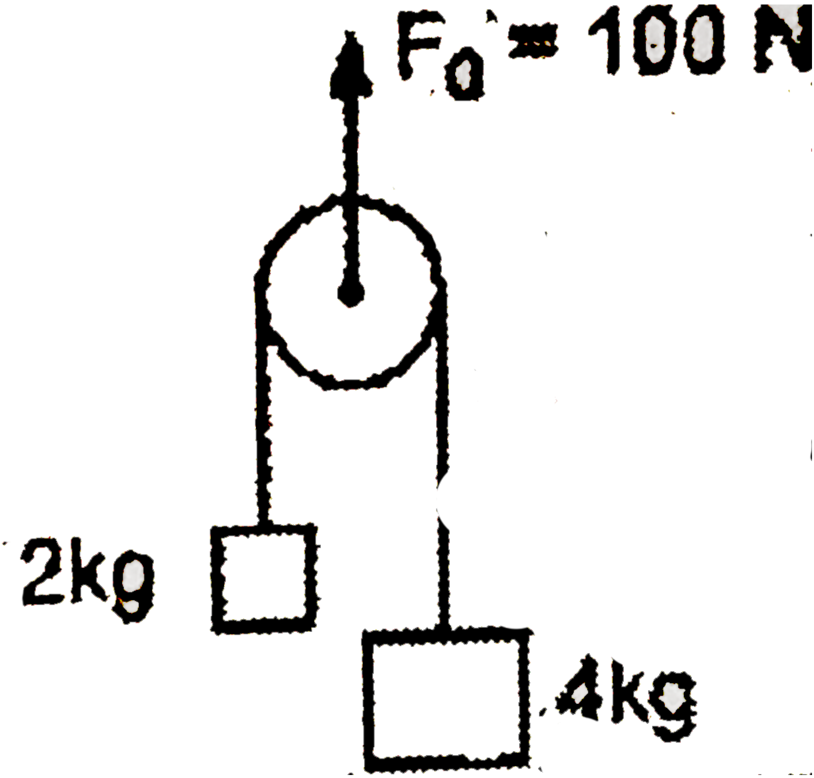
67. Two blocks of masses $m_i = 2kg$ and $m_2 = 4kg$ hang, over a massless pulley as shown in the figure. A force $F_0 = 100N$ acting at the axis of the pulley accelerates the system upwards Then :



A. acceleration of 2kg mass is $15m/s^2$

B. acceleration of 4kg mass is $2.5m/s^2$

C. acceleration of both masses is same

D. acceleration of both the masses is upward

Answer: a,b,d

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68. Which of the following is/are incorrect :

A. If net normal force on a surface is zero, friction will be zero

B. Value is static friction is given by $\mu_s N$

C. Static friction opposes relative motion between two surfaces is contact

D. kinetic friction reduces velocity of an object.

Answer: a,b,c,d

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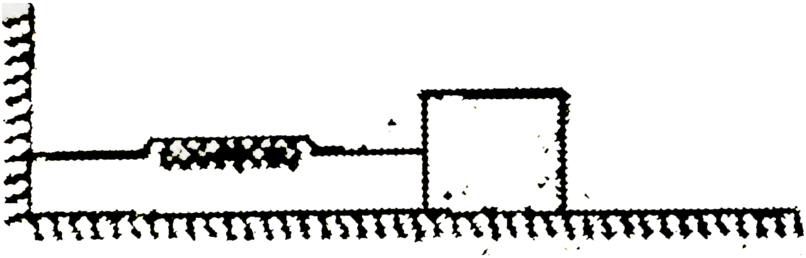
69. A spring block system is placed on a rough horizontal floor. The block is pulled towards right to gives spring some elongation and released, Then :



A. the block may stop before the spring attains its natural length

B. the block must stop with spring having some compression

C. the block may stop with spring having sme compression

D. it is not possible that the block stops at mean position

Answer: a,c

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70. In the above situation the block will have maximum velocity when :

A. the spring force becomes zero

B. the frictional froce becomes zero

C. the net force becomes zero

D. the acceleration of block becomes zero

Answer: c,d

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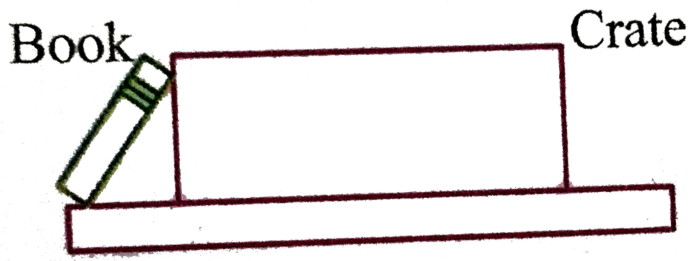
71. A book leans against a crate on a table. Neither is moving Which of the following statements concerning this situation is/are incorrect.



A. The force of the book on the crete is less than that of crete on the book

B. Althrough there is no friction acting on the crate, there must be friction acting on the book or else it will fall

C. The net force acting on the book is zero

D. The direction of the frictional force ating on the book is in the same direction as the frictional acting on the crate.

Answer: a,b,d

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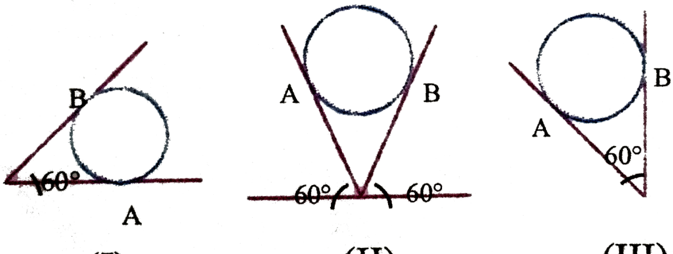
72. An iron sphere weighing $10N$ rests in a V shaped smooth trough whose sides form an angle of 60° as shown in the Then the reaction forces are



(I) (II) (III)

A. $R_A = 10N$ and $R_B = 0$ in case (i)

B. $R_A = 10N$ and $R_3 = 10N$ in case (ii)

C. $R_A = \frac{20}{\sqrt{3}}N$ and $R_B \cong \frac{10}{\sqrt{3}}N$ in case (iii)

D. $R_A = 10N$ and $R_B = 10N$ in all the three cases

Answer: a,b,c

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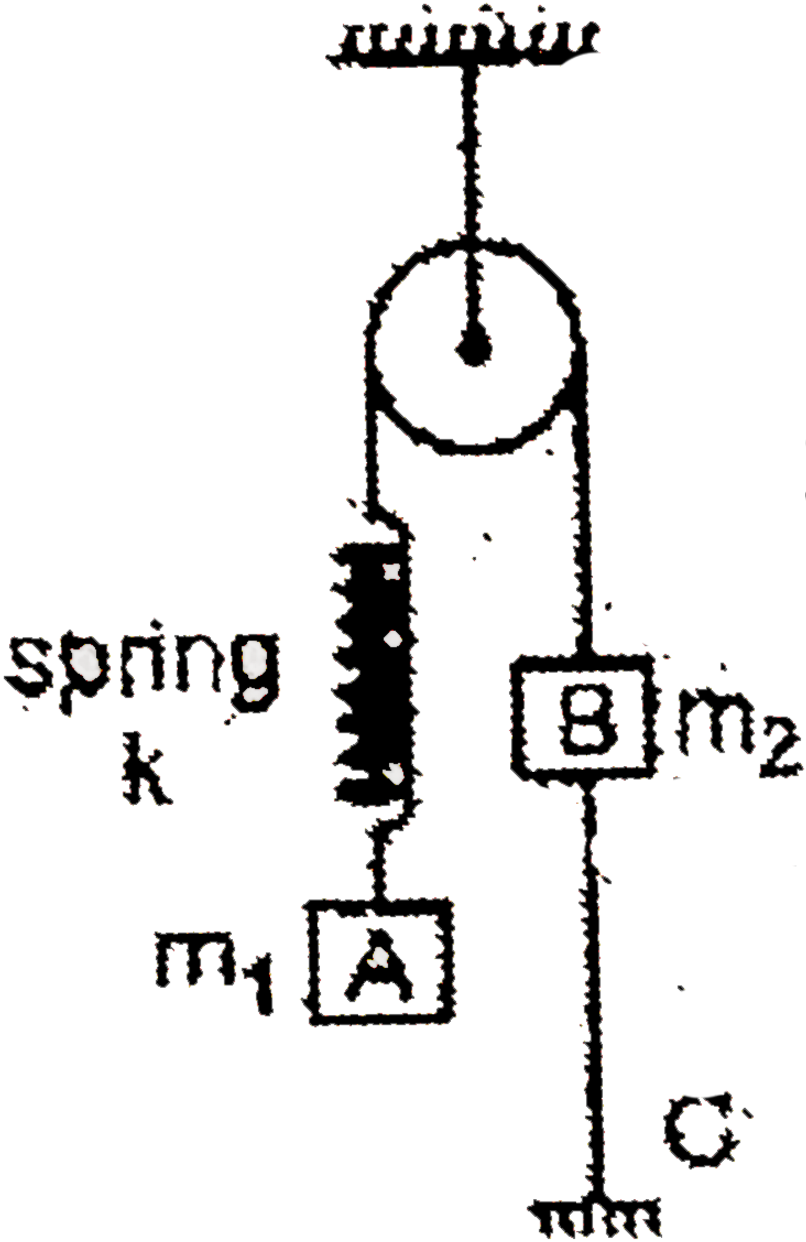
73. In the system shown in the figure $m_1 > m_2$. System is held at rest by thread BC. Just after the thread BC is burnt :



A. initial acceleration of m_2 will be upwards

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

C. initial acceleration of m_1 will be equal to zero

D. magnitude of initial acceleration of two blocks will be non-zero and unequal.

Answer: a,c

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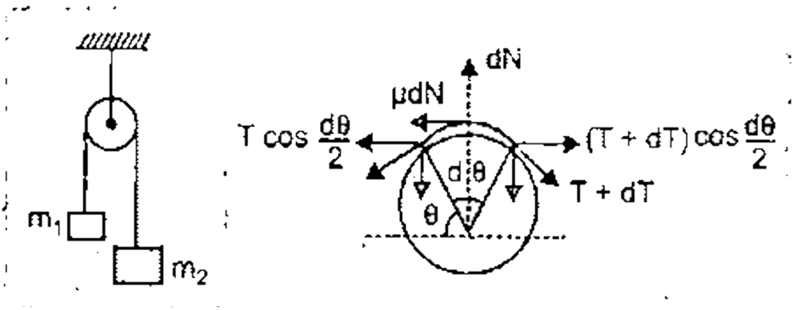
Level-3

1. Effect of friction between pulley and thread :

In ideal cases i.e., when pulley and strings are massless and no friction exists at any contact surface, then tension in the string is constant throughout its length. But consider a, massless pulley and massless string but friction exists between pulley and string With coefficient μ. Then tension at the two ends of the pulley will be different. As shown in figure, consider an element of string :

$$dN = (T + dT)\sin\frac{d\theta}{2} + T\sin\frac{d\theta}{2}$$



$$(T + dT)\cos\frac{d\theta}{2} - T\cos\frac{d\theta}{2} - \mu dN = dra = 0 \text{ (massless strings)}$$

$$dT\cos\frac{d\theta}{2} = \mu dN$$

$$dT\cos\frac{d\theta}{2} = \mu\left[(T + dt)\sin\frac{d\theta}{2} + T\sin\frac{d\theta}{2}\right]$$

$$dt.\cos\frac{d\theta}{2} = \mu\left[T\sin\frac{d\theta}{2} + dT.\sin\frac{d\theta}{2} + T\sin\frac{d\theta}{2}\right]$$

$$dT = \mu\left[T.\frac{d\theta}{2} + 0 + T\frac{d\theta}{2}\right] = \mu T\cos\theta$$

int_(T_(1))^(T_(2)) (d T)/T=int _(0)^(pi)mu d theta rArr ln(T_(2)/T_(1))=mu pi

rArrT_(2)/T_(1)=e^(mu pi)

$Supposecofficientofictionbetweenthestr \in g$ and $p \leq\_$ yismu =1/pi`

What should be the ratio of heavier mass to lighter mass for no motion ?

A. e

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

C. e^{L}

D. e^R

Answer: a

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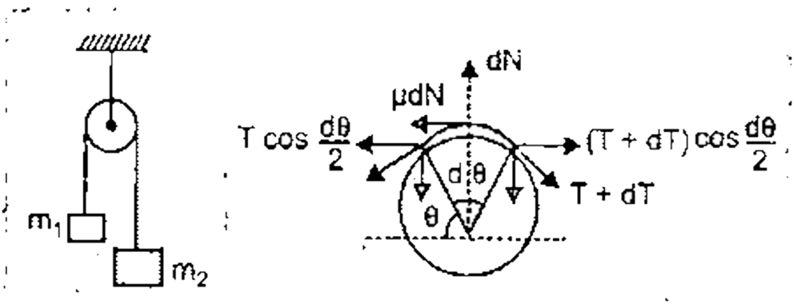
2. Effect of friction between pulley and thread :

In ideal cases i.e., when pulley and strings are massless and no friction exists at any contact surface, then tension in the string is constant throughout its length. But consider a, massless pulley and massless string but friction exists between pulley and string With coefficient μ. Then tension at the two ends of the pulley will be different. As shown in figure, consider an element of string :

$$dN = (T + dT)\sin\frac{d\theta}{2} + T\sin\frac{d\theta}{2}$$



$$(T + dT)\cos\frac{d\theta}{2} - T\cos\frac{d\theta}{2} - \mu dN = dra = 0 \text{ (massless strings)}$$

$dT\cos\frac{d\theta}{2}=\mu dN$

$dT\cos\frac{d\theta}{2}=\mu\left[(T+dt)\sin\frac{d\theta}{2}+T\sin\frac{d\theta}{2}\right]$

$dt.\cos\frac{d\theta}{2}=\mu\left[T\sin\frac{d\theta}{2}+dT.\sin\frac{d\theta}{2}+T\sin\frac{d\theta}{2}\right]$

$dT=\mu\left[T.\frac{d\theta}{2}+0+T\frac{d\theta}{2}\right]=\mu T\cos\theta$

int_(T_(1))^(T_(2)) (d T)/T=int _(0)^(pi)mu d theta rArr ln(T_(2)/T_(1))=mu pi

rArrT_(2)/T_(1)=e^(mu pi)

$Supposecofficientofictionbetweenthestr \in g$ and $p \leq$ yismu =1/pi

Ifm_(2)=2em` then acceleration of each mass is :

A. g

B. $g/3$

C. $eg/3$

D. zero

Answer: b

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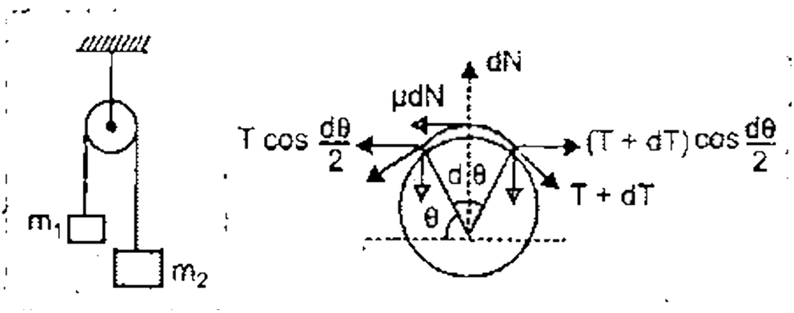
3. Effect of friction between pulley and thread :

In ideal cases i.e., when pulley and strings are massless and no friction exists at any contact surface, then tension in the string is constant throughout its length. But consider a, massless pulley and massless string but friction exists between pulley and string With coefficient μ. Then tension at the two ends of the pulley will be different. As shown in figure, consider an element of string :

$$dN=(T+dT)\sin\frac{d\theta}{2}+T\sin\frac{d\theta}{2}$$



$$(T+dT)\cos\frac{d\theta}{2}-T\cos\frac{d\theta}{2}-\mu dN=dra=0 \text{ (massless strings)}$$

$$dT\cos\frac{d\theta}{2}=\mu dN$$

$$dT\cos\frac{d\theta}{2}=\mu\left[(T+dt)\sin\frac{d\theta}{2}+T\sin\frac{d\theta}{2}\right]$$

$$dt.\cos\frac{d\theta}{2}=\mu\left[T\sin\frac{d\theta}{2}+dT.\sin\frac{d\theta}{2}+T\sin\frac{d\theta}{2}\right]$$

$$dT=\mu\left[T.\frac{d\theta}{2}+0+T\frac{d\theta}{2}\right]=\mu T\cos\theta$$

int_(T_(1))^(T_(2)) (d T)/T=int _(0)^(pi)mu d theta rArr ln(T_(2)/T_(1))=mu pi rArrT_(2)/T_(1)=e^(mu pi)

$Supposecofficientofictionbetweenthestr \in g$ and $p \leq_ yis$mu =1/pi`

The tension on side ofheavier\nass will be:

A. $m_1 g$

B. $m_2 g$

C. $\frac{2m_2 g}{3}$

D. $\frac{2m_1 g}{3}$

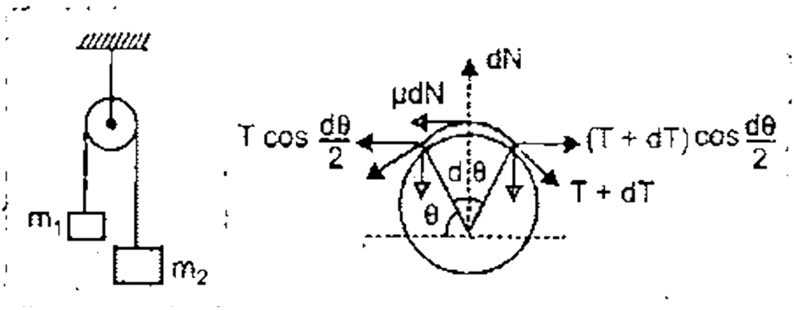
Answer: c

View Text Solution

4. Effect of friction between pulley and thread :

In ideal cases i.e., when pulley and strings are massless and no friction exists at any contact surface, then tension in the string is constant throughout its length. But consider a, massless pulley and massless string but friction exists between pulley and string With coefficient μ. Then tension at the two ends of the pulley will be different. As shown in figure, consider an element of string :

$$dN = (T + dT)\sin\frac{d\theta}{2} + T\sin\frac{d\theta}{2}$$



$$(T + dT)\cos\frac{d\theta}{2} - T\cos\frac{d\theta}{2} - \mu dN = dra = 0 \text{ (massless strings)}$$

$$dT\cos\frac{d\theta}{2} = \mu dN$$

$$dT\cos\frac{d\theta}{2} = \mu\left[(T + dt)\sin\frac{d\theta}{2} + T\sin\frac{d\theta}{2}\right]$$

$$dt.\cos\frac{d\theta}{2} = \mu\left[T\sin\frac{d\theta}{2} + dT.\sin\frac{d\theta}{2} + T\sin\frac{d\theta}{2}\right]$$

$$dT = \mu\left[T.\frac{d\theta}{2} + 0 + T\frac{d\theta}{2}\right] = \mu T\cos\theta$$

int_(T_(1))^(T_(2)) (d T)/T=int _(0)^(pi)mu d theta rArr ln(T_(2)/T_(1))=mu pi

rArrT_(2)/T_(1)=e^(mu pi)

$Supposecofficientofictionbetweenthestr \in g$ and $p \leq\_$ yismu =1/pi`

The tension on side of lighter mass will be:

A. $m_1 g$

B. $m_2 g$

C. $\frac{2m_2 g}{3}$

D. $\frac{4m_1g}{3}$

Answer: d

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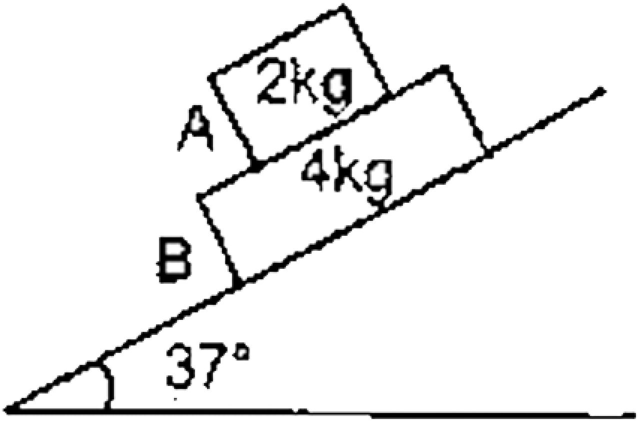
5. consider the situation shown in figure in which a block 'A' of mass 2 kg is placed over a biock.'B' of mass 4 kg. The combination of the blocks are placed on a inclined plane of inclination 37° with horizontal. The coefficient of friction between block B and inclined plane is μ_2 and in between the two, blocks is μ_1. The system is released from rest.

$\left(\text{Take } \ g = 10m/\sec^2\right)$



If $\mu_1 = 0.8, \mu_2 = 0.8$ then :

A. both blocks will move together

B. only block A will move and block B remains at rest

C. only block B will move and block A remains at rest.

D. none of the blocks will move

Answer: d

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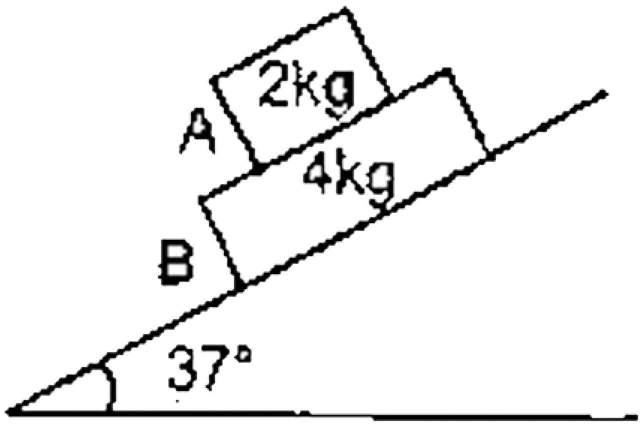
6. consider the situation shown in figure in which a block 'A' of mass 2 kg is placed over a biock.'B' of mass 4 kg. The combination of the blocks are placed on a inclined plane of inclination 37° with horizontal. The coefficient of friction between block B and inclined plane is μ_2 and in between the two, blocks is μ_1. The system is released from rest.

$\left(\text{Take } \; g = 10 m / \sec^2\right)$



In the previous question the frictional force between block B and plane is :

A. 36 N

B. 24 N

C. 12 N

D. 48 N

Answer: a

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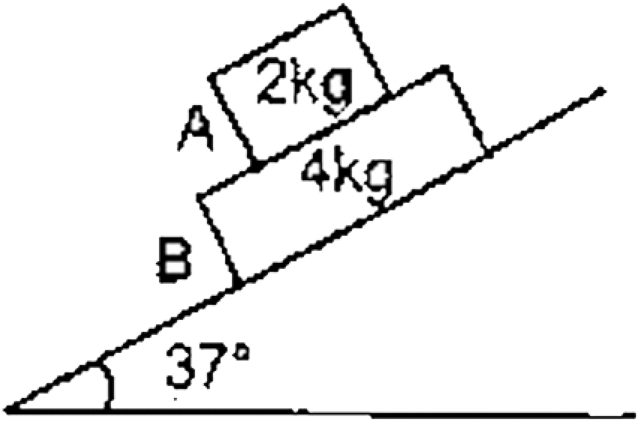
7. consider the situation shown in figure in which a block 'A' of mass 2 kg is placed over a biock.'B' of mass 4 kg. The combination of the blocks are placed on a inclined plane of inclination 37° with horizontal. The coefficient of friction between block B and inclined plane is μ_2 and in between the two, blocks is μ_1. The system is released from rest.

$\left(\text{Take } \; g = 10m/\sec^2\right)$



If $\mu_1 = 0.5, \mu_2 = 0.5$ then :

A. Both block will move but with different accelerations

B. Both block will move together

C. Only block A will move

D. Only block B will move

Answer: b

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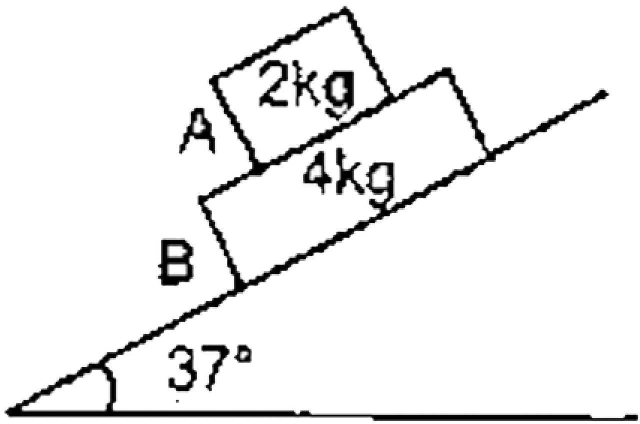
8. consider the situation shown in figure in which a block 'A' of mass 2 kg is placed over a biock.'B' of mass 4 kg. The combination of the blocks are placed on a inclined plane of inclination 37° with horizontal. The coefficient of friction between block B and inclined plane is μ_2 and in between the two, blocks is μ_1. The system is released from rest.

$\left(\text{Take } g = 10 m / \sec^2\right)$



The frictional force acting between the two blocks in the previous question is :

A. 8 N

B. 6 N

C. 4 N

D. 0

Answer: a

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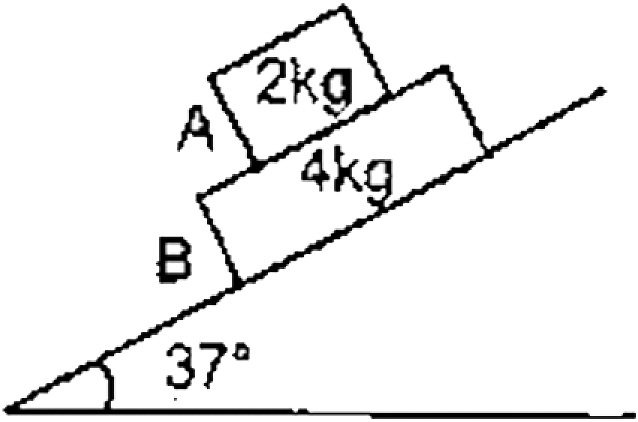
9. consider the situation shown in figure in which a block 'A' of mass 2 kg is placed over a biock.'B' of mass 4 kg. The combination of the blocks are placed on a inclined plane of inclination 37° with horizontal. The coefficient of friction between block B and inclined plane is μ_2 and in between the two, blocks is μ_1. The system is released from rest.

$\left(\text{Take } \ g = 10m / \sec^2\right)$



If $\mu_1 = 0.4, \mu_2 = 0.5$ then:

A. Both block will move but block A will slide over the blockB

B. Both block will move together

C. None of them will move

D. Only block A will move

Answer: a

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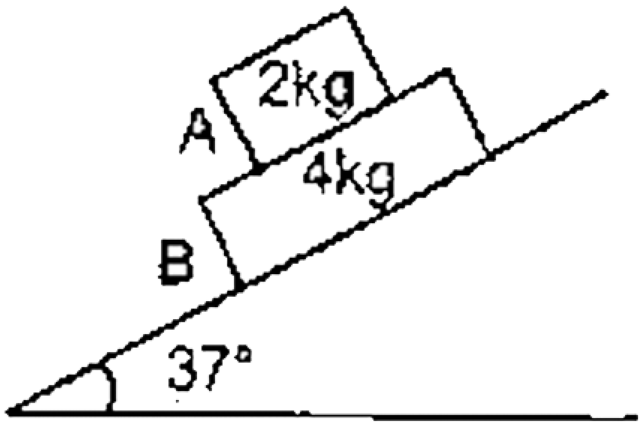
10. consider the situation shown in figure in which a block 'A' of mass 2 kg is placed over a biock.'B' of mass 4 kg. The combination of the blocks are placed on a inclined plane of inclination 37° with horizontal. The coefficient of friction between block B and inclined plane is μ_2 and in between the two, blocks is μ_1. The system is released from rest.

$\left(\text{Take } g = 10m/\sec^2\right)$



The frictional force acting between the blocks in the previous case will be:

A. 8 N

B. 6.4 N

C. 4 N

D. zero

Answer: b

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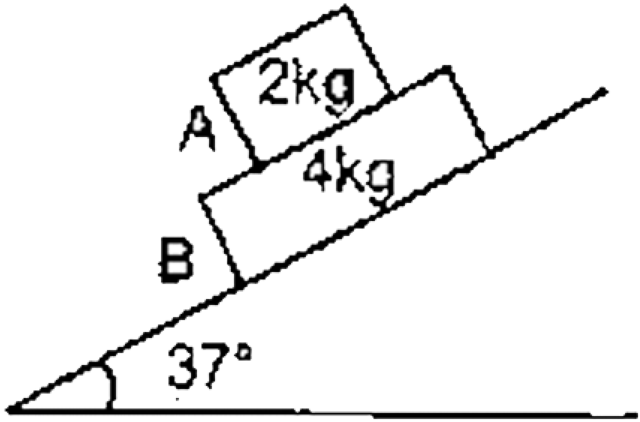
11. consider the situation shown in figure in which a block 'A' of mass 2 kg is placed over a biock.'B' of mass 4 kg. The combination of the blocks are placed on a inclined plane of inclination 37° with horizontal. The coefficient of friction between block B and inclined plane is μ_2 and in between the two, blocks is μ_1. The system is released from rest.

$\left(\text{Take } \ g = 10m/\sec^2\right)$



If $\mu_1 = 0.5, \mu_2 = 0.4$ then:

A. Both blocks will move but with different acceleration

B. Both blocks does not move

C. Only block A will move

D. Both blocks move together

Answer: d

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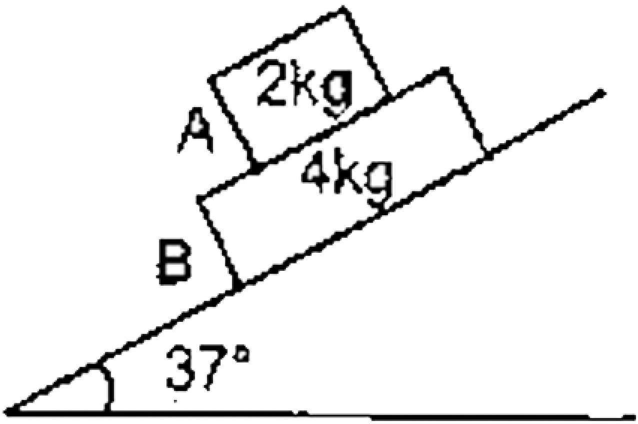
12. consider the situation shown in figure in which a block 'A' of mass 2 kg is placed over a biock.'B' of mass 4 kg. The combination of the blocks are placed on a inclined plane of inclination 37° with horizontal. The coefficient of friction between block B and inclined plane is μ_2 and in between the two, blocks is μ_1. The system is released from rest.

$\left(\text{Take } g = 10m/\sec^2\right)$



The frictional force acting between the blocks in the previous case :

A. 8 N

B. 6.4 N

C. 6 N

D. zero

Answer: d

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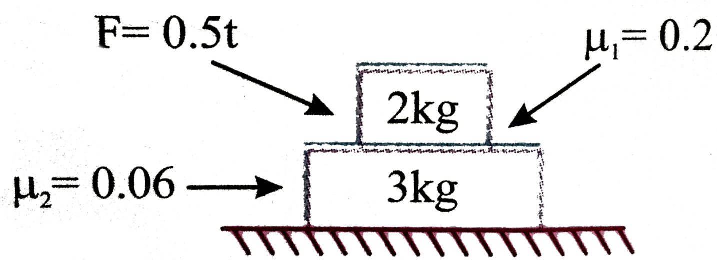
13. In the given figure, the blocks of mass $2kg$ and $3kg$ are placed one over the other as shown. The surface are rough with coefficient of friction $\mu_1 = 0.2, \mu_2 = 0.06$. A force $F = 0.5t($ where $'t'$ in sec) is applied on upper block in the direction shown. Based on above data answer the following questions.

$(g = 10m/\sec^2)$



The motion of blocks $2kg$ and $3kg$ will begin at time $t = -, -$ respectively

A. 8,8 sec

B. 6,8 sec

C. 8,6 sec

D. 6,6 sec

Answer: d

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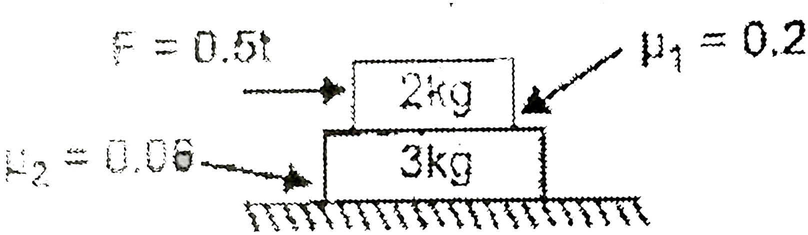
14. In the given figure, the blocks of mass 2kg and 3kg are placed one over the other as shown. The surface are rough with coefficient of friction $\mu_1 = 0.2$, $\mu_2 = 0.06$. A force $F = 0.5t$ (where 't' in sec) is applied on upper block in the direction shown. Based on above data answers the following questions. $(g = 10m / \sec^2)$



The realtive slipping between the blocks occurs at $t =$

A. 6 sec

B. 8 sec

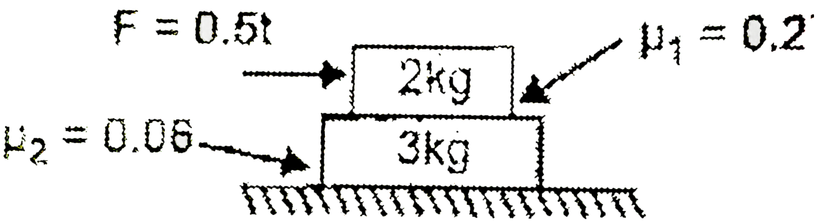
C. $\frac{28}{3}$sec

D. Never

Answer: c

Watch Video Solution

15. In the given figure, the blocks of mass 2kg and 3kg are placed one over the other as shown. The surface are rough with coefficient of friction $\mu_1 = 0.2$, $\mu_2 = 0.06$. A force $F = 0.5t$ (where 't' in sec) is applied on upper block in the direction shown. Based on above data answers the following questions. $(g = 10m/\sec^2)$



The frictional force acting between the two blocks at $t = 9$ sec

A. 4 N

B. 3 N

C. 3.6 N

D. 3.2 N

Answer: c

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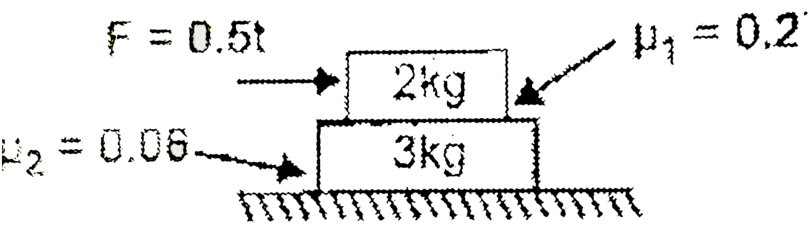
16. In the given figure, the blocks of mass 2kg and 3kg are placed one over the other as shown. The surface are rough with coefficient of friction $\mu_1 = 0.2, \mu_2 = 0.06$. A force $F = 0.5t$ (where 't' in sec) is applied on upper block in the direction shown. Based on above data answers the following questions. $(g = 10m/\sec^2)$



The frictional force acting between the blocks at $t = 10 \sec$ is

A. 4 N

B. 3 N

C. 3.6 N

D. 3.2 N

Answer: a

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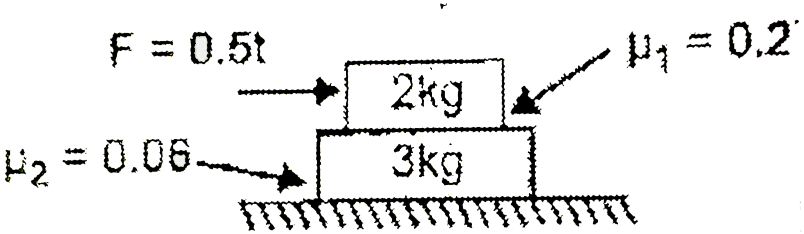
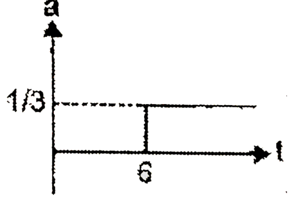
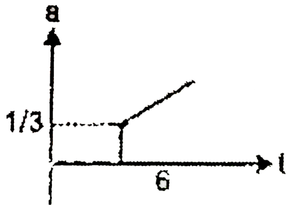
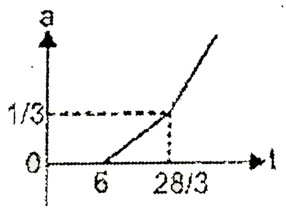
17. In the given figure, the blocks of mass 2kg and 3kg are placed one over the other as shown. The surface are rough with coefficient of friction $\mu_1 = 0.2$, $\mu_2 = 0.06$. A force $F = 0.5t$ (where 't' in sec) is applied on upper block in the direction shown. Based on above data answers the following questions. $(g = 10m/\sec^2)$

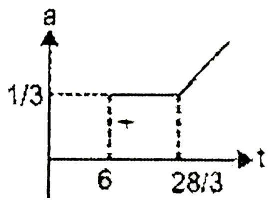


The acceleration time graph for 2kg blok is :

A. 

B. 

C. 

D. 

Answer: c

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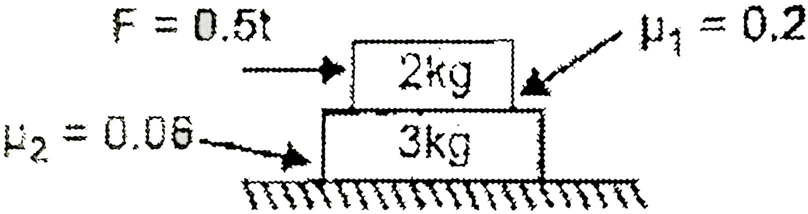
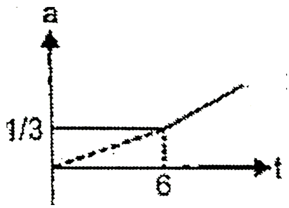
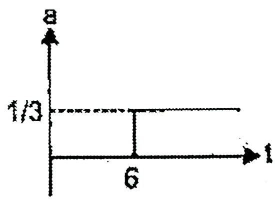
18. In the given figure, the blocks of mass 2kg and 3kg are placed one over the other as shown. The surface are rough with coefficient of friction

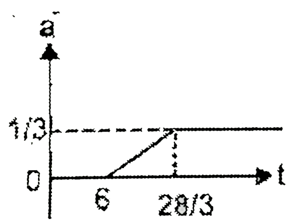
$\mu_1 = 0.2, \mu_2 = 0.06$. A force $F = 0.5t$ (where 't' in sec) is applied on upper block in the direction shown. Based on above data answers the following questions. $(g = 10m/\sec^2)$

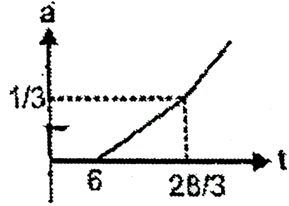


The acceleration time graph for 4 kg block is :

A. 

B. 

C. 

D. 

Answer: c

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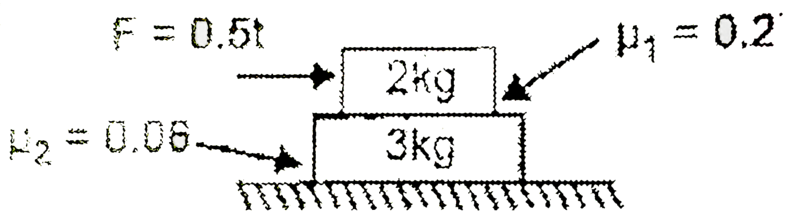
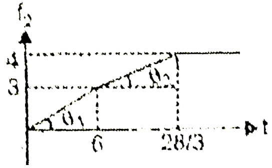
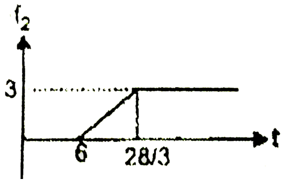
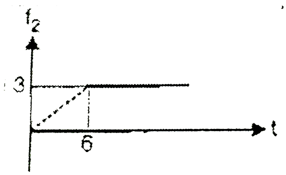
19. In the given figure, the blocks of mass 2kg and 3kg are placed one over the other as shown. The surface are rough with coefficient of friction $\mu_1 = 0.2, \mu_2 = 0.06$. A force $F = 0.5t$ (where 't' in sec) is applied on upper block in the direction shown. Based on above data answers the following questions. $(g = 10m / \sec^2)$



The frictional force acting between 3 kg block and ground w.r.t. time will vary as :

A. 

B. 

C. 

D. None of these

Answer: c

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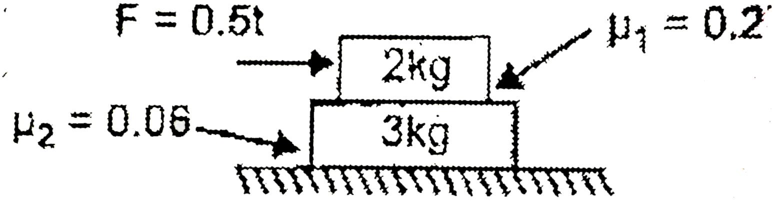
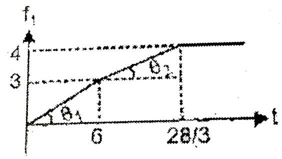
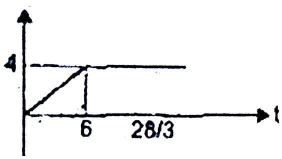
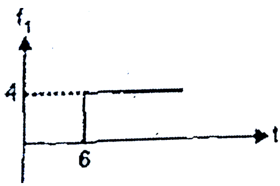
20. In the given figure, the blocks of mass 2kg and 3kg are placed one over the other as shown. The surface are rough with coefficient of friction $\mu_1 = 0.2, \mu_2 = 0.06$. A force $F = 0.5t$ (where 't' in sec) is applied on upper block in the direction shown. Based on above data answers the following questions. $(g = 10m / \sec^2)$



The friction force between the blocks and time graph is :

A. 

B. 

C. 

D. None of these

Answer: a

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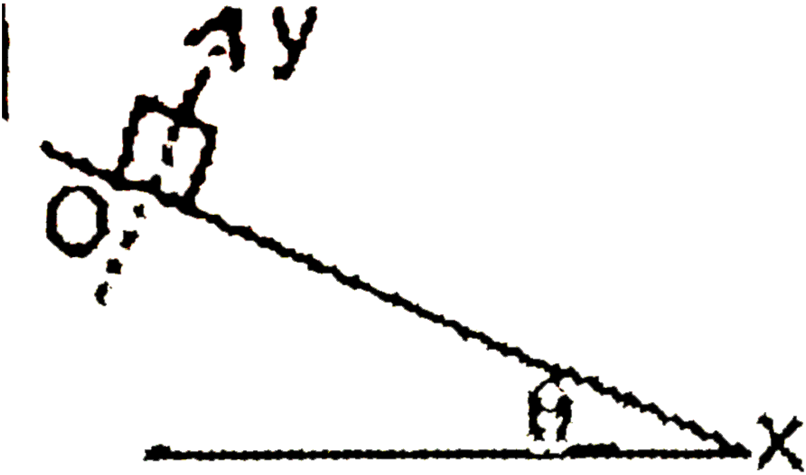
21. In the adjacent figure, x-axis has been taken down the inclined plane. The coefficient of friction varies with x as $\mu = kx$, where $k = \tan\theta$. A block is released at O



The maximum velocity of block will be :

A. $\sqrt{g}$

B. $\sqrt{g\sin\theta}$

C. $\sqrt{g\cos\theta}$

D. $\sqrt{g\tan\theta}$

Answer: b

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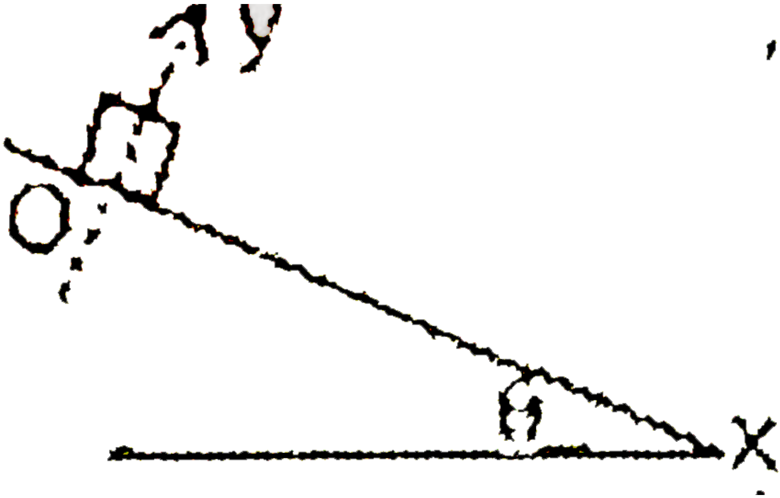
22. In the adjacent figure, x-axis has been taken down the inclined plane. The coefficient of friction varies with x as $\mu = kx$, where $k = \tan\theta$. A block is released at O



Maximum distance traveled by the block :

A. 1 m

B. 2 m

C. 3 m

D. $\frac{1}{2}$ m

Answer: b

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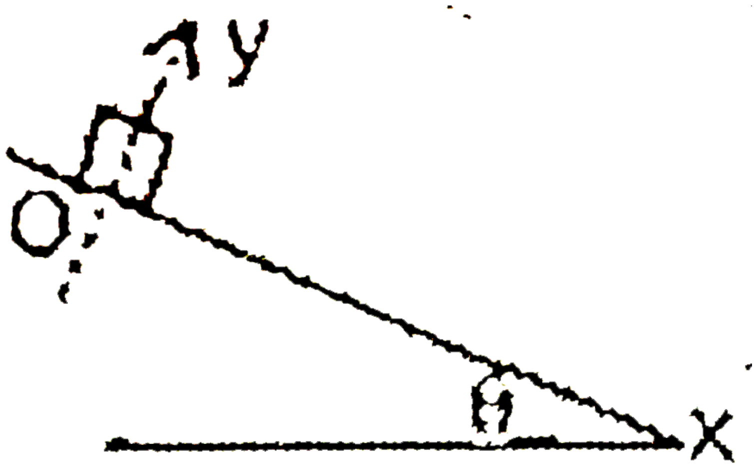
23. In the adjacent figure, x-axis has been taken down the inclined plane. The coefficient of friction varies with x as $\mu = kx$, where $k = \tan\theta$. A block is released at O



Frictional force acting on the block after it comes to rest :

A. $mg\sin\theta$

B. $2mg\sin\theta$

C. $\frac{mg\sin\theta}{2}$

D. $2mg\cos\theta$

Answer: a

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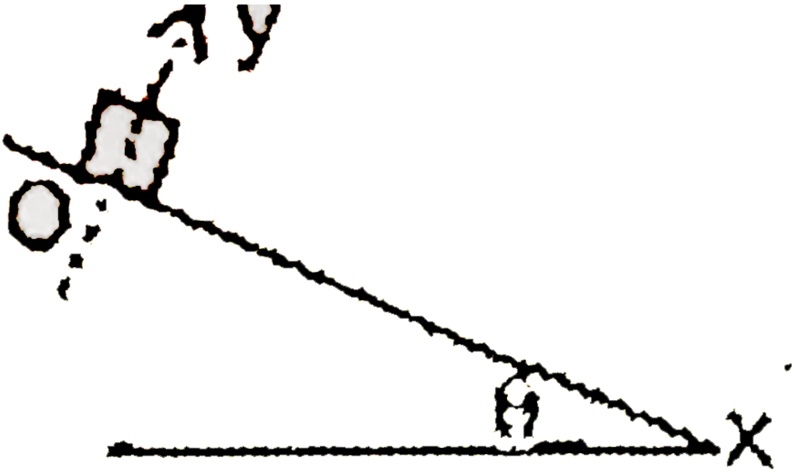
24. In the adjacent figure, x-axis has been taken down the inclined plane. The coefficient of friction varies with x as $\mu = kx$, where $k = \tan\theta$. A block is released at O



Frictional acting on the block just before it comes to rest :

A. $mg\sin\theta$

B. $2mg\sin\theta$

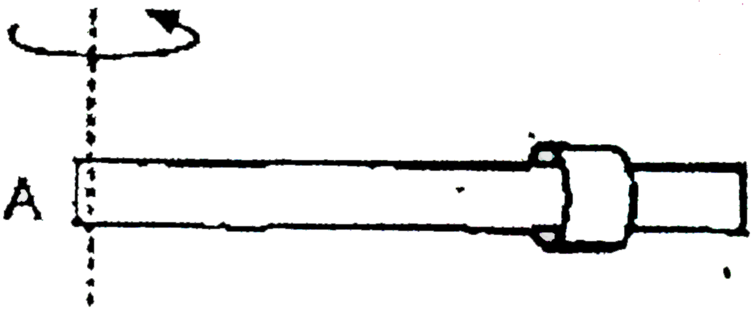
C. $\frac{mg\sin\theta}{2}$

D. $2mg\cos\theta$

Answer: b

Watch Video Solution

25. The figure shows a rod which startsm rotating with angular acceleration α about vertical axis passing through one of its end (A) in horizontal plane. A bead of mass m just fit's the rod and is situated at a distance 'r' from end A. Friction exists between rod and the bead with coefficient μ. As the angular velocity of rod increases the bead starts sliding over the rod (say after time t_0)



Based on above information answer the following question :

The normal force acting on bead at time $t(< t_0)$ is :

A. mg

B. $mr(\alpha t)^2$

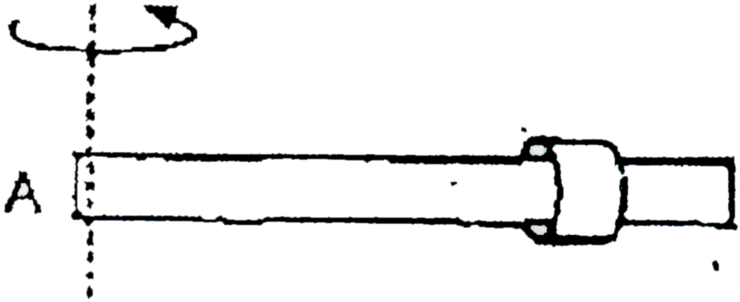
C. $m\sqrt{g^2 + r^2(\alpha t)^4}$

D. $m\sqrt{g^2 + (r\alpha)^2}$

Answer: d

Watch Video Solution

26. The figure shows a rod which startsm rotating with angular acceleration α about vertical axis passing through one of its end (A) in horizontal plane. A bead of mass m just fit's the rod and is situated at a distance 'r' from end A. Friction exists between rod and the bead with coefficient μ. As the angular velocity of rod increases the bead starts sliding over the rod (say after time t_0)



Based on above information answer the following question :

Friction force acting on bead at time $t(<t_0)$ is given by :

A. $\mu m g$

B. $mr(\alpha t)^2$

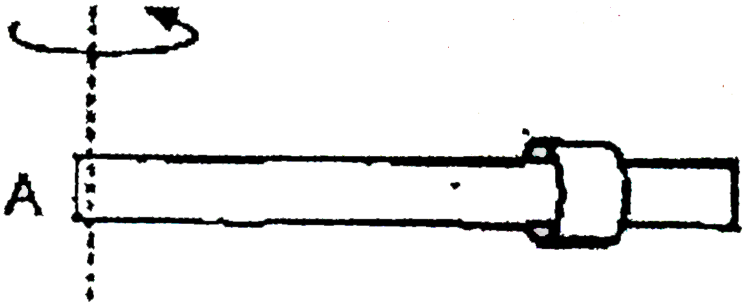
C. $m\mu\sqrt{g^2+(r\alpha)^2}$

D. $\mu m\sqrt{g^2+r^2(\alpha t)^4}$

Answer: b

Watch Video Solution

27. The figure shows a rod which startsm rotating with angular acceleration α about vertical axis passing through one of its end (A) in horizontal plane. A bead of mass m just fit's the rod and is situated at a distance 'r' from end A. Friction exists between rod and the bead with coefficient μ. As the angular velocity of rod increases the bead starts sliding over the rod (say after time t_0)



Based on above information answer the following question :

If the bead start sliding at $t = t_0$ then value of t_0 is given by :

A. $\sqrt{\dfrac{\mu\sqrt{g^2 + (r\alpha)^2}}{r\alpha^2}}$

B. $\sqrt{\dfrac{mg}{r\alpha^2}}$

C. $\sqrt{\dfrac{\mu\sqrt{g^2 + (r\alpha)^2}}{r\alpha^2}} - \sqrt{\dfrac{mg}{r\alpha^2}}$

D. None of these

Answer: a

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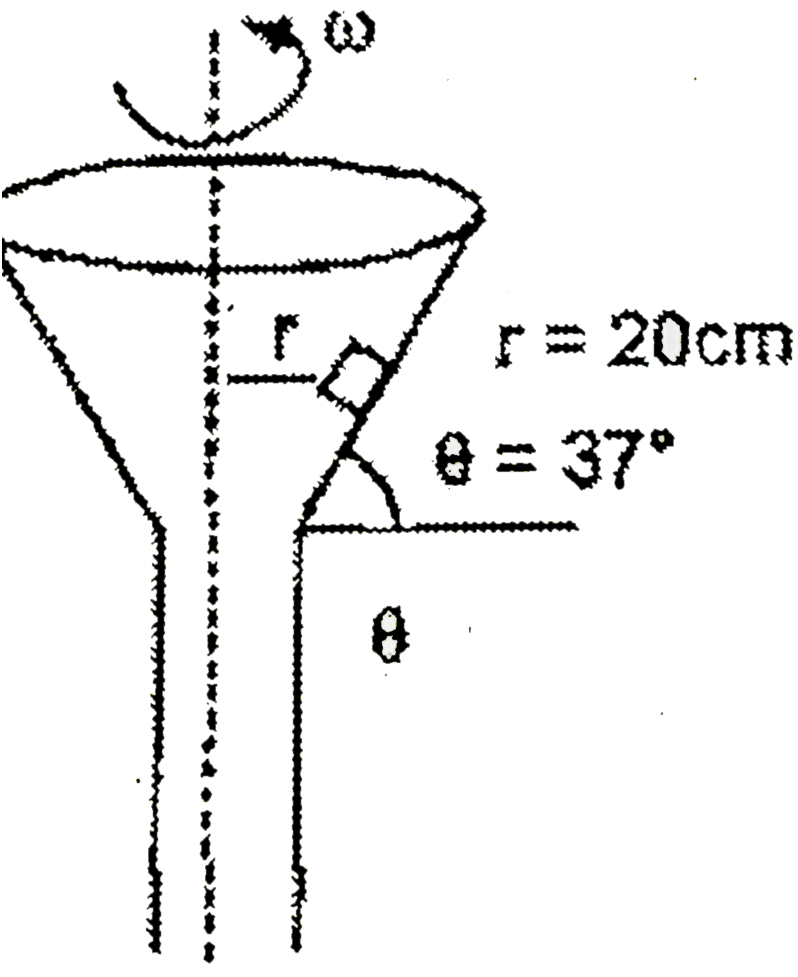
28. A very small cube of mass 2kg is placed on the surface of a funnel as shown in figure. The funnel is rotating about its vertical axis of symmetry with angular velocity ω. The wall of funnel makes an angle 37° with horizontal. The distance of cube from the axis of rotation is 20 cm and friction coefficient is μ (Take $g = 10 m / s^2$)



The friction force acting between the block and surface (if $\mu = 0.3$) of funnel at $\omega = 5 rad / s$ is :

A. 6.6 N

B. 4 N

C. 2.2 N

D. zero

Answer: b

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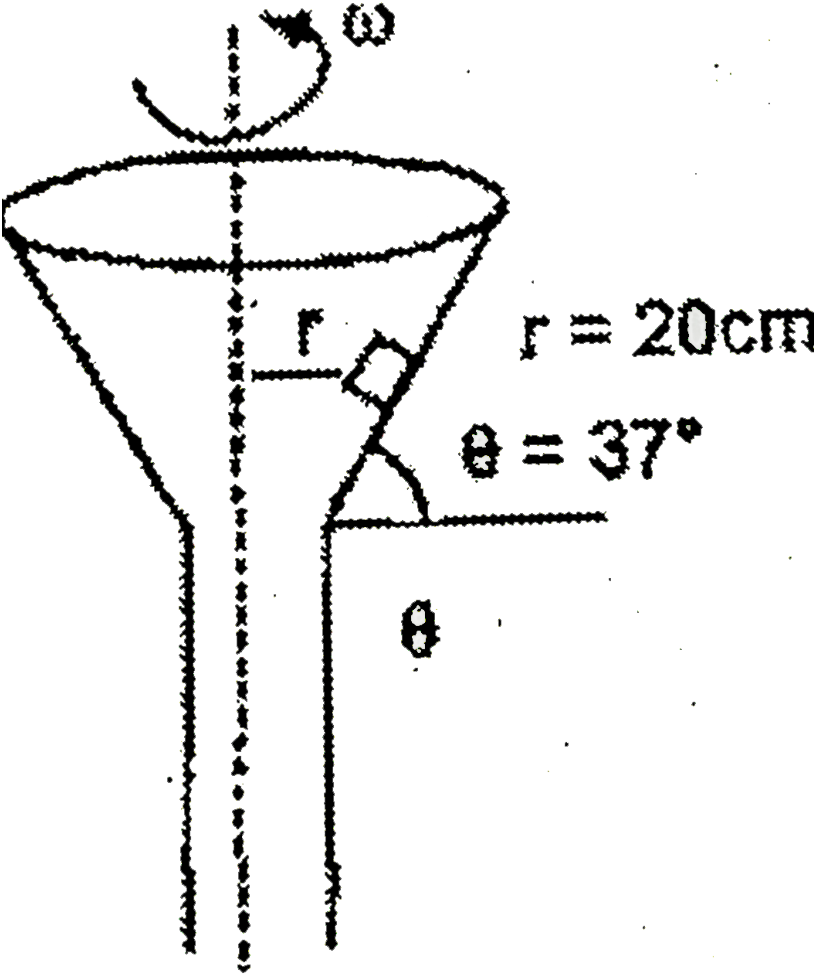
29. A very small cube of mass 2kg is placed on the surface of a funnel as shown in figure. The funnel is rotating about its vertical axis of symmetry with angular velocity ω. The wall of funnel makes an angle 37° with horizontal. The distance of cube from the axis of rotation is 20 cm and friction coefficient is μ (Take $g = 10 m / s^2$)



For what value of ω, there would be no frictional force acting between the surfaces :

A. 5 rad/sec

B. $\sqrt{\dfrac{75}{2}}$ rad/sec

C. $\sqrt{6}$ rad/sec

D. $\sqrt{40}$ rad/sec

Answer: b

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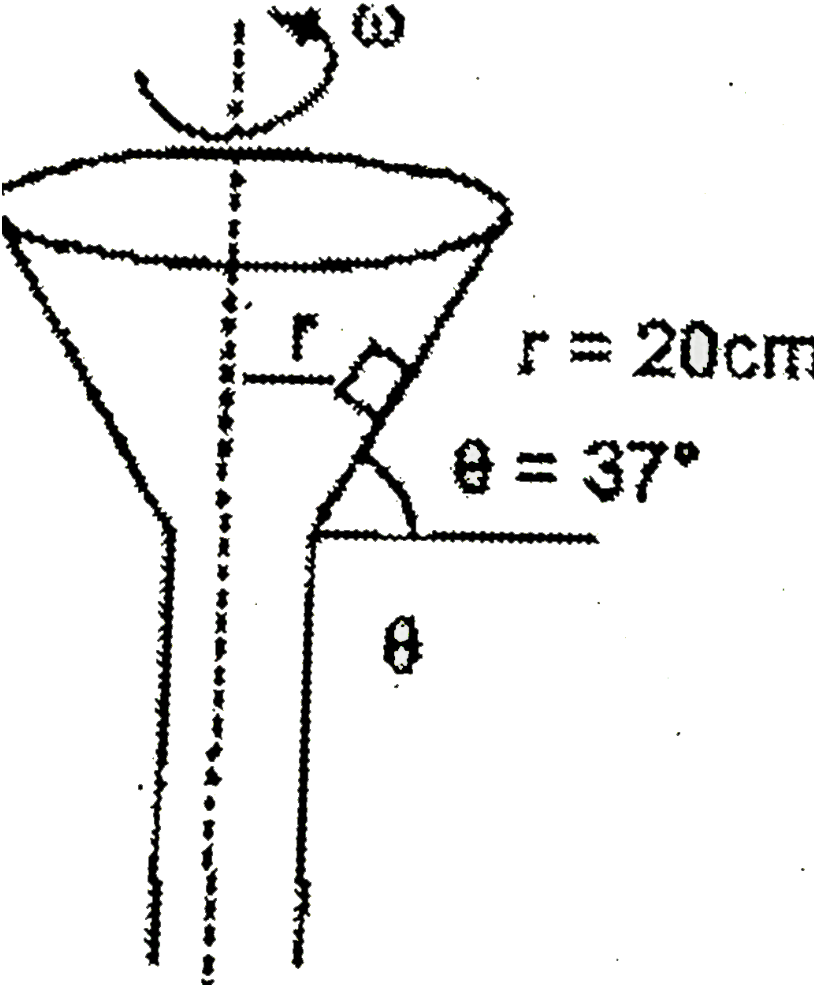
30. A very small cube of mass 2kg is placed on the surface of a funnel as shown in figure. The funnel is rotating about its vertical axis of symmetry with angular velocity ω. The wall of funnel makes an angle 37° with horizontal. The distance of cube from the axis of rotation is 20 cm and friction coefficient is μ (Take $g = 10m/s^2$)



The maximum value of angular velocity for which no relative slipping occur and also direction of frictional force is : (take $\mu = 2/3$)

A. $\sqrt{\frac{425}{3}}$ rad/sec, down the surface of funnel

B. $\sqrt{\frac{25}{3}}$ rad/sec, up the surface of funnel

C. $\sqrt{\frac{25}{9}}$ rad/sec, up the surface of funnel

D. $\sqrt{\frac{25}{9}}$ rad/sec, down the surface of funnel

Answer: a

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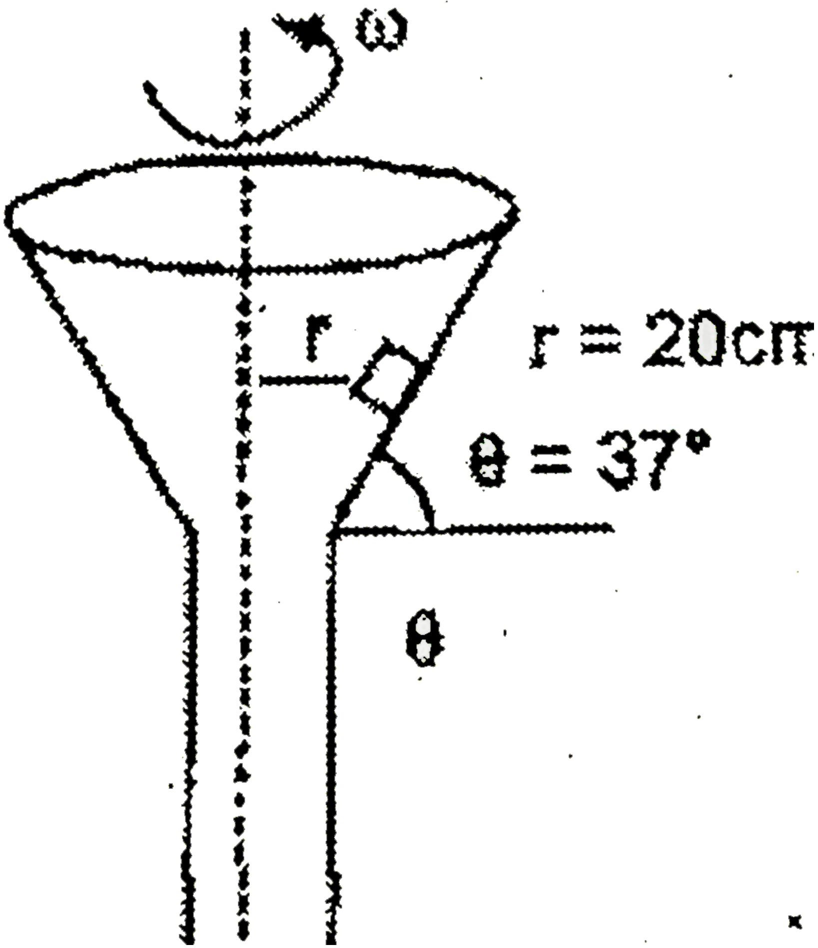
31. A very small cube of mass 2kg is placed on the surface of a funnel as shown in figure. The funnel is rotating about its vertical axis of symmetry with angular velocity ω. The wall of funnel makes an angle 37° with horizontal. The distance of cube from the axis of rotation is 20 cm and friction coefficient is μ (Take $g = 10m/s^2$)



The mimimum value of angular velocity for which relative slipping occurs and also the direction of frictional force acting $\mu = 2/3$:

A. $\sqrt{\frac{25}{9}}$

B. $\sqrt{\frac{15}{3}}$

C. $\sqrt{\frac{9}{25}}$

D. $\sqrt{\frac{3}{25}}$

Answer: a

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32. A car is moving with speed v and is taking a turn on a circular road of radius 10 m. The angle of banking is 37°. The driver wants that car does not slip on the road. The coefficient of friction is $0.4\left(g = 10m/\sec^2\right)$

The speed of car for which no frictional force is produced is :

A. 5 m/sec

B. $5\sqrt{3}m/\sec$

C. $3\sqrt{5}m/\sec$

D. $10m/\sec$

Answer: b

Watch Video Solution

33. A car is moving with speed v and is taking a turn on a circular road of radius 10 m. The angle of banking is 37°. The driver wants that car does not slip on the road. The coefficient of friction is $0.4(g = 10m / \sec^2)$

The friction force acting when $v = 10m / \sec$ and mass of car is 50 kg is :

A. 400 N

B. 100 N

C. 300 N

D. 200 N

Answer: b

Watch Video Solution

34. A car is moving with speed v and is taking a turn on a circular road of radius 10 m. The angle of banking is 37°. The driver wants that car does not slip on the road. The coefficient of friction is $0.4(g = 10m / \sec^2)$

If the car were moving on a flat road and distance between the front tyres is 2 m and the height of the centre of the mass of the car is 1m from the ground, then, the minimum velocity for which car topples is :

A. $5m / \sec$

B. $5\sqrt{3}m / \sec$

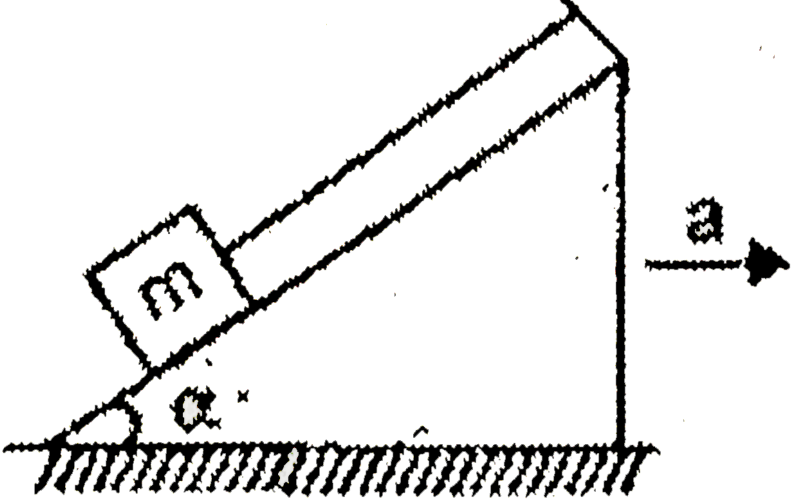
C. $3\sqrt{5}m / \sec$

D. $10m / \sec$

Answer: d

Watch Video Solution

35. A body of mass $m = 1.8kg$ is placed on an inclined plane, the angle of inclination is $\alpha = 37^{\circ}$, and is attached to the top end of the slope with a thread which is parallel to the slop. Then the slope is moved with a horizontal acceleration of a. Fraction is negligible.



The acceleration, if the body pushes the slope with a force of $\frac{3}{4}mg$ is :

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

B. $0.5m/s^2$

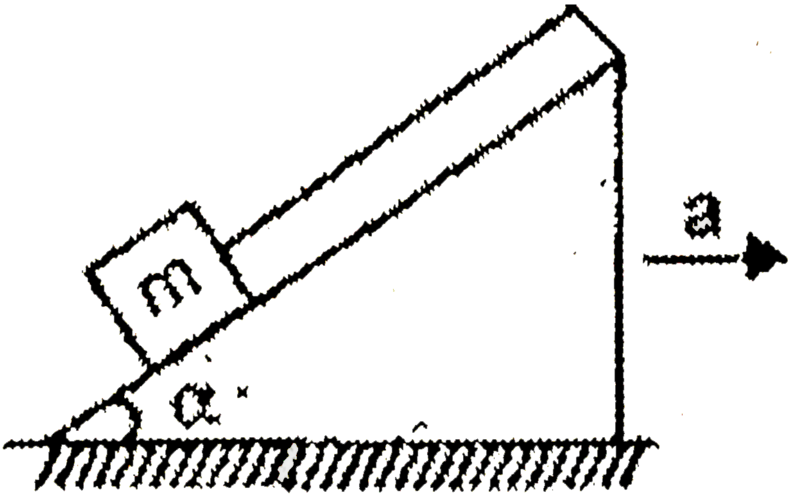
C. $0.75m/s^2$

D. $\frac{5}{6}m/s^2$

Answer: d

View Text Solution

36. A body of mass $m = 1.8kg$ is placed on an inclined plane, the angle of inclination is $\alpha = 37^{\circ}$, and is attached to the top end of the slope with a thread which is parallel to the slop. Then the slope is moved with a horizontal acceleration of a. Fraction is negligible.



The tension in thread is :

A. 12 N

B. 10 N

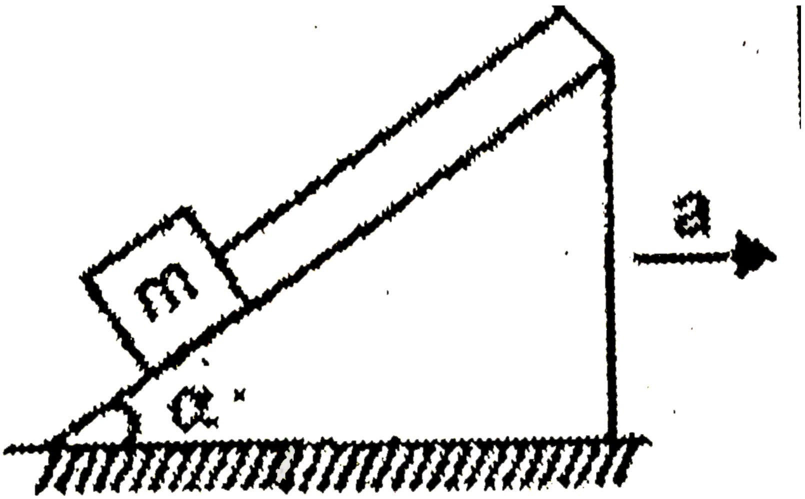
C. 8 N

D. 4 N

Answer: a

View Text Solution

37. A body of mass $m = 1.8kg$ is placed on an inclined plane, the angle of inclination is $\alpha = 37^\circ$, and is attached to the top end of the slope with a thread which is parallel to the slop. Then the slope is moved with a horizontal acceleration of a. Fraction is negligible.



At what acceleration will the body lose contact with plane :

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

B. $7.5 m/s^2$

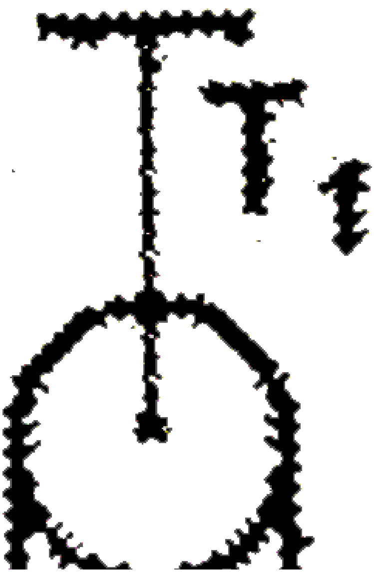
C. $10m/s^2$

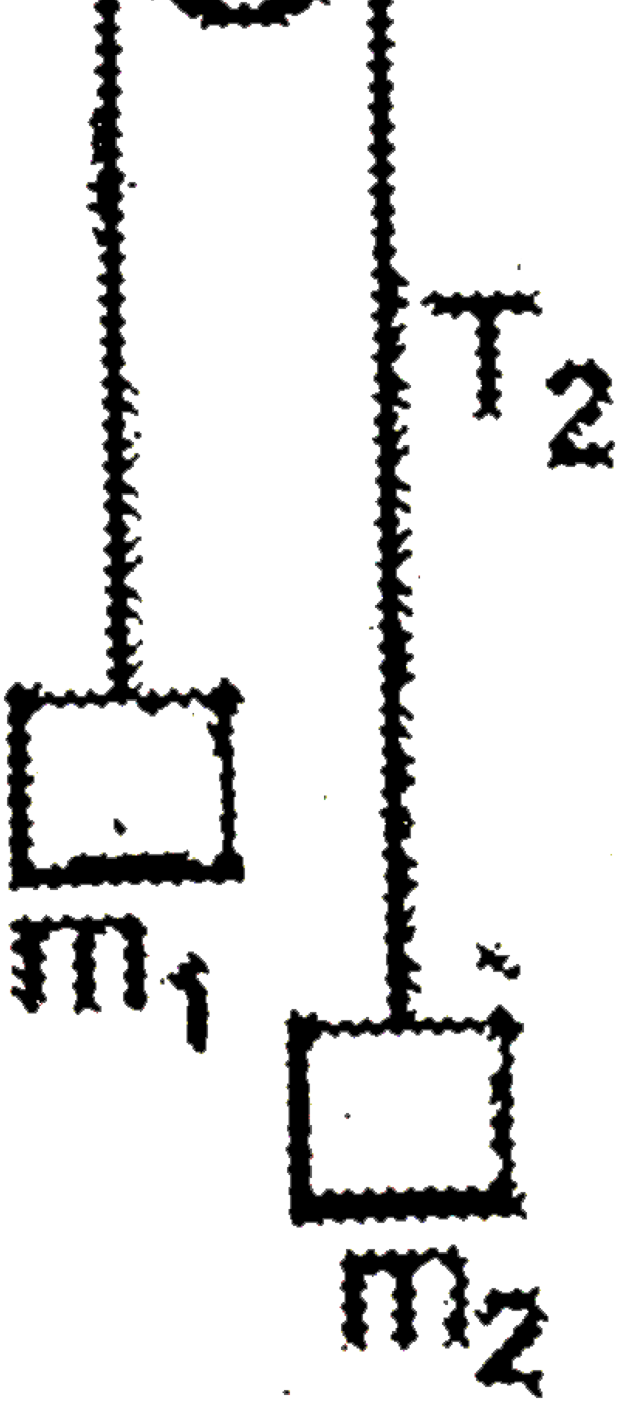
D. $5m/s^2$

Answer: a

View Text Solution

38. A lift can move upward or downward. A light inextensible string fixed from ceiling of lift when a frictionless pulley and tensions in string T_1. Two masses of m_1 and m_2 are connected with inextensible light string and tension in this string T_2 as shown in figure. Read the questionbs carefully and answer




T2
m1
m2

If $m_1 + m_2 = m$ and lift is moving with constant velocity then value of T_1 :

A. $\geq mg$

B. $= mg$

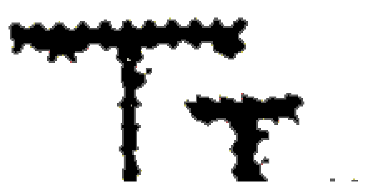
C. $\leq mg$

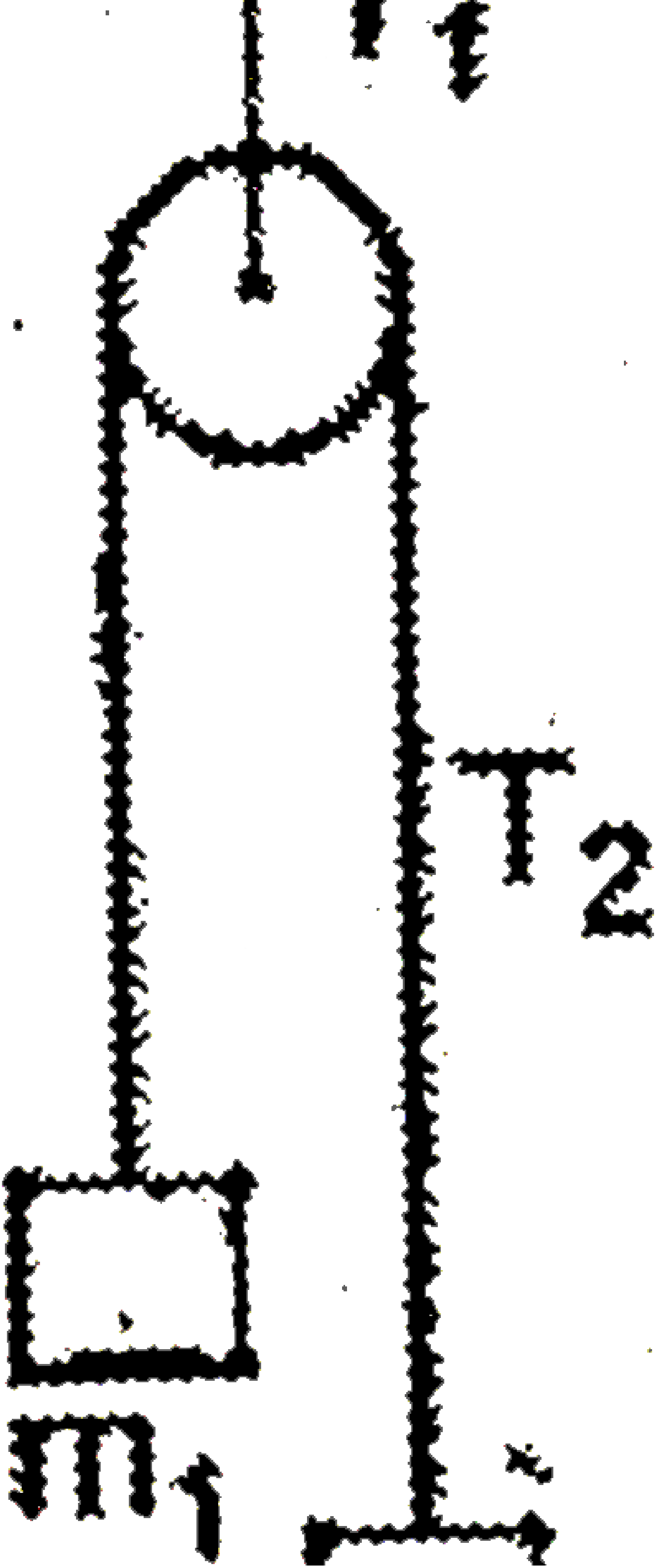
D. $> mg$

Answer: c

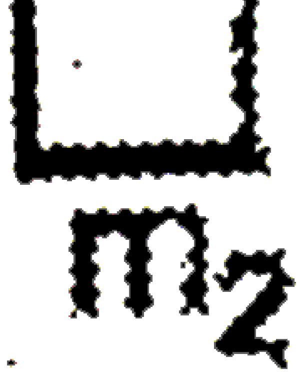
Watch Video Solution

39. A lift can move upward or downward. A light inextensible string fixed from ceiling of lift when a frictionless pulley and tensions in string T_1. Two masses of m_1 and m_2 are connected with inextensible light string and tension in this string T_2 as shown in figure. Read the questionbs carefully and answer





T2
m1



If m_1 is very small as compared to m_2 and lift is moving with constant velocity then value of T_2 is nearly :

A. m_2g

B. $2m_1g$

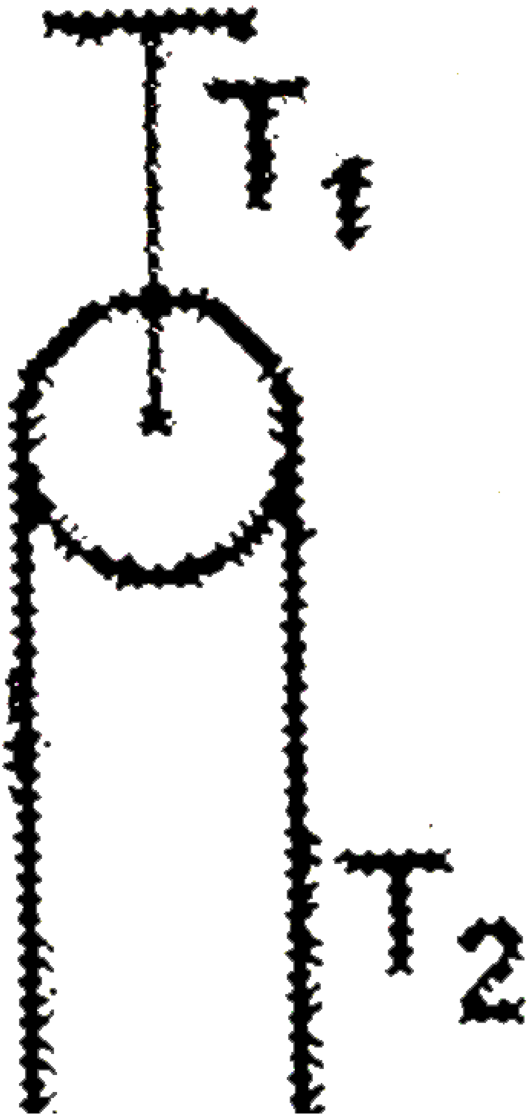
C. $(m_1 + m_2)g$

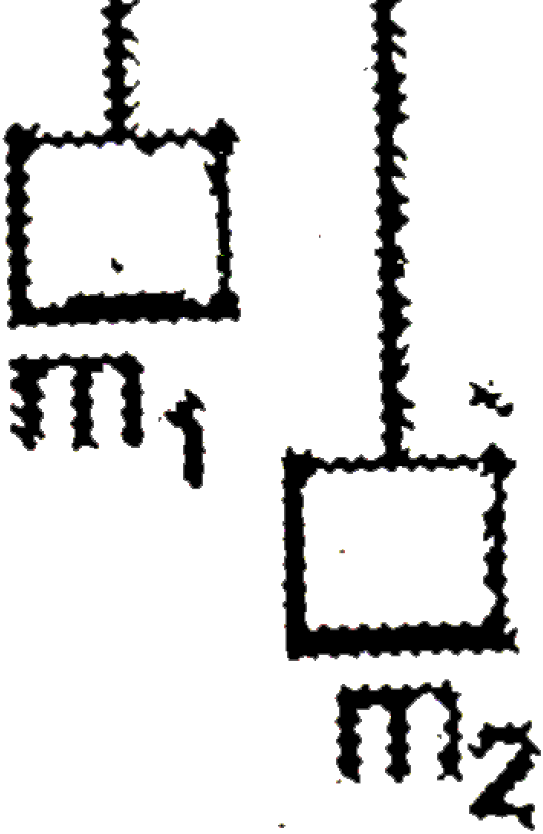
D. zero

Answer: b

Watch Video Solution

40. A lift can move upward or downward. A light inextensible string fixed from ceiling of lift when a frictionless pulley and tensions in string T_1. Two masses of m_1 and m_2 are connected with inextensible light string and tension in this string T_2 as shown in figure. Read the questionbs carefully and answer





If $m_1 = m_2$ and m_1 is moving at a certain instant with velocity v upward with respect to lift and the lift is moving in upward direction with constant acceleration $(a < g)$ then speed of m_1 with respect to lift :

A. increases

B. decreases

C. remains constant

D. depend upon acceleration of lift

Answer: c

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41. A shot putter with a mass of 80 kg pushes the iron ball of mass of 6 kg from a standing position accelerating it uniformly from rest at an angle of 45° with the horizontal during a time interval of 0.1 seconds. The ball leaves his hand when it is 2m high above the level, ground and hits the ground 2 seconds later.

The acceleration of the ball in shot putter's hand :

A. $11\sqrt{2}m/s^2$

B. $100\sqrt{2}m/s^2$

C. $90\sqrt{2}m/s^2$

D. $9\sqrt{2}m/s$

Answer: c

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42. A shot putter with a mass of 80 kg pushes the iron ball of mass of 6 kg from a standing position accelerating it uniformly from rest at an angle of 45° with the horizontal during a time interval of 0.1 seconds. The ball leaves his hand when it is 2m high above the level, ground and hits the ground 2 seconds later.

The horizontal distance between the point of release and the point where the ball hits the ground :

A. 16 m

B. 18 m

C. 20 m

D. 22 m

Answer: b

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43. A shot putter with a mass of 80 kg pushes the iron ball of mass of 6 kg from a standing position accelerating it uniformly from rest at an angle of 45° with the horizontal during a time interval of 0.1 seconds. The ball leaves his hand when it is 2m high above the level, ground and hits the ground 2 seconds later.

The minimum value of the static coefficient of frictin if the shot putter does not slip during the shot is closet to :

A. 0.28

B. 0.38

C. 0.48

D. 0.58

Answer: b

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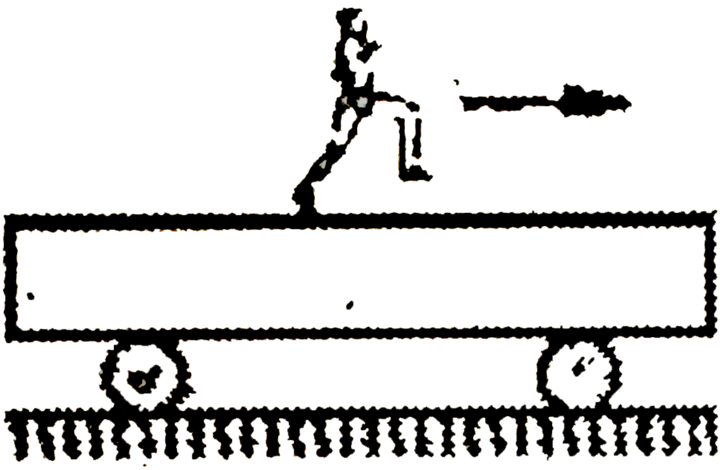
44. In the figure shown, the mass of the trolley is 100 kg and it can move without friction on the horizontal floor. It length is 12 cm. The mass of the girl is 50 kg. Friction exists between is 12 m. The mass of the girl is 50 kg. Friction exists between the shoes of the girl and the trolley's upper surface, with $\mu = 1/3$, The girl can run with a maximum speed $= 9m/s$ on the surface of the trolley, with respect to the surface $= 9m/s$ on the surface of thr trolley, with respect to the surface. At $t = 0$ the girlm starts running from left to the right. The trolley was initially stationary. $(g = 10m/s^2)$



The minimum time in which the girl can acquire her maximum speed, for no slipping is :

A. 1.5 s

B. 1.8 s

C. 2 s

D. None of these

Answer: b

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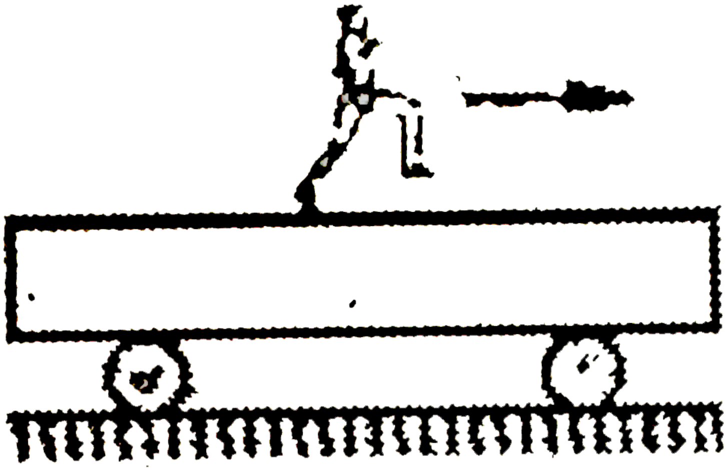
45. In the figure shown, the mass of the trolley is 100 kg and it can move without friction on the horizontal floor. It length is 12 cm. The mass of the girl is 50 kg. Friction exists between is 12 m. The mass of the girl is 50 kg. Friction exists between the shoes of the girl and the trolley's upper surface, with $\mu = 1/3$, The girl can run with a maximum speed $= 9m/s$ on the surface of the trolley, with respect to the surface $= 9m/s$ on the surface of thr trolley, with respect to the surface. At $t = 0$ the girlm starts running from left to the right. The trolley was initially stationary. $(g = 10m/s^2)$



The total kinetic energy of system (trolley + girl) at the instant the girl acquires her maximum relative speed with respect to trolley, is :

A. 1350 J

B. 1250 J

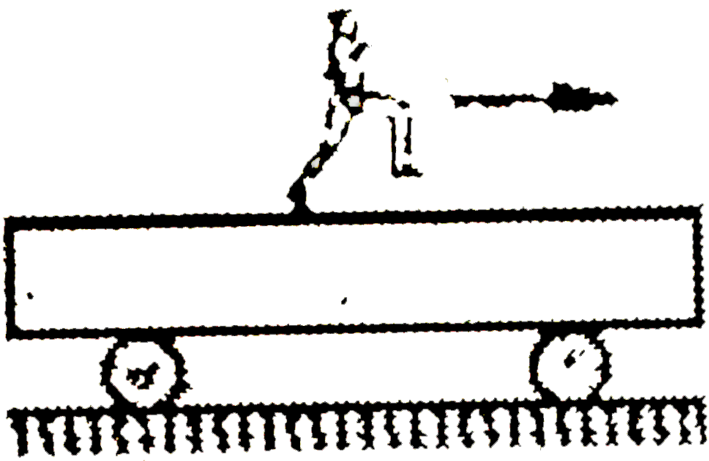
C. 2475 J

D. None of these

Answer: a

Watch Video Solution

46. In the figure shown, the mass of the trolley is 100 kg and it can move without friction on the horizontal floor. It length is 12 cm. The mass of the girl is 50 kg. Friction exists between is 12 m. The mass of the girl is 50 kg. Friction exists between the shoes of the girl and the trolley's upper surface, with $\mu = 1/3$, The girl can run with a maximum speed $= 9m/s$ on the surface of the trolley, with respect to the surface $= 9m/s$ on the surface of thr trolley, with respect to the surface. At $t = 0$ the girlm starts running from left to the right. The trolley was initially stationary. $(g = 10m/s^2)$



The displacement of the trolley by the time the girl reaches the right end of the trolley is :

A. 6 m

B. 12 m

C. 3 m

D. 4 m

Answer: d

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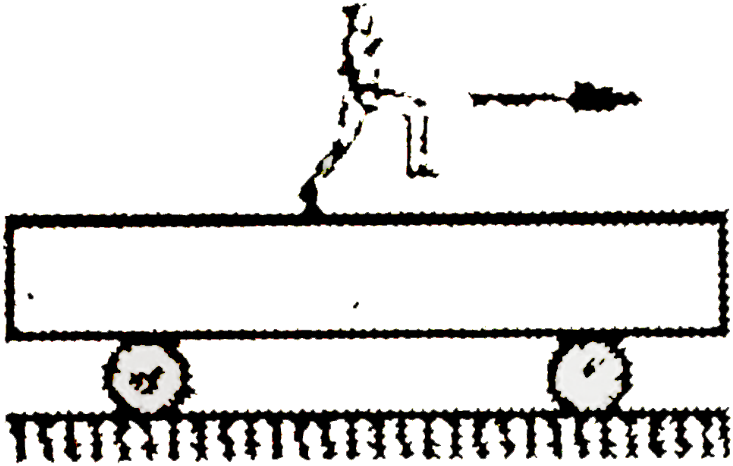
47. In the figure shown, the mass of the trolley is 100 kg and it can move without friction on the horizontal floor. It length is 12 cm. The mass of the girl is 50 kg. Friction exists between is 12 m. The mass of the girl is 50 kg. Friction exists between the shoes of the girl and the trolley's upper surface, with $\mu = 1/3$, The girl can run with a maximum speed $= 9m/s$ on the surface of the trolley, with respect to the surface $= 9m/s$ on the surface of thr trolley, with respect to the surface. At $t = 0$ the girlm starts running from left to the right. The trolley was initially stationary. $(g = 10m/s^2)$



The minimum time in which the girl can stop from 9 m/s relative speed, to zero relative speed, without causing her shoes to slip is :

A. 5/3 s

B. 4/3 s

C. 9/5 s

D. None of these

Answer: c

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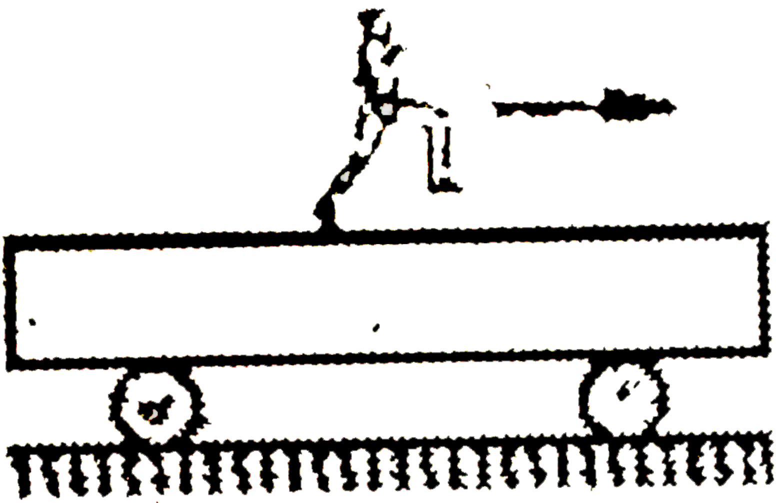
48. In the figure shown, the mass of the trolley is 100 kg and it can move without friction on the horizontal floor. It length is 12 cm. The mass of the girl is 50 kg. Friction exists between is 12 m. The mass of the girl is 50 kg. Friction exists between the shoes of the girl and the trolley's upper surface, with $\mu = 1/3$, The girl can run with a maximum speed $= 9m/s$ on the surface of the trolley, with respect to the surface $= 9m/s$ on the surface of thr trolley, with respect to the surface. At $t = 0$ the girlm starts running from left to the right. The trolley was initially stationary. $(g = 10m/s^2)$



At a certain moment when the girl was accelerating, the earth frame accelerating of the trolley is found to be $1m/s^2$. At this moment, the friction force between the girl's shoes and the trolley's surface is :

A. 200 N

B. 150 N

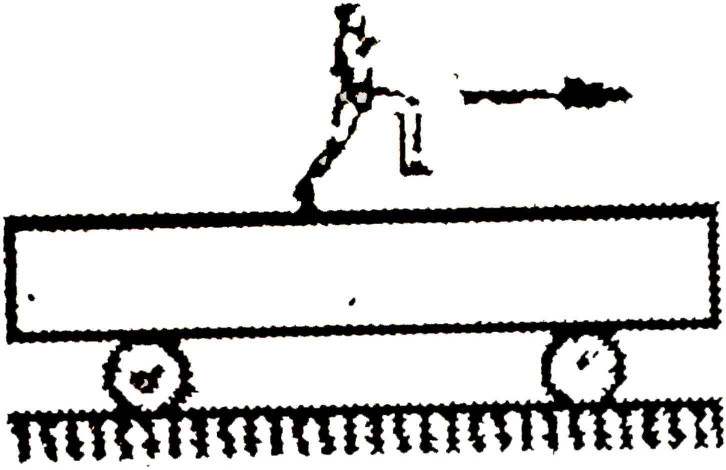
C. 100N

D. None of these

Answer: c

View Text Solution

49. In the figure shown, the mass of the trolley is 100 kg and it can move without friction on the horizontal floor. It length is 12 cm. The mass of the girl is 50 kg. Friction exists between is 12 m. The mass of the girl is 50 kg. Friction exists between the shoes of the girl and the trolley's upper surface, with $\mu = 1/3$, The girl can run with a maximum speed $= 9m/s$ on the surface of the trolley, with respect to the surface $= 9m/s$ on the surface of thr trolley, with respect to the surface. At $t = 0$ the girlm starts running from left to the right. The trolley was initially stationary. $(g = 10m/s^2)$



Suppose the girl accelerates slowly, at a constant rate, and acquires the relative speed of $9m/s$ only when it reaches the right end of the trolley, then what must be the earth frame acceleration of the girl ?

A. $2.5m/s^2$

B. $2.25m/s^2$

C. $1.125m/s^2$

D. $3.375m/s^2$

Answer: b

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Matching type

1. A motorcycle moves around a vertical circle with a constants speed under the influence of the force of gravity $\overrightarrow{W}$, friction between wheel and track $\overrightarrow{f}$ and normal reaction between wheel track $\overrightarrow{N}$:

	Column-1		Column-2
(A)	Constant magnitude	(P)	$\overrightarrow{N}$
(B)	Directed towards centre when value in non-zero	(Q)	$\overrightarrow{N}+\overrightarrow{f}$
(C)	Total reaction force by track	(R)	$\overrightarrow{f}+\overrightarrow{\text{w}}$
(D)	When motion is along vertical the value is zero	(S)	$\overrightarrow{N}+\overrightarrow{\text{w}}+\overrightarrow{f}$

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2. A block is projected with an initial velocity v_{Block} on a long conveyor belt moving with velocity v_{Block} (at that instant)having constant acceleration a_{Belt}. Mark the correct option regarding friction after long time (friction coefficient between block and belt $= \mu$). If :

	Column-1		Column-2
(A)	$v_{\text{Block}} = 2v_{\text{Belt}}$ and $a_{\text{Belt}} = 0$	(P)	zero
(B)	$v_{\text{block}} = 2v_{\text{Belt}}$ and $a_{\text{Belt}} > \mu g$	(Q)	f_s static friction $(0 < f_s < f_L)$
(C)	$v_{\text{Block}} = 2v_{\text{Belt}}$ and $a_{\text{Belt}} = \mu g$	(R)	f_L limiting friction
(D)	$v_{\text{Block}} = 2v_{\text{Belt}}$ and $a_{\text{Belt}} < \mu g$	(S)	f_K kinetic friction

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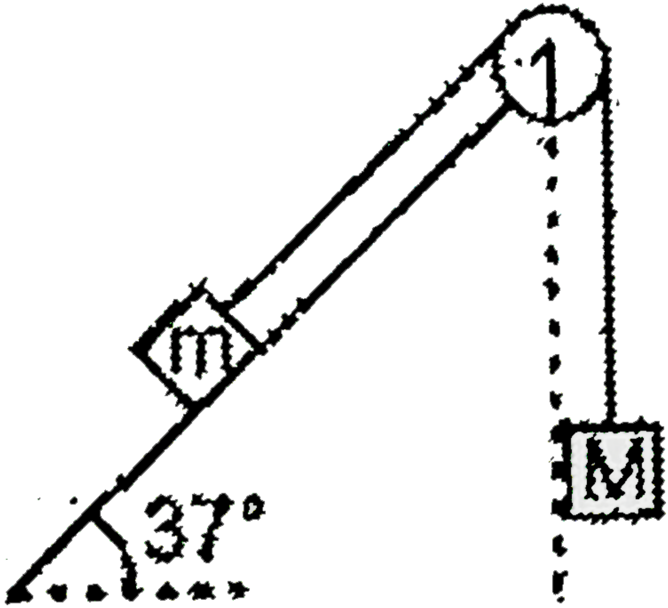
3. The inclined surface is rough $\mu = \frac{1}{2}$. For different values of m and M system slides down or up the plane or remains stationary. Match the appropriate entries of column-1 with those of column-2



	Column-1		Column-2
(A)	Minimum value of $\frac{m}{M}$ so theta m slides down	(P)	$\frac{5}{3}$
(B)	Minimum valie of $\frac{M}{m}$ so that m slides up	(Q)	1
(C)	Value of $\frac{m}{M}$ so that friction force on m is zero	(R)	$\frac{3}{5}$
(D)	Ratio of vertical component of acceleration of m and acceleration of M	(S)	5

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4. A river is flowing with speed 3 km/hr west to east. A man swims with speed 5 km/hr in still water. Man is at south bank of the river. Match the column-1 with direction of velocities of man w.r.t. ground in column-2

Column-1		Column-2
(A) Man swims at an angle 127° from river flow	(P)	↑
(B) Man swims right angle to river flow	(Q)	↖
(C) Man swims at an angle 143° from river flow	(R)	↗
	(S)	←

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5. A particle is moving on a straight line. It is initially at rest

$v =$ instantaneous velocity

P = instantaneous power S = displacement

F= force t = time

Match the possible expression of the quantities in column-1 with the situation in column-2

	Column-1		Column-2
(A)	$v^3 \propto S$	(P)	P = constant
(B)	$v^2 \propto t$	(Q)	$P \propto v$
(C)	$v^2 \propto S$	(R)	F = constant
(D)	$v \propto t$	(S)	$F \propto \frac{1}{v}$
		(T)	$P \propto t$

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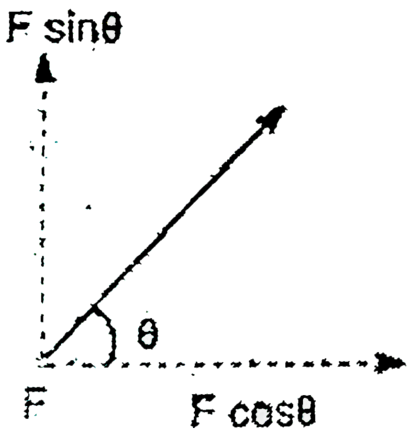
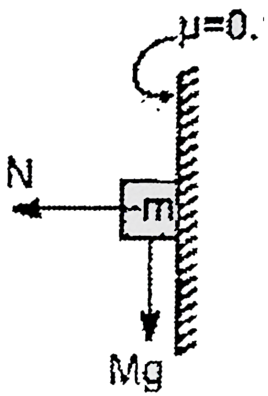
6. Match the column:





	Column -1		Column -2
(A)	$\theta = 37^\circ$	(P)	f is upwards
(B)	$\theta = 45^\circ$	(Q)	f is downwards
(C)	$\theta = 53^\circ$	(R)	f is static
		(S)	f is kinetic

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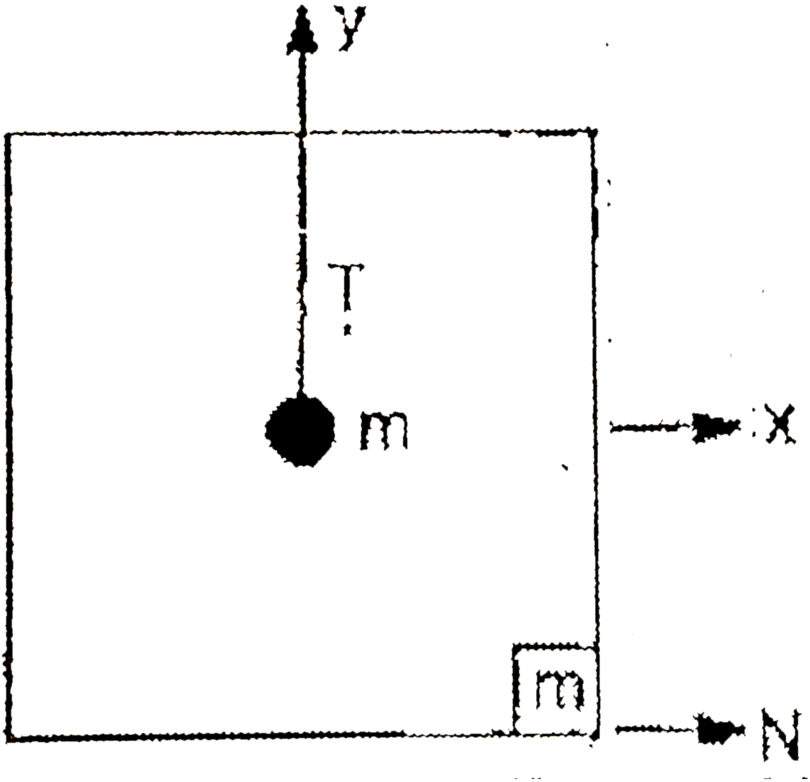
7. Lift can move in y-axis as well as along x-axis. A ball of mass m is attached to ceiling of lift with inetensible light rope and box of mass mis placed against a wall as shown in figure. Neglect friction everywhere.



	Column -1		Column -2
(A)	In figure lift is moving along x-axis then, value of T may be	(P)	zero
(B)	Lift moving toward right along x-axis with decreasing speed then value of N may be	(Q)	$> mg$
(C)	Lift is moving in upward direction (y-axis) then value of T may be	(R)	$< mg$
(D)	Lift is moving in downward direction with constant velocity then value of T may be	(S)	$= mg$

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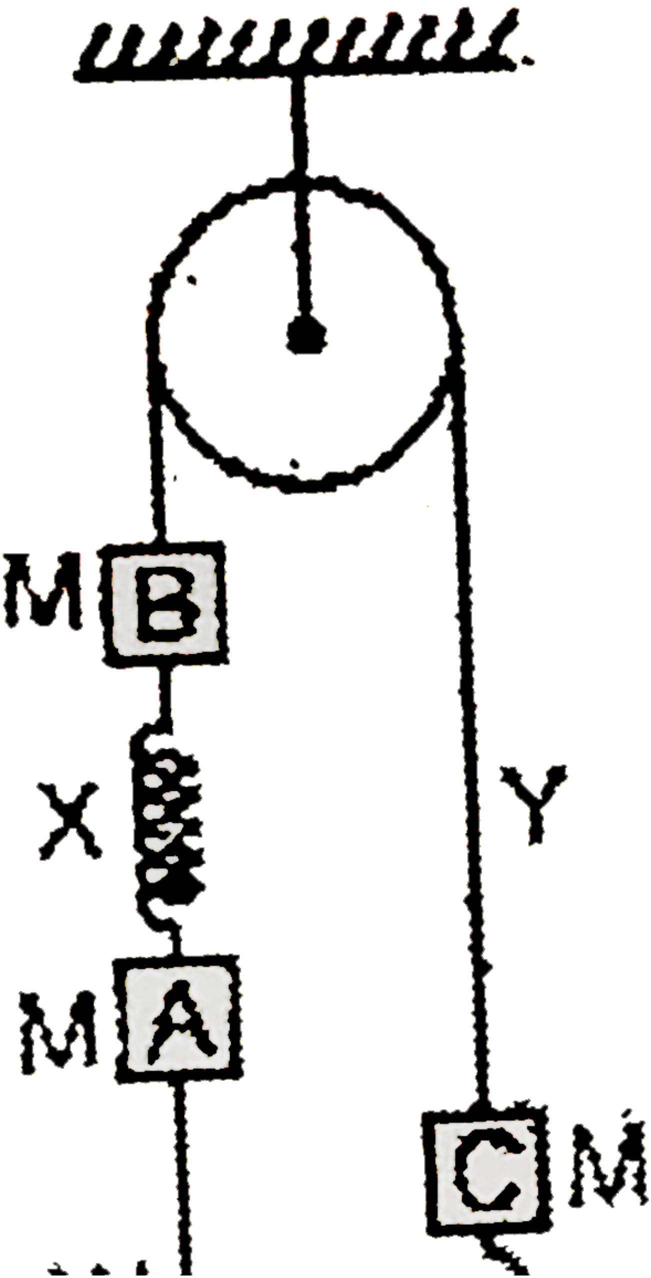
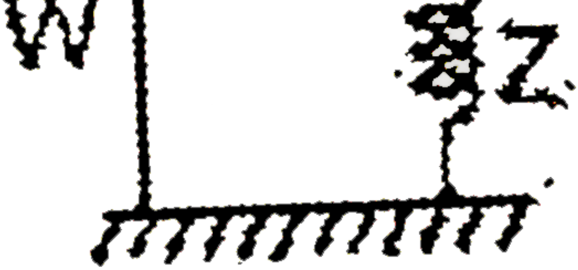
8. In the diagram strings, springs and the pulley are light and ideal. The system is in equilibrium with the strings taut $(T > 0)$, match the column. Masses are equal.





	Column -1		Column -2
(A)	Just after string W breaks	(P)	$a_A = 0$
(B)	Just after spring X breaks	(Q)	$a_B = 0$
(C)	Just after string Y breaks	(R)	$a_C = 0$
(D)	Just after spring Z breaks	(S)	$a_B = a_C$

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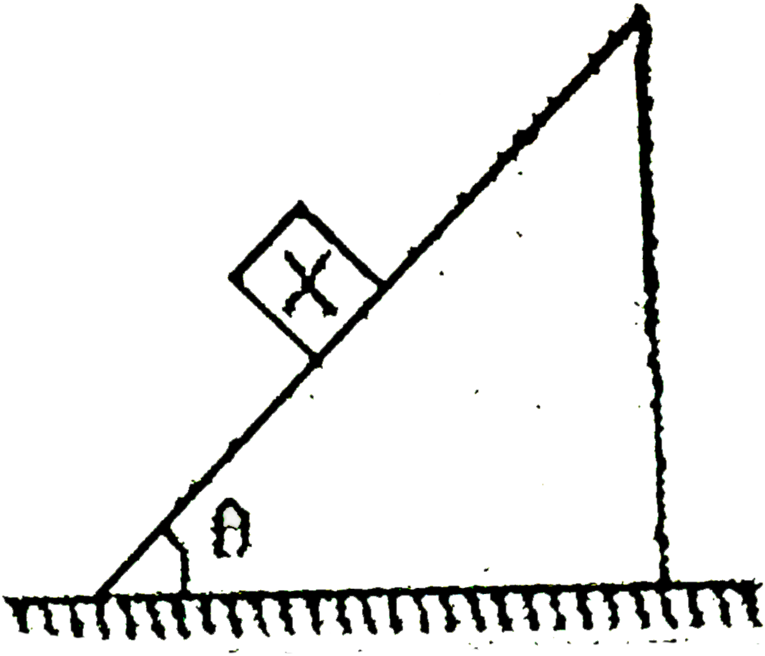
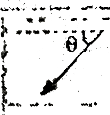
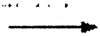
9. In the situation shown, all surfaces are frictionless and triangular wedge is free to move. In column-2, the direction of certain vectors are shown. Match the direction of quantities in column-1 with possible vector in column-2.



	Column-1		Column-2
(A)	acceleration of the block X relative to ground	(P)	
(B)	acceleration of block X relative to wedge	(Q)	
(C)	normal force by block on wedge	(R)	
(D)	net force on the wedge	(S)	

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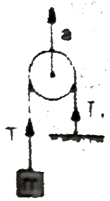
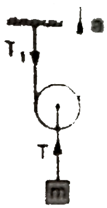
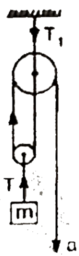
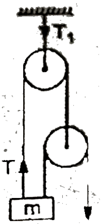
10. See the diagrams carefully in Column-1 and match each with the obeying relation (S) in column-2. The string is massless, inextensible and pulley is frictionless in each case. a=g/3, m= mass of block T = tension in a given string, $a_{\text{pulley}} =$ acceleration of movable pulley in each case, acceleration due to gravity is g.

Column-1	Column-2
(A) 	(P) $a_{block} \le a$
(B) 	(Q) $a_{pulley} \le a$
(C) 	(R) $T > mg$
(D) 	(S) Force on fixed support $T_1 > (3/2)mg$

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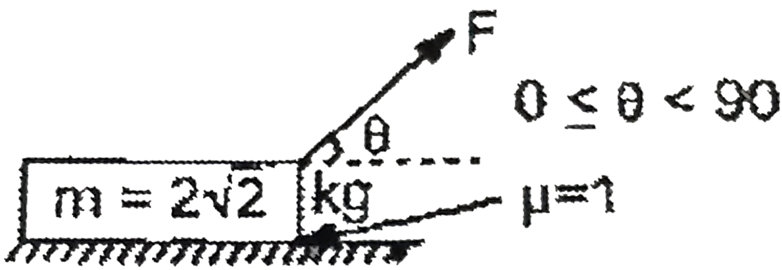
11. A block is placed on a rough horizontal surface. A constant force F is acting on the block as shown in the figure.



Column-1 gives the magnitude of force F and column-2 gives information about friction acting on the block. Match the entries in column-1 to all possible entries in column-2.

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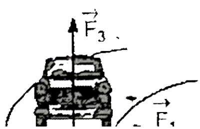
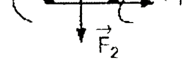
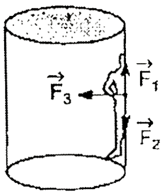
12. Column-1 shows certain siruations and column-2 shows information about forces.

Column-1	Column-2
(A) Situation 	(P) $\vec{F}_1 + \vec{F}_2 + \vec{F}_3$ is centripetal force.



Front view of a car rounding a curve with constant speed

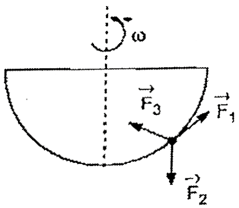
(B)



Passengers in a rotor not sliding relative to rotor wall cylindrical rotor is rotating with constant angular velocity about its symmetry axis.

(Q) $\vec{F}_1$ is static friction

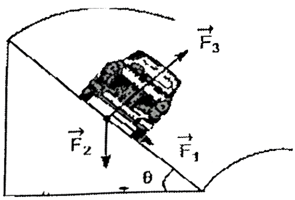
(C)



Particle kept on rough surface of a bowl, no relative motion of particle in bowl, bowl has constant angular velocity.

(R) $\vec{F}_1$ can be in direction opposite to that shown in figure.

(D)



Car moving on a banked road with constant speed, no sideways skidding

(S) $\vec{F}_1 + \vec{F}_2 = \vec{0}$

(T) $\vec{F}_1 + \vec{F}_2 + \vec{F}_3 = \vec{0}$

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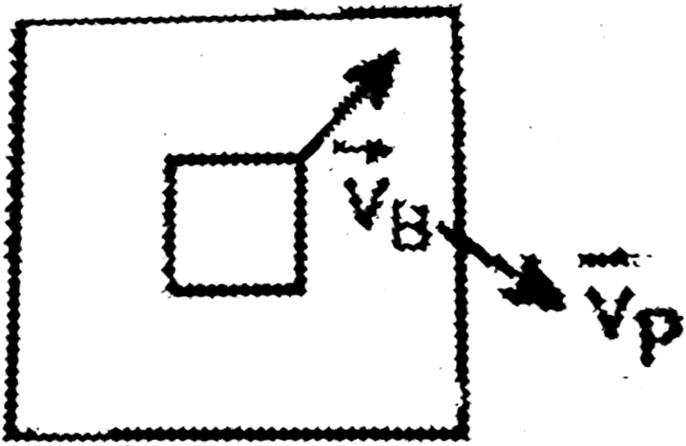
13. Find unit vector in direction of friction force acting on block

$\vec{v}_p = 7\hat{i} - 2\hat{j}, \vec{v}_B = 3\hat{i} + \hat{j}$



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