PHYSICS

BOOKS - DC PANDEY PHYSICS (HINGLISH)

CENTRE OF MASS, IMPULSE AND MOMENTUM

Only One Option Is Correct For Jee Mains

1. Two particles having mass ratio $n:1$ are interconnected by a light inextensible string that passes over a smooth pulley . If the system is released , then the acceleration of the centre of mass of the system is

A. $(n-1)^2$ g

B. $\left(\frac{n+1}{n-1}\right)^2$ g

C. $\left(\frac{n-1}{n+1}\right)^2 g$

D. $\left(\frac{n+1}{n-1}\right) g$

Answer:

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2. A ball of mass 50 gm is dropped from a height h=10m. It rebounds losing 75 percent of its kinetic energy. If it remains in contanct with the ground for $\Delta t = 0.01$ sec. the impulse of the impact force is (take $g = 10m/s^2$)

A. $1.3N - s$

B. 1.06 N-s

C. 1300 N-s

D. 105 N-s

Answer:

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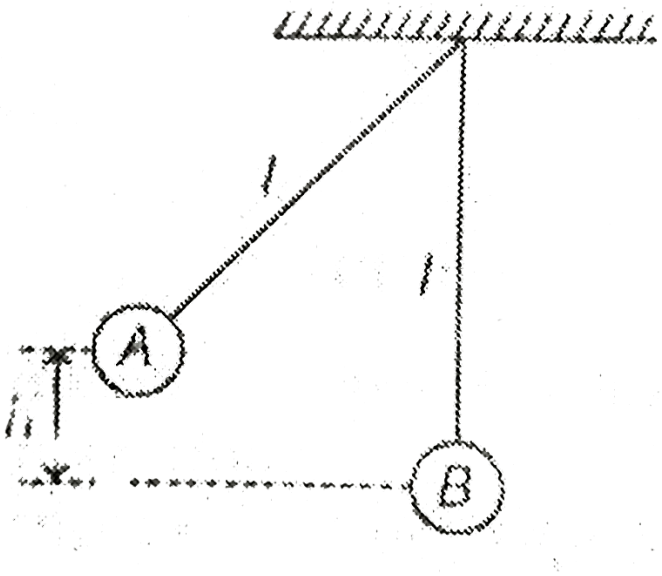
3. In an arrangement shown , bob A on the left is pulled aside . It is then released and allowed to collide with other bob B which is at rest . A perfectly inelastic collision occurs and the system rises to a height h/4 . The ratio of the masses of the bobs is



A. 1

B. 2

C. 3

D. 4

Answer:

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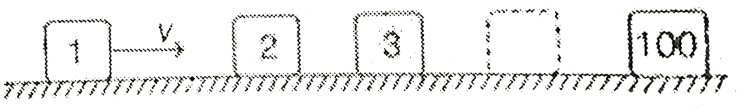
4. There are hundred indentical blocks equally spaced on a frictionless track as shown in the figure . Initially , all the blocks are separate . Each collision is perfectly inelastic . The final velocity will be



A. $\frac{V}{99}$

B. $\frac{V}{100}$

C. zero

D. NONE

Answer:

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5. A stationary body explodes into two fragments of masses m_1 and m_2. If momentum of one fragment is p, the energy of explosion is

A. $\frac{p^2}{2(m_1+m_2)}$

B. $\frac{p^2}{2\sqrt{m_1+m_2}}$

C. $\frac{p^2(m_1+m_2)}{2m_1m_2}$

D. $\frac{p^2(m_1+m_2)}{m_1m_2}$

Answer:

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6. A ball collides with an inclined plane of inclination θ after falling through a distance h. if it moves horizontal just after the impact, the coefficient of restitution is

A. $\tan^2\theta$

B. $\cot^2\theta$

C. $\tan\theta$

D. $\cot\theta$

Answer:

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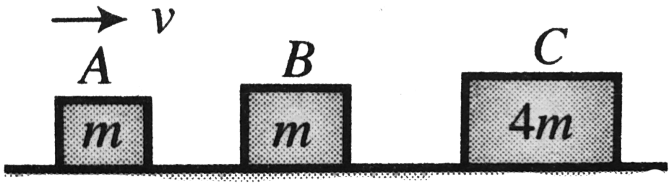
7. Three blocks are initially placed as shown in the figure. Block A has mass m and initial velocity v to the right. Block B with mass m and block C with mass $4m$ are both initially at rest. Neglect friction. All collisions are elastic. The final velocity of blocks A is



A. 0.6 v to the left

B. 0.4 v to the left

C. v to the left

D. 0.4 v to the right

Answer:

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8. A force exerts an impulse Ion a particle changing its speed from initial velocity u to final velocity $2u$. The applied force and the initial velocity are oppositely oriented along the same line. The work done by the force is

A. $\frac{3}{2}$ l u

B. $\frac{1}{2}$ l u

C. l u

D. 2 l u

Answer:

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9. A ball is projected from ground with a velocity V at an angle θ to the vertical. On its path it makes an elastic collison with a vertical wall and returns to ground. The total time of flight of the ball is

A. $\frac{2v\sin\theta}{g}$

B. $\frac{2v\cos\theta}{g}$

C. $\frac{v\sin2\theta}{g}$

D. $\frac{v\cos\theta}{g}$

Answer:

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10. An open water tight railway wagon of mass $5 \times 10^3 kg$ moves at an initial velocity $1.2m/s$ without friction on a railway track. Rain drops fall vertically downwards into the wagon. The velocity of the wagon after it has collected $10^3 kg$ of water will be :-

A. 0.5 m/s

B. 0.6 m/s

C. 1 m/s

D. 0.8 m/s

Answer:

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11. A rocket of mass 4000 kg is set for vertical firing. How much gas must be ejected per second so that the rocket may have initial upwards acceleration of magnitude $19.6m/s^2$? [Exhaust speed of fuel $= 980m/s$]

A. $240kgs^{-1}$

B. $60kgs^{-1}$

C. $120kgs^{-1}$

D. $20kgs^{-1}$

Answer:

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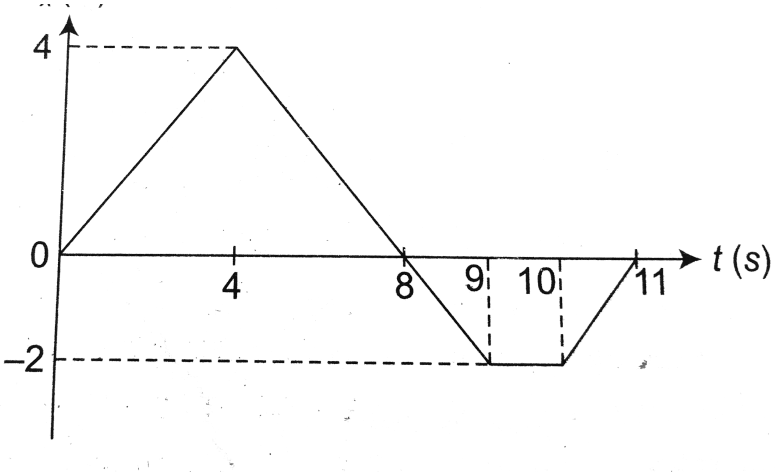
12. A 2kg toy car can move along an x axis. Graph shows force F_x , acting on the car which being at rest at time $t = 0$. The velocity of the particle at $t = 0s$ is:



A. 2 m/s

B. 5 m/s

C. 6.5 m/s

D. 4.5 m/s

Answer:

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13. The displacement of a particle of mass 2kg moving in a straight line varies with times as $x = \left(2t^3 + 2\right)m$. Impulse of the force acting on the particle over a time interval between t = 0 and t = 1 s is

A. 10 N-s

B. 12 N-s

C. 8 N-s

D. 6 N-s

Answer:

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14. Ball 1 collides directly with another identical ball 2 at rest. Velocity of second ball becomes two times that of 1 after collison. Find the coefficient of restitution between the two balls?

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15. A particle of mass 1 kg is projected at an angle of 30° with horizontal with velocity v = 40 m/s . The change in linear momentum of the particle after time t = 1 s will be (g = 10 m/s^2)

A. 7.5 kg- m/s

B. 15 kg - m/s

C. 10 kg-m/s

D. 20 kg-m/s

Answer:

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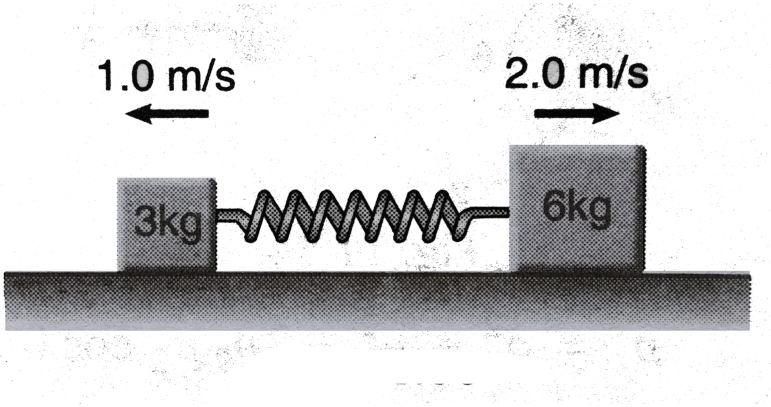
16. Two blocks of masses $3kg$ and $6kg$ respectivley are placed on a smooth horizontal surface. They are connected by a light spring of force constant $k = 200N/m$. Initially the spring is unstretched. The indicated velocities are imparted to the blocks. Find the maximum extension of the spring.



A. 30 cm

B. 25 cm

C. 20 cm

D. 15 cm

Answer:

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17. The centre of mass of a non uniform rod of length L, whose mass per unit length varies as $\rho = \frac{k.\ x^2}{L}$ where k is a constant and x is the distance of any point from one end is (from the same end)

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

B. $\frac{L}{8}$

C. $\frac{K}{L}$

D. $\frac{3K}{L}$

Answer:

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18. A particle of mass m is made to move with uniform speed u along the perimeter of a regular polygon of n sides. What is the magnitude of impulse applied by the particle at each corner of the polygon?

A. 2 mv sin $\frac{\pi}{2n}$

B. mv sin $\frac{\pi}{2n}$

C. m v cos $\frac{\pi}{2n}$

D. 2 mv cos $\frac{\pi}{2n}$

Answer:

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19. From a circular disc of radius R, a square is cut out with a radius as its diagonal. The center of mass of remaining portion is at a distance from the center)

A. $\frac{R}{\pi - 2}$

B. $\frac{R}{\pi}$

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

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

Answer:

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20. A Force F = $\left(2\hat{i}+\hat{j}+3\hat{k}\right)$ N acts on a particle of mass 1 kg for 2 s . If initial velocity of particle is u = $\left(2\hat{i}+\hat{j}\right)$ m/s . Speed of particle at the end of 2 s will be

A. 12 m/s

B. 6 m/s

C. 9 m/s

D. 4 m/s

Answer:

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21. A bullet is fired from a gun The force on a bullet is $F = 600 - 2 \times 10^5 t$ newton. The force reduces to zero just

when the bullet leaves barrel Find the impulse imparted to the bullet .

A. 8 N-s

B. 0.9 N-s

C. 1.8 N-s

D. 2.4 N-s

Answer:

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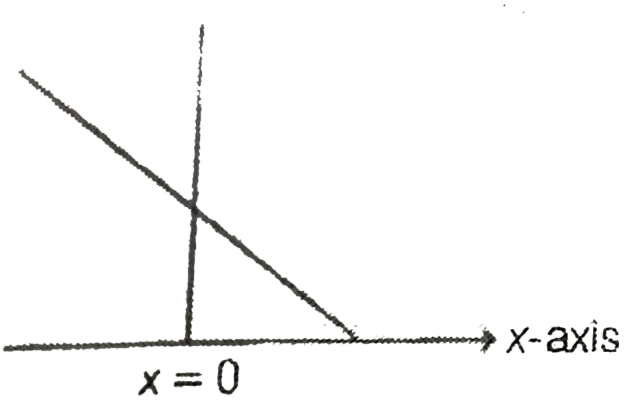
22. A uniform rod of length l is kept vertically on a rough horizontal surface at x = 0 . It is rotated slightly and released . When the rod finally falls on the horizontal surface , the lower

end will remain at



A. $x = l/2$

B. $x > l/2$

C. $x < l/2$

D. $x = 0$

Answer:

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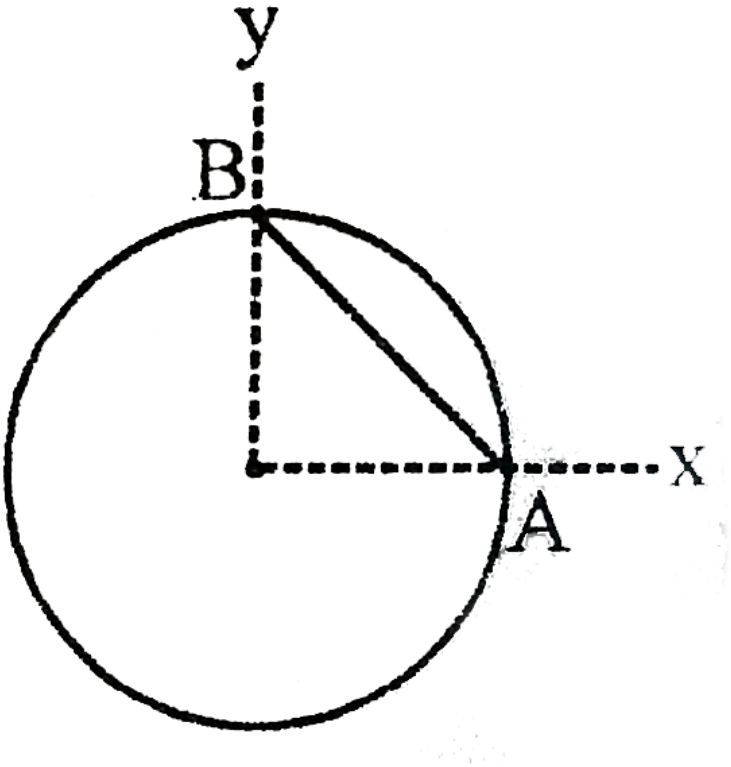
23. An object comprises of a uniform ring of radius R and its uniform chord AB (not necessarily made of the same material) as shown. Which of the following can not be the centre of mass of object



A. (R/3, R/3)

B. $\left(R/\sqrt{2}, R/\sqrt{2}\right)$

C. (R/4 , R/4)

D. None of these

Answer:

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24. A projectile of mass 3m explodes at highest point of its path. It breaks into three equalparts. One part retraces its path, the second one comes to rest. The range of the projectile was 100 m if no explosion would have taken place. The distance of the third part from the point of projection when it finally lands on the ground is -

A. 100 m

B. 50 m

C. 250 m

D. 300 m

Answer:

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25. A metre rule, weighing 100 g rests on a table with a part projecting over the edge. Find the length of the part projecting out if a 5 g body hung at the end just tills the rule.

A. 37.5 cm

B. 26.8 cm

C. 40.2 cm

D. 47.6 cm

Answer:

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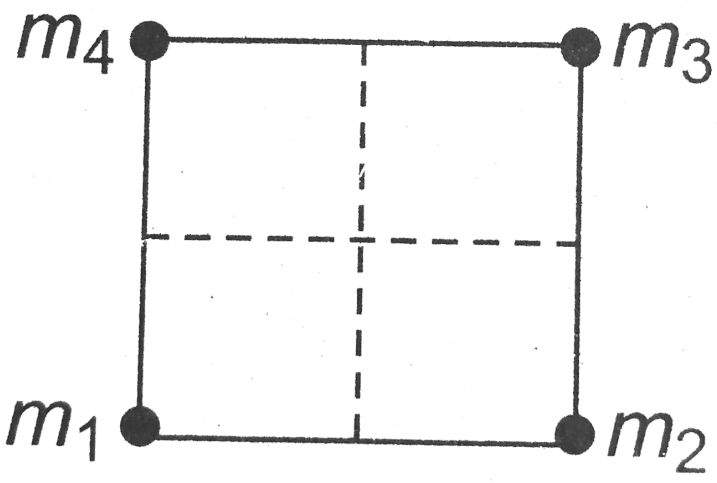
26. Four paticle of masses $m_1 = 2m, m_2 = 4m, m_3 = m$ and m_4 are placed at four corners of a square. What should be the value of m_4 so that the centres of mass of all the four particle are exactly at the centre of the square ?



A. 2m

B. 8 m

C. 6 m

D. None of these

Answer:

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27. Mass is non - uniformly distributed on the circumference of a ring of radius a and centre at origin . Let b be the distance of centre of mass of the ring from origin. Then ,

A. b = a

B. $0 \leq b \leq a$

C. $b < a$

D. $b > a$

Answer:

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28. A man of mass 80 kg is riding on a small cart of mass 40 kg which is rolling along a level floor at a speed 2 m/s . He is running on the cart , so that his velocity relative to the cart is 3 m/s in the direction opposite to the motion of cart . What is the speed of the centre of the mass of the system ?

A. 1.5 m/s

B. 1 m/s

C. 3 m/s

D. Zero

Answer:

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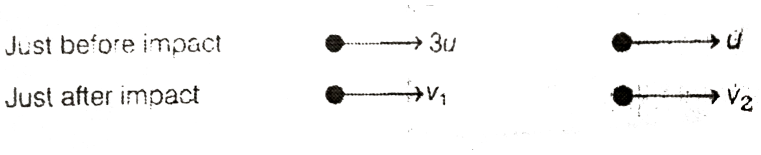
29. Two smooth objects with a coefficient of restitution e , collides directly and bounce as shown .

Newton ' law of restitution gives



A. $e \times 4u = v_2 + v_1$

B. $e \times 2u = v_1 - v_2$

C. $e \times 2u = v_2 - v_1$

D. It cannot be applied as the masses are not known

Answer:

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30. Two billiard balls of same size and mass are in contact on a billiard table. A third ball of same mass and size strikes them symmetrically and remains at rest after the impact. Find the coefficient of restitution between the balls?

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

B. $\frac{1}{3}$

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

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

Answer:

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31. After perfectly inelastic collision between two identical balls moving with same speed in different directions, the speed of the combined mass becomes half the initial speed. Find the angle between the two before collision.

A. 60°

B. 45°

C. 120°

D. 30°

Answer:

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32. A ball strickes a horizontal floor at an angle $\theta = 45^\circ$ with the normal to floor. The coefficient of restitution between the

ball and the floor is $e = 1/2$. The fraction of its kinetic energy lost in the collision is.

A. $\frac{5}{8}$

B. $\frac{3}{8}$

C. $\frac{3}{4}$

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

Answer:

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33. A gardener waters the plants by a pipe of diameter 1 cm . The water comes out at the rate of 20 cc/s . The reactionary force exerted on the hand of the gardener is

A. 2.54×10^{-5} N

B. 1.62×10^{-3} N

C. 5.1×10^{-3} N

D. Zero

Answer:

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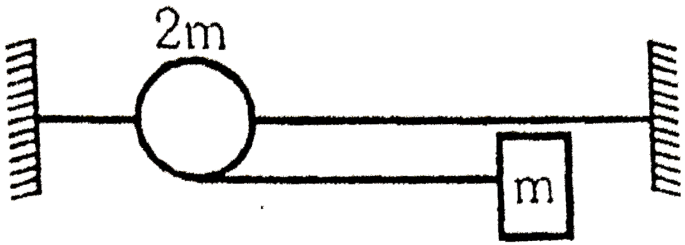
34. A bead can slide on a smooth straight wire and a particle of mass m attached to the bead by a light string of length L. The particle is held in contact with the wire and with the string taut and is then let fall. If the bead has mass $2m$ then when the string makes an angle θ with the wire, the bead will have

slipped a distance.



A. $L(1-\cos\theta)$

B. $\frac{L}{2}(1-\cos\theta)$

C. $\frac{L}{3}(1-\cos\theta)$

D. $\frac{L}{6}(1-\cos\theta)$

Answer:

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35. A man of mass m moves with a constant speed on a plank of mass M and length l kept initially at rest on a frictionless

horizontal surface, from one end to the other in time t. The speed of the plank relative to grounud while man is moving, is

A. $\frac{L}{t}\left(\frac{M}{m}\right)$

B. $\frac{L}{t}\left(\frac{m}{M+m}\right)$

C. $\frac{L}{t}\left(\frac{M}{M-m}\right)$

D. None of these

Answer:

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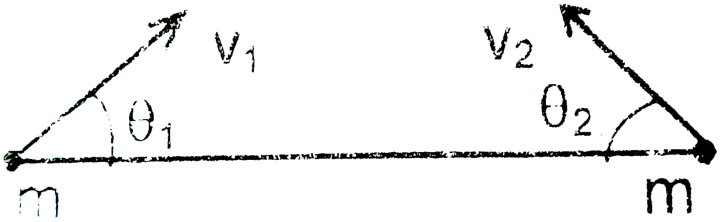
36. Two particles of equal mass 'm' are projected from the ground with speed v_1 and v_2 at angles θ_1 and θ_2 at the same times as shown in figure. The centre of mass of the two

particles.



A. will move in a parabolic path for any values of v_1, v_2, θ_1 and θ_2

B. can move in a vertical line

C. can move in horizontal line

D. will move in a straight line for any value of v_1, v_2, θ_1 and θ_2

Answer:

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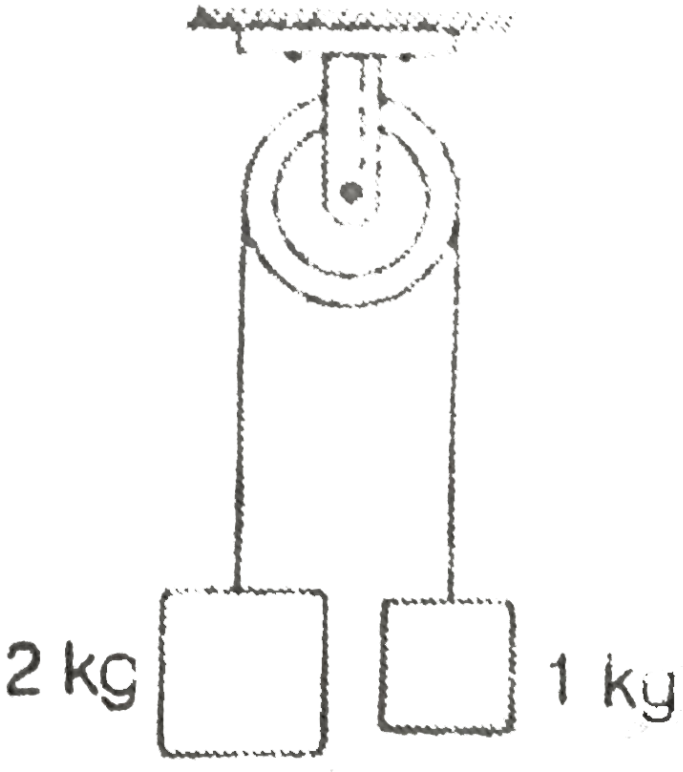
37. Two blocks of masses 2 kg and 1 kg respectively are tied to the ends of a string which passes over a light frictionless pulley . The masses are held at rest at the same horizontal level and then released . The distance traversed by centre of mass in 2 s is (g = 10 m/s^2)



A. 1.42 m

B. 2.22 m

C. 3.12 m

D. 3.33 m

Answer:

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38. A boy of mass $60kg$ is standing over a platform of mass $40kg$ placed over a smooth horizontal surface. He throws a stone of mass $1kg$ with velocity $v = 10m/s$ at an angle of 45° with respect to the ground. Find the displacement of the platform (with boy) on the horizontal surface when the stone lands on the ground. Take $g = 10m/s^2$.

A. 25 cm

B. 5 cm

C. 10 cm

D. 50 cm

Answer:

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39. A particle of mass m moving with a speed v hits elastically another staionary particle of mass $2m$ on a smooth horizontal circular tube of radius r. Find the time when the next collision will take place?

A. $\frac{2\pi r}{v}$

B. $\frac{4\pi r}{v}$

C. $\frac{3\pi r}{2v}$

D. $\frac{\pi r}{v}$

Answer:

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40. A particle of mass 100 g moving at an initial speed u collides with another particle of same mass kept initially at rest. If the total kinetic energy becomes 0.2 J after the collision what could be minimum and the maximum value of u.

A. minimum value of v is 2 m/s

B. maximum value of v is 4 m/s

C. minimum value of v is 3 m/s

D. maximum value of v is 6 m/s

Answer:

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41. A sphere is moving with velocity vector $2\hat{i} + 2\hat{j}$ immediately before it hits a vertical wall. The wall is parallel to $\hat{j}$ and the coefficient of restitution of the sphere and the wall is $e = \frac{1}{2}$. Find the velocity of the sphere after it hits the wall?

A. $\hat{i} - \hat{j}$

B. $-\hat{i} + 2\hat{j}$

C. $-\hat{i} - \hat{j}$

D. $2\hat{i} - \hat{j}$

Answer:

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42. In one dimensional elastic collison of equla masses, the velocities are interchanged. Can velocities ina one dimensional collision be interchanged if the masses are not equal?

A. Only (i) is correct

B. Only (ii) is correct

C. Both (i) and (ii) are correct

D. Both (i) and (ii) are wrong

Answer:

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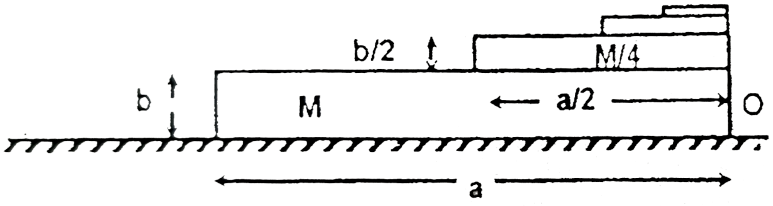
43. Infinite number of bricks are placed one over the other as shown in the figure. Each succeeding brick having half the length and breadth of its preceding brick and the mass of each succeeding bricks being $(1/4)^{th}$ of the preceding one. Taking $'O'$ as the origin, the x coordinate of centre of mass of the system of bricks is at



A. $-\frac{a}{7}$

B. $\frac{3a}{7}$

C. $-\frac{3a}{7}$

D. $-\frac{2a}{7}$

Answer:

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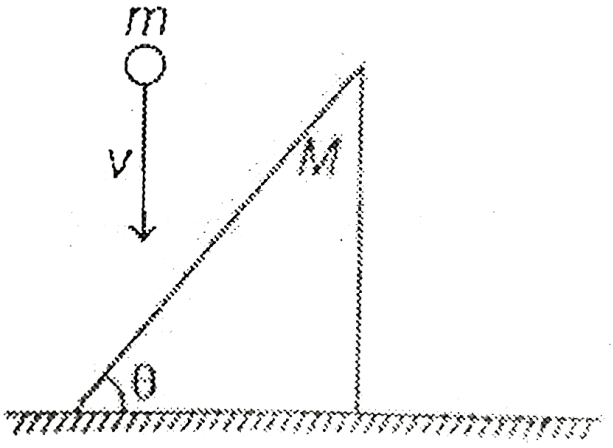
44. A ball of mass m moving vertically down , collides with inclined surface of the wedge . After the collision , wedge starts moving in horizontal direction with velocity v_0 . If all the surfaces are smooth then impulse applied by wedge on the ball during collision is given by



A. $Mv_0\sin\theta$

B. $Mv_0\cos\theta$

C. $\frac{Mv_0}{\sin\theta}$

D. $\frac{Mv_0}{\cos\theta}$

Answer:

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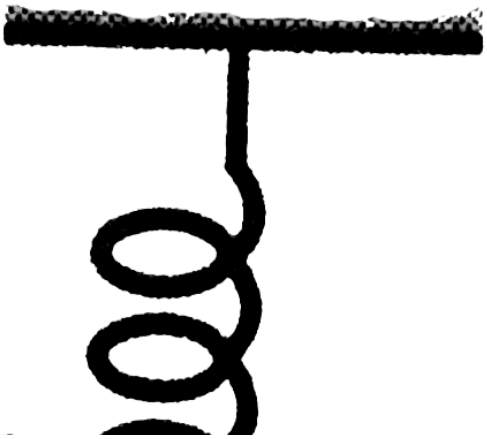
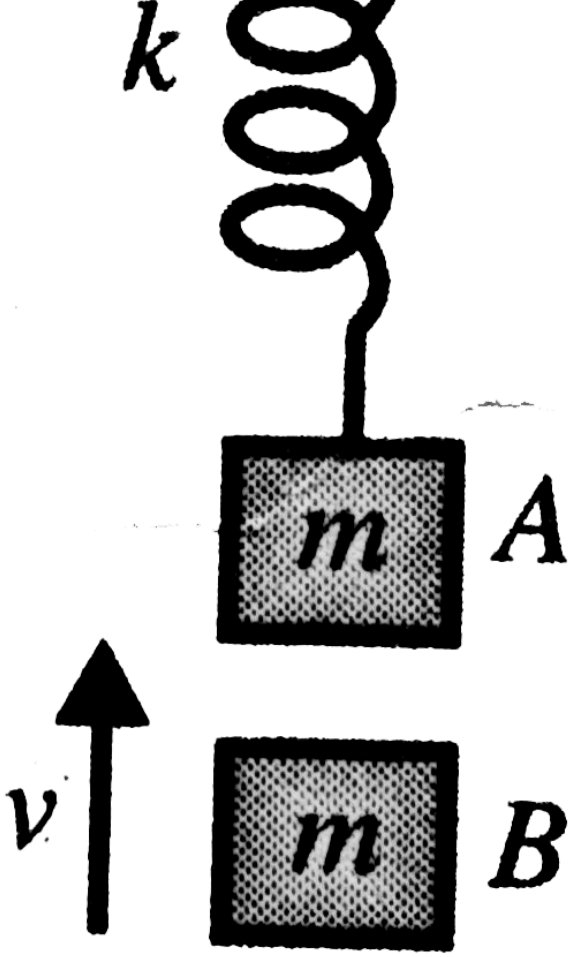
45. Block A is hanging from a vertical spring and is at rest. Block B strikes the block A with velocity v and sticks to it. Then the value of v for which the spring just attains natural length is





A. $\sqrt{\frac{5mg^2}{k}}$

B. $\sqrt{\frac{6mg^2}{k}}$

C. $\sqrt{\frac{4mg^2}{k}}$

D. $\sqrt{\frac{8mg^2}{k}}$

Answer:

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46. Three blocks of identical masses are placed on a frictionless table as shown . The centre block is at rest , whereas the other two blocks are moving directly towards the stationary block with identical speed v . The centre block is initially closer to the left block than the right one . All collisions are elastic . After long time , which of the following is true .

A. The centre block is moving towards left

B. The centre block is at rest somewhere to the left of its initial position .

C. The centre block is at rest at its initial position

D. The centre block is at rest somewhere to the right of its initial position .

Answer:

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47. A stream of water droplets, each of mass m = 0.001kg are fired horizontally at a velocity of $10m/s$ towards a vertical steel plate where they collide. The droplets one spaced equidistant with a spacing of $1cm$. What is approximate average force exerted on the plate by the water droplets. (Assuming that they do not rebound after collision.)

A. 10 N

B. 100 N

C. 1 N

D. $0.1N$

Answer:

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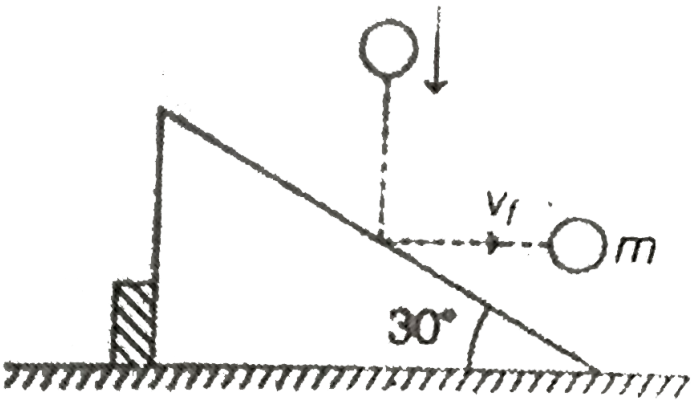
Only One Option Is Correct For Jee Advanced

1. As shown in the figure a body of mass m moving vertically with speed 3 m/s hits a smooth fixed inclined plane and rebounds with a velocity v_f in the horizontal direction . If angle

of plane with horizontal is 30° , the velocity v_f will be



A. 3 m/s

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

C. $1/\sqrt{3}m/s$

D. 2 m/s

Answer:

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2. A hemisphere of radius R and mass 4 m is free to slide with its base on a smooth horizontal table . A particle of mass m is placed on the top of the hemisphere . The angular velocity of the particle relative to centre of hemisphere at an angular displacement θ when velocity of hemisphere has become v is

A. $\frac{5v}{R\cos\theta}$

B. $\frac{2v}{R\cos\theta}$

C. $\frac{3v}{R\sin\theta}$

D. $\frac{5v}{R\sin\theta}$

Answer:

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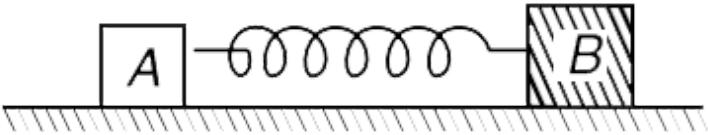
3. Two blocks A and B of mass m and $2m$ respectively are connected by a light spring of force constant k. They are placed on a smooth horizontal surface. Spring is stretched by a length x and then released. Find the relative velocity of the blocks when the spring comes to its natural length



A. $\left(\sqrt{\frac{3k}{2m}}\right)x$

B. $\left(\sqrt{\frac{2k}{3m}}\right)x$

C. $\sqrt{\frac{2kx}{m}}$

D. $\sqrt{\frac{3km}{2x}}$

Answer:

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4. A ball of mass m approaches a heavy wall of mass M with speed 4 m/s along the normal to the wall. The speed of wall before collision is 1m/s towards the ball. The ball collides elastically with the wall. What can you say about the speed of the ball after collision? Will it be slightly less than or slightly higher than 6 m/s ?

A. 5 m/s away from the wall

B. 9 m/s away from the wall

C. 3 m/s away from the wall

D. 6 m/s away from the wall

Answer:

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5. A tennis ball bounces down a flight of stairs, striking each step in turn and rebounding to half to height of the step. The coefficient of restitution is

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

B. $\frac{1}{\sqrt{2}}$

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

D. 1

Answer:

Watch Video Solution

6. A gun fires a bullet. The barrel of the gun is inclined at an angle of 45° with horizontal. When the bullet leaves the barrel

it will be travelling at an angle greater than 45° with the horizontal. Is this statement true or false?

A. 45°

B. less than 45°

C. more than 45°

D. zero

Answer:

Watch Video Solution

7. A small block of superdense material has a mass $\frac{M}{3}$, where M is the mass of earth . It is released from rest from a height h ($<<$ radius of earth) from the surface of earth . The speed of the block at a height $\frac{h}{2}$ is

A. $\sqrt{gh}$

B. $\frac{\sqrt{(3gh)}}{2}$

C. $\sqrt{\frac{2gh}{3}}$

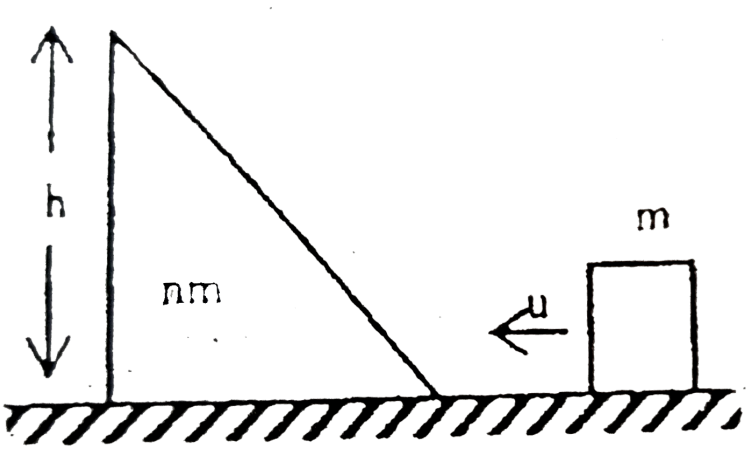
D. $\sqrt{2gh}$

Answer:

Watch Video Solution

8. A block of mass m is pushed towards a movable wedge of mass nm and height h, with a velocity u. All surfaces are smooth. The minimum value of u for which the block will reach

the top of the wedge is



A. $2\sqrt{gh}$

B. $\sqrt{3gh}$

C. $\sqrt{6gh}$

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

Answer:

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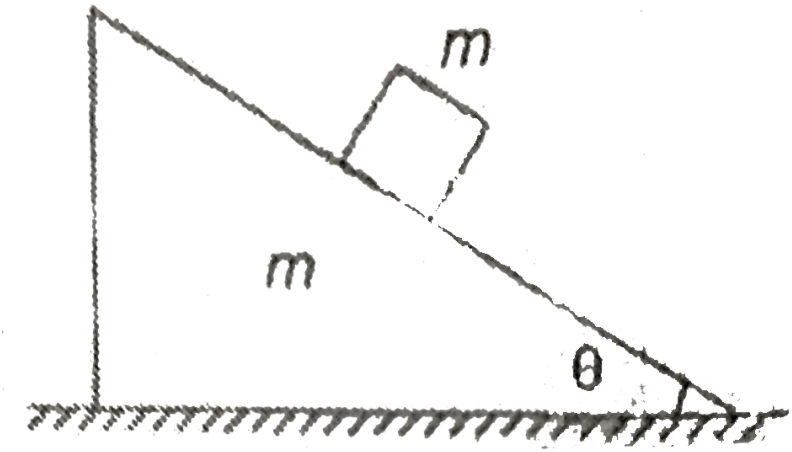
9. A block of mass m slides down on inclined wedge of same mass m as shown in figure . Friction is absent everywhere . Acceleration of centre of mass of the block and wedge is



A. zero

B. $\frac{g\sin^2\theta}{(1+\sin^2\theta)}$

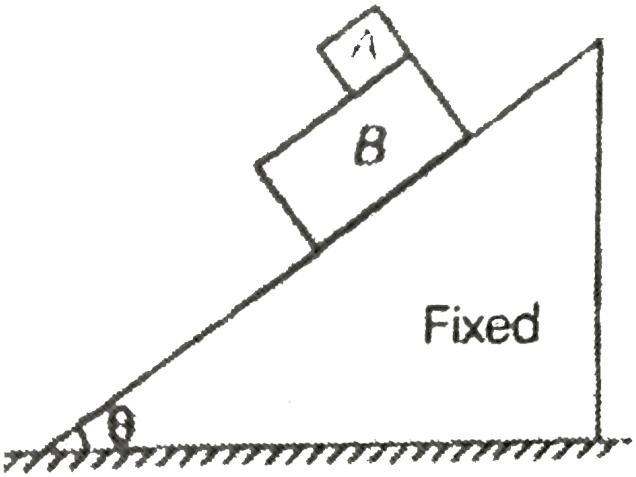
C. $\frac{g\cos^2\theta}{(1+\sin^2\theta)}$

D. $\frac{g\sin\theta}{(1+\cos\theta)}$

Answer:

Watch Video Solution

10. A block A slides over an another block B which is placed over a smooth inclined plane as shown in figure . The coefficient of friction between the two blocks A and B is μ . Mass of block B is two times the mass of block A . The acceleration of the centre of mass of two blocks is



A. g sin θ

B. $\frac{g\sin\theta - \mu g\cos\theta}{3}$

C. $\frac{g\sin\theta}{3}$

D. $\frac{2g\sin\theta - \mu g\cos\theta}{3}$

Answer:

Watch Video Solution

11. The momentum of a particle is $P = A + Bt^2$. Where , A and B are constant perpendicular vectors . The force acting on the particle when its acceleration is at 45° with its velocity is

A. $2\sqrt{\frac{A}{B}}B$

B. 2B

C. zero

D. 2A

Answer:

Watch Video Solution

12. Two blocks A and B of equal masses are attached to a string passing over a smooth pulley fixed to a wedge as shown in figure. Find the magnitude of acceleration of centre of mass of the two blocks when they are released from rest. Neglect friction.

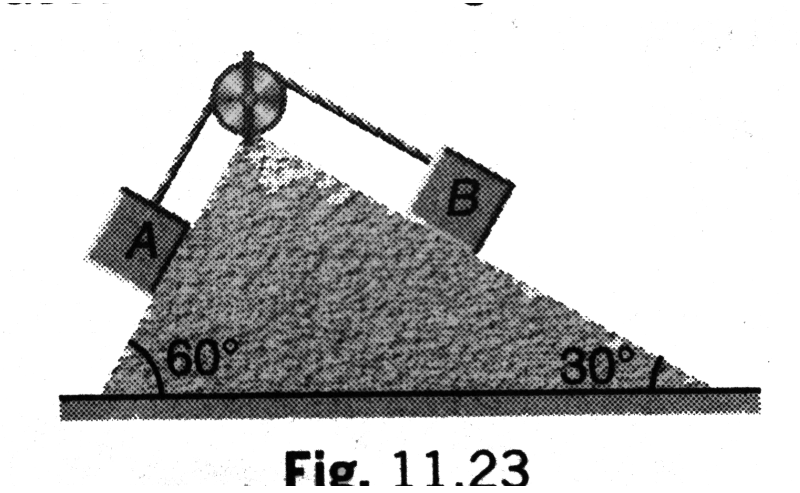


Fig. 11.23

A. $\left(\frac{\sqrt{3}-1}{4\sqrt{2}}g\right)$

B. $(\sqrt{3}-1)g$

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

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

Answer:

Watch Video Solution

13. A rope thrown over a pulley has a ladder with a man of mass m on one of its ends and a counter balancing mass M on its other end. The man climbs with a velocity v_r relative to ladder. Ignoring the masses of the pulley and the rope as well as the friction on the pulley axis, the velocity of the centre of mass of this system is:

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

B. $\frac{m}{2M}v_r$

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

D. $\frac{2M}{m}v_r$

Answer:

Watch Video Solution

14. Two particles of equal mass have velocities $\overrightarrow{v}_1 = 2\hat{i} = m/s^{-1}$ and $\overrightarrow{v}_2 = 2\hat{j}m/s^{-1}$. First particle has an acceleration $\overrightarrow{a}_1 = \left(3\hat{i} + 3\hat{j}\right)ms^{-2}$ while the acceleration of the other particle is zero. The centre of mass of the two particles moves in a path of.

A. circle

B. parabola

C. staright line

D. ellipse

Answer:

Watch Video Solution

15. A particle of mass $2m$ is projected at an angle of 45° with horizontal with a velocity of $20\sqrt{2}m/s$. After $1s$ explosion takes place and the particle is broken into two equal pieces. As a result of explosion one part comes to rest. Find the maximum height attained by the other part. Take $g = 10m/s^2$.

A. 50 m

B. 25 m

C. 40 m

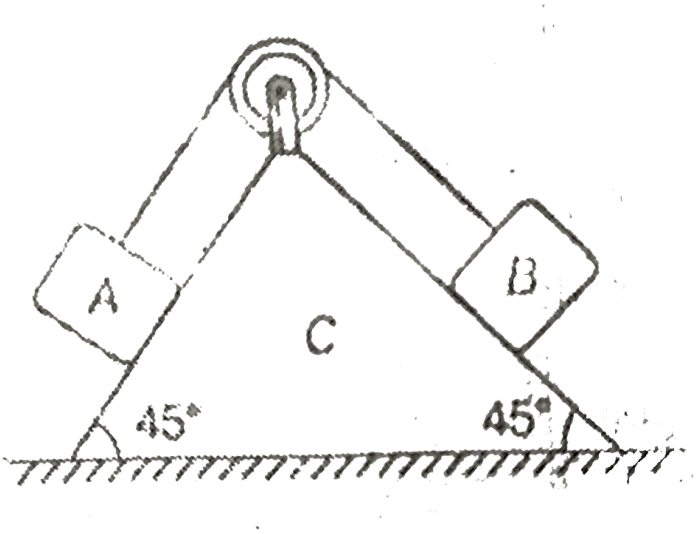
D. 35 m

Answer:

Watch Video Solution

16. A system of two blocks A and B and a wedge C are released from rest as shown in figure . Masses of the blocks and the wedge are m , 2m and 2m respectively . The displacement of wedge C when block B slides down the plane a distance 10 cm is

(neglect friction)



A. $5\sqrt{2}$ cm

B. $3\sqrt{2}$ cm

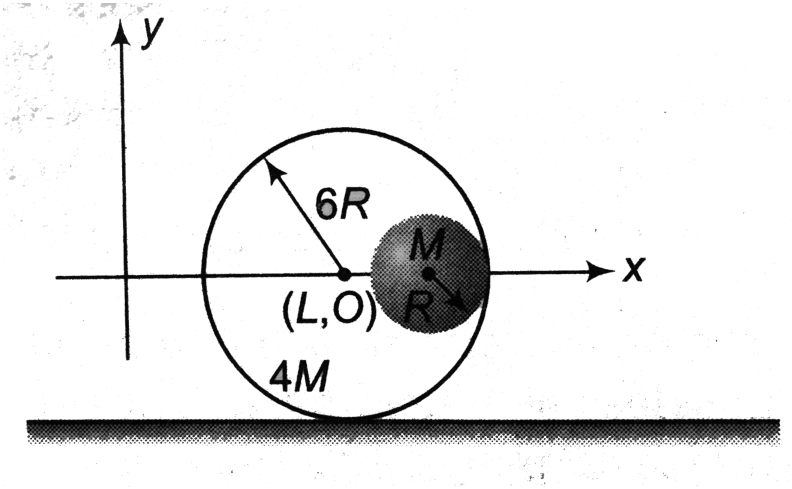
C. 4 cm

D. $\frac{5}{\sqrt{2}}$ cm

Answer:

Watch Video Solution

17. A small sphere of radius R is held against the inner surface of larger sphere of radius $6R$ (as shown in figure). The masses of large and small spheres are $4M$ and M respectivley. This arrangement is placed on a horizontal table. There is no friction between any surfaces of contact. The small sphere is now released. Find the coordinates of the centre of the large spheres, when the smaller sphere reaches the other extreme position.



A. R

B. 2R

C. 3R

D. 4R

Answer:

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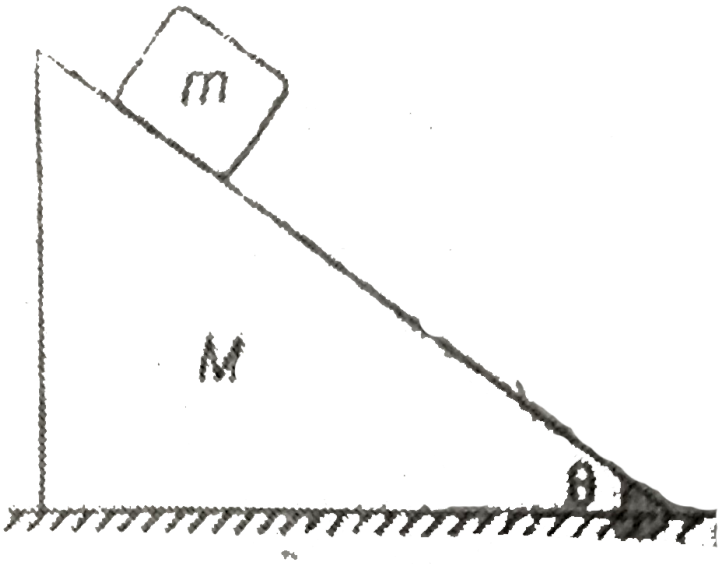
18. A block of mass m slides over a smooth wedge of mass M which is placed over a rough horizontal surface . The centre of mass of the system will move towards left



Here μ = coefficient of friction between the wedge and the ground .

A. if mg cos $\theta \sin\theta > \mu(M+m)g$

B. if mg $\sin\theta > \mu Mg$

C. if mg cosθ sin $\theta > \mu Mg$

D. None of the above

Answer:

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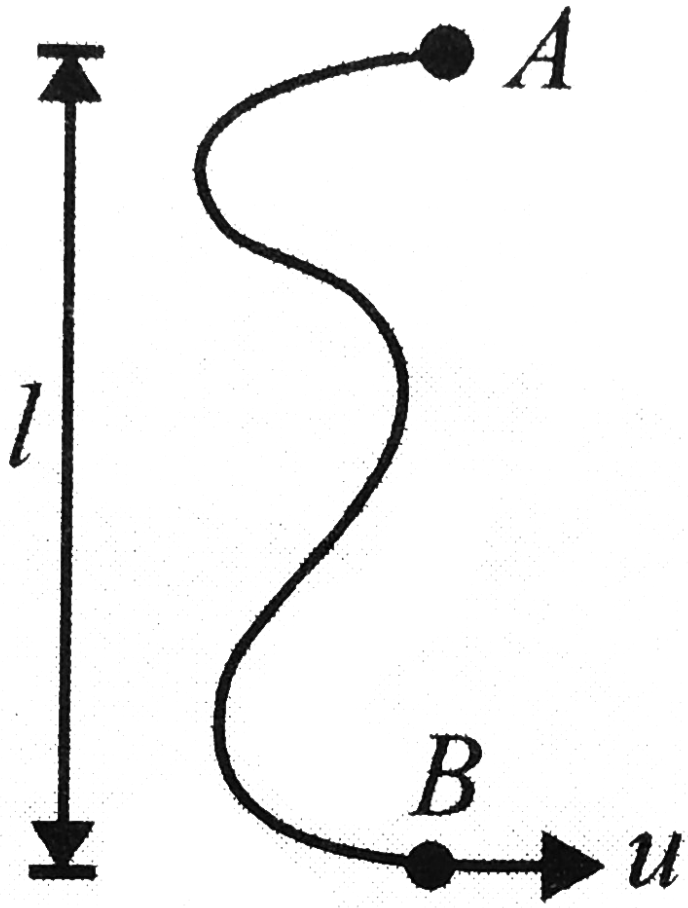
19. Two particles A and B of equal mass m are attached by a string of length $2l$ and initially placed over a smooth horizontal table in the positoin shown in fig. particle B is projected across the table with speed u perpendicular to AB as shown in the figure. find the velocities of each particle after the string

becomes taut and the magnitude of the impulse tension.



A. $\frac{u\sqrt{3}}{4}$

B. $u\sqrt{3}$

C. $\frac{u\sqrt{3}}{2}$

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

Answer:

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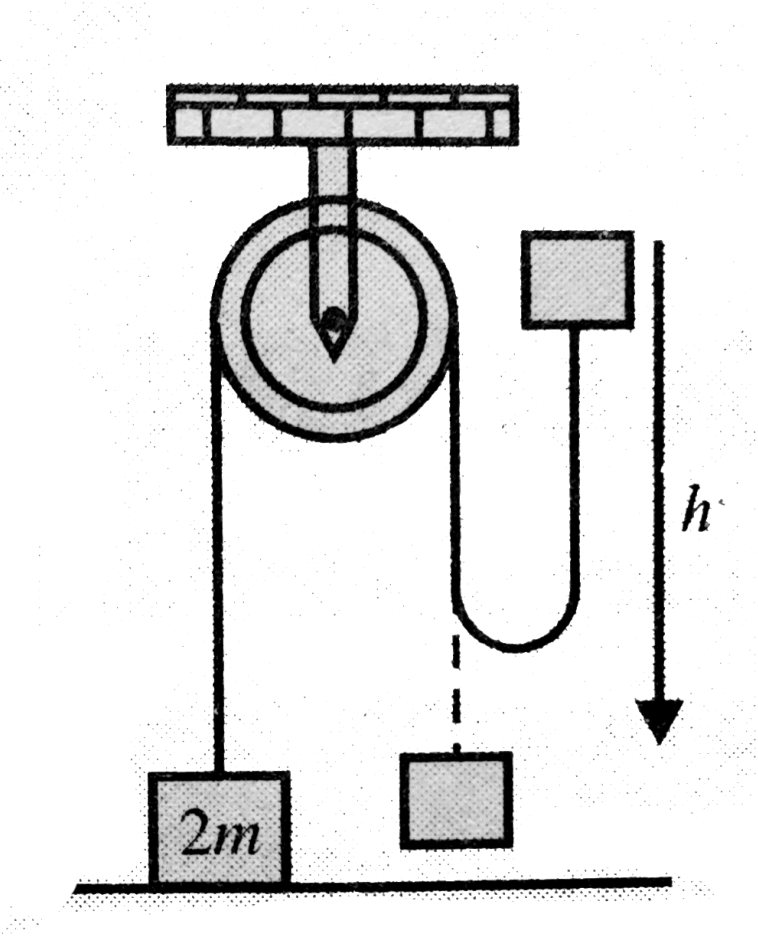
20. A mass m rests on a horizontal table. It is attached to a light inextensible string which passes over a smooth pulley and carries a mass m at the other end. If the mass m is raised vertically through a distance h and is then dropped, what is the

speed with which the mass $2m$ begins to rise?



A. $\sqrt{2gh}$

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

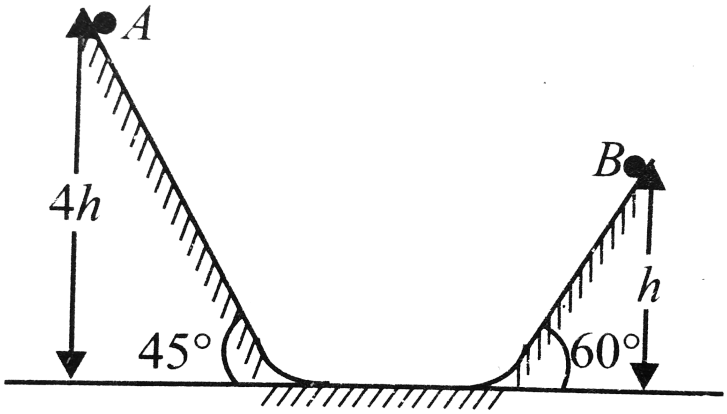
C. $\frac{\sqrt{gh}}{2}$

D. $\sqrt{gh}$

Answer:

Watch Video Solution

21. Two identical balls A and B are released from the position shown in Fig. They collide elastically with each other on the horizontal portion. The ratio of heights attained by A and B after collision is (neglect friction)



A. $1:4$

B. $2:1$

C. $4:13$

D. $2:5$

Answer:

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22. A small block of mass M moves with velocity 5 m/s towards an another block of same mass M placed at a distance of 2 m on a rough horizontal surface . Coefficient of friction between the blocks and ground is 0.25 . Collision between the two blocks is elastic , the separation between the blocks , when both of them come to rest , is (g = $10m/s^2$)

A. 3 m

B. 4 m

C. 2 m

D. 1.5 m

Answer:

Watch Video Solution

23. A gun fires a shell and recoils horizontally . If the shell travels along the barrel with speed v , the ratio of speed with which the gun recoils if (i) the barrel is horizontal (ii) inclined at an angle of 30° with horizontal is

A. 1

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

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

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

Answer:

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24. A body of mass m_0 is placed on a smooth horizontal surface . The mass of the body is decreasing exponentially with disintegration constant , λ . Assuming that the mass is ejected backwards with a relative velocity u . If initially the body was at rest , the speed of body at time t is

A. $ue^{\lambda t}$

B. $u\lambda t$

C. $ue^{-\lambda t}$

D. $u\left(1-e^{-\lambda t}\right)$

Answer:

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25. A ballon has 2 g of air . A small hole is pierced into it . The air comes out with relative velocity 4 m/s . If the balloon shrinks completely in 2.5 s , the average force acting on the balloon is

A. $0.008N$

B. 0.0032 N

C. 8 N

D. 3.2 N

Answer:

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26. In a one-dimensional collision between two identical particles. A and B, B is stationary and A has momentum p before impact. During impact, B gives an impulse J to A. Find the coefficient of restitution between A and B?

A. $\frac{2J}{P} - 1$

B. $\frac{2J}{P} + 1$

C. $\frac{J}{P} + 1$

D. $\frac{J}{P} - 1$

Answer:

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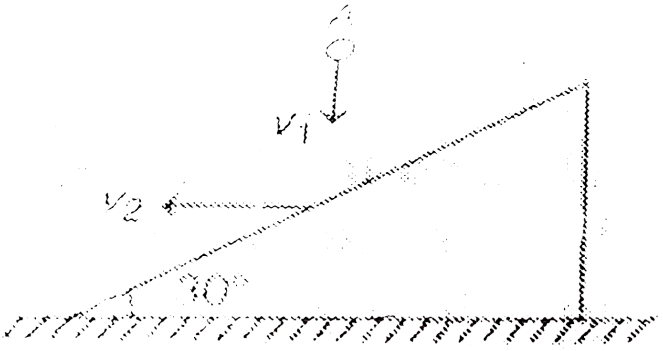
27. A ball A is falling vertically downwards with velocity v_1 . It strikes elastically with a wedge moving horizontally with velocity v_2 as shown in figure . What must be the ratio $\frac{v_1}{v_2}$, so that the ball bounces back in vertically upward direction relative to the wedge



A. $\sqrt{3}$

B. $\frac{1}{\sqrt{3}}$

C. 2

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

Answer:

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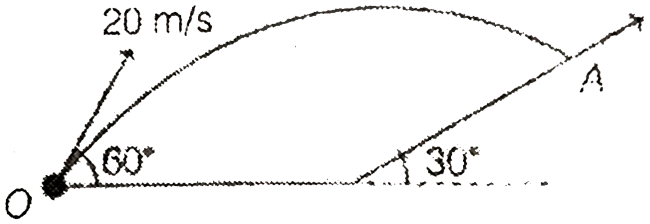
28. A ball is projected from the point O with velocity 20 m/s at an angle of 60° with horizontal as shown in figure. At highest point of its trajectory it strikes a smooth plane of inclination 30° at point A. The collision is perfectly inelastic. The maximum height from the ground attained by the ball is $(g = 10m/s^2)$



A. 18.75m

B. 15 m

C. 22.5 m

D. 20.25 m

Answer:

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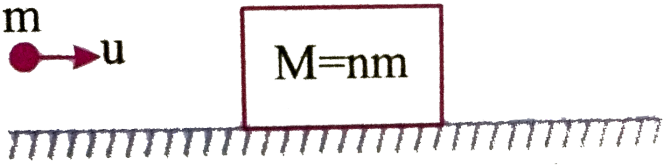
29. A bullet of mass 'm' moving with velocity 'u' passes through a wooden block of mass $M = nm$ as shown in figure. The block is resting on a smooth horizontal floor. After passing through the block, velocity relative to the block is



A. $\frac{(1+n)v-u}{n}$

B. $\frac{nv-u}{n+1}$

C. $\frac{\mathrm{nu}-v}{n+1}$

D. $\frac{(1+n)v+u}{2n+1}$

Answer:

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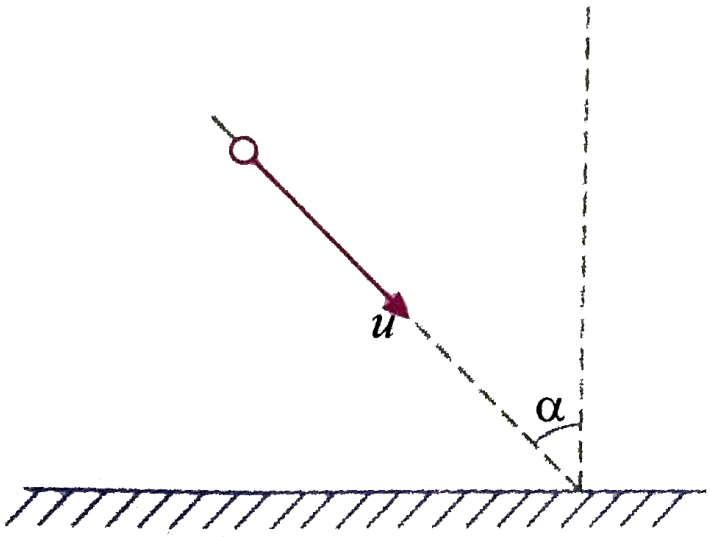
30. A ball of mass m collides with the ground at an angle. With the vertical. If the collision lasts for time t, the average force exerted by the ground on the ball is : (e = coefficient of

restitution between the ball and the ground)



A. $\frac{emu\cos\alpha}{t}$

B. $\frac{2(1+e)mu\cos\alpha}{t}$

C. $\frac{(1+e)mu\cos\alpha}{t}$

D. $\frac{emu}{t}$

Answer:

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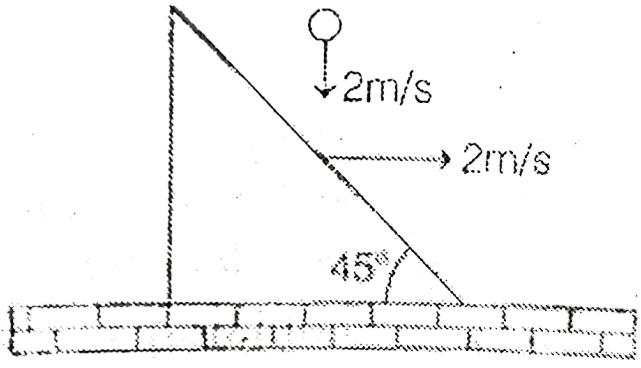
31. A small ball falling vertically downward with constant velocity $2m/s$ strikes elastically an inclined plane moving with velocity $2m/s$ as shown in figure. The velocity of rebound of the ball with respect ground is



A. $4m/s$

B. $2\sqrt{5}m/s$

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

D. $2m/s$

Answer:

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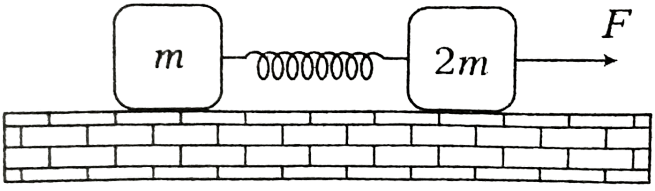
32. Two blocks of mass m and 2m are kept on a smooth horizontal surface. Theya are connected by an ideal spring of force constant k. Initially the spring is unstretched. A constant force is applied to the heavier block in the direction shown in figure. Suppose at time t displacement of smaller block is x_1 then displacement of the heavier block at this moment would be



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

B. $\frac{Ft^2}{6m} + \frac{x}{3}$

C. $\frac{x}{3}$

D. $\frac{Ft^2}{4m} - \frac{x}{2}$

Answer:

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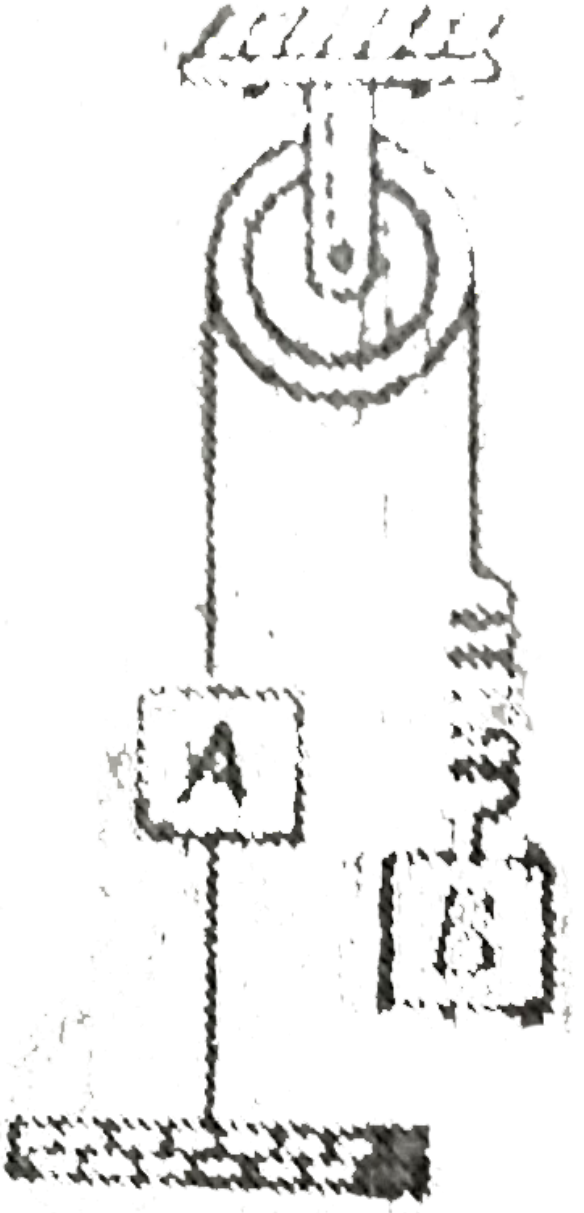
33. Blocks A and B shown in the figure are having equal masses m. The system is released from rest with the spring unstretched. The string between A and ground is cut, when there is maximum extension in the spring. The acceleration of

centre of mass of the two blocks at this instant is



A. g

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

C. 2g

D. zero

Answer:

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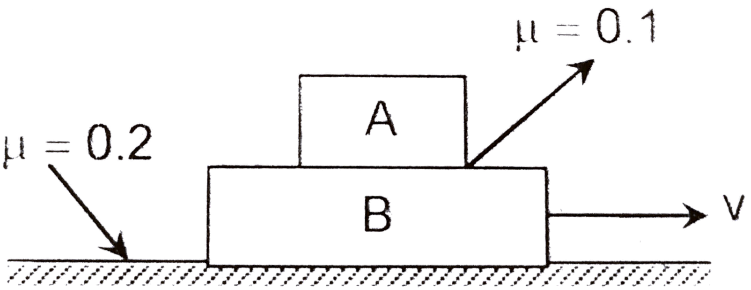
34. Both the blocks as shown in figure are given together a horizontal velocity towards right. The acceleration of the centre

of mass of the system of block is $(m_A = 2m_B = 2kg)$.



A. zero

B. $5/3m/s^2$

C. $7/3m/s^2$

D. $2m/s^2$

Answer:

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35. A particle of mass 3m is projected from the ground at some angle with horizontal. Its horizontal range is R. At the highest point of its path it breaks into two pieces of masses m and 2m respectively. The smallar mass comes to rest. The larger mass finally falls at a distance x from the point of projection where x is equal to

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

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

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

D. $2.5R$

Answer:

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36. A girl throws a ball with an initial velocity v at an angle 45°. The ball strikes a smooth vertical wall at a horizontal distance d from the girl and after rebound returns to her hands. What is the coefficient of restitution between wall and ball ? $\left(v^2 > dg\right)$

A. $v^2 - gd$

B. $\frac{gd}{v^2 - gd}$

C. $\frac{gd}{v^2}$

D. $\frac{v^2}{gd}$

Answer:

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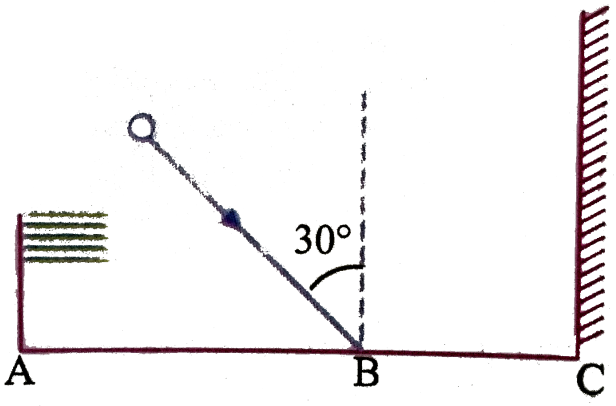
37. A ball collides at B with velocity $10m/s$ at 30° with vertical. There is a flag at A and a will at C. Collision of ball with

groundis perfectly inelastic $(e = 0)$ and that with wall is elastic $(e = 1)$. Given $AB = BC = 10m$. Find the time after which ball will collide with the flag.



A. 4

B. 5

C. 6

D. ball will not collide with the flag

Answer:

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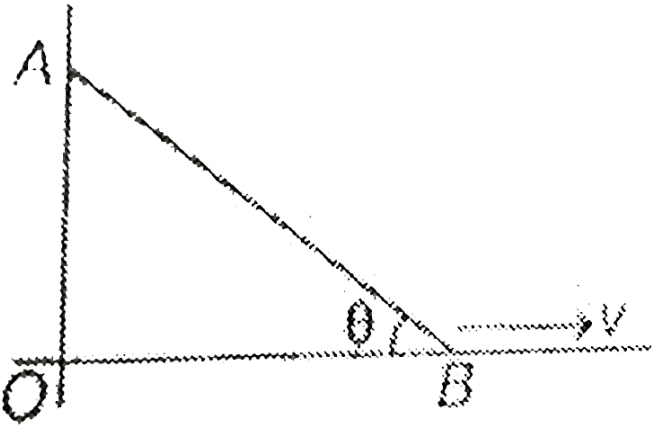
38. The lower end of a 4 m long uniform rod AB is pulled with constant speed v=4 m/s. The speed of centre of mass of the rod at $\theta = 60^\circ$ will be



A. $\frac{4}{\sqrt{3}} m/s$

B. $2\sqrt{3} m/s$

C. $4m/s$

D. $4\sqrt{3} m/s$

Answer:

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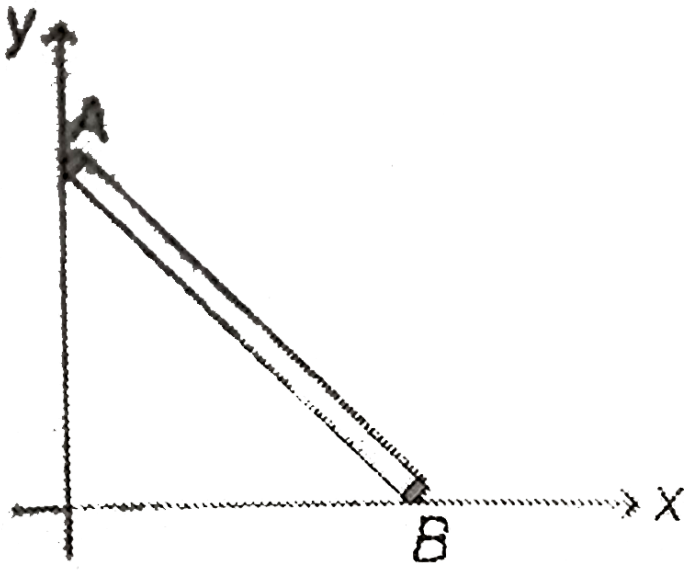
39. A rigid rod leans against a vertical wall (y-axis) as shwon in figure. The other end of the rod is ion the horizontal floor. Point A is pushed downwards with constant velocity. Path of the centre of the rod is



A. a parabola

B. an ellipse

C. a circle of radius $l/2$ and centre at origin

D. a circle of radius $l/2$ but centre not at origin

Answer:

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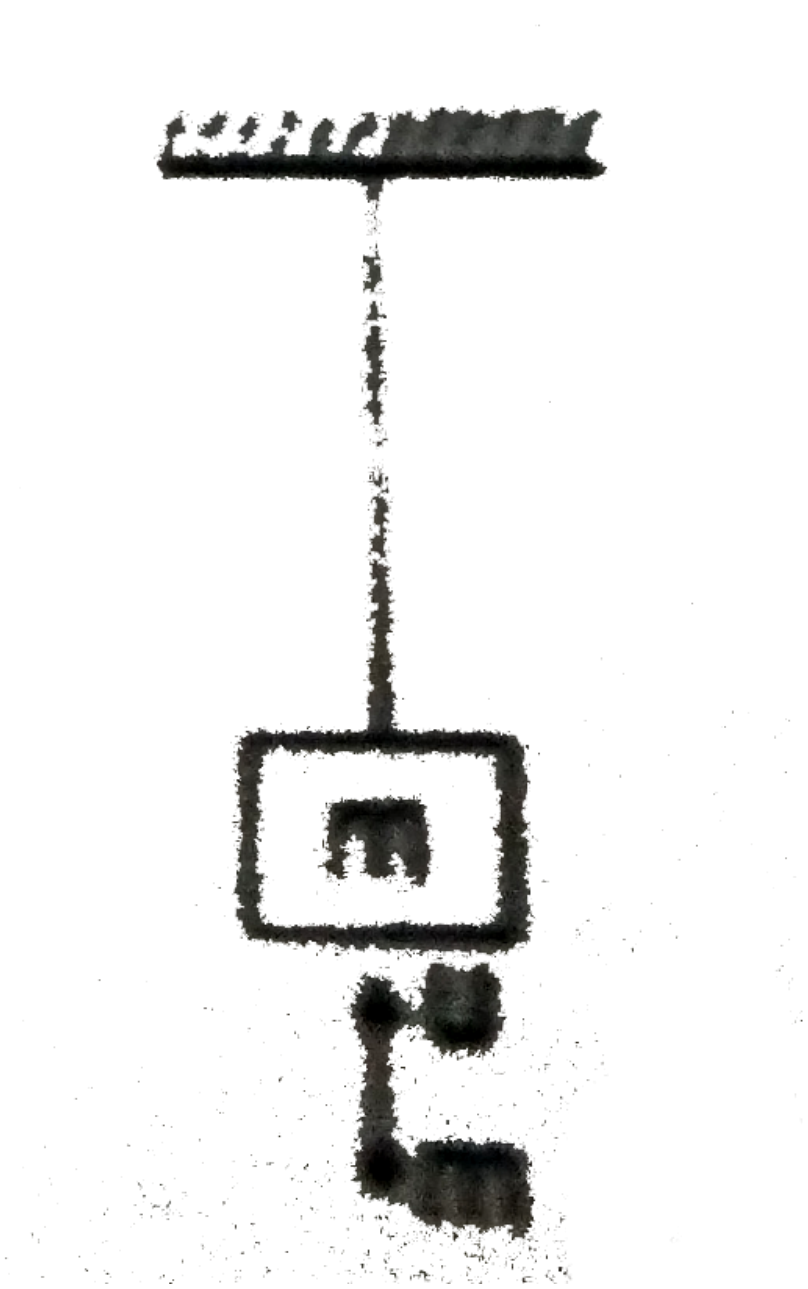
40. A bullet of mass m moving vertically upwards instantaneously with a velocity 'u' hits the hanging block of mass 'm' and gets embedded in it, as shown in the figure. The height through which the block rises after the collision.

(assume sufficient space above block) is:



A. $u^2 / 2g$

B. u^2/g

C. $u^2/8g$

D. $u^2/4g$

Answer:

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41. A super-ball of mass m is to bounce elastically back and forth between two rigid walls at a distance d from each other. Neglecting gravity and assuming the velocity of super-ball to be v_0 horizontally, the average force being exerted by the super-ball on each wall is

A. $\frac{1}{2}\frac{mv_0^2}{d}$

B. $\frac{mv_0^2}{d}$

C. $\frac{2mv_0^2}{d}$

D. $\frac{4mv_0^2}{d}$

Answer:

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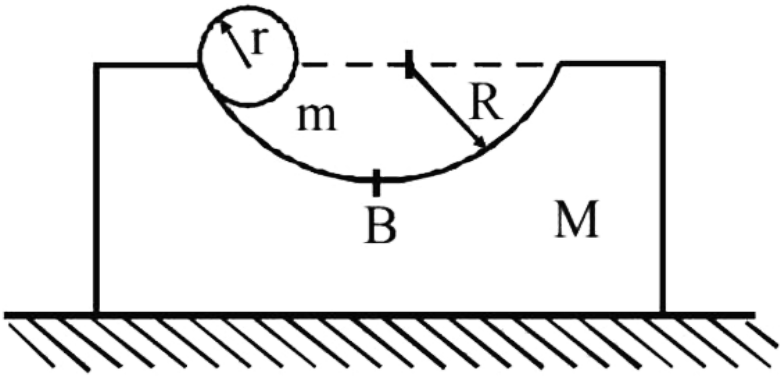
42. A block of mass M with a semicircualr of radius R, rests on a horizontal frictionless surface. A uniform cylinder of radius r and mass m is released from rest the top point A The cylinder slips on the semicircular frictionless track. How far has the block moved when the cylinder reaches the bottom (point B) of the track ? How fast is the block moving when the cylinder

reaches the bottom of the track?



A. $\frac{M(R-r)}{M+m}$

B. $\frac{m(R-r)}{M+m}$

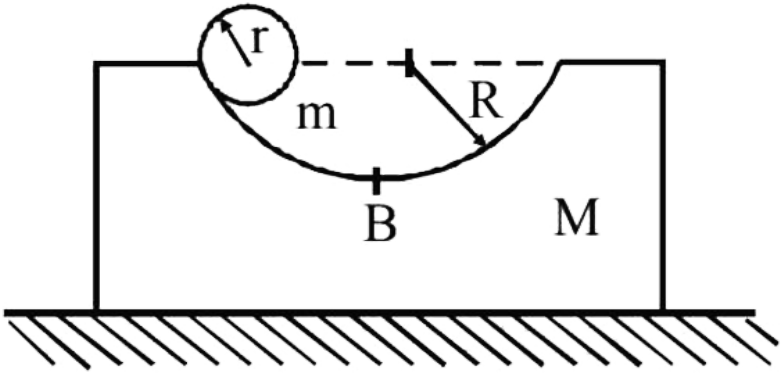
C. $\frac{(M+m)R}{M}$

D. None of these

Answer:

Watch Video Solution

43. A block of mass M with a semicircualr of radius R, rests on a horizontal frictionless surface. A uniform cylinder of radius r and mass m is released from rest the top point A The cylinder slips on the semicircular frictionless track. How far has the block moved when the cylinder reaches the bottom (point B) of the track ? How fast is the block moving when the cylinder reaches the bottom of the track?



A. $M\sqrt{\dfrac{2g(R-r)}{M(M+m)}}$

B. $m\sqrt{\dfrac{2g(R-r)}{m(M+m)}}$

C. $m\sqrt{\frac{2g(R-r)}{M(M+m)}}$

D. $M\sqrt{\frac{2g(R+r)}{M(M+m)}}$

Answer:

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44. A skater of mass m standing on ice throws a stone of mass M with a velocity of v in a horizontal direction. The distance over which the skater will move back (the coefficient of friction between the skater and the ice is μ)

A. $\frac{M^2V^2}{2m\mu g}$

B. $\frac{MV^2}{2m^2\mu g}$

C. $\frac{M^2V^2}{2m^2\mu g}$

D. $\frac{M^2V^2}{2m^2\mu^2 g}$

Answer:

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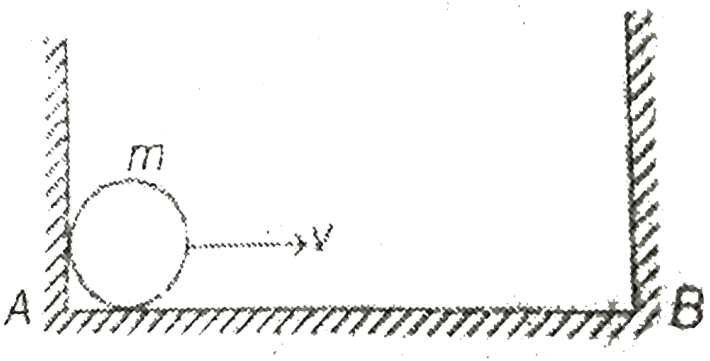
45. A small ball on a frictionless horizontal surface moves towards right with velocity v. It collides with the wall and returns back and continues to and fro motion. If the average speed for first to and fro motion of the ball is $\left(\frac{2}{3}\right)$v, then the coefficient of restitution of impact is



A. 0.5

B. 0.8

C. 0.25

D. 0.75

Answer:

Watch Video Solution

46. A body of mass m is dropped from a height of h. Simultaneously another body of mass $2m$ is thrown up vertically with such a velocity v that they collide at height $\frac{h}{2}$. If the collision is perfectly inelastic, the velocity of combined mass at the time of collision with the ground will be

A. $\sqrt{\frac{5gh}{4}}$

B. $\sqrt{gh}$

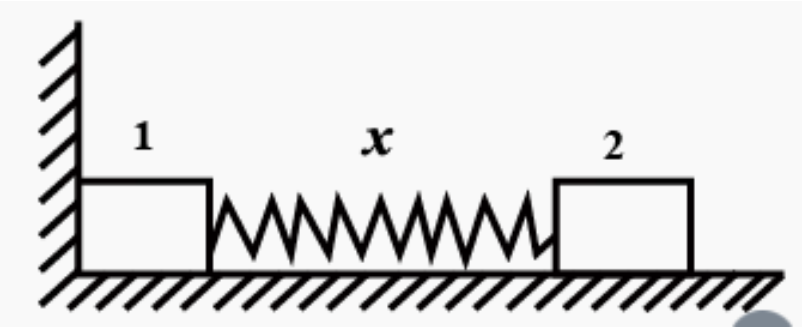
C. $\sqrt{\frac{gh}{4}}$

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

Answer:

Watch Video Solution

47. Two bars of masses m_1 and m_2 connected by a weightless spring of stiffness k, rest on a smooth horizontal plane. Bar 2 is shifted by a small distance x_0 to the left and released. The veloicyt of the centre of mass of the system when bar 1 breaks off the wall is



A. $\frac{x\sqrt{m_2k}}{m_1+m_2}$

B. $x\sqrt{\frac{K}{m_1+m_2}}$

C. $\frac{x\sqrt{m_1k}}{m_1+m_2}$

D. $\frac{\sqrt{m_1k}}{m_1+m_2}$

Answer:

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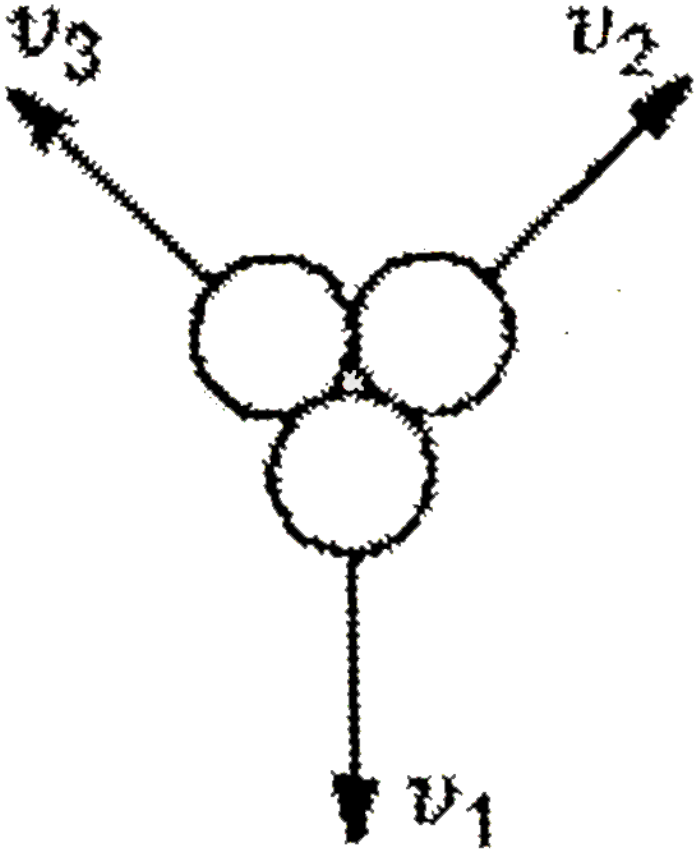
48. A rocket is projected vertically upwords. It explodes at the/ topmost point of its trajectory into three identical fragments . One of the fragments comes straight down in time t 1 while the1 other two land at a time t_2 after explosion. Find the height

at which the explosion ocurred in terms of t_1 and t_2 ?



A. $\frac{gt_1t_2(t_2+3t_1)}{2(t_1+t_2)}$

B. $\frac{gt_1t_2^2}{2t_3}$

C. $\frac{gt_1t_2(t_1+2t_2)}{2(2t_1+t_2)}$

D. $\frac{gt_1t_2(2t_1+t_2)}{4(t_1+2t_2)}$

Answer:

Watch Video Solution

49. A raindrop as it falls through for or mist collects mass at a uniform rate. The drop starts from rest with zero radius and remains spherical at all times. The acceleration with which it falls

A. is constant and equal to $g/2$

B. is constant and equal to $g/3$

C. increases with me

D. decreases with time

Answer:

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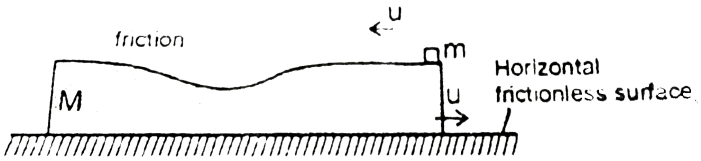
50. A small block of mass 'm' is placed on bigger block of mass M_1 which is placed on a fractionless horizontal surface. The two blocks are given equal speed u_1 but opposite directions, as shown in the figure. After sometime, it is observed that both blocks are moving in the direction of motion of the lower block, with a speed greater than $\frac{u}{2}$. It can be concluded that -



A. $M > 3m$

B. $3M < m$

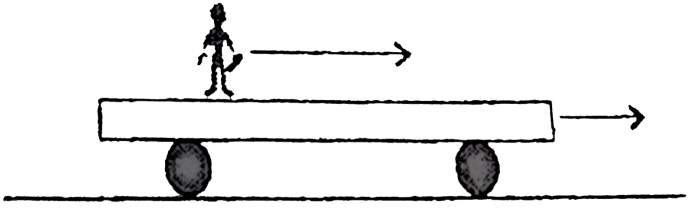
C. $m > 2M$

D. M and m can have any value such that $M > m$

Answer:

Watch Video Solution

51. A trolley is moving horizontally with a constant velocty of vm/s w.e.t. earth. A man starts running from one end of the trolley with velocity $1.5vm/s$ w.r.t. to trolley. After reaching the opposite end, the man return back and continues running with a velocity of $1.5vm/s$ w.r.t. the trolley in the baclward direction. If the length of the trolley is L then the displacement of the man with respect to earth during the process will be :-



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

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

C. $\frac{5L}{3}$

D. 1.5L

Answer:

Watch Video Solution

52. A bullet of mass m penetrates a thickness h of a fixed plate of mass M. If the plate was free to move, then the thickness penetrated will be

A. $\frac{SM}{m}$

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

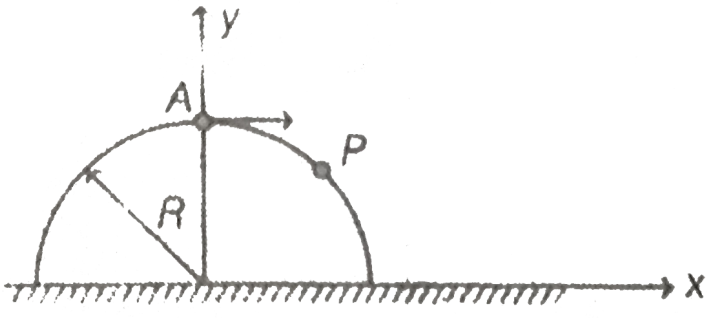
C. $\frac{SM}{M+m}$

D. $\frac{SM}{M}$

Answer:

Watch Video Solution

53. A small particle is placed at the top point A of a fixed smooth hemisphere of radius R. Particle is given small displacement towards right and it starts slipping. Calculate velocity of the particle after hitting horizontal perfectly inelastic surface.



A. $\sqrt{gR}$

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

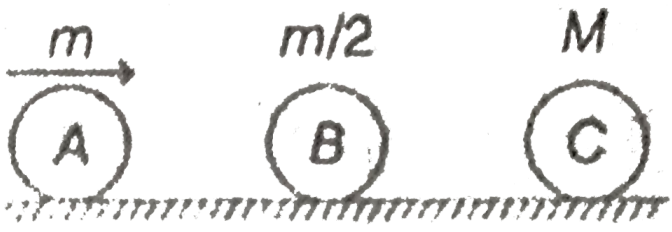
C. $\frac{2}{3}\sqrt{\frac{2}{3}gR}$

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

Answer:

Watch Video Solution

54. Three masses A, B and C are kept on a smooth horizontal surface as shown in the fiugre. A sharp impulse is given to the mass A, so that it starts moving towards B with speed v_0. What is the minimum value of m so that there is only one collision between masses A and B (all collisions are elastic)



A. M

B. $\frac{10M}{3}$

C. $\frac{8M}{3}$

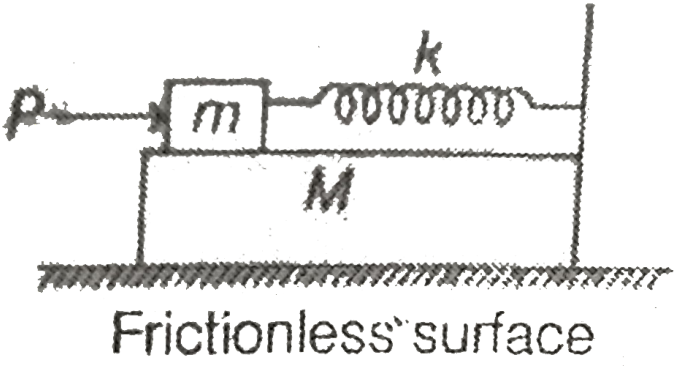
D. $(2M)$

Answer:

Watch Video Solution

55. A block of mass m is attached with a spring of force constant k. The block is kept on a frictionless plank. Mass of the plank is M and it is also kept on a horozontal frictionless surface. Initially the sysetm is stationaryl. An impulse p is applied on the block as shown. The maximum copression in the

spring will be



A. $\sqrt{\frac{MP^2}{m(M+m)k}}$

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

C. $\sqrt{\frac{MP^2}{m^2k}}$

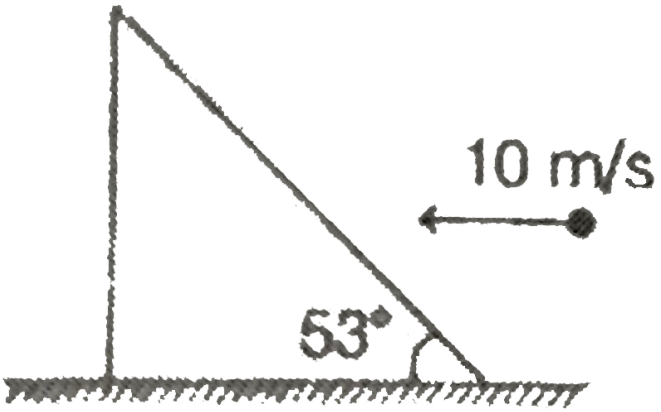
D. $\sqrt{\frac{MP^2}{M^2k}}$

Answer:

Watch Video Solution

More A Than One Option Is Correct

1. A ball mass 2 kg moving horizontally with velocity 10 m/s hits a wedge of mass 5 kg placed on a horizontal surface as shown in the figure. Just after collision klvelocity of wedge is 3.2 m/s. There is no friction at any contact surface. Then (take sin



$30^\circ = 3/5$)

A. Speed of ball just collision id $2\sqrt{10}$ m/s

B. limpulse applied by ball on the wedge during collsion is

20 N-s

C. Both are correct

D. Both are wrong

Answer:

Watch Video Solution

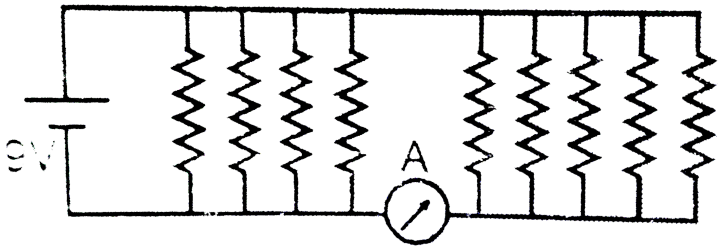
Comprehension Type Questions

1. Comprehension # 1

If net force on a system in a particular direction is zero (say in horizontal direction), we can apply: $\Sigma m_R x_R = \Sigma m_L x_L$, $\Sigma m_R v_R = \Sigma m_L v_L$ and $\Sigma m_R a_R = \Sigma m_L a_L$

Here R stands for the masses which are moving towards right and L for the masses towards left, x is displacement, v is velocity and a the acceleration (all with respect to ground).

A small block of mass $m = 1kg$ is placed over a wedge of mass $M = 4kg$ as shown in figure. Mass m is released from rest. All surface are smooth. Origin O is as shown.



Final velocity of the wedge is .....m/s :-

A. $\sqrt{3}$

B. $\sqrt{2}$

C. $\frac{1}{\sqrt{2}}$

D. $\frac{1}{\sqrt{3}}$

Answer:

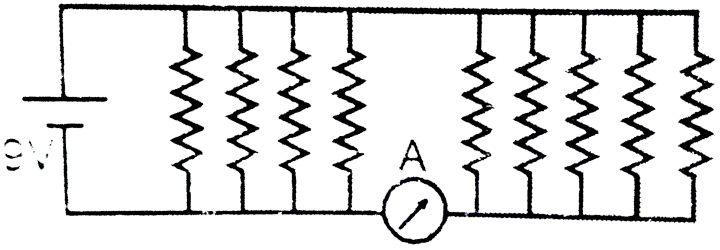
Watch Video Solution

2. Comprehension # 1

If net force on a system in a particular direction is zero (say in horizontal direction), we can apply: $\Sigma m_R x_R = \Sigma m_L x_L$, $\Sigma m_R v_R = \Sigma m_L v_L$ and $\Sigma m_R a_R = \Sigma m_L a_L$

Here R stands for the masses which are moving towards right and L for the masses towards left, x is displacement, v is velocity and a the acceleration (all with respect to ground).

A small block of mass $m = 1kg$ is placed over a wedge of mass $M = 4kg$ as shown in figure. Mass m is released from rest. All surface are smooth. Origin O is as shown.



The block will strike the x-axis at $x =$ ..... m :-

A. 4.2

B. 7.6

C. 5.6

D. 6.8

Answer:

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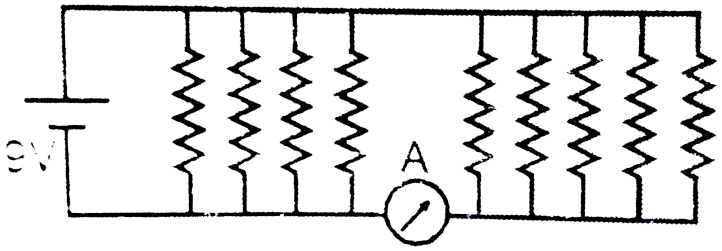
3. Comprehension # 1

If net force on a system in a particular direction is zero (say in horizontal direction), we can apply: $\Sigma m_R x_R = \Sigma m_L x_L$, $\Sigma m_R v_R = \Sigma m_L v_L$ and $\Sigma m_R a_R = \Sigma m_L a_L$

Here R stands for the masses which are moving towards right and L for the masses towards left, x is displacement, v is velocity and a the acceleration (all with respect to ground).

A small block of mass $m = 1kg$ is placed over a wedge of mass

$M = 4kg$ as shown in figure. Mass m is released from rest. All surface are smooth. Origin O is as shown.



Normal reaction between the two blocks at an instant when absolute acceleration of m is $5\sqrt{3}m/s^2$ at 60° with horizontal is ..... N. Normal reaction at this instant is making 30° with horizontal.

A. 6

B. 10

C. 4

D. 5

Answer:

Watch Video Solution

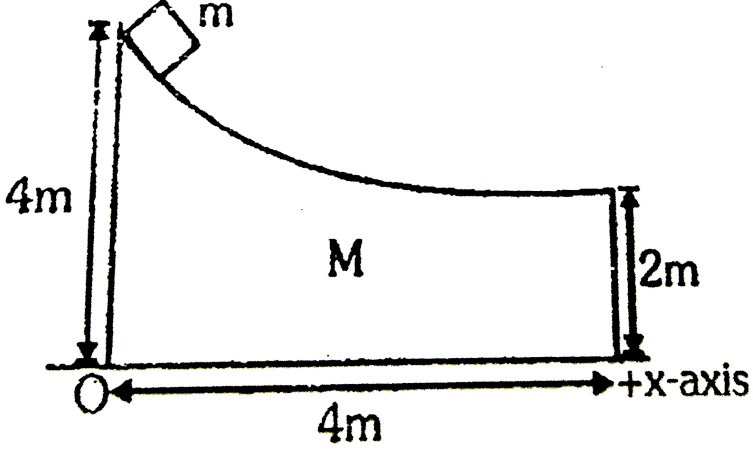
4. Comprehension # 1

If net force on a system in a particular direction is zero (say in horizontal direction) we can apply:

$\Sigma m_R x_R = \Sigma m_L x_L, \Sigma m_R v_R = \Sigma m_L v_L$ and

$\Sigma m_R a_R = \Sigma m_L a_L$

Here R stands for the masses which are moving towards right and L for the masses towards left, x is displacement, v is velocity and a the acceleration (all with respect to ground). A small block of mass $m = 1kg$ is placed over a wedge of mass $M = 4kg$ as shown in figure. Mass m is released from rest. All surface are smooth. Origin O is as shown.



At the same instant reaction on the wedge from the ground is .....N.

A. 42.5

B. 40

C. 43.46

D. None of the above

Answer:

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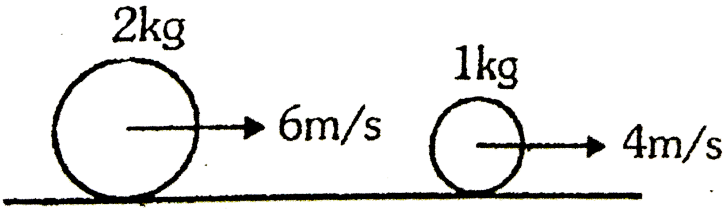
5. Comprehension # 2

When two bodies collide normally they exert equal and opposite impulses on each other. Impulse $=$ change in linear momentum. Coefficient of restitution between two bodies is given by :- $e = \dfrac{|\text{Relative velocity of separation}|}{|\text{Relative velocity of approach}|} = 1$, for elastic collision.



Two bodies collide as shown in figure. During collision they exert impulse of magnitude J on each other.

If the collision is elastic, the value of J is ..... Ns.

A. $10/3$

B. $5/4$

C. $8/3$

D. $3/2$

Answer:

Watch Video Solution

6. Comprehension # 2

When two bodies collide normally they exert equal and opposite impulses on each other. Impulse $=$ change in linear momentum. Coefficient of restitution between two bodies is given by :-

$$e = \frac{|\text{Relative velocity of separation}|}{|\text{Relative velocity of approach}|} = 1, \text{ for elastic collision}$$

Two bodies collide as shown in figure. During collision they exert impulse of magnitude J on each other.

For what value of J (in Ns) the $2kg$ block will change its direction of velocity?

A. $J < 12$

B. $J > 12$

C. $J < 10$

D. $J > 10$

Answer:

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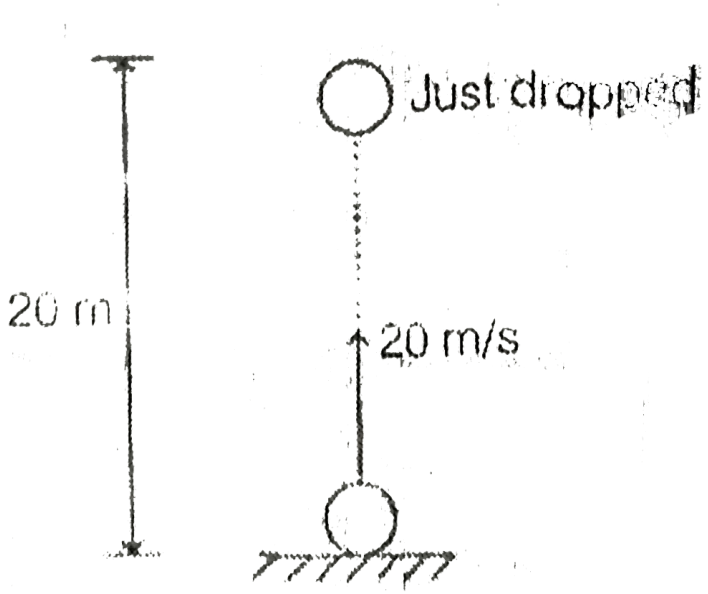
7. Two identiacal masses are as shown in figure. One is thrown upwards with velocity 20 m/s and another is just dropped simultaneously.

The masses collide I air and stick together. After how much time

the combined mass will fall to the gorund (calculate the time from the starting when the motion was started)



A. $\left(1+\sqrt{2}\right)s$

B. $2\sqrt{2}s$

C. $\left(2+\sqrt{2}\right)s$

D. None of the above

Answer:

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8. Two identiacal masses are as shown in figure. One is thrown upwards with velocity 20 m/s and another is just dropped simultaneously.

In the above problem, to what maximum height (from ground) with the combined mass rise ?

A. 25 m

B. 18 m

C. 15 m

D. 20 m

Answer:

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9. Two identiacal masses are as shown in figure. One is thrown upwards with velocity 20 m/s and another is just dropped simultaneously.

If the collision between them is elastic, find the time interval between their striking with ground 

A. Zero

B. 2 s

C. 1 s

D. 3 s

Answer:

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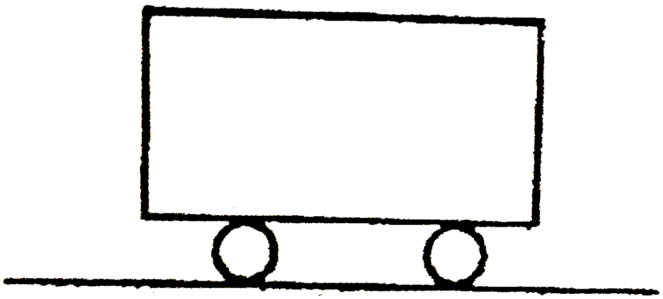
10. Comprehension # 4

When the mass of a system is variable, a thrust force has to be applied on it in addition to all other forces acting on it. This thrust force is given by : $\vec{F} = \vec{v}_r\left(\pm\frac{dm}{dt}\right)$. Here $\vec{v}_r$ is the relative velocity with which the mass dm either enters or leaves the system.



A car has total mass $50kg$. Gases are ejected from its backwards with relative velocity $20m/s$. The rate of ejection of gas is $2kg/s$. Total mass of gas is $20kg$. Coefficient of friction between the car and road is $\mu = 0.1$.

Car will start moving after time $t =$ .....s.

A. 4

B. 10

C. 5

D. 8

Answer:

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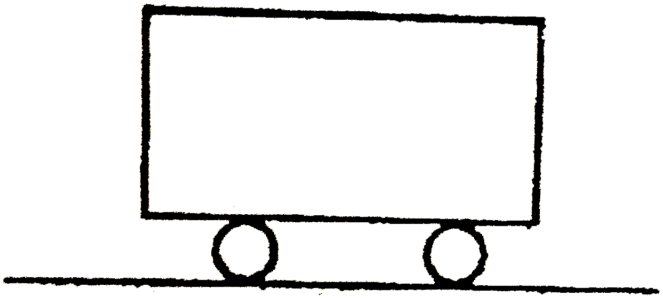
11. Comprehension # 4

When the mass of a system is variable, a thrust force has to be applied on it in addition to all other forces acting on it. This thrust force is given by : $\vec{F} = \vec{v}_r\left(\pm\frac{dm}{dt}\right)$. Here $\vec{v}_r$ is the relative velocity with which the mass dm either enters or leaves the system.



A car has total mass $50kg$. Gases are ejected from its backwards with relative velocity $20m/s$. The rate of ejection of gas is $2kg/s$. Total mass of gas is $20kg$. Coefficient of friction between the car and road is $\mu = 0.1$.

Maximum speed of car will be $v = \ldots\ldots m/s$:- (Take $\ln\left(\frac{4}{3}\right) = 0.28$)

A. 0.6

B. 0.8

C. 1.0

D. 1.2

Answer:

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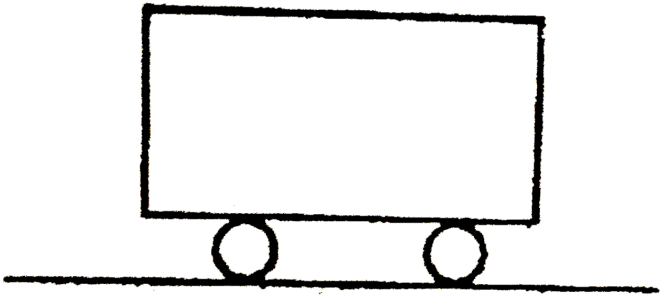
12. Comprehension # 4

When the mass of a system is variable, a thrust force has to be applied on it in addition to all other forces acting on it. This thrust force is given by : $\vec{F} = \vec{v}_r\left(\pm\frac{dm}{dt}\right)$. Here $\vec{v}_r$ is the relative velocity with which the mass dm either enters or leaves the system.



A car has total mass $50kg$. Gases are ejected from its backwards

with relative velocity $20m/s$. The rate of ejection of gas is $2kg/s$. Total mass of gas is $20kg$. Coefficient of friction between the car and road is $\mu = 0.1$.

Car will stop after (from starting) $t =$ ..... . s.

A. 12.2

B. 6.4

C. 10.6

D. 5.8

Answer:

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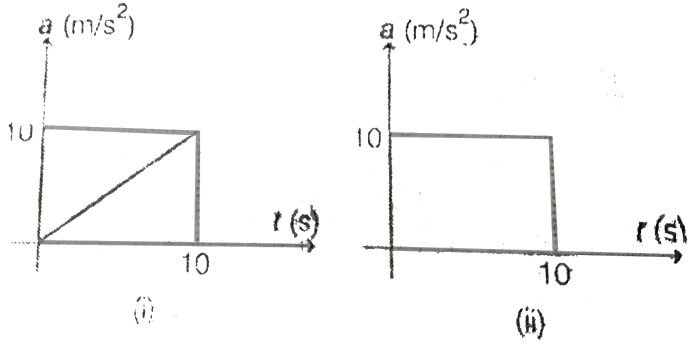
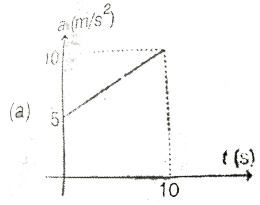
13. Acceleration of two identical particles moving in a straight line are as shown in figure.

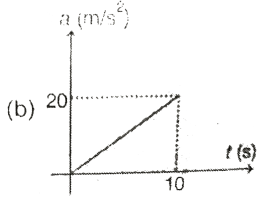


The corresponding a-t graph of their centre of mass will be

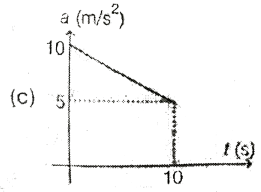
A.



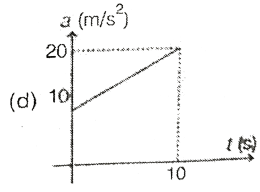
B.



C.



D.



Answer:

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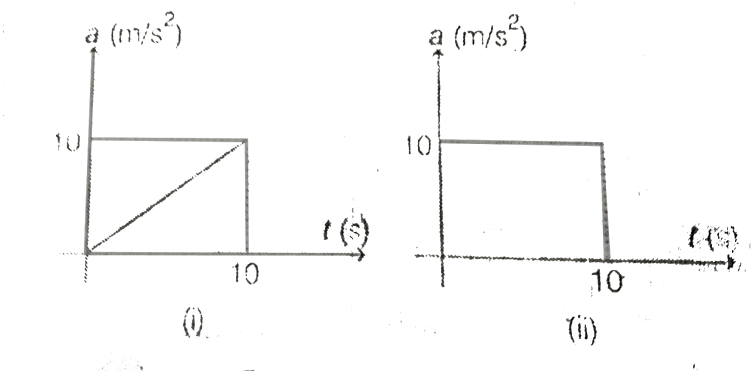
14. Acceleration of two identical particles moving in a straight line are as shown in figure.



If initial velocity of both the particles was zero. Then velocity of their centre of mass after 10 s will be

A. 40 m/s

B. 60 m/s

C. 75 m/s

D. 120 m/s

Answer:

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15. Comprehension # 5

One particle of mass $1kg$ is moving along positive x-axis with velocity $3m/s$. Another particle of mass $2kg$ is moving along y-axis with $6m/s$. At time $t = 0$, $1kg$ mass is at $(3m, 0)$ and $2kg$ at $(0, 9m)$, $x - y$ plane is the horizontal plane. (Surface is smooth for question 1 and rough for question 2 and 3)

The centre of mass of the two particles is moving in a straight line for which equation is :

A. y=x+2

B. $y=4x+2$

C. $y=2x-4$

D. $y=2x+4$

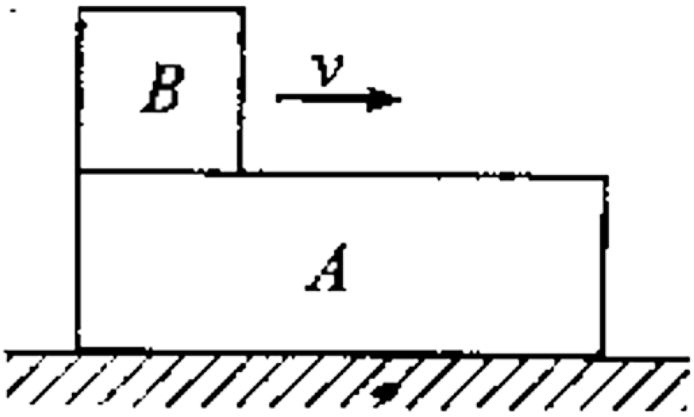
Answer:

Watch Video Solution

Others

1. A long block A is at rest on a smooth horizontal surface. A small block B, whose mass is half of A, is placed on A at one end and projected along A with some velocity u. The coefficient of

friction between the blocks is μ:



A. the blcks will reach a final common velocity $\mu/3$

B. the work done against frotion is two-third of the initial knetic energy of B

C. before the block reach a common velocity the acceleration of A relative to B is (2//3) μ g

D. before the blocks reach a common velocity, the accelerartion of A relative to B is $(3/2)\mu g$

Answer:

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2. In a one dimensional collision between two identical particles A and B, B is stationary and A has momentum p before impact. During impact, B gives impulse J to A.

A. the total momentum of A plus B system is before and after the impact and (p-J) during the impact

B. during the impact B bives impulse J to A

C. the coefficient of restitution is $(2J/p) - 1$

D. the coefficient of resitution is $(2J/p) + 1$

Answer:

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3. Ball A of mass m strickes a stationary ball B of mass M and undergoes an elastic collision. After collision bill A has a speed one third of its initial speed. The ratio of M/m is

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

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

C. 2

D. 4

Answer:

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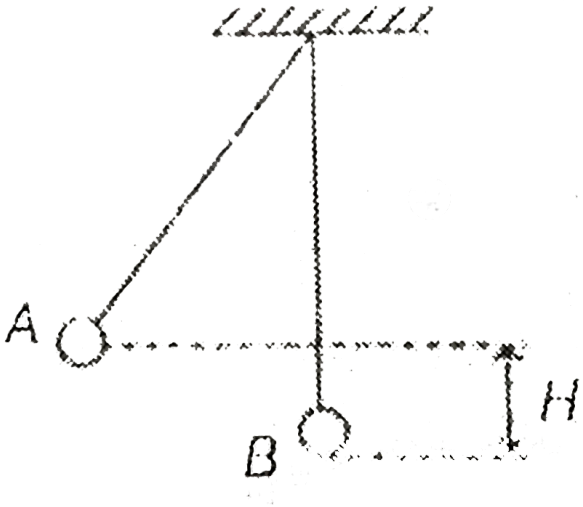
4. Two small balls A and B of mass M and 3M hang from the ceiling by strings of equal length. The ball A is drawn aside, so that it is raised to a height H. It is then releases and collides with ball B. Select the correct answer (s)



A. If collision is elestic, ball B will rise to a height $H/4$

B. If the colisionis elastic ball A will rise upto a height $H/4$

C. If the coliision is perfectly inelastic, the combined mass wil rise to a height $H/16$

D. If the colision is persectly inelastic, the combined mass will rise to a height $H/4$

Answer: A,D

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5. Two particale of same mass and charge throw in same direction along the horizonal with same velocity v from two didffent heights h_1 and h_2 $(h_1 < h_2)$. Initially they were located in the same vertical line. Select the corredct alternative (s).

A. Both the particles always lie on a vertical line

B. Acceleration of the centre of mass of the two particles is g downwards

C. Horizontal dosplacement on reaching to ground of particle lying at h_1 is less than the value, which would had been in the absence of charges on them

D. Horizontal displacement on reaching to ground of particle lying at h_2 is more than the value, which would had been in the absence of charges on them

Answer:

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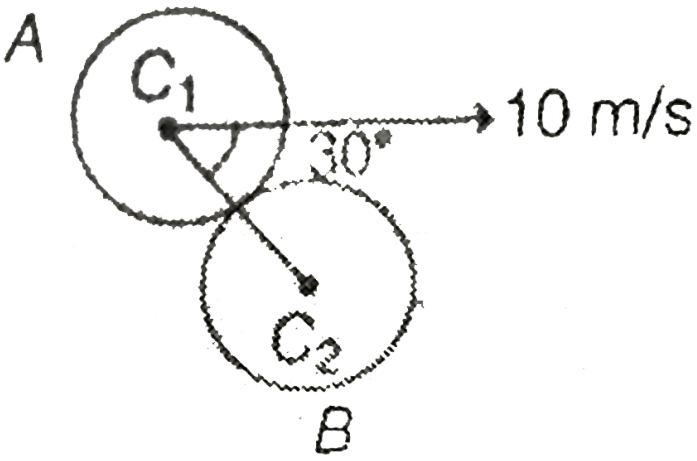
6. A ball A collides elasticlly with an another identical bass B with velocity 10 m//s at an angle of 30° from the line joining

their centres C_1 and C_2 Select the correct alternative (s).



A. Velocity of ball A after colision is 5 m//s

B. Velocity of ball B after colision is $5\sqrt{3}$ m//s

C. Both the balls move at right angles after collision

D. Kinetic enrergy will not be conserved here, because coollision is not head on

Answer: B,C,D

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7. A projectile is fixed on a horizontal ground. Coefficient of restitution between the projectile and the ground is 'e'. If a, b and c be the ration of time of flight $\left[\frac{T_1}{T_2}\right]$, maximum height $\left[\frac{H_1}{H_2}\right]$ and horizontal range $\left[\frac{R_1}{R_2}\right]$ in first two collisions with the ground, then

A. $a = \frac{1}{e}$

B. $b = \frac{1}{2_e}$

C. $c = \frac{1}{2_e}$

D. All of these

Answer:

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8. A man of mass m is standing on a stationary flat car of mass M. The car can move without friction along horizontal rails. The man starts walking with velocity v relative to the car. Work done by him

A. is less then $\frac{1}{2}mv^2$, if he walks along the rails

B. is equal to $\frac{1}{2}mv^2$, if he walks normal to the rails

C. can never be less than $\frac{1}{2}mv^2$,

D. is greater then $\frac{1}{2}mv^2$, if he walks aling the rails

Answer:

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9. A particle moving with kinetic energy E makes and head on elastic collision with an identical particle at rest. Durig the

collision

A. elastic potential energy of the system is always zero

B. maximum elastic potential energy of the systyem is E/2

C. minimum kinetic energy of the system is E/2

D. kinetic energy of the system is constant

Answer: B,C

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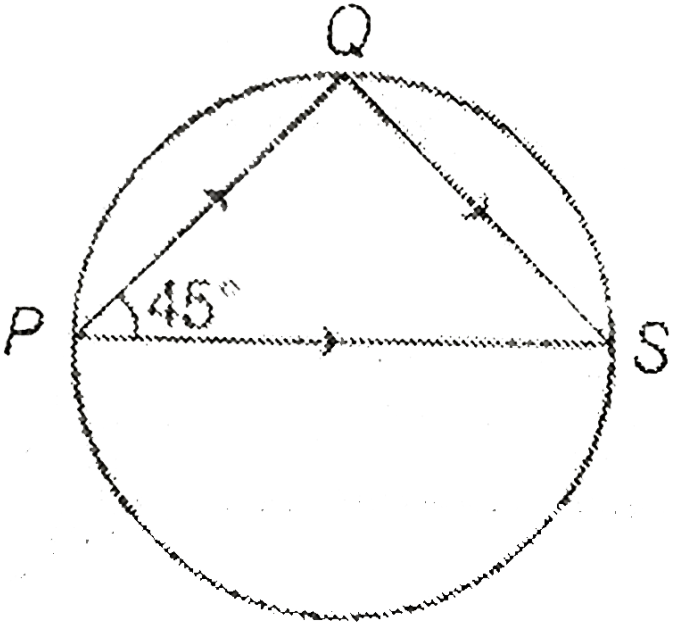
10. A body if fired from point P and strikes at Q inside a smooth circular wall as shown in the figure. It rebounds to poing S

(diametrically oppositee to P), then



A. the coefficient of restitution is $\frac{1}{2}$

B. the coefficient of restitution is 1

C. kinetic enrergy is conserved in this collision

D. kinetic energy is not conserved in this collision

Answer: B,D

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11. A ball B of mass m is lying at rest on the top surface of a smooth horizontal table 5 m high. Another moovin ball A of same mass make an elastic colision with B slides off the table and strikes the floor at a horizonatal distance of 10 m from the table. Then select the correct alternatives (s). $[g = 10m/s^2]$

A. The velocity of the ball A befor collisionis 5 m/s

B. The kinetic energy of the ball B at the time when it strikes yhe ground is (mx100) J

C. the velocity of the ball A before collision is 10 m/s

D. The kinetic energy of the ball B at the time when it strikes the ground is (50xm) J

Answer: C,D

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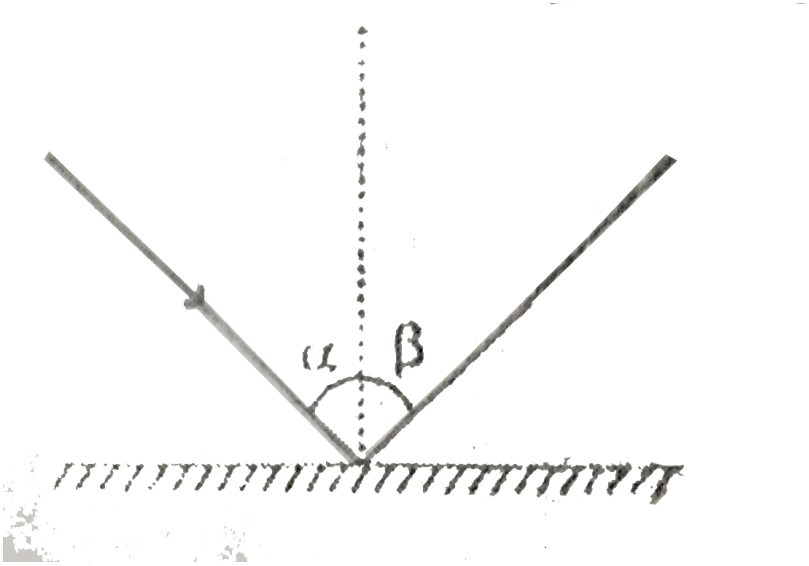
12. A ball strikes the ground at an angle α. and rebound at an angle β. with the verticlal as shown in the figure .Then ,



A. coefficient of restitution is $\frac{\tan\alpha}{\tan\beta}$

B. $\alpha < \beta$ the collision is inelastic

C. if $\alpha < \beta$ the collision is elastic

D. if $\alpha > \beta$ the collision is inelastic

Answer:

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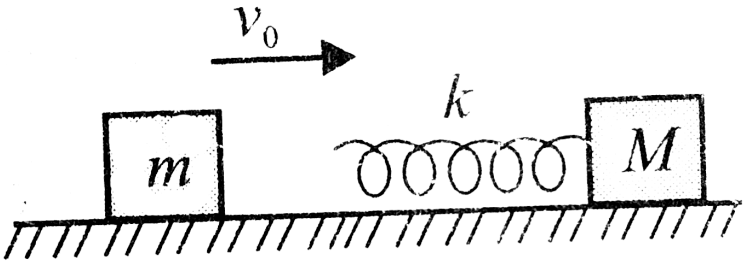
13. A block of mass m moving with a velocity v_0 collides with a stationary block of mass M to which a spring of stiffness k is attached, as shown in Fig. Choose the correct alternative(s)



A. The velocity of centre of mass is $\frac{m}{m+M}v_0$

B. The initial kinetic energy of the system in the centre of mass frame is $\frac{1}{4}\left(\frac{mM}{M+m}\right)v_0^2$

C. The maximum compression in the spring is $\sqrt{\frac{nM1}{(m+M)k}}$

D. When the spring is in the state of maximum compression the kinetic energy in the centre of mass frame is zero

Answer:

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14. In which o the following cases the centre of mass of a rod is certainly not at its centre?

A. the density cintinuously increase from left to right

B. the density con tinuously decreases from left to right

C. the density decreases from left to tight upto the center and then incrases

D. the density increases from left to right upto the centre and then decreases

Answer:

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15. A nonzero external force acts on a system of particles. The velocity and the acceleration of the centre of mass are found to be $v_0 \text{and} a_0$ at an instant t. It is possible that:

A. $v_0 = 0, a_0 = 0$

B. $v_0 = 0, a_0 \neq 0$

C. $v_0 \neq 0, a_o = 0$

D. $v_0 \neq 0, a_o \neq 0$

Answer:

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16. Two particles A and B of equal size but of masses mkg and $2mkg$ are moving directly towards each other with speeds $21m/s$ and $4m/s$ respectively. After collision, A moves with a speed of $1m/s$ in the original direction. Then:

A. The velocity of B after collisionis 5 m/s opposite its direction of mation before collision.

B. The coefficient of restitution is 0.2

C. The loss of kinetic energy due to collision is 200 J

D. The impulse of the force between the two balls is 40 N-s

Answer:

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17. Two identical particles A and B of mass m each are connected together by a light and inextensible string of length l. The particle are held at rest in air in same horizontal level at a separation I. Both particles are released simultaneously and one of them (say A) is given speed V_0 vertically upward. Choose the correct options (s). Ignore air resistance.

A. The maximum height attained by the center of mass of the system of A and B is $\frac{v_0^2}{8g}$

B. The kinetic energy of the system of A and B when the centre of mass is at its highest point is $\frac{mv_0^2}{2}$

C. The maximum height attained by the centre of mass of the system of A and B is $\frac{v_0^2}{4g}$

D. The kinetic energy of the system of A and B when the centre of mass is at its highest point is $\frac{mv_0^2}{4}$

Answer:

Watch Video Solution

18. A smooth sphere A of mass m collides elastically with an identical sphere B at rest. The velocity of A before collision is $8m/s$ in a direction making 60° with the line of centres at the time of impact, Then

A. The spher A comes to rest after collision

B. The sphere B will move with a speed of 8 m/s after collision

C. The directions of motion of A and Bafter collision are at tight angles

D. The speed of B after collsion is 4 m/s

Answer:

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19. Comprehension # 5

One particle of mass $1kg$ is moving along positive x-axis with velocity $3m/s$. Another particle of mass $2kg$ is moving along y-axis with $6m/s$. At time $t = 0$, $1kg$ mass is at $(3m, 0)$ and $2kg$ at $(0, 9m)$, $x - y$ plane is the horizontal plane. (Surface is

smooth for question 1 and rough for question 2 and 3)

If both the particles have the same value of coefficient of friction $\mu = 0.2$. The centre of mass will stop at time $t =$ .....s :-

A. 1.5

B. 4.5

C. 3.0

D. 2.0

Answer:

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20. Comprehension # 5

One particle of mass $1kg$ is moving along positive x-axis with

velocity $3m/s$. Another particle of mass $2kg$ is moving along y-axis with $6m/s$. At time $t = 0$, $1kg$ mass is at $(3m, 0)$ and $2kg$ at $(0, 9m)$, $x - y$ plane is the horizontal plane. (Surface is smooth for question 1 and rough for question 2 and 3)

Co-ordinates of centre of mass where it will stop finally are :-

A. (2.0 m,14.25 m)

B. (2.25 m,10 m)

C. (3.75 m,9 m)

D. (1.75 m,12 m)

Answer:

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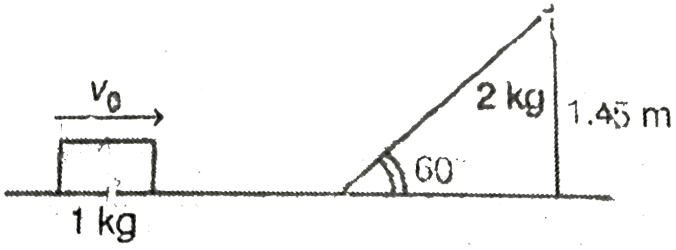
21. A block of mass 1 kg is moving towards a movablen vedge of amss 2 kg as shown in figure. All surfaces are smooth. When the block leaves the wedge from top, its velocity is making an angle $\theta = 30^\circ$ with horizontal.



The value of v_0 in m/s is

A. 4

B. 7

C. 10

D. 9

Answer:

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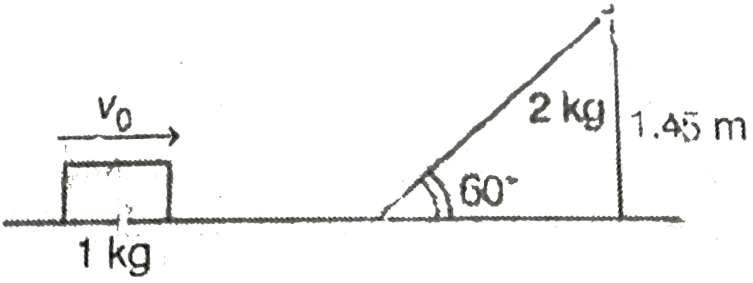
22. A block of mass 1 kg is moving towards a movablen vedge of amss 2 kg as shown in figure. All surfaces are smooth. When the block leaves the wedge from top, its velocity is making an angle $\theta = 30^\circ$ with horizontal.



To what maximum height will the block rise

A. 1.9 m

B. 2.7 m

C. 1.6 m

D. 1.45 m

Answer:

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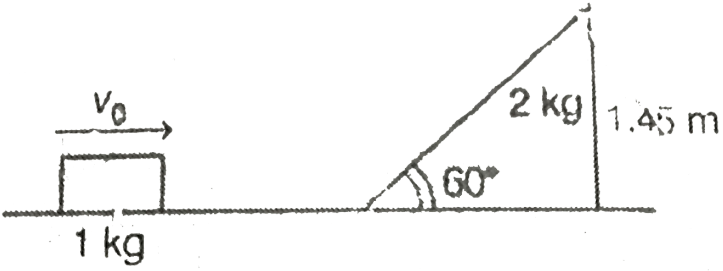
23. A block of mass 1 kg is moving towards a movablen vedge of amss 2 kg as shown in figure. All surfaces are smooth. When the block leaves the wedge from top, its velocity is making an angle $\theta = 30^\circ$ with horizontal.



In the whole process let J be the magnitude of net impulse given to the block by the wedge, J_H its horizontal component and J_V its vertical component. Then

A. $J = \frac{8}{\sqrt{3}}$ N-s

B. $J_H = 4N - s$

C. $J_V = \frac{4}{\sqrt{3}}$ N-s

D. All of the above

Answer:

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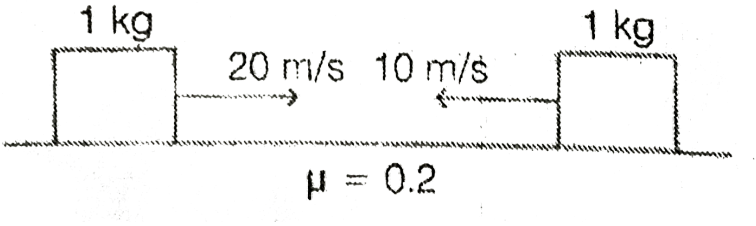
24. Two blocks (from very far apart) are approaching towards each other with velocities as shown in figure. The coefficient of friction for the blocks is $\mu = 0.2$.



Linear momentum of the system is

A. conserved all the time

B. never conserved

C. is conserved only upto 5 s

D. None of the above

Answer:

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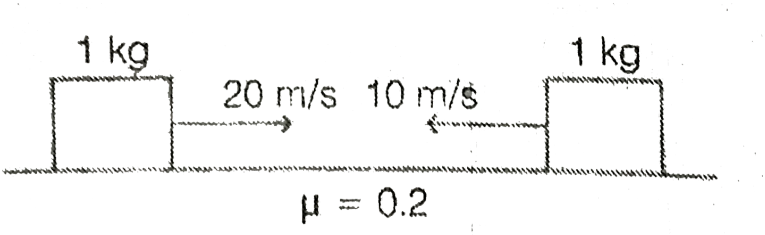
25. Two blocks (from very far apart) are approaching towards each other with velocities as shown in figure. The coefficient of friction for the blocks is $\mu = 0.2$.



How much distance will centre of mass travel before coming permanently to rest.

A. 25 m

B. 37.5 m

C. 42.5 m

D. 50 m

Answer:

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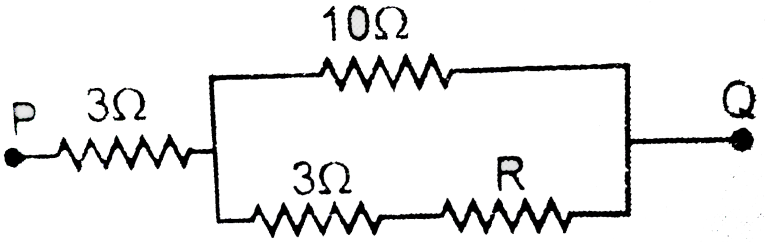
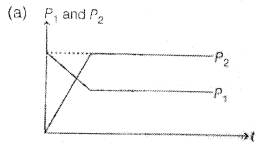
26. Comprehension # 6

A $1kg$ block is given a velocity of $15m/s$ towards right over a very long rough plank of mass $2kg$ as shown in figure.

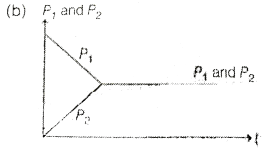


The correct graph showing linear momentum of $1kg$ (i.e. p_1) and of $2kg$ (i.e. p_2) versus time is :

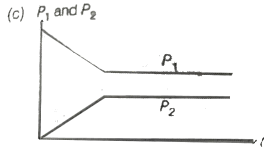
A.



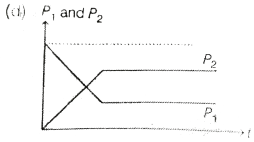
B.



C.



D.



Answer:

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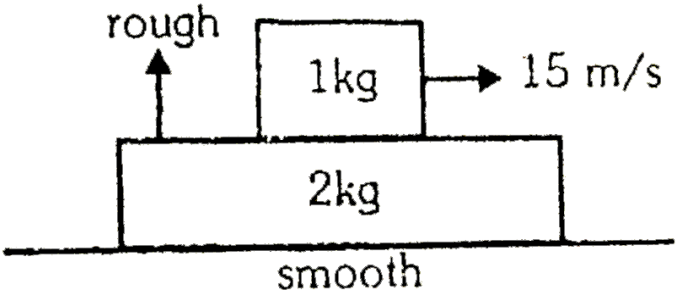
27. Comprehension # 6

A $1kg$ block is given a velocity of $15m/s$ towards right over a very long rough plank of mass $2kg$ as shown in figure.



If coefficient of friction between the two blocks is equal to 0.4, then magnitude of initial slope of p_1 versus t and p_2 versus t (in SI unit) will be :-

A. 4 and 2

B. 2 and 4

C. 4 and 4

D. 2 and 2

Answer:

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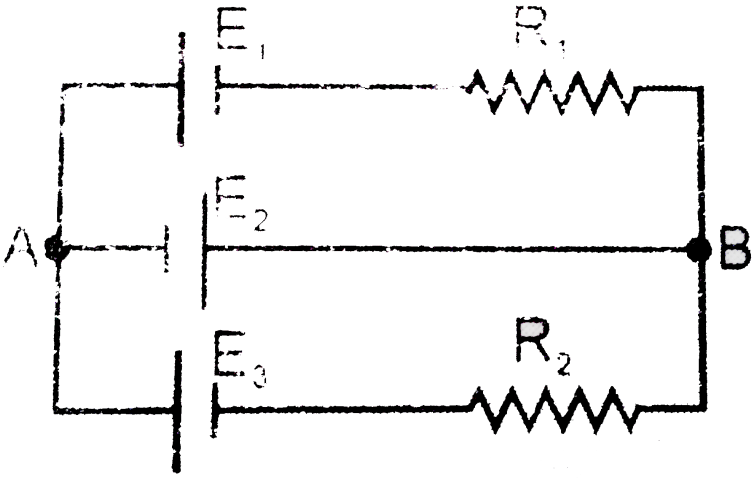
28. Comprehension # 6

A $1kg$ block is given a velocity of $15m/s$ towards right over a very long rough plank of mass $2kg$ as shown in figure.



Momentum of both the blocks are equal at time $t = \ldots\ldots\ldots s$:

A. 1.75

B. 1.875

C. 2.5

D. 1.25

Answer:

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29. A ball of mass 3 kg is thrown upwards with velocity 20 m/s. After 1 s it explodes in 2 pieces one of mass 1 kg and other or 2 kg. After explosion both the pices maintain their vertical velocities but on ground they fall 90 m aport.

Speed of both the pieces just after explosion are (both in m/s)

A. $10\sqrt{5}, 10\sqrt{2}$

B. 30, 20

C. $20\sqrt{3}, 10\sqrt{3}$

D. $20\sqrt{2}, 20$

Answer:

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30. A ball of mass 3 kg is thrown upwards with velocity 20 m/s. After 1 s it explodes in 2 pieces one of mass 1 kg and other or 2 kg. After explosion both the pices maintain their vertical velocities but on ground they fall 90 m aport

Energy produced (in joule) during explosion is

A. 150

B. 200

C. 300

D. 450

Answer:

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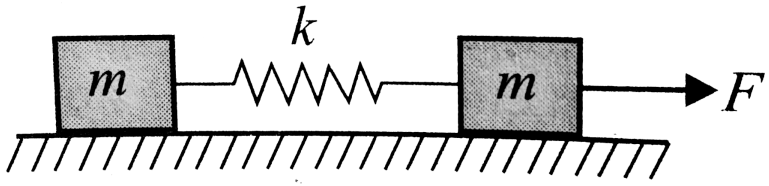
31. Two blocks of equal mass m are connected by an unstretched spring and the system is kept at rest on a frictionless horizontal surface. A constant force F is applied on the first block pulling away from the other as shown in Fig.



Then the displacement of the centre of mass in at time t is

A. $\frac{Ft^2}{2m}$

B. $\frac{Ft^2}{3m}$

C. $\frac{Ft^2}{4m}$

D. $\frac{Ft^2}{m}$

Answer:

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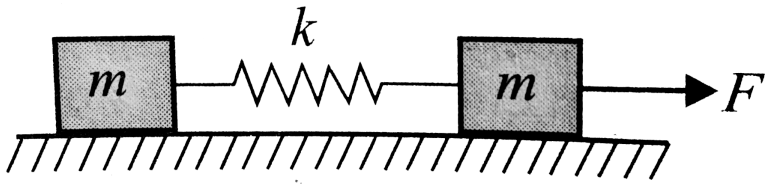
32. Two blocks of equal mass m are connected by an unstretched spring and the system is kept at rest on a frictionless horizontal surface. A constant force F is applied on the first block pulling away from the other as shown in Fig.



If the extension of the spring is x_0 at time t, then the displacement of the first block at this instant is

A. $\frac{1}{2}\left(\frac{Ft^2}{2m} + \times_0\right)$

B. $\left(\frac{Ft^2}{2m} - \times_0\right)$

C. $\frac{1}{2}\left(\frac{Ft^2}{2m} - \times_0\right)$

D. $\left(\frac{Ft^2}{2m} + \times_0\right)$

Answer:

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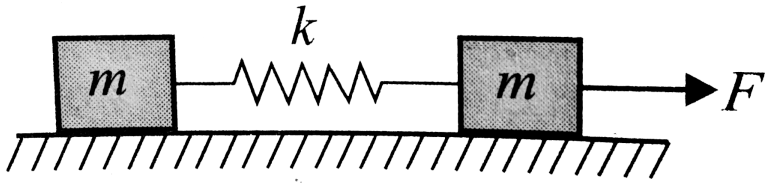
33. Two blocks of equal mass m are connected by an unstretched spring and the system is kept at rest on a frictionless horizontal surface. A constant force F is applied on the first block pulling away from the other as shown in Fig.



If the extension of the spring is x_0 at time t, then the displacement of the first block at this instant is

A. $\left(\frac{Ft^2}{2m} - \times_0\right)$

B. $\frac{1}{2}\left(\frac{Ft^2}{2m} + \times_0\right)$

C. $\frac{1}{2}\left(\frac{2Ft^2}{m} - \times_0\right)$

D. $\frac{1}{2}\left(\frac{Ft^2}{2m} - \times_0\right)$

Answer:

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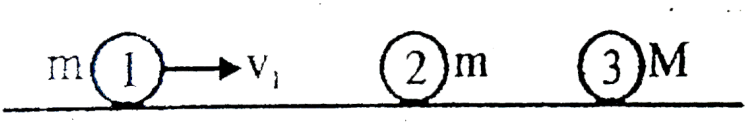
34. Two balls marked 1 and 2 of the same mass m and a third ball marked 3 of mass M are arranged over a smooth horizontal surface as shown in the figure. Ball 1 moves with a velocity v_1 towards ball 2. All collisions are assumed to be elastic. If $M < m$, the number of collisions between the balls will be.



A. one

B. two

C. three

D. four

Answer:

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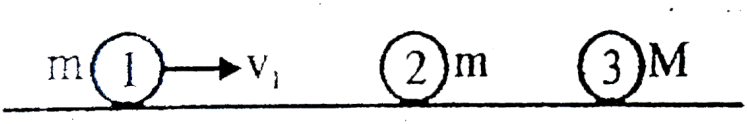
35. Two balls marked 1 and 2 of the same mass m and a third ball marked 3 of mass M are arranged over a smooth horizontal surface as shown in the figure. Ball 1 moves with a velocity v_1 towards ball 2. All collisions are assumed to be elastic. If $M < m$, the number of collisions between the balls will be.



A. one

B. two

C. three

D. four

Answer:

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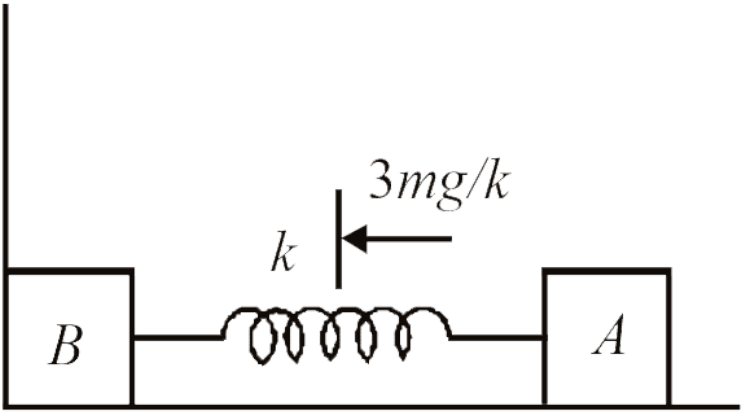
36. A system consists of block A and B each of mass m connected by a light spring as shown in the figure with block B in contact with a wall. The block A compresses the spring by 3mg/k from natural length of spring and then released from rest. Neglect friction anywhere



Acceleration of centre of mass of system comprising A and B just after A is released is

A. 0

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

C. 3g

D. g/2

Answer:

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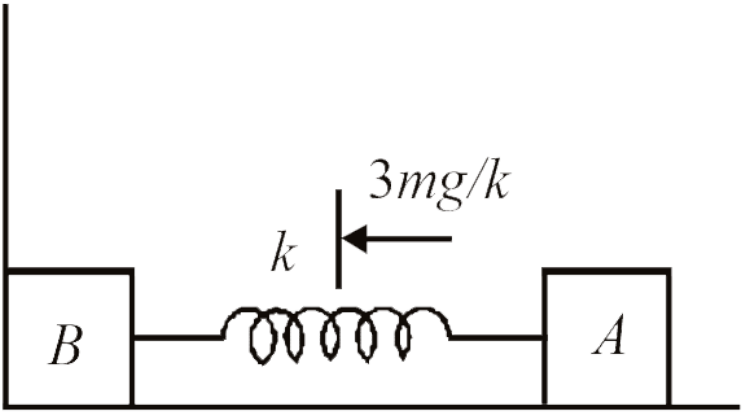
37. A system consists of block A and B each of mass m connected by a light spring as shown in the figure with block B in contact with a wall. The block A compresses the spring by 3mg/k from natural length of spring and then released from rest. Neglect friction anywhere.



Velocity of centre of mass of system comprising A and B when block B just loses contact with the wall

A. $\sqrt{\frac{m}{K}}$

B. $\frac{3g}{2}\sqrt{\frac{m}{k}}$

C. $2g\sqrt{\frac{m}{k}}$

D. None of these

Answer:

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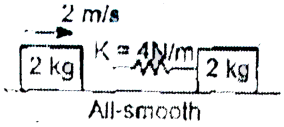
38. In the arrangement shown in figure match the following:



Column-1		Column-2	
(A)	Velocity of centre of mass	(P)	2 SI unit
(B)	Velocity of combined mass when compression in the spring is maximum	(Q)	1 SI unit
(C)	Maximum compression in the spring	(R)	4 SI unit
(D)	Maximum potential energy stored in the spring	(S)	0.5 SI unit

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39. A particle of mass m, kinetic energy K and momentum p collides head on elastically with another particle of mass $2m$ at

rest. After collision, :

	Column I		Column II
(A)	Momentum of first particle	(p)	$3/4p$
(B)	Momentum of second particle	(q)	$-K/9$
(C)	Kinetic energy of first particle	(r)	$-p/3$
(D)	Kinetic energy of second particle	(s)	$\frac{8K}{9}$
		(t)	None

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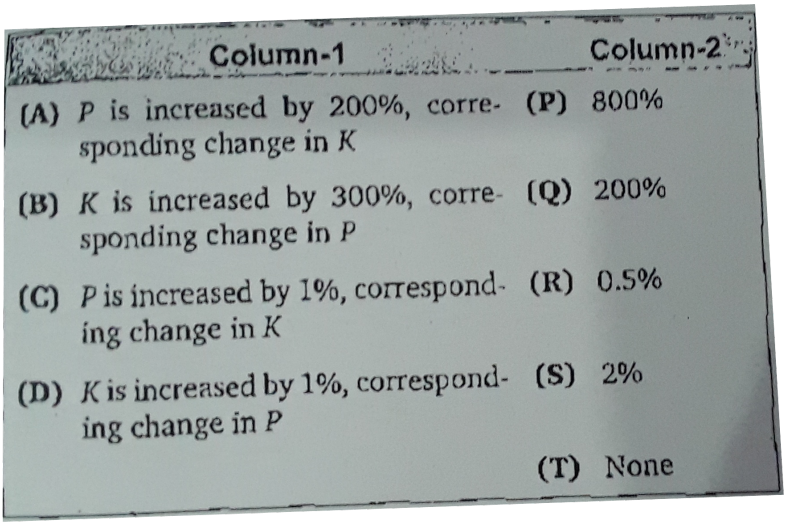
40. Match the following: (P = momentum of particle, K = kinetic energy of particle)



Column-1		Column-2	
(A)	P is increased by 200%, corresponding change in K	(P)	800%
(B)	K is increased by 300%, corresponding change in P	(Q)	200%
(C)	P is increased by 1%, corresponding change in K	(R)	0.5%
(D)	K is increased by 1%, corresponding change in P	(S)	2%
		(T)	None

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41. Four point are placed at four comerse of a squared of side 4 m as shown. Match the following table.

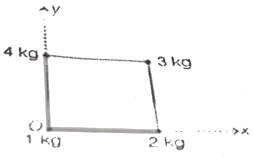

Table-1	Table-2
(A) x-co-ordinate of centre of mass of 4 kg and 2 kg	(P) (7/2)m
(B) x-co-ordinate of centre of mass of 4 kg, 2 kg and 3 kg	(Q) 4/3 m
(C) y-co-ordinate of centre of mass of 1 kg, 4 kg and 3 kg	(R) 3 m
(D) y-co-ordinate of centre of mass of 1 kg and 3 kg	(S) (20/9) m

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42. Two balls of mass m and $2m$ each have momentum $2p$ and p in the direction shown in figure. During collision they exert an impulse of magnitude p on each other.

Column I		Column II	
(A)	After collision momentum of m	(p)	$2p$
(B)	After collision momentum of 2m	(q)	p
(C)	Coefficient of restitution between them	(r)	1
		(s)	None

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