PHYSICS

BOOKS - PRADEEP PHYSICS (HINGLISH)

LAWS OF MOTION

sample problems

1. A constant force acting on a body of mass $3kg$ changes its speed from $2ms^{-1}$ to

$3.5ms^{-1}$ in 25 s. The direction of motion of the body remains unchanged. Calculate magnitude and direction of the force.

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2. A Car of mass 1000 kg is moving with a velocity of $10m/s$ under the action of a forward force of $1000N$ and retarding force of 500 N due to friction. Wath be its velocity after 5 seconds ?

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3. Two masses of 10 kg and 6 kg connected at the two ends of an inextensible string pass over a smooth frictionless pulley . Calculate acceleration of the system and tension in the string .

A. 71.5 N

B. 72.5 N

C. 73.5 N

D. 74.5 N

Answer: C

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4. A hammer of mass 1 kg moving with speed of $6ms^{-1}$ strikes a wall and comes to rest in 0.1 s . Calculate (i) the impules of force (ii) the retardation of the hammer , and (iii) the retarding force that stops the hammer .

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5. While leunching a rocket a rocket of mass $2 \times 10^2 kg$, a force of 5×10^5 . N is applied for 10 seconds . What is the velocity attained by the rocket at the end of $10s$?

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6. How does a bike helmet protect our head ?

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7. What part does physics play in the desingn of running shoes ?

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8. A machine gun has a mass of $20kg$. It fires $35g$ bullets at the rate of400 bullets per minute with a speed of $400m/s$ What force must be applied to the gun to keep it in position ?

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9. A 50 gram bullet leaves a rifle with a velocity of $400m/s$, and the rifle recoils with a velocity of $0.5m/s$. What is the mass of the rifle

A. 10 kg

B. 20 kg

C. 30 kg

D. 40 kg

Answer: D

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10. A man standing in a lift holds a spring balance with a load of $5kg$ suspended from it What would be the reading of the balance when the lift is descending with an acceleration of $3.8m/s^2$.

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11. The strings of a parachute can bear a maximum tension of $72kg$ wt . By what minimum acceleration can a person of 90 kg descend by means of this parachute ?

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12. A 30 kg Sell is flying at $36m/s$. When the shell explodes into two parts of $12kg$ and $18kg$, the lighter part stops, and heavier part files on . What is the velocity of heavier part ? .

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13. A rocket motor consumes one quintal of fuel per secound . The exhaust speed of gases w.r.t roket is $5km/s$ Calculate the force exerted on the rocket. What is the velocity acquired by the rocket , when its mass reduces to$1/100$th of its initial mass ?.

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14. Fuel is consumed in a rocket at the rate of $200kg/s$. What is the thrust experienced by the roket if exhaust gases are ejected at a speed of $45km/s$?

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15. A heavy box of mass 20 kg is placed on a horizontal surface . If coefficient of kinetic friction between the box and the horizontal surface . Is 0.25 calculate the force of kinetic friction Also calculate acceleration produced under a force of 98 N applied horizontally ?

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16. A wooden block is kept on a polished wooden plank whose inclination is increased gradully . The block starts slipping when the plank makes an angle of 25° with the horizontal . However , once started , the block can continue with unifrom speed , if the inclination is reduced to 21 Calculate coefficient of static and dynamic friction between the block and the plank .

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17. A block slides down an incline of angle 30° with an acceleration of $g/4$ Find the coefficient of kinetic friction .

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18. A cricket ball is rolled on ice with a velocity of $5.6m/s$ and comes to rest after travelling 8 m . Find the coefficient of friction Given $g = 9.8m/s^{2}$.

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19. Calculate the power of an engine , which can just pull a train of mass 5000 quintals up an incline of 1 in 50 at the rate of $54km/h$. The resistance due to friction is $0.8N/\text{quintal}$. Take $g = 9.8m/s^2$.

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20. A bend in a level road has a radius of 100 m Find the maximum speed which a car turning this bend may have without skidding if coefficient of friction between the tyres and the road is 0 .8 S .

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21. An aircraft executes a horizontal loop at a speed of $720 kmh^{-1}$, with its wings banked at 15° What is the radiue of the loop ?

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22. A motor cyclist loops a vertical loop of diameter 50 m , without dropping down even at uppermost point . What is the minimum speed at lowest and highest points of the loop ?

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solved examples

1. A force of $5N$ gives a mass m_1, an acceleration of $8m/s^2$, and a mass m_2, an acceleration of $24m/s^2$. What acceleration would it give if both the masses are tied together?

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2. A bullet of mass $100gram$ moving with $20m/s$ Strikes a wooden plank and penetrates upto 20 cm. Calculate the resistance offered by the wooden plank .

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3. A bus starts from rest accelerating unifromly with $4ms^{-2}$. At $t = 10s$,a stone is dropped from the window of the bus 2 m high . If $g = 10m/s^2$, what are the magnitude of velocity and acceleration of the stone at 10 .2 s ?

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4. An astronaut accidentally gets separated out his small spaceship accelerating in interstellar space at a constant rate of $100ms^{-2}$. What is the acceleration of the astronaut the instant after he is outside the spaceship? (Assume that there are no nearby stars to exert gravitional force on him)

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5. The motion of a particle of mass m is described by $y = ut + \frac{1}{2}gt^2$. Find the force acting on the particale .

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6. A balloon has a mass of 10 gram in air. The air escapes from the balloon at a unifrom rate with a velocity of $5cm/s$ and the balloon shrinks completely in 2.5 s . Calculate the average force acting on the balloon.

7. Two bodies A and B each of mass m are fixed together by a massless spring . A force F acts on the mass B as shown in fig .3 (a)18. At the instant shown , the body A has an acceleration a What is the acceleration of B ?

8. A hydrogen gas filled ballon having a mass of 25 g is released up in air . As the ballon descends , the gas starts leking from it with a unifrom velocity of $12cm / s$ and as a result the balloon shrinks completely in 5 s . Find the average force acting on the ballon .

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9. Forces of $\sqrt{2}N$ and $6\sqrt{2}N$ are acting on a body of mass 10 kg at an angle of 60° to each other . Find the acceleration , distance covered and velocity of the body after 10 second , if the body is initially at rest .

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10. A bullet of mass 0.04 kg moving with a speed of $90ms^{-1}$ enters a heavy wooden block and is stooped after a distance of 60 cm . What is the average resistive force exerted by the block on the bullet ?

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11. A batsman hits back a ball straight in the direction of the bowler without changing its initial speed of $12ms^{-1}$. If the mass of the ball is 0.15 kg , determine the impulse imparted to the ball . (Assume linear motion of the ball).

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12. A ball moving with a momen - tum of $15kgms^{-1}$ strickes against the wall at an

angle of 30° and is reflected back with the same momentum at the same angle . Calculte impulse.

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13. A cricket ball of mass 150 kg is moving with a velocity of $12m/s$ and is hit by a bat so that ball is turned back with a velocity of $20m/s$. The force of the blow acts for 0.01 s on the ball . Find the average force exerted by the bat on the ball.

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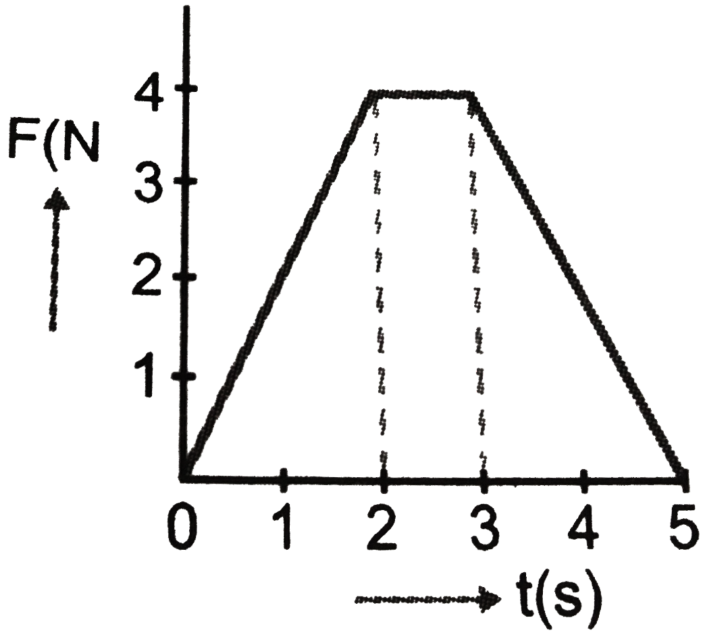
14. A force acting on a body of mass 2 kg varies with time as shown in fig . 20 find impulse of the force and final velocity of the body.



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15. A machine gun has a mass of 20 kg . It fire 20 gram bullets at the rate of 300 bullets per second at a speed of $250m/s$. What force must be applied on the gun to keep it in position ?

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16. Two identical billiard balls striks a rigid wall with the same speed but at different angles , and get reflected without any change in speed

, as shown in Fig . What is (i) the direction of the force on the wall due to each ball ? (ii) the ratio of the magnitudes of impulses imparted to the balls by the wall ?

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17. A ball of mass 0.2 kg travelling in a straight line with a speed of m/s along negative x-axis id deflected by a bat $15m/s$ along negative x - axis is deflected by a bat at an angle of 30° If the speed of the ball after deflection is $10m / s$, find the impulse on the ball.

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18. An elevator weighing 5000 kg is moving upward and tension in the supporting cable is 5000 N . Find upward acceleration . Starting from rest , how far does it rise in 10 secound ?

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19. Find the appared weight of a man weighing 49 kg on earth, when he is standing in a lift which is (i) rising with an acceleration of $1.2m / s^2$ (ii) going down with same acceleration (iii) falling freely under gravity (iv) going up or down with unifrom velocity . Take $g = 9.8m / s^2.\backslash$

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20. A 70 kg man in sea is being lifted by a helicopter with the help of a rope , which can bear a maximum tension of 100 kg wt . With what maximum acceleration the helicopter should rise so that the rope does not break ? Take $g = 9.8 m / s^2$.

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21. A lift of mass 2000 kg is supported by thick steel ropes . If maximum upward acceleration of the lift be $1.2m/s^2$, and the breaking stress for the ropes be

$2.8 \times 10^8 Nm^{-2}$

what should be the minimum diameter of rope ?

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22. A lift starts from rest with a constant upward acceleration It moves 1.5 m in the first 0.4 A person standing in the lift holds a packet of 2 kg by a string Calculate the tension in the string during the motion .

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23. A lift is going up. The total mass of the lift and the passengers is 1500 kg . The variation in the speed of the lift is given by the graph shown in Fig . What will be the tension in the rope pulling the lift at (i) $t = 1s$, (ii) $t = 6s$ (iii) $t = 11s$?

What is the height to which the lift takes the passengers ? During the course of entirs motion What is the average velocity and average acceleration of the lift ? Taken $g = 9.8m/s^2$

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24. Fig show two bodies A and B of masses 2.5 kg and 2.8 kg respectively from a rigid support by two inextensible wires each of length 1.8 m . The upper wire is of negligible mass and lower wire is of mass $1.5 kg / m$. If the entire system moves upwards with an acceleration of $2 m / s^2$, find tension (i) at middle point p of upper wire (ii) at middle point Q of lower wire . Take $g = 10 m / s^2$

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25. A machine gun has a mass of 10 kg . It fires 30 gram bullets at the rate of 6 bullets per secound with a speed of $400m/s$. What force must be to the gun to keep it in position ?

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26. A hunter has a machine gun that can fire 50 g bullets with a velocity of $150m/s$. A 60 kg tiger springs at him with a velocity of $10ms^{-1}$ How many bullets must the hunter fire per secoud into the tiger in order to stop him in his track.

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27. A man weighing $60kg$ runs along the rails with a velocity of $8km/h$ and jumps into a car of mass 1 quintal standing on the rails. Calculaate the velocity with which car will start travelling along the rails.

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28. A car of mass one metric ton travelling at $32m/sc$ dashes into the rear of a truck of mass $8000kg$ moving in the same direction with a velocity of $4m/s$ After the collision the car bounces back wards with a velocity of $8m/s$ What is the velocity of the truck after the impact ?

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29. A dise of mass 10 g is kept floating horizontally by throwing 10 marbles per secound against it from below . If mass of each marble is 5 g Calculate the velocity with which marbles are striking the disc . Assume that marbles strike the disc . Normally and rebound downwards with the same speed.

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30. A body of mass 1 kg at rest explodes into three fragments of masses in the ratio 1 : 1 : 3 . The two pieces of equal mass fly in mutually perpendicular directions with a speed of $30m/s$ each . What is the velocity of the heavier fragment ?

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31. A machine gun fires a bullet of mass 40 g with a velocity $1200 ms^{-1}$. The man holding it can exert a maximum force of 144 N on the gun. How many bullets can be fire per second at the most?

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32. A hunter has a machine gun that can fire 50 g bullets with a velocity of $150 m / s$. A 60 kg tiger springs at him with a velocity of

$10ms^{-1}$ How many bullets must the hunter fire per secoud into the tiger in order to stop him in his track.

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33. A rocket has a mass of 2×10^4 kg of which half is fuel Assume that the fuel is consumed at a constant rate as the rocket is fired and there is contact thrust of 5×10^6 N neglecting air resistance and any possible variation of g comput (i) the intial acceleration (ii) acceleration just when the whole fuel is consumed .

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34. Calculate the ration m_0 / m for a rocket if it is to escape from the earth . Given escape velocity $= 11.2 km / s$ and exhaust speed of gases is $2 km / s$.

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35. A rocket is set for vertical firing If the exhaust speed is $1200ms^{-1}$, how much gas must be ejected per second to supply the thrust needed (i) to overcome the weight of rocket (ii) to give to the rocket an initial vertical upward acceleration of $29.6m/s^2$ Given mass of rocket = 6000 kg.

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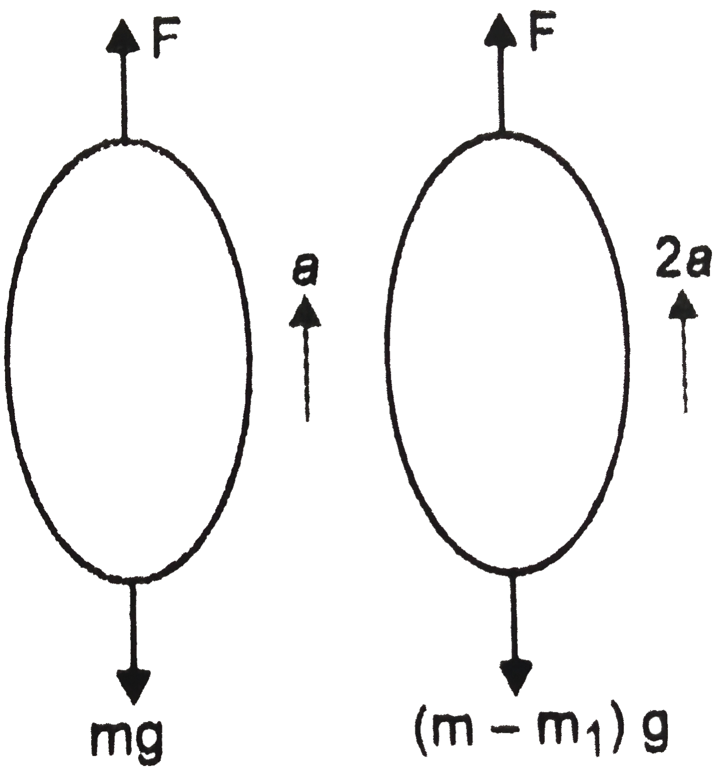
36. A ballon of mass m is rising up with an acceleration a show that the fraction og weight of balloon that must be detached in order to double its acceleration , assuming the upthrust of air to remain the same



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37. A rocket motor consumes 100 kg of fuel per second exhausting it with a speed of $6 \times 10^3 ms^{-1}$ What thrust is exerted on the rocket ? What will be the velocity of the rocket at the instant its mass is reduced to $(1/40)$ of its initial mass ? Take initial velocity of rocket as zero . Neglect gravity .

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38. A rocket burns 0.5 kg of fuel per second ejecting it as gases with a velocity of $1600 m / s$ relative to the rocket . How much force is exerted on the rocket ? Also , calculate the velocity attainted by the rocket , when its mass reduces to $\frac{1}{200}$ th of its initial mass .

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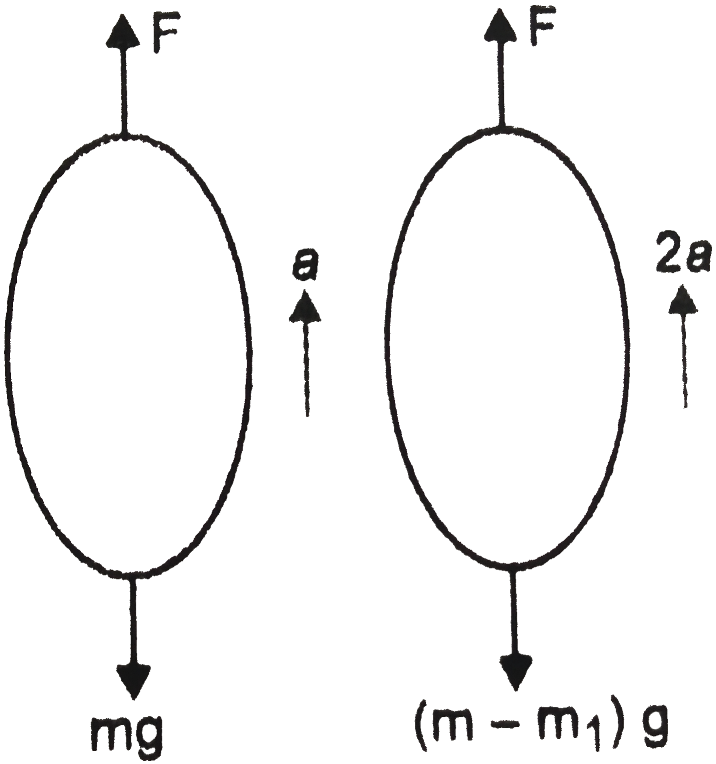
39. A ballon of mass m is rising up with an acceleration a show that the fraction og weight of balloon that must be detached in order to double its acceleration , assuming the upthrust of air to remain the same



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40. A train is moving along a horizontal track . A pendulum suspended from the roof makes an angle of 4° with the vertical . If $g = 10m/s^2$, what is the acceleration of the train ?

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41. A body of mass m is suspended by two strings making angles α and β with the horizontal. Find the tensions in the strings.

42. A body m_1 of mass 10 kg is placed on a smooth horizontal table It is connected to a string which passes over a frictionless pulley and carries at the other end , a body m_2 of mass 5 kg What acceleration will be produced in the bodies when the nail fixed on the table is removed ? what will be the tension in the string during the motion of the bodies ? What when the bodies stop ? (g= 9.8 N ? kg) .

43. A mass of 6 kg is suspended by a rope of length 2 m from the ceilling A force of 50 N in the horizontal direction is applied at the mid - point P of the rope as shown . What is the angle the rope makes with the vertical in equilibrium ? (Take = $10ms^{-2}$) . Neglect mass of the rope .

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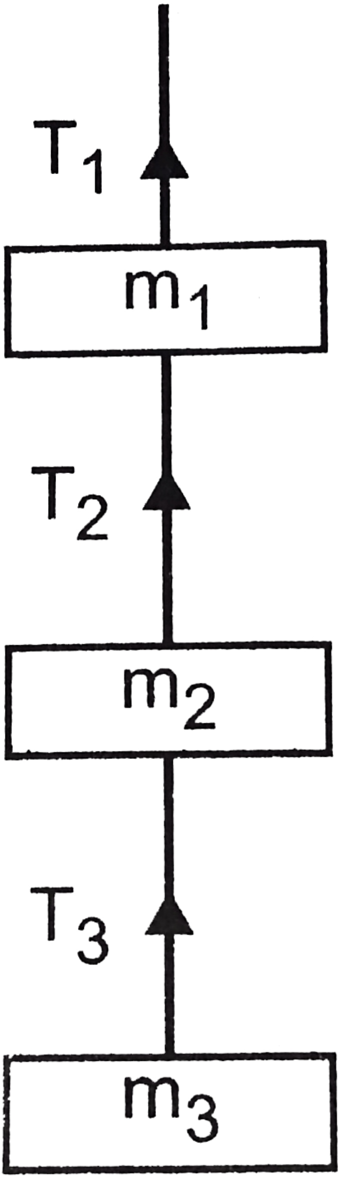
44. The masses $m_1 m_2$ and m_3 of the three bodies shown in fig . Are 5 , 2 and 3 kg respectively Calculate the valuse of tension $T_1 T_2$ and T_3 when (i) the whole system is going upward with an acceleration of $2m/s^2$ (ii) the whole system is stationary

$(g = 9.8m / s^2)$.



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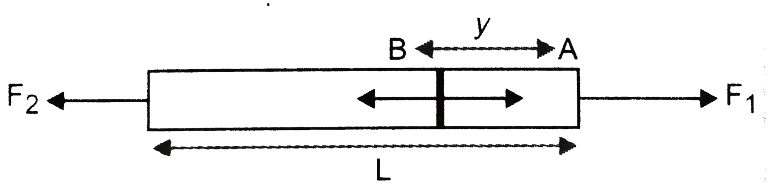
45. What is the tension in a rod of length length L and mass M at a distance y fromF_1 when the rod is acted on by two unequal force F_1 and $F_2(\ < F_1)$ as shown in.



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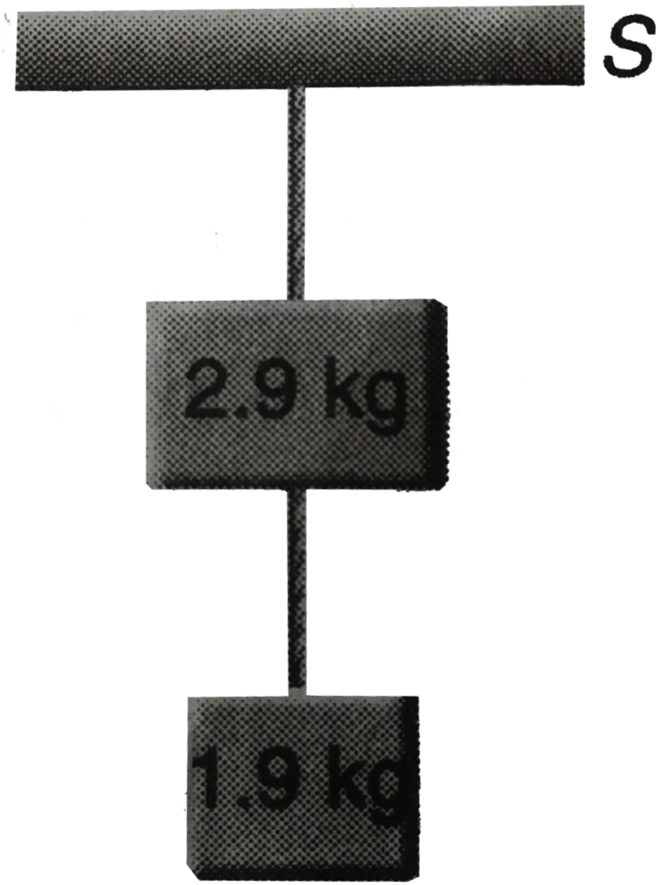
46. Two blocks of masses $2.9kg$ and $1.9kg$ are suspended from a rigid support S by two inextensible wires each of length $1m$, as shown in figure.The upper wire has negligible mass and the lower wires and support have an uniformly distributed mass of $0.2kg$ .The whole system of blocks, wire and support have an upwards acceleration of $0.2m/s^2$. Acceleration due to gravity is $9.8m/s^2$.

(a) Find the tension at the mid point of the lower wire.

(b)Find the tension at the mid point of the upper wire.



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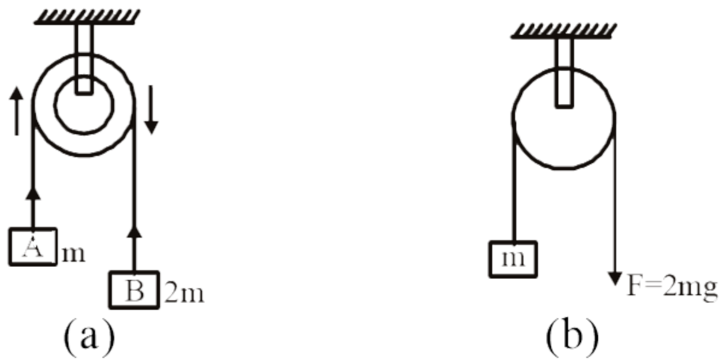
47. The pulley arrangements of fig (a) and (b) are identical. The mass of the rope is negligible. In (a) the mass m is lifted up by attaching a mass 2 m to the other end of the rope. In (b) m is lifted up by pulling the other end of the rope with a constant downward force F = 2 mg. Which of the following is correct?



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48. A pull of 15 N is applied on a rope attached to a block of mass 7 kg lying on a smooth horizontal surface. forcs exerted on the rope by the block ?

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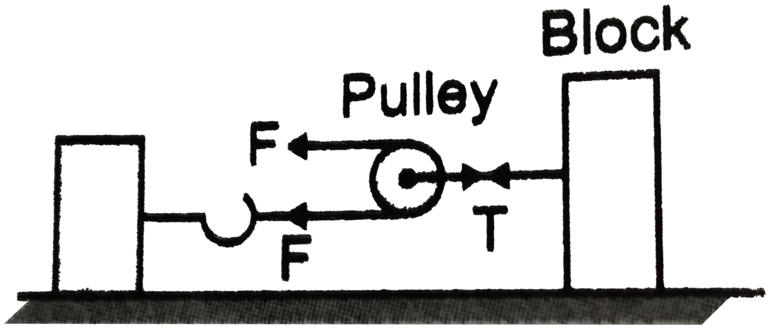
49. A block of mass 100 kg is set into motion on a frictionless horizontal surface with the help of a frictionless pulley and rope system shown in What horizontal force should be applied on the rope to produce an acceleration of $0.1m/s^2$



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50. Two blocks of masses 50 kg and 30 kg connected by a massless string pass over a light frictionless pulley and rest on two smooth planes inclined at angles 30° and 60°

resp . With horizontal .Determine the accelertion in the two blocks and tension in the string $g = 10m / s^2$.

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51. A block of weight 20 N is placed on a horizontal table and a tension T is applied on the block . Tension can be increased to 8 N before the block begins to slide . A force of 4 N keeps the block moving at constant speed , once it has been set in motion . Find the coefficients of static friction and kinetic friction].

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52. The coefficient of friction between the ground and the wheels of a car between the ground and the wheels of acar moving on a horizontal road is 0.5 If the car starts from rest , what is the minimum distance in which it can acquire a speed of $72km/h$? take $g = 10ms^{-2}$.

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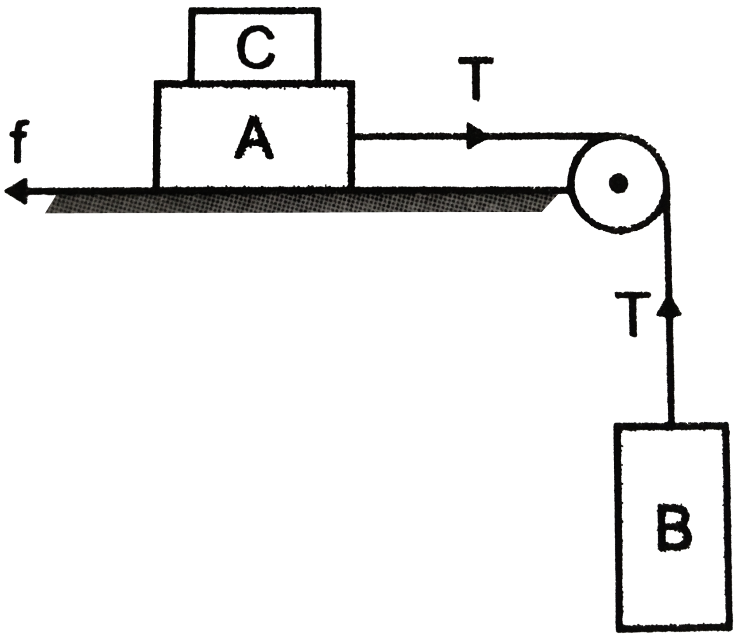
53. In the masses of A and B are 10 kg and 5 kg . Calculate the minimum mass of C which may stop A from slipping Coefficient of static friction between block A and table is 0.2



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54. A body rolled on ice with a velocity of $8ms^{-1}$ comes to rest after travelling a distance of 4 m . Calculate the coefficient of friction .

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55. Detrmine the maximum acceleration of the train in which a box lying on the floor will remain stationary given that the coefficient of static friction between the box and the train s floor is 0.15 given $g = 10m / s^2$.

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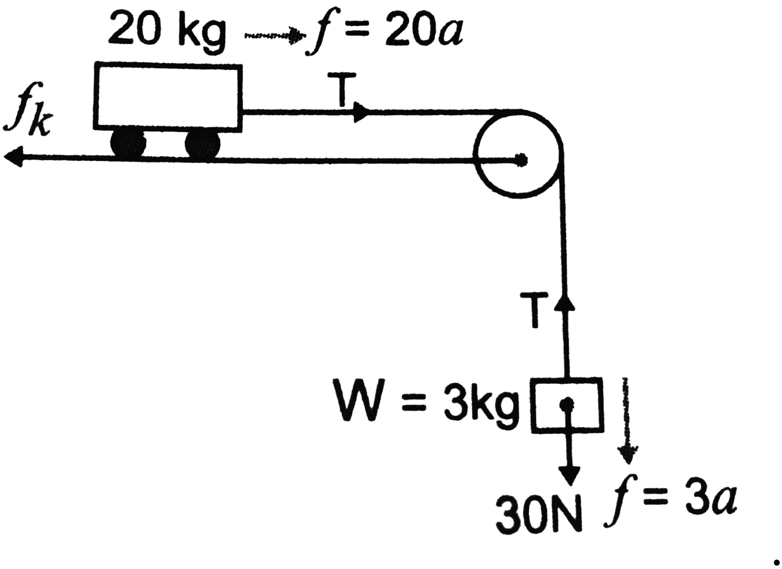
56. What is the acceleration of the block and trolley system shown in if the coefficient of kinetic friction between the trolley and the surface is 0 .04 ? What is the tension in the string ? Take $g = 10ms^{-2}$ Neglect the mass of

the string



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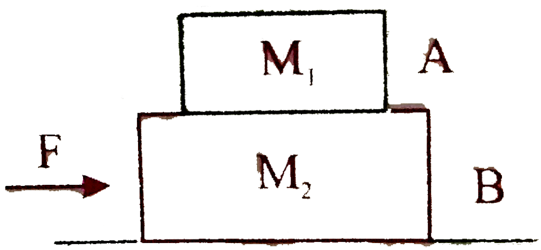
57. A block the of mass $4kg$ is placed on another block of mass $5kg$ and the block B rests on a smooth horizontal table for sliding the block A on B a horizontal force $12N$ is required to be applied force on it How much maximum horizontal force can be applied on 'B' s that both A and B move together? Also find out the accleration proudced by this force



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58. A particle of mass m rests on a horizontal floor with which it has a coefficient of static friction μ. It is desired to make the body move by applying the minimum possible force F. Find the magnitude of F and the direction in which it has to be applied.

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59. A bullet of mass 0.01 kg is fired horizontal into a 4 kg wooden block block at rest , on a horizontal surface. The coefficient of kinetic friction between the block and surface is 0.25 the combination moves 20 m before coming to rest . With what speed did the bullet strike the block ?

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60. A cubical block rests on an inclined plance of $\mu = \frac{1}{\sqrt{3}}$. Determine the angle at which the block just slides down the incline .

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61. A block of mass 10 kg is sliding on a surface inclined at 30° with horizontal . If coefficient of friction between the block and the surface is 0.5 , find acceleration produced in the block . Take $g = 9.8m/^2$.

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62. Find the force required to move a train of mass 10^5 kg up an incline of 1 in 50 with an acceleration of $2ms^{-2}$. Coefficient of friction between the train and rails is 0.005. Take $g = 10^2$.

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63. A railway engine weighing 40 metric ton is travelling along a level track at a speed of $54kmH^{-1}$ What additional power is required to maintain the same speed up an incline of 1 in 49 Take $g = 9.8m/s^2$ and $mu = 0.1$.

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64. A block A of mass 14 kg moves alongg an inclined plance that makes an angle of 30° with the horizontal . This block is connected to another block B of mass 14 kg by a taut massless string that runs around a massless frictionless pulley . The block B moves down with constant velocity . Calculate force of friction and coefficient of kinetic friction .

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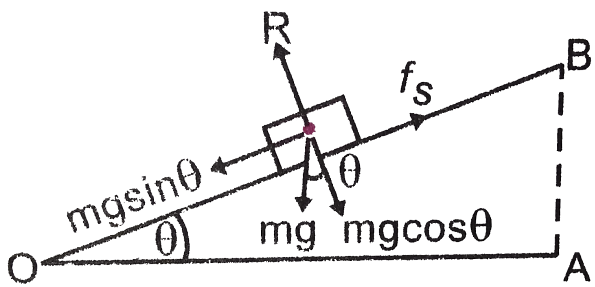
65. A mass of 4 kg rest on a horizontal plane . The plane is gradually inclined until an angle $0 = 15^\circ$ with the horizontal and the mass just begins to slide . What is the coefficient of static friction between the block and the surface ?



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66. An engine of 100 H.P draws a train of mass 200 metric ton with a velocity of $36km/h$. Find the coefficient of friction.

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67. A mass of 200 kg is placed on a rough inclined plane of angle 30°. If coefficient of limiting friction is $1/\sqrt{3}$, find the least forces in newton, acting parallel to the plane (i) to keep the mass from sliding down (ii) to move the mass up the plane.

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68. Find the force required to move a train of 2000 quintals up an incline of 1 in 50 , with an acceleration of $2ms^{-2}$, the force of friction being 0.5 newton per quintal.

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69. A piece of ics slides down a 45° incline in twice the time it takes to slide down a frictionless 45° incline . What is the coefficient of friction between the ice and the incline ? .

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70. Two blocks $m_1 = 4kg$ and $m_2 = 2$ kg connected by a weightless rod slide down a plane having an inclination of 37° . The coefficient of dynamic friction of m_1 and m_2

with the inclined plane are $\mu_1 = 0.75$ and $\mu_2 = 0.25$ respectively Find the common acceleration of the two blocks and tension in the rod Take is $37^\circ = 0.6$ and $\cos 37^\circ = 0.8$.

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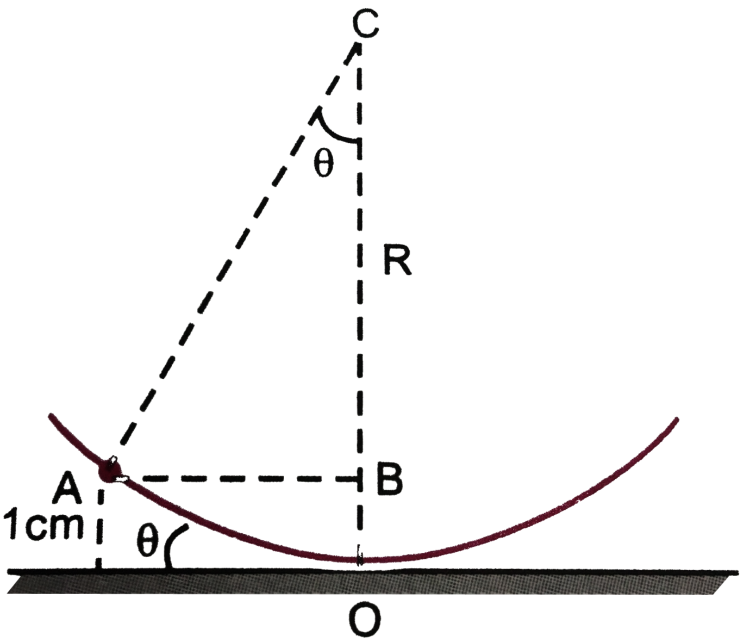
71. Aparticle of mass 1 g executes an oscillatory motion on the concave surface of a spherical dish of radius 2m placed on a horizontal plane, Figure . If the motion of the particle begins from a point on the dis at a height of 1 cm.

from the horizontal plane and coefficient of friction is 0.01 , fing the total distance covered by the particle before coming to rest.



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72. A block of mental of mass 50 gram placed over an inclined plane at an angle of 15° slides down without acceleration . If the inclination is increased by 15° , what would be the acceleration of the block ?

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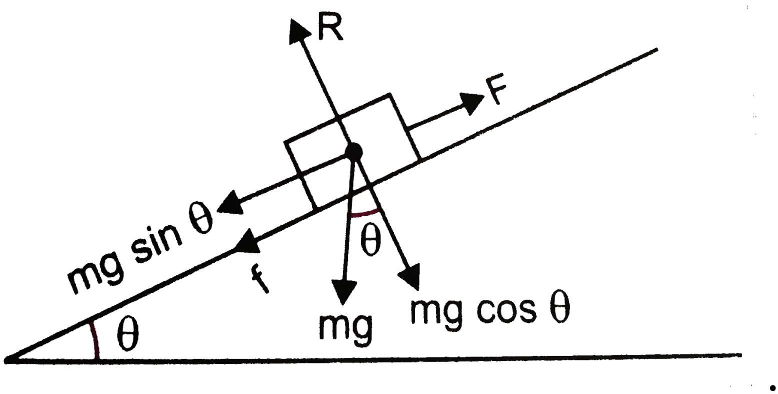
73. A body of mass 10 kg is placed on an inclined surface of angle 30° . If coefficient of limiting friction is $1/\sqrt{3}$, find the inclined

plane. Force is being exerted parallel to the inclined plane



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74. A stone of mass 4 kg is attached to a string of 10 m length and is whirled in a horizontal circle . Calculate the max . Velocity with which the stone can be whirled if the string can withstand a maximum tension of 160 N .

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75. A gramophone disc rotates at 60 rpm . A coin of mass 18 g is placed at a distance of 8 cm from the centre . Calculate centrifugal force on the coin . Take $\pi^2 = 9.87$.

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76. Find the maximum speed at which a car can turn round a curve of $30m$ radius on a level road if coefficient of friction between the tyres and road is $0.4. Take g = 10m/s^2$.

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77. A string breaks under a load of 4.8kg A mass of 0.5 kg is attached to one end of a string 2 m long and is rotated in a horizontal circle. Calculate the greatest number of

revolutions that the mass can make without breaking the string.

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78. A car travels on a flat, circular track of radius $200m$ at $30ms^{-1}$ and has a centripetal acceleration $= 4.5ms^{-2}$. (a) If the mass of the car is 1000 kg , what frictional force is required to provide the acceleration ? (b) If the coefficient of static friction is 0.8, what is the maximum speed at which the car can circle the track ?

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79. Two small wooden blocks are placed on a crircular rotating table of radius 1 m at distance 10 cm and 60 cm from the centre of the table the table is rotating with angular velocity $4rad/s$, about the axis of rotation . Out of these two blocks , which one continues to revolve with the table ? Give $\mu = 0.2$.

Watch Video Solution

80. A sphere of mass 200 g is attached to an inextensible string of length 130 cm whose upper end is fixed to the ceilling . The sphere is made to describe a horizontal circle of radius 50 cm Calculate the periodic time of this conical pendulum and the tension in the string .

Watch Video Solution

81. A particle describes a horizontal circle on the smooth inner surface of a conical funnel as shown in Fig. If the height of the plane of the circle above the vertex is $9.8cm$, find the speed of the particle.

Watch Video Solution

82. A curve in a road froms an are of radius 800 m If the road is 39.2 m wide Calculate the safe speed for turning if outer edge of the road is 0.5 m higher than the inner edge .

Watch Video Solution

83. A cyclist riding at a speed of $14\sqrt{3}ms^{-1}$ takes a turn around a circular road of radius $20\sqrt{3}$ m . What is his inclination with horizontal ?

Watch Video Solution

84. A cyclist speeding at $6m/s$ in a circle of 36 m diameter makes an angle 0 with the verticl . What is the value of 0 ? Also , deter - mine the minimum possible value of the coefficient of friction between the tyres and the road .

Watch Video Solution

85. A car is speeding on a horizontal road curving round with a radius 60 m The coefficient of friction between the wheels and the road in 0.5 The height of centre of gravity of the car from the road level is 0.3 m and the distance between the wheels is 0 .8 m . Calculate the maximum safe velocity for negotiating the curve . Will the car skid or topple if this velocity is exceeded ?

Watch Video Solution

86. Find the angle through which a cyclist bends when he covers a circular path $34.3m$ long in $\sqrt{22}$ sec . Given $g = 9.8ms^{-2}$.

Watch Video Solution

87. A cyclist speeding at $18km/h$ on a level road takes a sharp circular turn of radius 3 m without reducing the speed . The coefficient of static friction between the tyres and the road is 0.1 Will the cyclist slip while taking the turn ?

Watch Video Solution

88. A circular racetrack of radius 300 m is banked at an angle of 15° If the coefficient of friction between the wheels of a race car and the road is 0.2 what is the (a) optimum speed of the race car to avoid wear and tear on its tyres , and (b) maximum permissible speed to aviod slipping ?

Watch Video Solution

89. A circular race track of radius 400 m is banked at an angle of 10° . If the coefficient of friction between the wheels of a race car and the road is 0.2 , what is the (i) optimum speed of the race car to aviod wear and tear on its tyres .

maximum permissible speed to aviod slipping ?

Watch Video Solution

90. A railway carriage has its CG at a height of 1 m above the rails , which are 1 m apart . Calculate the maximum safe speed at which it can travel round an unbanked curve of radius 80 m .

Watch Video Solution

91. A stone is tied to a weightless string and revolved in a vertical circle of radius 5 m . What should be the minimum speed of the stone at the highest point of the circle so that the string does not slack ? What should be the speed of the stone at the lowest point of vertical circle ? Take $g = 9.8ms^2$.

Watch Video Solution

92. A bucket containing water is tied to one end of a rope of length 2.5 m and rotated about the other end in a vertical circle so that water does not spill even when bucet is upside down . What is the maximum velocity of the bucket at which this happens ? How many rotations per minute is it making $g = 10m / s^2$

.

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93. In a circus , the diameter of globe of death is 20 m . From what minimum height must a motor cyclist start in order to go around the globe successfully ? .

Watch Video Solution

94. A small stone of mass 200 g is tied to one end of a string of length 80 cm . Holding the other end in hand , the stone is whirled into a vertical circle What is the minimum speed that needs to be imparted at the lowest point of the circular path , so that the stone is just able to complete the vertical circle ? what would be the tension at the lowest point of circular path ? $(Take g = 10m / s^2)$.

Watch Video Solution

95. A massless string of length 1.2 m has a breaking strength of 2 kg wt . A stone of mass 0.4 kg tied to one end of the string is made to move in a vertical circle by holding the other end in hand . Can the particle describe the vertical circle ? Take $g = 10ms^{-2}$.

Watch Video Solution

96. A small stone of mass 0.2 kg tied to a massless , inextensible string is rotated in a vertical circle of radius 2 m If the particle is just able to complete the vertical circle what is its speed at the highest point of the circular path ? How would the speed get affected if the mass of the stone is increased by 50% ? Take $g = 10m / s^2$.

Watch Video Solution

97. A particle of mass 150 g is attached to one end of a massless inextensible string It is made to describe a vertical circle of radius 1 m When the string is making an angle of 48.2° with the vertical, its instantaneous speed is $2m / s$ What is the tension in the string in this position ? Whould this particle be able to complete its circular path ? .

Watch Video Solution

98. A bucket containing 4 kg of water , is tied to a rope of length 2.5 m and rotated in a vertical circle in such a way that the water in upside down position What is the speed of the bucket at (a) highest point and (b) lowest point of its circular path ? Take $g = 10m/s$.

Watch Video Solution

99. Shown a smooth looping the loop track A particle of mass m is released from oint A , as shown If H = 3 r , whould the particle loop the loop ? What is the force on the circular track when the particle is at point (i) B (ii) C ? .

Watch Video Solution

100. A child revolves a stone of mass 0 .5 kg tied to the end of a string of length 40 cmin a vertical circle . The speed of the stone at the lowest point of the circle is $3m/s$ Calculate tension in the string at this point.

Watch Video Solution

101. An aeroplane flying in the sky dives with a speed of $360km/h$ in a verticale circle of radius 200 m The weight of pilot sitting in it is 75 kg Calulate the force with which the pilot presses his seat when the aeroplane is (i) at the lowest position and (ii) at the highest position Take $g = 10m/s^{-2}$.

Watch Video Solution

102. A bullet of mass 0.01 kg is fired horizontal into a 4 kg wooden block block at rest , on a horizontal surface. The coefficient of kinetic friction between the block and bullet is 0.25 the combination moves 20 m before coming to rest . With what speed did the bullet strike the block ?

Watch Video Solution

103. A body starts rolling down an inclined plane , the top half is rough . Find the ratio of the force of friction and weight of the body if the body is brought to rest just when it reaches the bottom , the angle of the plane being 30° .

Watch Video Solution

104. A wooden block of mass 2 kg rests on a soft horizontal floor . When aniron cylinder of mass 25 kg is placed on top of the block , the floor yields steadily , and the block and the cylinder go down with an acceleration of $0.1ms^{-2}$ What is the action of the block on the floor (a) before and (b) after the floor yields ? Take $g = 10ms^{-2}$. Identify the action reaction pairs in the problem .

Watch Video Solution

conceptual problmes

1. Can a body in liner motion be in equillibrium ?

View Text Solution

2. A stone when thrown on a glass window smashes the window pane to pieces , but a bullet from the gun passes through making a clean hole. Why ?

Watch Video Solution

3. A person sitting in a carriage at rest pushes it from within. Will the carriage move ?

Watch Video Solution

4. The distance traveled by a body is directly proportional to time Is any external force acting on it ?

Watch Video Solution

5. A particle of mass 0.3 kg is subjected to a force F = - kx , Where = $15Nm^{-1}$. What will be its initial acceleration when particle is released from a point 20 cm away from origin ?

Watch Video Solution

6. Heavier bodies need greater initial effort to put them in motion Way ?

Watch Video Solution

7. A part of Newton's first law states that a body continuous to move uniformly in the absence of an external force appears contradictory Comment.

Watch Video Solution

8. Four blocks of the same mass m connected by cords are pulled by a force F on a smooth horizontal surface as shown in Determine the tensions $T_1 T_2$ and T_3 in the cords.

Watch Video Solution

9. The speed of driving a car safely in darkness depends upon the range of headlights Explain

.

Watch Video Solution

10. A force of $5N$ changes the velocity of a body from $10ms^{-1}$ to $20ms^{-1}$ in $5\sec$. How much force is required to bring about the same change in $2\sec$?

Watch Video Solution

11. Earth is a rotating frame of reference, even then it is considered as inertial frame of reference for all practical purposes. Why ?

Watch Video Solution

12. The motion of a particle of mass m is described by $y = ut + \frac{1}{2}gt^2$. Find the force acting on the particle.

Watch Video Solution

13. Aeroplanes having wings fly at low altitudes while jet planes fly at high altitudes . Way ?

Watch Video Solution

14. A thief jumps from the upper storey of a house with a load on this back. What is the force of the load on his back, when thief is in air ?

Watch Video Solution

15. According to Newton' s third law, every force is a accompanied by an equal and opposite force. How can anything move then ?

Watch Video Solution

16. A meteorite burns in the atmosphere before it reaches the earth' s surface. What happens to its momentum ?

Watch Video Solution

17. On the pan of a spring balance , is placed a beaker containing water . How will the reading of spring balance change if we dip our finger in this water ?

Watch Video Solution

18. A person of mass m is hanging from a rope fastened to a stationary balloon of mass M If the person climbs the rope , then with what velocity the balloon would move and in what direction ?

Watch Video Solution

19. Vehicles stop on applying brakes . Does this phenomenon violate the principle of conservation of momentum ?]

Watch Video Solution

20. Three identical blocks, each having a mass M, are pushed by a force F on a frictionless table as shown in (figure) What is the acceleration of the blocks? What is net force on block A? What force does A apply on B? What force does B apply on C? show action reaction pairs on the contact surface of the blocks.

Watch Video Solution

21. A bullet fired from a gun is more dangerous than an air molecule hitting a person , though both of them have almost the same speed Way ?

Watch Video Solution

22. A rocket can move in air free space, but a jet plane cannot. Why?

Watch Video Solution

23. Why is it difficult to move a bike with its brakes on ?

Watch Video Solution

24. Send is spread on tracks covered with snow. Why ?

Watch Video Solution

25. When a weel is rolling on a level , what is the directionv of fricctional force between the wheel and the road ?

Watch Video Solution

26. Is large brake on a bicycle wheel more effective than a small one ? Explain

Watch Video Solution

27. How do we save petrol when the types of the motor cycle are fully inflated ?

Watch Video Solution

28. A block of mass 1 kg lies on a horizontal surface in a truck. The coefficient of static friction between the block and the surface is 0.6. If the acceleration of the truck is $5m/s^2$, the frictional force acting on the block is........... newtons.

Watch Video Solution

29. A block is gently placed at the top of an inclined plane 6.4 m long . Find the time taken by the block to slide down to the bottom of the plane . The plane makes an angle30° with the horizontal Coefficient of friction between the block and the plane is 0.2 Take $g = 10m/s^2$.

Watch Video Solution

30. How does a lubricant help in reducing friction ?

Watch Video Solution

31. When a person walks on a rough surface, the frictional force exerted by the surface on the person is opposite to the direction of his motion.

Watch Video Solution

32. Can coefficient of friction exceed unity ?

Watch Video Solution

33. Why are ball bearings used in machinery ?

Watch Video Solution

34. Write a note on banking of roads.

Watch Video Solution

35. A horse pulling a cart has to apply a greater force to start the cart than to keep the cart in motion Why ?

Watch Video Solution

36. How does banking of roads reduce wear and tear of the tyres ?

Watch Video Solution

37. Why has a horse to pull a cart harder during the first few steps of his motion ?

Watch Video Solution

38. Why does a cyclist lean to one side while going along a curve ? In what direction does he lean ?

Watch Video Solution

39. A stone tied at the end of sring is whirled in a circle. If the string break , the stone flies away tangentially . Why ?

Watch Video Solution

40. Why does a child in a merry - go - round press the side of his seat radially outward ?

Watch Video Solution

41. What is the source of centripetal force , when an electron revolves around the nucleus ?

Watch Video Solution

42. A bucket containing water is rotated in a vertical circle. Explain why water does not fall.

Watch Video Solution

43. Why does a pilot not fall down when his aeroplane loops a vertical loop ?

Watch Video Solution

44. One aften comes across the following kind of statement concerning circular motion A particle moving uniformly along a circle experiences a force directed towards the center and an equal and opposite force directed away from the centre The two forces together keep the particle in equilibrium Explain what is wrong with the statement ?

Watch Video Solution

45. If a force is acting on a moving body in a direction perpendicular to the direction of motion what will be its effect on speed and direction of the body ?

Watch Video Solution

Very short answer questions

1. If the net force acting on a body be zero, will it remain necessarily at rest ?

Watch Video Solution

2. The distance travelled by a body is directly proportional to time Is any external force acting on it ?

Watch Video Solution

3. A body is acted upon by a number of external forces. Can it remain at rest ?

Watch Video Solution

4. A person sitting in the compartment of a tarin moving with unifrom speed throws a ball in the upward direction . What path of the ball will appear to him ? What to a person standing outside ?

Watch Video Solution

5. If a force is acting on a moving body in a direction perpendicular to the direction of motion what will be its effect on speed and direction of the body ?

Watch Video Solution

6. A retarding force is applied to stop a motor car . If the speed of the motor car is doubled , how much more distance will it cover before stopping under the same retarding force ?

Watch Video Solution

7. A body is dropped from the celling of a transparent cabin falling freely towards the earth . Describe the motion of the body as observed by an observer (a) sitting in the cabin (b) standing on earth.

Watch Video Solution

8. The linear momentum of a body can change only in the direction of applied force Comment .

Watch Video Solution

9. A force is always required to move a body uniformly . Comment .

Watch Video Solution

10. Calculate the net force acting on a body of mass 10 kg moving with a unifrom velocity of $2ms^{-1}$.

Watch Video Solution

11. Calculate the mass of a body weighing 100 dyne . Take $g = 10ms^{-2}$.

Watch Video Solution

12. On what factors does the thrust on a rocket depend ?

Watch Video Solution

13. Calculate the force acting on a body whose linear momentum changes by $20kgms(-1)$ in 10 s.

Watch Video Solution

14. A ball is suspended by a cord from the ceilling of a motor car What will be the effect on the position of the ball , if (i) the car is moving with unifrom velocity (ii) car is accelerated (iii) car is turning towards left ?

Watch Video Solution

15. A vessel containing water is given a constant acceleration 'a' towards the right along a straight horizontal path. Which of the following diagrams in Fig. represents the surface of the liquid?

Watch Video Solution

16. What is the ratio of SI to CGS units of linear momentum ?

Watch Video Solution

17. Show that if the force acting on a particle is zero , its momentum will remain unchanged.

Watch Video Solution

18. The length of an ideal spring in increases by 0.1 cm when a body of 1 kg is suspended from it If this spring is laid on a frictionless horizontal table and bodies of 1 kg each are suspended from its ends , then what will be the increase in its length ?

Watch Video Solution

19. The two ends of a spring - balance are pulled each by a force of 10 kg wt What will be the reading of the balance ?

Watch Video Solution

20. A lift is accelerated upward Will the apparent weight of a person inside the lift increase , decrease or remain the same relative to its real weight ? If the lift is going with unifrom speed then ?

Watch Video Solution

21. A ball of 0.5 kg mass moving with a speed of $10m/s$ rebounds after strinking normally a perfectly elastic wall . Find the change in momentum of the ball.

Watch Video Solution

22. A body of 2 kg is suspended on a spring balance hung vertically in a lift . If the lift is falling downward under acceleration due to gravity g then what will be the reading of the balance ? If going upward with the same acceleration then ?

Watch Video Solution

23. A 5- kg body is suspendel from a spring - balance , and an identical body is balanced on a pan of a physical balance . If both the balances are kept in an elevator , then what would happen in each case when the elevator is moving with an upward acceleration ?

Watch Video Solution

24. A thief jumps from the roof of a house with a box of weight W on his head. What will be the weight of the box as experienced by the thief during jump ?

Watch Video Solution

25. Action and rection forces do not balance each other Why ?

Watch Video Solution

26. What is the principle of working of a rocket ?

Watch Video Solution

27. Why does a gun recoil When a bullet is fired ?

Watch Video Solution

28. An impulsive force of 100 N acts on a body for 1 s What is the change in its linear momentum ?

Watch Video Solution

29. Can a single isolated force exist in nature ?

Watch Video Solution

30. What are the conditions for maximum and minimum pull of a lift on a supporting cable ?

Watch Video Solution

31. What is the principle of working of a rocket ?

Watch Video Solution

32. A bomb explodes in mid air into two equal fragments . What is the angle between their directions of motion ?

Watch Video Solution

33. Can a rocket operate in free space ?

Watch Video Solution

34. Why do we easily slip on a rainy day ?

Watch Video Solution

35. What are the factors on which coefficient of friction depends ?

Watch Video Solution

36. What type of friction is involved when anaxle rotates in a sleeve ?

Watch Video Solution

37. Is frictions independent of actual area of contact ?

Watch Video Solution

38. The fast moving vehicles are given streamline shape . Why ?

Watch Video Solution

39. Rubber tyres are perferred to steel tyres . Why ?

Watch Video Solution

40. What is the relation between coefficient of friction and angle of repose ?

Watch Video Solution

41. Is frictions a self adjusting force ?

Watch Video Solution

42. What is the angle between frictional force and instantaneous velocity of the body moving over a rough surface ?

Watch Video Solution

43. Can we get off a frictionless horizontal surface by umppin ?

Watch Video Solution

44. What is the angle of friction between two surfaces in contact , if coefficient of friction is $1/\sqrt{3}$?

Watch Video Solution

45. What is dry friction ? And what is wet friction ?

Watch Video Solution

46. What is the unit of coefficient of friction depend ?

Watch Video Solution

47. What are the factors on which coefficient of friction depends ?

Watch Video Solution

48. Out of stiatic friction limiting friction and dynamic friction which is largest ?

Watch Video Solution

49. What is the angle of friction between two surfaces in contact , if coefficient of friction is $1/\sqrt{3}$?

Watch Video Solution

50. What is the angle between frictional force and instantaneous velocity of the body moving over a rough surface ?

Watch Video Solution

51. It is easier to roll a barrel than to pull it along the road. Why ?

Watch Video Solution

52. A bucket of water is rotated in a vertical circle so that surface of water is at a distance r from the axix of rotation What is the minimum angular velocity so that the water does not spill out ?

A. $\sqrt{2g/r}$.

B. $\sqrt{g/r}$.

C. $\sqrt{3g/r}$.

D. $\sqrt{4g/r}$.

Answer: B

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53. What is the apparent weight of a boby of mass m at (a) the highest and (b) lowest point if it is just looping the loop in a vertical circle ?

Watch Video Solution

54. The acceleration of a train travelling at $40m/s$ as it goes round a curve of 160 m in radius is ?

Watch Video Solution

55. A ball of 1 gm released down an inclined plane describes a circle of radius 10 cm in the vertical plane on reaching the bottom . The minimum height of the inclined plane is ... cm.

Watch Video Solution

56. A stone is tied to one end of a string and rotated in a vertical circle . What is the difference in tensions of the string at lowest and highest points of the vertical circle ?

Watch Video Solution

57. A body is moving with a unifrorm speed along a circle . Is there any force acting on the body ?

Watch Video Solution

58. Can centripetal force produe rotation ?

Watch Video Solution

59. Which one is real force - centripetal or centrifugal force ?

Watch Video Solution

60. What provides centripetal force to a car turning on a level road ?

Watch Video Solution

61. When a body moves along a circular path which thing experiences centrifugal force ?

Watch Video Solution

62. Does the angle of banking depend on mass of the vehicle ?

Watch Video Solution

63. What is the maximum velocity with which a vehicle can negotiate a turn of radius r safely when coefficient of friction between tyres and road is μ ?

Watch Video Solution

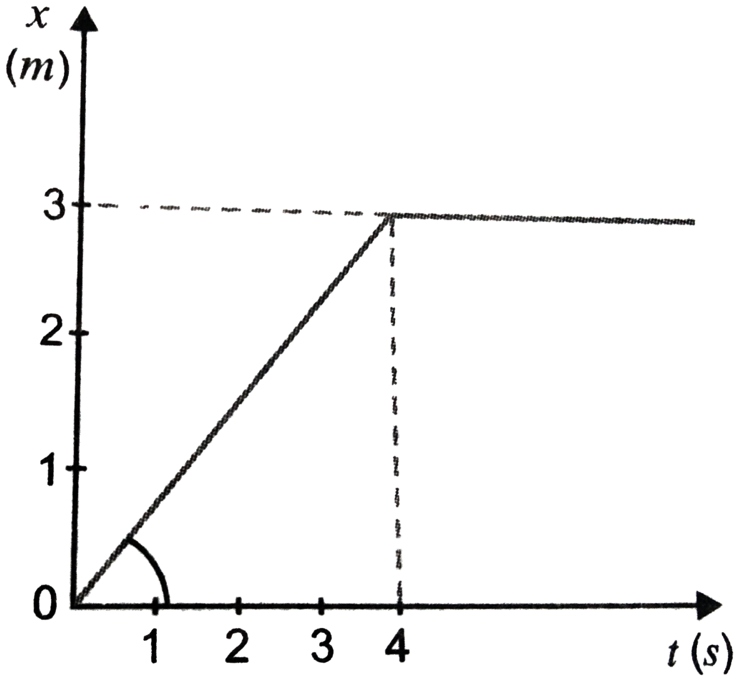
64. A girl ridding a bicycle along a straight road with a speed of $5ms^{-1}$ throws a stone of mass 0.5 kg which has a speed of $15ms^{-1}$ with respect to the ground along her direction of motion. The mass of the girl and bicycle is $5kg$. Does the speed of the bicycle change after the stone is thrown ? What is the change in speed, if so ?

Watch Video Solution

65. A person of mass 50 kg stands on a weighing scale on a lift . If the lift is descending with a downward acceleration of $9ms^{-2}$ what would be the reading of the weighing scale? $(g = 10ms^{-2})$.

Watch Video Solution

66. The position time graph of a body of mass $2kg$ is as given in What is the impulse on the body at $t = 0$ s and $t = 4s$?



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67. A person driving a car suddenly applies the brakes on seeing a child on the road ahead . If he is not wearing seat belt, he falls forward and hits his head against the steering weel. Why ?

Watch Video Solution

68. The velocity of a body of mass $2kg$ as a function of t is given by $v(t) = 2t\hat{i} + t^2\hat{j}$ Find the momentum and force acting on it at time $t = 2s$.

Watch Video Solution

69. A block placed on a rough horizontal surface is pulled by a horizontal force F Let f be the force applied by the rough surface on the block . Plot a graph of f versus F .

Watch Video Solution

70. Why are porcelain objects wrapped in paper or straw before packing for transportation ?

Watch Video Solution

71. Why does a child feel more pain when she falls down on a hard cement floor, than when she falls on the soft muddy ground in the garden ?

Watch Video Solution

72. A woman throws an object of mass 500 g with a speed of $25ms^{-1}$.

(a) What is the impulse imparted to the object ?

(b) If the object hitts a wall and rebounds with the half the original speed , what is the change in momentum of the object ?

Watch Video Solution

73. Why are mountain roads generally made winding upwards rather than going straight up ?

Watch Video Solution

Short Answer Questions

1. A body is acted upon by a number of external forces . Can it remain at rest ?

Watch Video Solution

2. If the net force acting on a body be zero , will it remain necessarily at rest ?

Watch Video Solution

3. Why do blades of an electric fan continue to rotate for some time, after the current is switched off ?

Watch Video Solution

4. If the speed of a motor car is doubled , how much more distance will it cover before stopping under the same retarding force ?

Watch Video Solution

5. Two bodies of masses M and m are allowed to fall from the same height. If air resistance for each body be same, will the two bodies reach the ground simultaneously ?

Watch Video Solution

6. A block of mass M is supported by a cord C from a rigid support, and another cord D is attached to the bottom of the block. If D is given a sudden jerk D breaks But if D is pulled steadily, cord C breaks. Why ?

Watch Video Solution

7. Two bodies of masses M and m are allowed to fall from the same height . If air resistance for each body be same , will the two bodies reach the ground simultaneously ?

Watch Video Solution

8. A soda water bottele is falling freely . Will the bubbles of gas rise in the water of the bottle ?

Watch Video Solution

9. An athelete runs a certain distance before taking a long jump . Why ?

Watch Video Solution

10. How do you account for the function of mud guards ?

Watch Video Solution

11. Calculate the force acting on a body which changes the momentum of the body at the rate of $1kgms^{-2}$.

Watch Video Solution

12. What is the funcation of shokers in scoots ?

Watch Video Solution

13. A cricket player lowers his hands while catching a ball . Why ?

Watch Video Solution

14. Why buffers are provided between the bogies of a train ?

Watch Video Solution

15. When a man jumps down from a height of several storeys onto a stretched trapaulin , he receives no injury . Why ?

Watch Video Solution

16. Air is thrown on a sail attached to a boat from an electric fan placed on the boat . Will the boat start moving ?

Watch Video Solution

17. A bird is sitting on the floor of a wire cage and the cage is in the hand of a boy . The bird starts flying in the cage . Will the boy experience any change in the weight of the cage ?

Watch Video Solution

18. A bird is sitting on the floor of a closed glass cage and the cage is in the hand of a girl. Will the girl experience any change in the weight of the cage when the bird (i) starts flying in the cage with a constant velocity (ii) flies upwards with acceleration (iii) flies downwards with acceleration ?

Watch Video Solution

19. When a ball is thrown upwards . Its momen tum first decreases and the increases Is conservation of linear momentum violated in this process?

Watch Video Solution

20. Explain what is menant by force , inertia and linear momentum.

Watch Video Solution

21. What is meant by law of inertia ? Disuss briefly the concept of inertial mass .

Watch Video Solution

22. State secound law of motion and show that second law is the real law of motion .

Watch Video Solution

23. Define absolute and gravitational units of force state relaction between them .

Watch Video Solution

24. State and Explain Newton s second law of motion Hence , Deduce the relation F = ma Where the symbols have their usual meaning .

Watch Video Solution

25. Explain the term impulse Show that impulse of a variable force is equal to area enclosed by the force - time curve .

Watch Video Solution

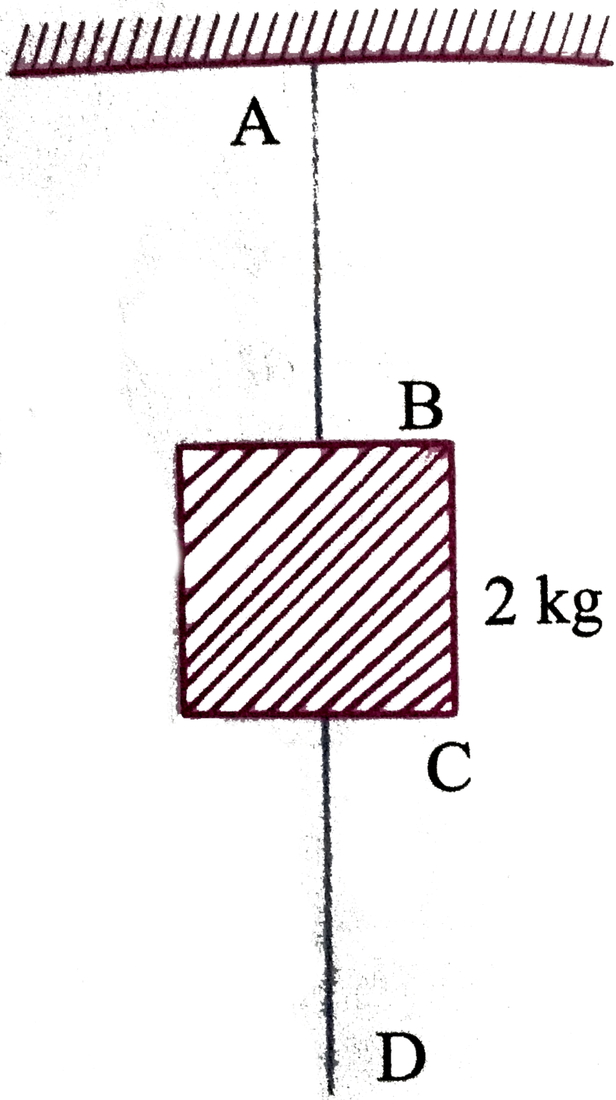
26. Discuss the apparent weight of a man in a lift when (i) kift is moving upwards with a constant speed (ii) lift is accelerated uniformly downwards .

Watch Video Solution

27. What do you understand by concurrent forcrs ? State the conditions for the equilibrium of a particle under the effect of concurrent forces .

Watch Video Solution

28. A mass of $2kg$ is suspended with thread AB (figure) Thread CD of the same type is attached to the other end of $2kg$ mass. Lower thread is pulled gradually, harder and harder in the downward gradually, harder and harder in the downward direction so as to apply force on AB. which of the threads will break and why?

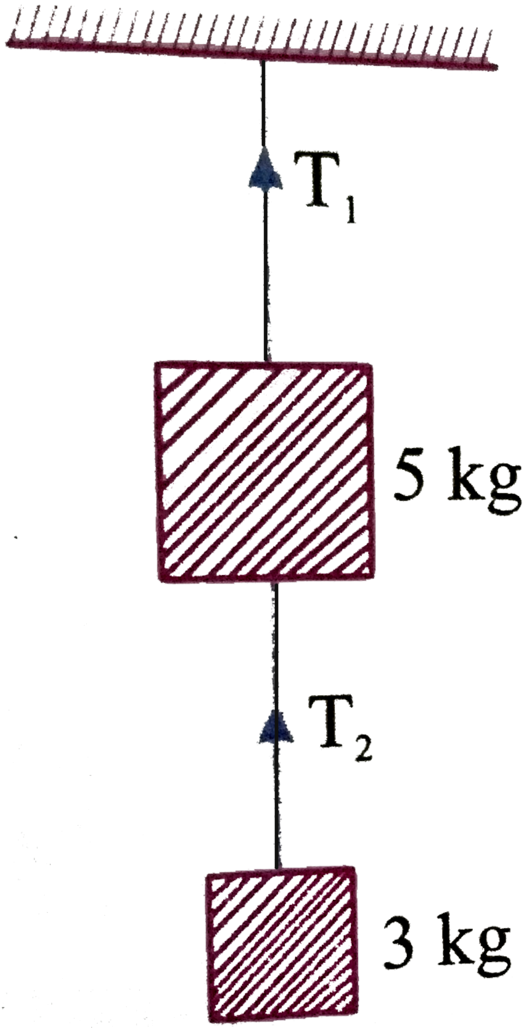


Watch Video Solution

29. In the above given problem if the lower thread is pulled with a jerk, what happens ?

View Text Solution

30. Two masses of $5kg$ and $3kg$ are suspended with help of massless inextensible strings as shown in figure. Calculate $T_1$and T_2 when whole system is going upwards with acceleration $= 2m/s^2 \left(use g = 9.8ms^{-2}\right)$.



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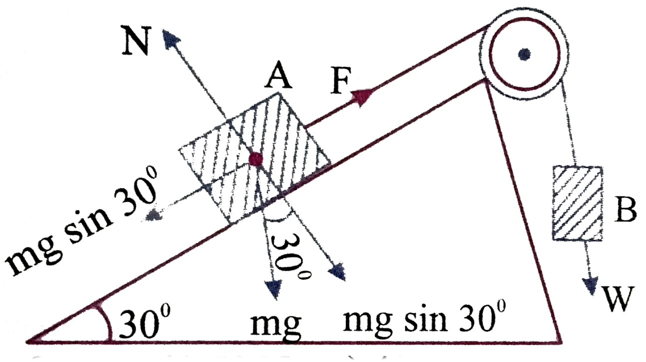
31. Block A of weight $100N$ rests on a frictionless inclined plane of slope angle 30° (Fig. 5.7). A flexible cord attached to A passes over a frictonless pulled and is connected to block B of weight W. Find the weight W for which the system in equilibrium.



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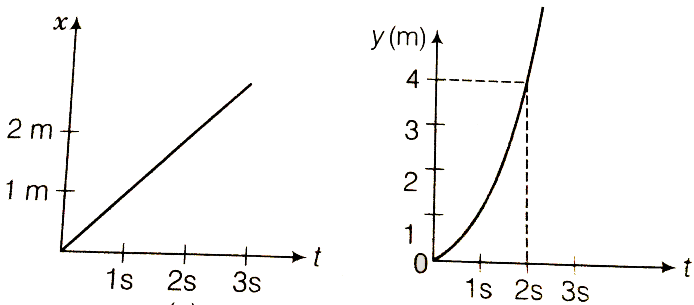
32. A block of mass M is held against a rough vertical wall by pressing it with a finger . If the coefficient of friction between the block and the wall is μ and the acceleration due to gravity is g , calculate the minimum force required to be applied by the finger to hold the block against the wall.

Watch Video Solution

33. a 100kg gun fires a ball of 1kg horizontally from a cliff of height 500m. If falls on the ground at a distance of 400m from the bottom of the cliff. The recoil velocity of the gun is (Take g: $10ms^{-2}$

Watch Video Solution

34. Figure shows (x,t) (y,t) diagram of a particle moving in 2-dimensions.



(a) (b)

If the particle has a mass of 500 g , find the force (direction and magnitude) acting on the particle .

Watch Video Solution

35. A person in an elevator accelerating upwards with an acceleration of $2ms^{-2}$, tosses a coin vertically upwards with a speed of $20ms^{-1}$. After how much time will the coin fall back into his hand ? (g = 10 ms^{-2})

Watch Video Solution

Long Answer Questions

1. Explain Newton s laws of motion and show that (i) Newton s first law of motion defines force and (ii) Newton s second law of motion gives us the measure of force.

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2. What are three types of inertia ? Given atleast two examples of each.

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3. State and prove the principle of conservation of linear momentum Show that a gun recoils when a bullet is fired from it

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4. State and explain Newton s third law of motion . Show that third law of motion is contained in first law of motion

Watch Video Solution

5. Name a varying mass system Drive the expressions the (i) for the velocity of propulsion of a rocket at any instant (ii) burnt out speed (iii) Thrust on the rocket

Watch Video Solution

6. Distinguish between static friction limitting friction and kinetic friction How do they vary with the applied force ? Which friction has least value and which one has highest value ?

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7. Discuss the motion of a body in a vertical circle Find expressions for the minimum velocity at the lowest point while looping a loop and difference of tensions in the string at the lowest and highest points.

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8. There are three forces F_1, F_2 and F_3 acting on a body , all acting on a point P on the body The body is found to moves with unifrom speed (a) Show that the forces are coplaner.

(b) Show that the torque acting on the body about any point due to these three forces is zero .

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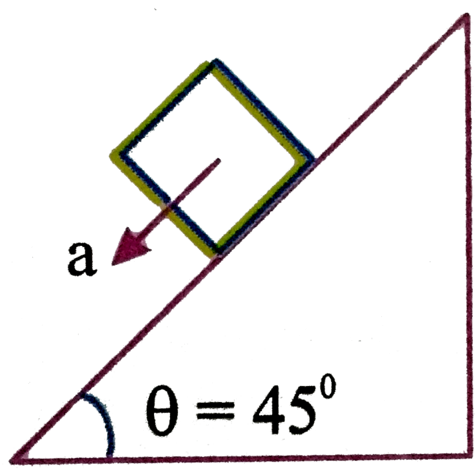
9. When body slides down from rest along smooth inclined plane making angle of 45° with the horizontal, it takes time T When the same body slides down from rest along a rough inclined plane making the same angle and through the same distance it is seen to take time pT, where p is some number greater that 1. Calculate late the coefficient of friction beween the body and the rough plane.



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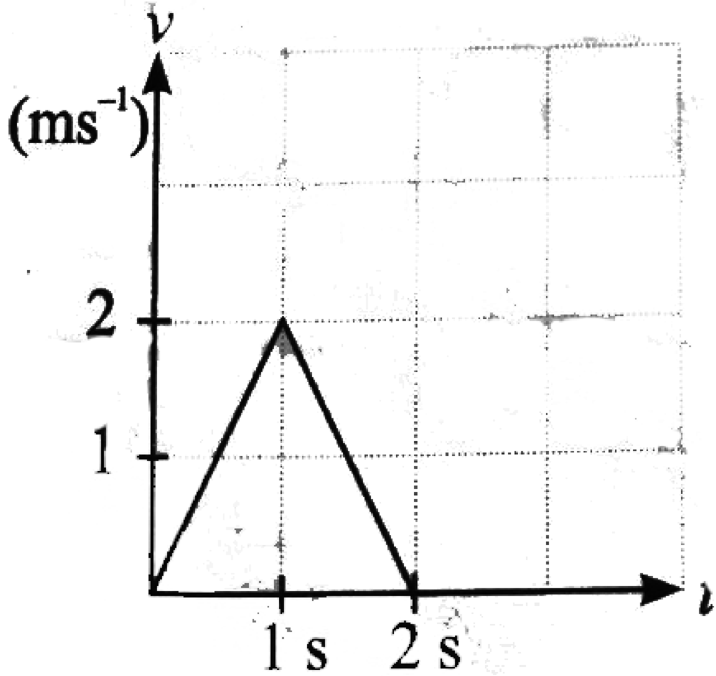
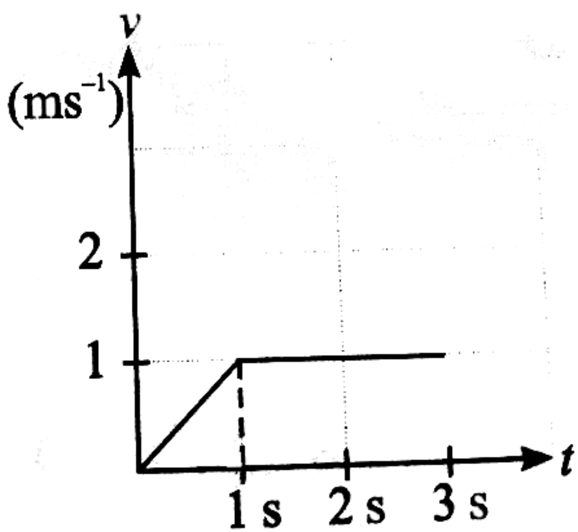


(a)

10.



(b)

Figure shows (v_x,t) and (v_y,t) diagram for a body of unit mass. Find the force as a function of time.

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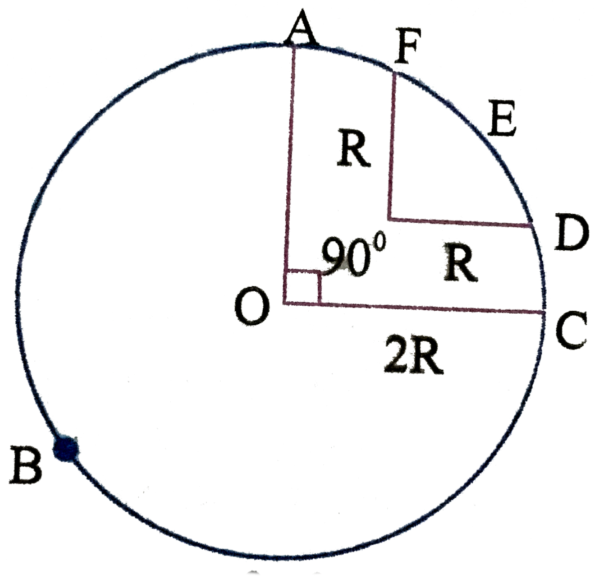
11. A racing car travels on a track (without banking) $ABCDEFA.ABC$ is a circular arc of radius $2R$. CD and FA are straight paths of length R and DEF is a circular arc of radius $R = 100m$. The co-efficient of friction on the road is ¼ $= 0.1$. the maximum speed of the car is $50ms - 1$. Find the minimum time for completing one round.



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12. The displacement vector of a particle of mass m is given by r (t) =

$\hat{i} A \cos \omega t + \hat{j} B \sin \omega t.$

(a) Show that the trajectory is an ellipse.

(b) Show that F = $-m\omega^2 r$.

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13. A cricket bowler releases the ball in two different ways

(a) giving it only horizontal velocity and

(b) giving it horizontal velocity and a small downward velocity.

The speed v_s at the time of release is the same

. Both are released at a height H from the ground . which one will have greater speed when the ball hits the ground ? Neglect air resistance .

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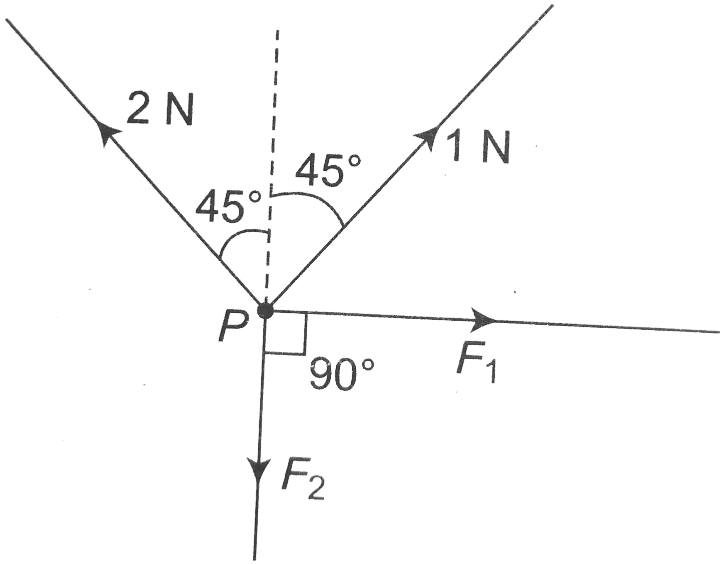
14. There are four force acting at a point p produced by strings as shown in figure, which is at rest. The force F_1 and F_2 are .



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15. A rectangular box lies on a rough inclined surface . The coefficient of friction between the surface and the box is μ. Let the mass of the box be m .

(a) At what angle of inclination θ of the plane to the horizontal will the box just start to slide down the plane ?

(b) What is the force acting on the box down the plane , if the angle of inclination of the plane is increased to $\alpha > \theta$?

(c) What is the force needed to be applied upwards along the plane to make the box either remain stationary or just move up with uniform speed ?

(d) What is the force needed to be applied upwards along the plane to make the box move up the plane with acceleration a ?

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16. A helicopter of mass 2000 kg rises with a vertical acceleration of $15ms^{-2}$. The total mass of the crew and passengers is 500 kg. Give the magnitude and direction of the (g $= 10ms^{-2}$)

(a) Force on the floor of the helicopter by the crew and passengers.

(b) action of the rotor of the helicopter on the surrounding air.

(c) force on the helicopter dur to the surrounding air.

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Curiosity Question

1. What do you think may be the cause of an earthquake ?

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Short Answer Questions

1. The minimum force required just to move a block on a rough horizontal surface is 10 N An applied force of 5 N fails to move the block. What are the values of static friction and dynamic friction ?

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2. Is frictions a self adjusting force ?

Watch Video Solution

3. Angle of repose of a rough inclined pane is 60° . What is the coefficient of friction ?

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4. A ball rolling on ice with a velocity of $4.9m/s$ stops after travelling 4 m . If

$g = 9.8 m / s^2$ what is the coefficient of friction ?

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5. Why are wheels of an automobile made circular ?

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6. Automobile tyres are generally provided with irregular projections over their surfaces,

why ?

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

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8. Why frictional force gets increased when two surfaces in contact are polished beyond a certain limit ?

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9. For looping a loop of radius 4 m through what minimum height should a particle descend ?

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10. Why are the passengers thrown outwards when a car in which they are travelling suddenly takes a circular turn?

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11. A motor cyclist is going in a vertical circle what is the necessary condition so that he may not fall down ?

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12. For oscillation of a simple pendulum of length L what is the maximum possible velocity at the lowest position What happens to the motion if velocity exceeds this value ?

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13. The driver of a truck travelling with a velocity upsilon suddenly notices a brick wall in front of him at a distance d It is better for him to apply brakes or to make a circular turn without applying brakes in order to just avoid crashing into the wall ? Why ?

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14. A particle moves in a circle of radius 20 cm Its linear speed is given by upsilon = 2 t where t is in second and upsilon in metre/second Find the radial and tangential acceleration at $t = 3s$.

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15. Explain static friction and kintic friction Can value of kinetic friction be greater than static friction Explain.

Watch Video Solution

16. Explain the origin of (i) sliding friction (ii) the rolling friction .

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17. Explain that static friction is a self adjusting force .

Watch Video Solution

18. Explain the terms (i) angle of friction (ii) coefficient of friction and (iii) angle of repose Establish a relation between them .

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19. Derive an expression for acceleration of a body down a rough inclined plane .

Watch Video Solution

20. Calculate the amount of work done in moving a body up a rough inclined plane .

Watch Video Solution

21. Why are the curved roads banked ? Obtain an expression for angle of banking of a curved road .

Watch Video Solution

22. Discuss the bending of a cyclist while describing a curved path Find the relation for angle of bending of the cyslist

Watch Video Solution

23. How does the lubrication of a machine help in reducing friction ?

Watch Video Solution

24. Why does water from a bucket not spill even when it is upside down while rotating in a vertical circle ?

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25. Establish that friction is a necessary evil

Watch Video Solution

26. Explain centripetal force and centrifugal force Can they balance each other ? Explaine.

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Advanced problems for competitions

1. A lift is going upwards with an acceleration of $4.9m/s^2$ What will be the apparent weight of a 60 kg person sitting in the lift ? What when the lift acquires a unifrom velocity of

$4.9m/s$? If rope of the lift is broken , then ?

Take $g = 9.8m/s^2$.

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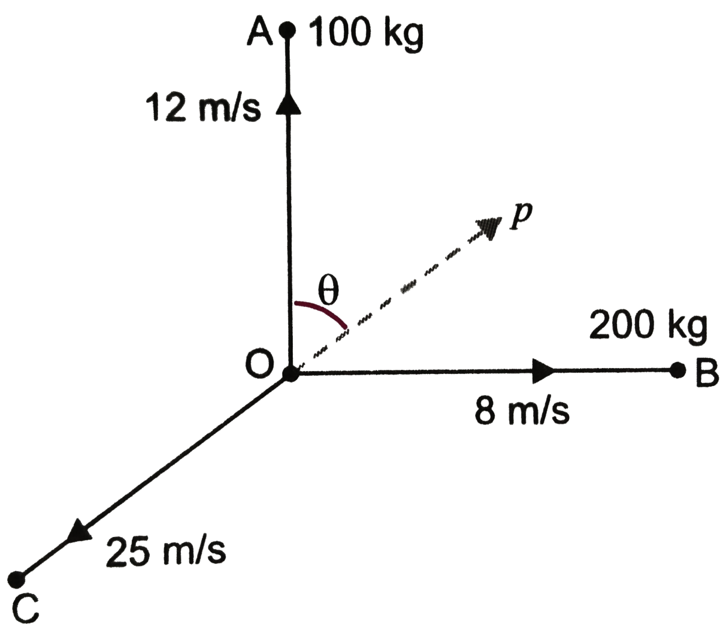
2. An explosion blows a rock into three pieces Two pieces whose masses are 200 kg and 100 kg go off at 90° to eachother with a velocity of $8m/s$ and $12m/s$ respectively If the third piece flies off with a velocity of$25m/s$ then calculate the mass of this piece and indicate the direction of flight of this piece in a diagram.



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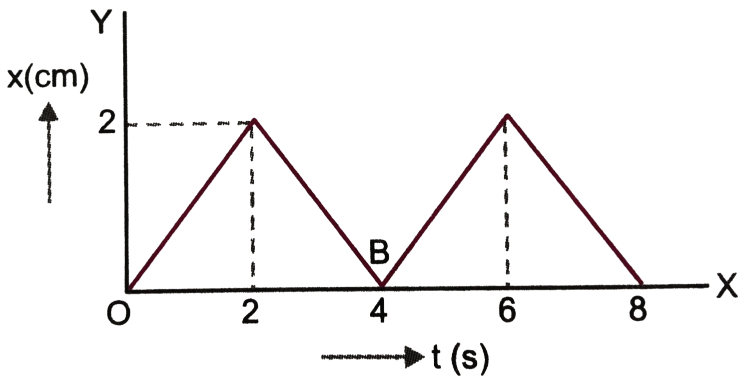
3. Shows the position time graph of a particle of mass 0.04 kg Suggest a suitable physical context for this motion What is the time between two conscutive impulse recevived by the particle ? What is the magnitude of each impulse ?



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4. A block of mass 15 kg is placed on a long trolly . The coefficient of friction between the block and trolly is 0.18 The trolly accelerates from rest at $0.5m/s^2$ for 20 seconds and then moves with a unifrom velocity Discuss the motion of the block as viewed by (i) a stationary observer on the ground (ii) an observer moving with the trolly .

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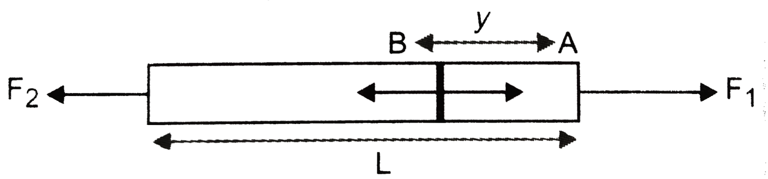
5. What is the tension in a rod of length length L and mass M at a distance y fromF_1 when the rod is acted on by two unequal force

F_1 and $F_2(< F_1)$ as shown in.



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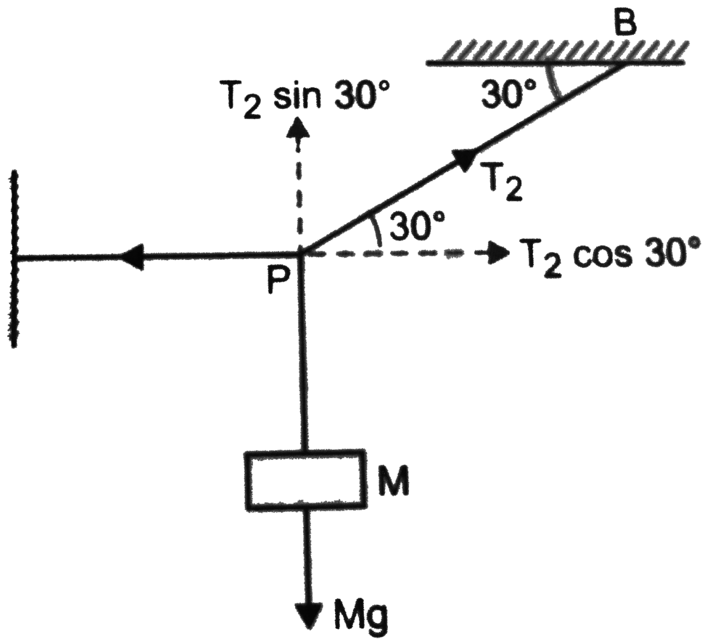
6. A mass M is hung with a light inextensible string as shown in Find the tension in the

horizontal part of the string .



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7. Two blocks $m_1 = 4kg$ and $m_2 = 2$ kg connected by a weightless rod slide down a

plane having an inclination of 37° . The coefficient of dynamic friction of m_1 and m_2 with the inclined plane are $\mu_1 = 0.75$ and $\mu_2 = 0.25$ respectively Find the common acceleration of the two blocks and tension in the rod Take is $\sin 37^{\circ} = 0.6$ and $\cos 37^{\circ} = 0.8$.

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8. A body of mass 5×10^{-3} kg is launched upon a rough inclined plane making an angle of 30° with the horizontal. Obtain the coefficient of friction between the body and the plane if the time of ascent is half of the time of descent.

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9. A wire of mass 9.8×10^{-3} kg per meter passes over a frictionless pulley fixed on the top of an inclined friction less plane which makes an angle of 30° with the horizontal Masses M_1 and M_2 are tied at the two ends of the wire The mass M_1 rests on the plane and mass M_2 hangs freely vertically downwards . The whole system is in equilibrium Now a transverse wave propagates along the wire with a velocity of $100m/s$ If $g = 9.8m/s^2$ calculate the value of masses M_1 and M_2 .

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10. Two particles of masses m_1 and m_2 in projectile motion have velocities $\vec{v}_1$ and $\vec{v}_2$, respectively , at time $t = 0$. They collide at time t_0. Their velocities become $\overrightarrow{v'}_1$ and $\overrightarrow{v'}_2$ at time $2t_0$ while still moving in air. The value of

$$\left|\left(m_1\overrightarrow{v'}_1 + m_2\overrightarrow{v'}_2\right) - \left(m_1\overrightarrow{v}_1 + m_2\overrightarrow{v}_2\right)\right|$$

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11. An aeroplane requires for take off a speed of $80km/h$ the run on the ground being 100 m The mass of aeroplane is 10^4 kg and ground is 0.2 What is the maximum force required by the engine of the plane for take off ?

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12. A particle of mass m rests on a horizontal floor with which it has a coefficient of static friction μ. It is desired to make the body move by applying the minimum possible force F. Find the magnitude of F and the direction in which it has to be applied.

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13. A smooth block is released at rest on a 45° incline and then slides a distance 'd'. The time taken to slide is 'n' times as much to slide on rough incline than on a smooth incline. The coefficient of friction is

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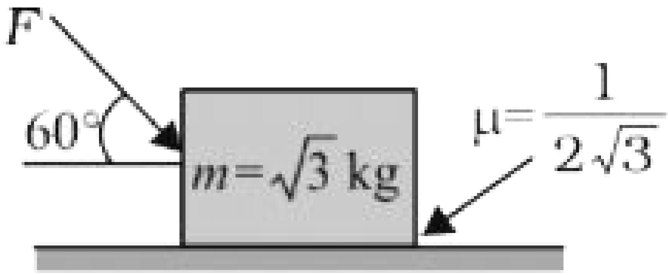
14. What is the maximum value of the force F such that the block shown in the figure does not move?



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15. The rear side of a truck is open and a box of 40 kg mass is placed 5 m from the open end The coefficient of friction between the box and the surface below it is 0.15 On a straight road the truck starts from rest and accelerates with $2m/s^2$ At what distance from the starting point does the box fall off the truck ? Ignore the size of the box .

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16. A hemispherical bowl of radius R si set rotating abouv its axis of symmetry whichis kept vertical. A small blcok kept in the bowl rotates with the bowl without slippingn on its surface. If the surfaces of the bowl is mooth, and the abgel made by the radius through the block with the vertical is θ, find the angular speed at which the bowl is rotating.

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17. A bullet of mass 10 gram is fired horizontally into a 5 kg wooden block at rest on a horizontal surface The coefficient of kinetic friction between the block and the surface is 0.1 Calculate the speed of the bullet striking the block if the combination moves 20 m before coming rest .

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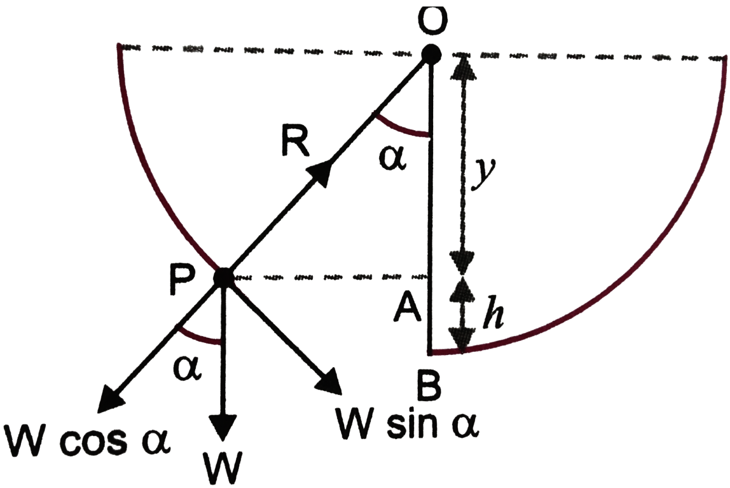
18. Calculate the height upto which an insect can crawl up a fixed bowl in the from of a hemisphere of radius r Given coefficient of friction $= 1\sqrt{3}$



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19. A $4m$ long ladder weighing $25kg$ rests with its upper end against a smooth wall and lower end on rough ground.What should be the minimum coefficient of friction between the

ground and the ladder for it to be inclined at 60° with the horizontal without slipping? $(Take g = 10 m/s^2)$

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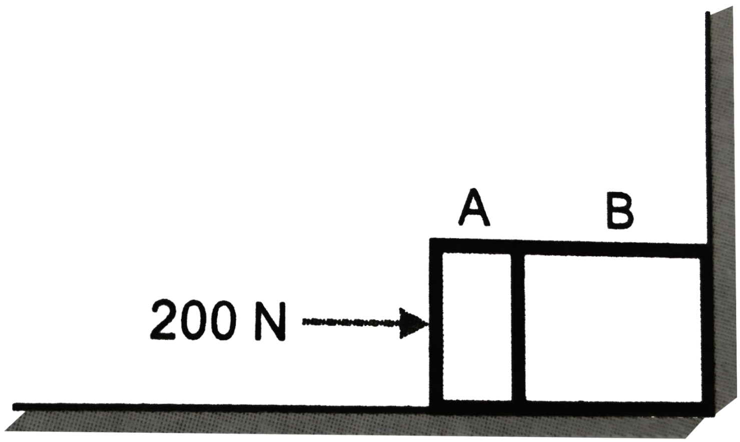
20. Two bodies A and B of mass 5 kg and 10 kg contact with each other rest on a table against a rigid The coefficient of friction between the bodies and the table is 0.05 A force of 200 N is applied horizontal on A What are (a) the reaction of thee wall (b) the the action , reaction forces between A & B ? What happens when the wall is removed ? Does the answer to (b) Change , when the bodies are in motion ? Ignore differnce between μ_s and μ_k



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EXERCISES

1. Give the magnitude and direction of the net force acting on

(a) a drop of rain falling down with a constant speed

(b) a crok of mass 10 g floating on water

(c) a kit skilfully held stationary in the sky

(d) a car moving with a constant velocity of $30kh/h$ on a rough road

(e) a high speed electron in space for from all gravitational obects and free of electric and magnetic fields.

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2. A pebble of mass 0.05 kg is thrown vertically upwards Give the magnitude and direction of net force on the pebble (a) during its upward motion (b) during its downward motion (c) at the highest point where it is momentarily rest Do your answers change if the pebble were thrown at an angle of say 45° horizontal direction Ignore air resistance .

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3. Given the magnitude and direction of the force acting on a stone of mass 0.1 kg (a) just after it is dropped from the window of a stationary train

(b) just after it is dropped from the window of a train running at a constant velocity of $36 km / hr$

(c) just after it is droped from the window of a train accelerating with $1 ms^{-2}$

(d) lying on the floor of a trin which is accelerating with $1 ms^{-2}$ the stone being at rest relative to the train .

Neglect the resistance of air throuhout .

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4. One end of string of length l is connected to a particle on mass m and the other end is connected to a small peg on a smooth horizontal table. If the particle moves in circle with speed v the net force on the particle (directed toward centre) will be (T reprents the tension in the string):

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5. A constant retarding force of 50 N is applied to a body of mass 20 kg moving intially with a speed of $15ms^{-1}$ How long does the body take to stop ?

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6. A constant force acting on a body of mass $3kg$ changes its speed from $2ms^{-1}$ to $3.5ms^{-1}$ in 25 s. The direction of motion of

the body remains unchanged . Calculte magnitutude and direction of the force .

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7. A body of mass 5 kg is acted upon by two perpendicular forces 8 N and 6 N Give the magnitude and direction of the acceleration of the body .

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8. The driver of a three wheeler moving with a speed of $36 km/h$ sees a child standing in the middle of the road and brings his vehicle to rest in 4 s just in time to save the child What is the average retarding force on the vechicle ? The mass of three wheeler is 400 kg and mass of the driver is 65 kg .

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9. A rocket with a lift off mass 20000 kg is blasted upwards with a net intial acceleration of $5ms^{-2}$ Calculate the initial thrust (force) of the blast.

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10. A body of mass 0 .40 kg moving intially with a constant speed of $10m/s$ to the north is subjected to a constant force of 8.0 N directed towards the south for 30 s Take the instant the force is applied to be t = 0 , and the position of the particle at that time to be x = 0 , predict its position at $t = -5s, 25s, 100s$?

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11. A truck starts from rest and accelerate uniformly with $2ms^{-2}$. At t = 10 s a stone is dropped by a person standing on the top of the truck (6 m high from ground) . What are

the (a) veloctiy and (b) acceleration of the stone at t = 11 s ? Neglect air resistance .

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12. A bob of mass 0.1 kg hung from the ceilling of a room by a string 2 m long is set into osillation The speed of the bob at its mean position $1m/s$ What is the trajectory of the bob if the string is cut when the bob is (a) at one of its extreme position (b) at is mean position ?

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13. A man of mass 70 kg stands on a weighing machine in a lift , which is moving (a) upwards with a unifrom speed of 10^{-1} (b) downwards with a unifrom acceleration of $5ms^{-2}$

(c) upwards with a unifrom acceleration of ms^{-2} What would be th readings on the scale in each case ?

(d) What would be the reading if the lift machanism failed and it hurtled down freely under gravity ?

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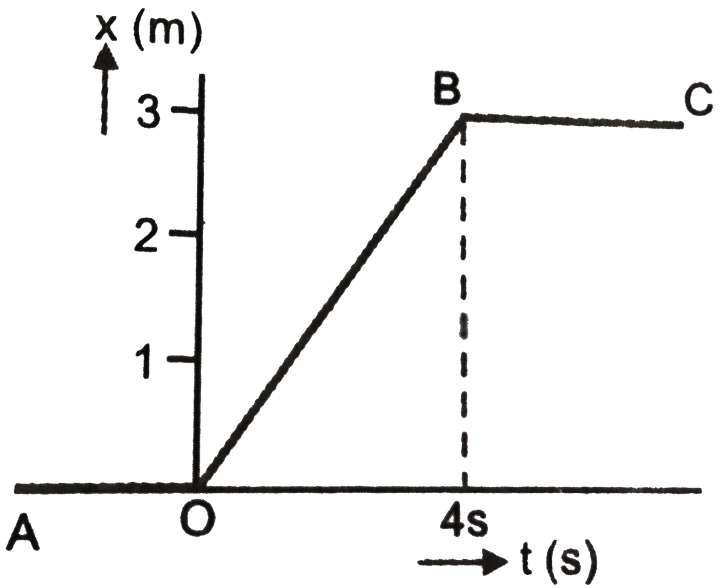
14. Shown the position time graph of a particle of mass 4 kg What is the force on the particle for $t < 0, 0 < t < 4s$ motion only



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15. Two bodies of masses 10 kg and 20 kg respectively kept on a smooth horizontal surface are tied to the ends of a light string A horizontal force F = 600 N is applied to (i) A and (ii) B aling the direction of string . What is the tension in the string in each case ?

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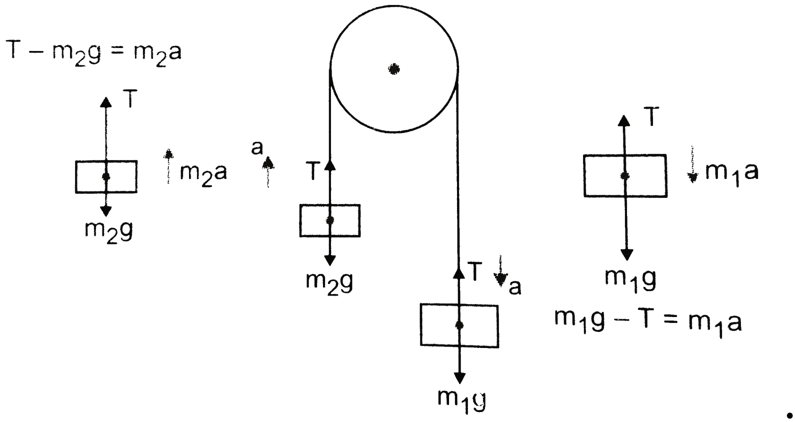
16. Two masses 8 kg and 12 kg are connected at the two ends of a light inextensible string that passes over a frictionless pulley Fibd the acceleration of the masses and tension in the string , when the masses are released



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17. A nucleus is at rest in the laboratory frame of reference Show that if it distintegrates into two smaller nuclei the products must be emitted in opposite directions .

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18. Two billiard balls each of mass 0 .05 kg moving in opposite directions with speed $6ms^{-1}$ collide and rebound with the same speed What is the impulse imparted to each ball due to the other ?

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19. A shell of mass 200g is fired by a gun of mass 100kg. If the muzzle speed of the shell is $80ms^{-1}$, then the rcoil speed of the gun is

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20. A batsman deflects a ball by an angle of 45° without changing its initial speed which is equal to $54k\frac{m}{h}$. What is the impulse imparted to the ball ? (Mass of the ball is 0.15 kg)

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21. A stone of of mass 0 .25 kg tied to the end of a string is whirled round in a circle of radius 1.5 m with a speed of $40 rev / \min$ in a horizontal plane What is the tension in the string ? What is the maximum speed with which the stone can be whirled around If the string can withstand a maximum tension of 200 N ?

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22. If in Q . 21 the speed of the stone is increased beyond the maximum permissible value and the string breaks suddenly which of the following correctly describes the trajectory of the stone after the string breaks :

(a) the stone jerks radially outwards

(b) the stone flies off tangentially from the instant the string breaks

(c) the stone flies off at an angle with the tangent whose magnitude depends on the speed of the stone ?

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23. Explain why

(a) A horse cannot pull a cart and run in empty space.

(b) Passengers are thrown forward from their seats when a speeding bus stops suddenly.

(c) A cricketer moves his hands backwards when holding a catch.

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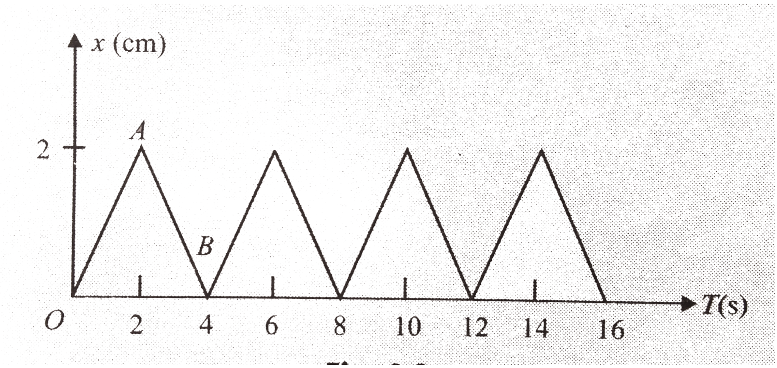
24. Figure shows the position-time graph of a particle of mass $0.04kg$. Suggest a suitable physical context for this motion. What is the time between two consecutive impulses received by the particle? What is the magnitude of each impluse?



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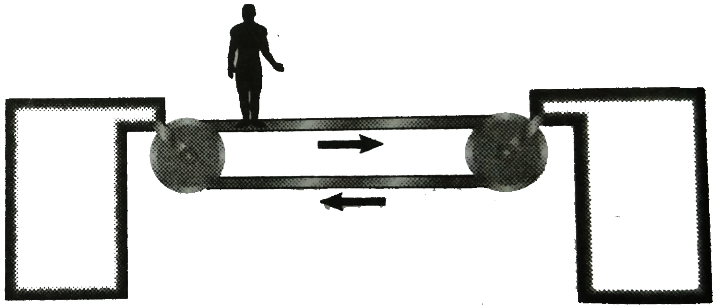
25. Figure shown a man standing stationary with respect to a horizontal converyor belt that is accelerationg with $1m/s^{-2}$. What is the net force on the man?If the coefficient of ststic friction between the man's shoes and the belt is 0.2 upto what maximum acceleration of the belt can the man continue to be stationary relative to the belt? Mass of the man $= 65kg(g = 9.8m/s^2)$



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26. A stone of mass m tied to one end of a string is revolved in a vertical circle of radius R the net forces at the lowest $(F_L$ and highest (F_H) points of the circle directed vertically downwards are :

(a) $F_L = mg - T_1 F_H = mg + T_2$

(b) $F_L = mg + T_1, F_H = mg - T_2$

(c)

$$F_L = mg + T_1 - \frac{mv_1^2}{R}, F_H = mg - T_2 + \frac{mv_1^2}{R}$$

(d)

$$F_L = mg - T_1 - \frac{mv_1^2}{R}, F_H = mg + T_2 + \frac{mv_2^1}{R}$$

Choose corret alternative T_1, v_1 denote the tension and speed at the lowest point T_2, v_2 denote corresponding valuse at the highest point .

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27. A helicopter of mass 1000 kg rises with a vertical acceleration of $15ms^{-2}$ The crew and the passengers weight 300 kg Give the magnitude and direction of

(a) force on the floor by the the crew and passengers

(b) action of the rotor of the helicopter on surrounding air (c) force on the helicopter due to surrounding air .

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28. A stream of water flowing horizontally with a speed of $15ms^{-1}$ pushes out of a tube of cross sectional area $10^{-2}m^2$ and hits a vertical wall near by what is the force exerted on the wall by the impact of water assuming.that it does not rebound? (Density of water $= 1000kgm^3$)

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29. Ten one-rupee coins are put on top of each other on a table. Each coin has a mass m . Give the magnitude and direction of

(a) the force on the 7^{th} coin (counted from the bottom due to all the coins on its top .

(b) the force on the 7^{th} coin by the eigth coin.

(c) the reaction of the 6^{th} coin one th 7^{th} coin

.

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30. An aircraft executes a horizontal loop at a speed of $720kmh^{-1}$, with its wings banked at 15° What is the radiue of the loop ?

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31. A train rounds an unbanked circular bend of radius 30 m at a speed of $54 km / h$ The mass of the train is 10^{6} kg What provides the centripetal force required for this purpose ? The engine or the rails ? What is the angle of banking required to prevent out the rails ?

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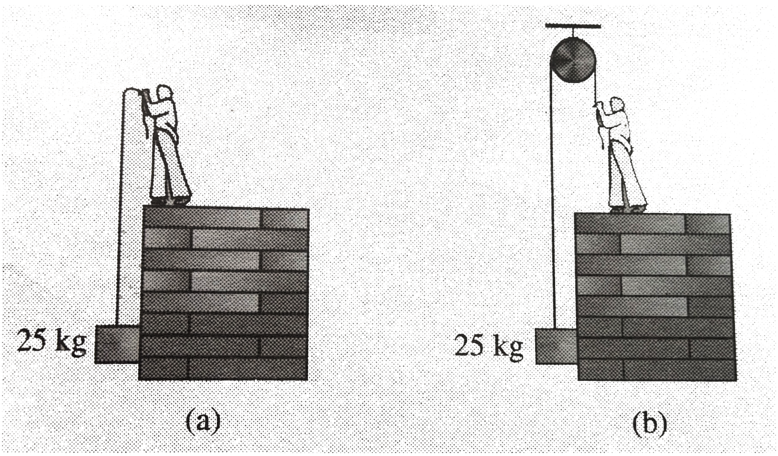
32. A block of mass 25 kg is raised by a 50kg man in two different ways as shown in fig. what is the action on the floor by the man in the two cases? If the floor yields to a normal force of $700N$, which mode should the man adopt to lift the block without the floor yielding?



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33. A monkey of mass 40 kg climbs on a rope which can withstand a maximum tesion of 600 N In which of the following cases will the rope break ? The monkey

(a) climbs up with an acceleration of $6ms^{-2}$

(b) climbs down with an acceleration of $4ms^{-2}$

(c) climbs up with a unifrom speed of $5ms^{-1}$

(d) falls down the rope nearly freely under gravity Ignore the mass of the rope .

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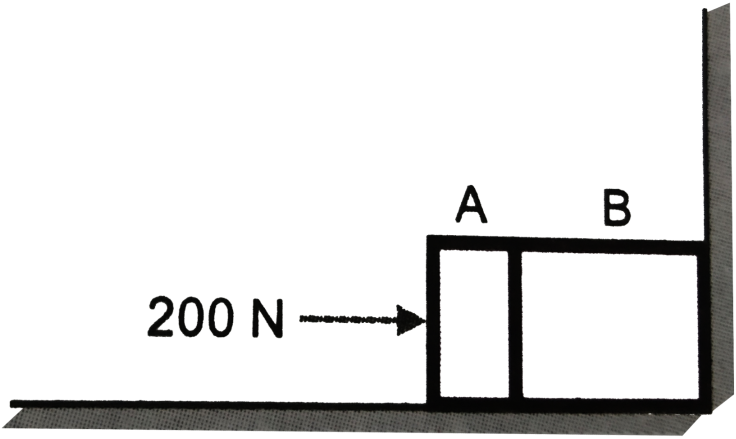
34. Two bodies A and B of mass 5 kg and 10 kg contact with each other rest on a table against a rigid The coefficient of friction between the bodies and the table is 0.15 A force of 200 N is applied horizontal on A What are (a) the reaction of thee wall (b) the the action , reaction forces between A & B ? What happens when the wall is removed ? Does the answer to (b) Change , when the bodies are in motion ? Ignore differnce between μ_s and μ_k



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35. A block of mass 15 kg is placed on a long trolly . The coefficient of friction between the block and trolly is 0.18 The trolly accelerates from rest at $0.5m/s^2$ for 20 seconds and then moves with a unifrom velocity Discuss the motion of the block as viewed by (i) a stationary observer on the ground (ii) an observer moving with the trolly .

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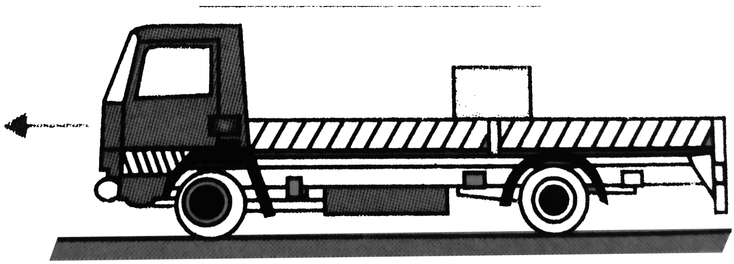
36. The rear side of a truck is open and a box of 40 kg mass is placed 5 m from the openend as shown The coefficient of friction between the box and the surface below it is 0.15 On a straight road the truck starts from rest and accelerates with $2ms^{-2}$ At what distance from the starting point does the box fall off the truck ? (Ignore the size of the box)



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37. A disc revovles with a speed of $33\frac{1}{3}rev/\min$ and has a radius of 15 cm Two coins are palaced at 4 cm and 14 cm away from the center of the record If the coefficient of friction between the coins and the record is 0.5 which of the coins will revolve with the road ?

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38. You may have seen in a circus a motorcyclist driving in vertical loops inside a death well (a hollow spherical chamber with holes so the spectators can watch from outside) Explain clearly why the motorcyclist does not drop down when he is at the uppermost point of death well with no support from below What is the minimum speed required at the uppermost position to perfrom a vertical loop if the radius of the chamber is 25 m ?

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39. A $70kg$ man stands in contact against the inner wall of a hollow cylindrical drum of radius $3m$ rotating about its verticle axis. The coefficient of friction between the wall and his clothing is 0.15 . What is the minimum rotational speed of the cylinder to enable the man to remain stuck to the wall (without falling) when the floor is suddenly removed?

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40. A thin circular wire of radius R rotatites about its vertical diameter with an angular frequency ω . Show that a small bead on the wire remain at its lowermost point for $\omega \leq \sqrt{g/R}$. What is angle made by the radius vector joining the centre to the bead with the vertical downward direction for $\omega = \sqrt{2g / R}$? Neglect friction.

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Additional Examples / Exercises

1. A stone of mass 0.2 kg is tied to one end of a string of length $80cm$ Holding the other end, the stone is wirled into a vertical circle. What is the minimum speed of the stone at the lowest point so that it just completes the circle What is the tension in the string at the lowest point of the circular path ? .

$(g = 10^{-2})$.

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2. A particle of mass 100 g is moving in a vertical circle of radius 2 m The particle is just looping the loop . What is the speed of the particle and tension in the string at the highest point of the circular path ? . $(g = 10ms^{-2})$.

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3. A particle of mass 0.2 kg attached to a massless string in a verticle circle of radius 1.2 m. It is imparted a speed of $8ms^{-1}$ at the lowest point of its circular path. Does the particle complete the verticle circle ? What is the change in tension in the string when the particle moves from the position where the string is vertical to the position where the string is horizontal ?

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4. A particle of mass 20 g is whirled into a vertical circle of radius 80cm using a massless string The speed of the particle when the string makes an angle 60° with the verticle line is $1.5ms^{-1}$ What is the tension in the string in this position ?

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5. A particle of mass 0.1kg has an iniital speed of $4ms^{-1}$ at a point A on a roudh horizontal road. The coefficient of friction between the object and road is 0.15. The particle moves to a point B at a distance of 2m from A. What is the speed of particle at B ?

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

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6. A particle of mass 0.2 kg has an intial speed of $5ms^{-1}$ at the bottom of a rough inclined plane of inclination 30° and vertical height 0.5 m . What is the speed of the particle as it reaches the top of the inclined plan ? (Take $\mu = 1/\sqrt{3}, g = 10ms^{-2}$) .

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Higher order thinking skills

1. A balloon with mass m is descending down with an acceleration a $(where a < g)$. How much mass should be removed from it so that it starts moving up with an acceleration a?

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2. A batsman deflects a ball by an angle of 45° without changing its initial speed which is equal to $54k\frac{m}{h}$. What is the impulse imparted to the ball ? (Mass of the ball is 0.15 kg)

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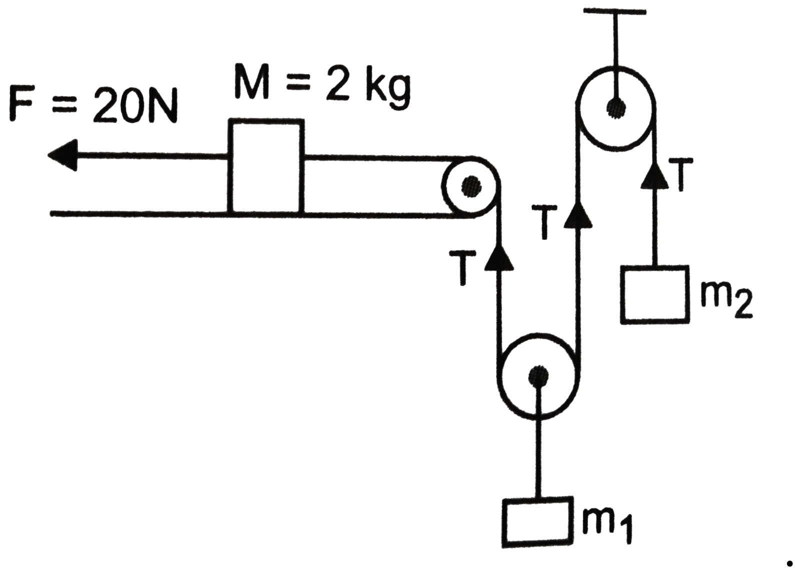
3. A constant force $F = 20N$ acts on a block of mass $2kg$ which is connected to two blocks of masses $m_1 = 1.0kg$ and $m_2 = 2kg$ as shown in Calculate the accelerations produced in ball the three blocks Assume pulleys are frictionless and weightless



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4. Two wooden blocks of masses $1kg$ and $2kg$ are separated by a certain distance A bullet of mass $50g$ fired from a gun pierces through the

block of mass $1kg$ and then stopped in the second block After the impact of the bullet both blocks start moving with the same speed Calculate the percentage loss in the initial velocity of the bullet when it is inbetween the two blocks .

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5. A very flexible unifrom chain of mass M and length L is suspended vertically so that its lower end just touches the surface of a table

When the upper end of the chain is released it falls with each link coming to rest the instant it strikes the table Find the force exerted by the chain on the table at the moment when x part of chain has already rested on the table .

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6. Assuming the length of a chain to be L and coefficient of static friction μ. Compute the maximum length of the chain which can be held outside a table without sliding.

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7. A hemispherical bowl of radius R is set rotating about its axis of symmetry which is kept vertical. A small block kept in the bowl rotates with the bowl without slipping on its surface. If the surfaces of the bowl is smooth, and the angle made by the radius through the block with the vertical is θ, find the angular speed at which the bowl is rotating.

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8. A railway engine weighing 40 metic ton is travelling along a level track at a speed of $54kmH^{-1}$ What additional power is required to maintain the same speed up an incline of 1 in 49 Take $g = 9.8m/s^2$ and $u = 0.1$.

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9. A boy (30 kg) sitting on his horse whips it. the horse speeds up at an average adcceleration of $2.0\frac{m}{s^2}$. (A). If the boy does not slide back, what is the force of friction exerted by the horse on the boy? (b).If the boy slides back during the acceleration, what can be said about the coefficient of static friction between the horse and the boy.

$$Take = 10\frac{m}{s^2}$$

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10. A block placed on a horizotnal surface is being pushed by a force F making an angle θ with the vertical. If the friction coefficient is μ. How much force is needed to get the block just started. Discuss the situation when $\tan\theta < \mu$.

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Value Based Questions with Answers

1. A body continues to move along the same straight line some external force compels it to change its direction of motion Rather the body moving along a straight line opposes the force that tries to change its straight line the path This is well known property of inertia of direction Read the above passage and answer the following questions:

(i) Mud guards over the wheels of an auto save us from mud .How ?

(ii) What are the implication of this study in day to day life?

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2. Impulse of a force is a measure of total effect of the force It is given by the product of everage force and the time for which the force acts on the body . Impulse of a force is measured by the total change in linear momentum produed during impact Impulse $\overrightarrow{I} = \overrightarrow{F}_{\text{avg}} \times t = \overrightarrow{p_2} - \overrightarrow{p_1}$ A given change in linear momentum can be produced by applying a larger force for a shorter time or by applying a smaller force for a longer time Read the above passage and answer the following questions

(i) What is the function of shockers in autos

(ii) What values of life do you learn from this study ?

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3. Tie a small piece of stone to one end of a string and whirl it in a circle with your hand The centripetal force required by the stone is being supplied by your hand through the string If the string breaks suddenly you observe that the stone flies off along the tangent to the circle at that instant . Read the above passage and answer the following questions:

(i) Why does the stone fly off along the tangent to the circle at the instant the string breaks

(ii) What lessons of life do you learn from this study ?

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4. Newton established that a force never occurs singly in nature Forces always occur in pairs as a result of mutual interaction between to bodies According to Newton s third law to every action there is always an equal and opposite reaction The force of action and reaction may appear due to actual physical contact of the two bodies or even from a distance The law is applicable whether the bodies are at rest or they are in motion. Read the above passage and answer the following questions

(i) It is difficult to walk on sand or ice Why?

(ii) What does the law imply in day to day life ?

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5. Though friction opposes relative motion yet in certain cases friction is also the cause of motion In fact without friction , motion cannot be started , stopped or transferred from one body to the other . Read the above passage and answer the following questions

(i) Give one example where friction cause motion

(ii) Give the direction of friction on front wheel and rear wheel of a bicycle when it is pedaled and when pedaling is stopped

(iii) frictions is a necessary evil What does this imply in day to day life ?

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Multiple Choice Questions

1. An external force is required to keep a body in uniform motion This statement was given by.

A. Aristotle

B. Newton

C. Archimedes

D. Einstein

Answer: A

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2. For a body of given mass graph between velocity of the body and its linear momentum is

A. a straight line with slope =0

B. a straight line with positive slope

C. a straight line with negative slope

D. a parabola

Answer: b

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3. Newton s first law defines

A. force only

B. inertia only

C. both force and inertia

D. Neither force nor inertia

Answer: C

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4. The mud guards over the wheels of a car work on the basis of

A. inertia of rest

B. inertia of direction

C. inertia of motion

D. none of these

Answer: B

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5. The linear momentum of a body changes at the rate of $10kgms^{-1}$ per second Force acting on the body is

A. 1N

B. 10N

C. 1kg f

D. 10 kg f

Answer: b

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6. The correct relation between absolute units of force on MKS system and CGS system is

A. 1 kgf = 9.8 N

B. 1 kgf = 1000 gf

C. 1 kg f

D. 10 kgf

Answer: D

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7. Accelerated motion is always due to

A. internal force

B. friction

C. external force

D. none of the above

Answer: C

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8. The dimensional formula of impulse is

A. $[ML^2T^{-2}]$

B. $[MLT^{-2}]$

C. $[ML^2T^{-1}]$

D. $[MLT^{-1}]$

Answer: d

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9. For a given change in linear momentum when time of impact increases force .

A. decreases

B. increases

C. remains same

D. none of the above

Answer: A

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10. Forces of action and reaction never cancel each other as they are

A. always equal

B. always opposite

C. acting on same body

D. acting on different bodies

Answer: D

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11. The minimum force required just to move a block on a rough horizontal surface is $5N$. The block fails to move when a force of $3N$ is applied on it. Static frition is .

A. $5N$

B. $3N$

C. $4N$

D. $zero$

Answer: b

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12. In the above question the force of limitting friction is

A. $3N$

B. $5N$

C. $4N$

D. $zero$

Answer: b

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13. In Ques 1 the force of dynamic friction is.

A. $5N$

B. $3N$

C. $< 5N$

D. $> 5N$

Answer: c

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

A. kinetic friction

B. limiting friction

C. static friction

D. all the three

Answer: c

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15. When the surfaces in contact are made too smooth by polishing, force of friction.

A. decreases

B. increases

C. becomes zero

D. becomes infinite

Answer: b

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16. Angle of repose for a rough inclined plan is 60° The coefficient of friction is.

A. $\sqrt{3}$

B. $1/\sqrt{3}$

C. 1

D. zero

Answer: a

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17. In moving a body of mass m once up and down a smooth incline θ total work done is (S is length of the plane).

A. $mg\sin\theta\times s$

B. $mg\cos\theta\times S$

C. $mg(\sin\theta-\cos\theta)$

D. zero

Answer: d

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18. In moving a body of mass m once up and down a smooth incline 0 total work done is (S is length of the plane):

A. $mg\sin\theta \times S$

B. $mg\cos\theta = S$

C. $2\mu mg\cos\theta \times s$

D. zero

Answer: c

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19. A ball rolling on ice with a velocity of $4.9m/s$ stops after travelling 4 m. If

$g = 9.8 m / s^2$ what is the coefficient of friction

?

A. 0.1

B. 0.2

C. 0.3

D. 0.4

Answer: b

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20. A particle will leave a vertical circle of radius r when its velocity at the lowest point of the circle (upsilon L) is .

A. $\sqrt{2}gr$

B. $\sqrt{5}gr$

C. √3 g r`

D. $\sqrt{6}gr$

Answer: c

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21. A ball is travelling with uniform translatory motion. This means that

A. it is at rest .

B. the path can be a straight line or circular and the ball travels with unifrom speed .

C. all parts of the ball have the same velocity is constant .

D. the center of the ball moves with constant velocity and the ball spins about its center uniformly .

Answer: c

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22. A metre scale is moving with uniform velocity. This implies .

A. the force acting on the scale is zero but a torque about the center of mass can act on the scale .

B. the force acting on the scale is zero and the torque acting about centre of mass of the scale is also zero .

C. the total force acting on it need not be zero but the torque on it is zero .

D. neither the force nor the torque need to be zero.

Answer: b

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23. A cricket ball of mass $150g$ has an initial velocity $\left(3\hat{i}+4\hat{j}\right)ms^{-1}$ and a final velocity $v=-\left(3\hat{i}+4\hat{j}\right)ms^{-1}$ after beigh hit The change in momentum (final momentum initial momentum) is (in kg ms^{-1})

A. zero

B. $-\left(0.45\hat{i}+0.6\hat{j}\right)$

C. $-\left(0.9\hat{i}+1.2\hat{j}\right)$

D. $-5\left(\hat{i}+\hat{j}\right)$

Answer: c

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24. In the previous problem 3 the magnitude of the momentum transferred during the hit is

.

A. zero

B. $0.75 kgms^{-1}$

C. $1.5 kgms^{-1}$

D. $14 kgms^{-1}$

Answer: c

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25. Conservation of momentum in a collision between particles can be understood from

A. conservation of energy

B. Newton s first law only

C. Newton s second law only

D. both Newton s second and third law

Answer: d

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26. A hockey player is moving northward and suddenly turns westward with the same speed to avoid an opponet. The force that acts on the player is.

A. frictional force along westward

B. muscle force along southward

C. frictional force along south- west

D. muscle force along south- west .

Answer: c

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27. A body of mass $2kg$ travels according to the law $x(t) = pt + qt^2 + rt^3$ where $p = 3ms^{-1}$, $q = 4ms^{-2}$ and $r = 5ms^{-3}$.

A. $136N$

B. $134N$

C. $158N$

D. $68N$

Answer: a

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28. A body with mass 5 kg is acted upon by a force $\overrightarrow{F} = \left(-3\hat{i} + 4\hat{j}\right)N$. If its initial velocity at t =0 is $\overrightarrow{v} = 6\hat{i} - 12\hat{j}ms^{-1}$, the time at which it will just have a velocity along the y-axis is :

A. never

B. $10s$

C. $2s$

D. $15s$

Answer: b

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29. A car of mass m starts from rest and acquires a velocity along east $v = v\hat{i}(v > 0)$ in two seconds Assuming the car moves with unifrom acceleration the force exerted on the car is .

A. $\frac{mv}{2}$ eastward and is exerted by the car engine

B. $\frac{mv}{2}$ eastward and is due to the friction on the tyres exerted by the road

C. more than $\frac{mv}{2}$ eastward exerted due to the engine and overcomes the friction of the road

D. $m\frac{v}{2}$ exerted by the engine

Answer: b

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30. The motion of a particle of mass m is given by $x = 0$ for $t < 0s$,$x(t) = A\sin 4\pi t$ for $0 < t < \left(\frac{1}{4}\right)s(A > 0)$,and $x = 0$ for $t > \left(\frac{1}{4}\right)s.$

A. The force at $t = (1/8)$ s on the particle is $16\pi^2 Am$

B. The particle is acted upon by an impulse of magnitude $4\pi^2 Am$ at $t = 0s$ and $t = (1/4)s$

C. The particle is not acted upon by any force

D. The particle is not acted upon by a constant force

Answer: a,b,d

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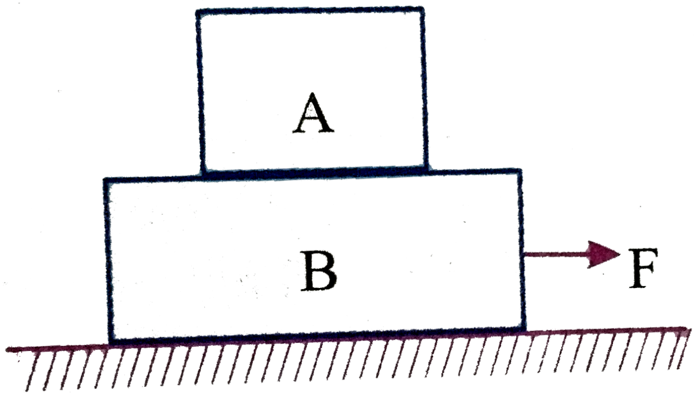
31. In the co-efficinet of friction between the floor and the body B is 0.1. The co-efficient of friction beteen the bodies B and A is 0.2 A fore F is applied as shown B The mass of A is $m/2$ and of B is m Which of the following statements are ture ?



A. The bodies will move together if $F = 0.25mg$

B. The body A will slip with respect to B if $F = 0.5mg$

C. The bodies will be at rest if $F = 0.5mg$

D. The maximum value of F for which the two bodies will move together is $0.45mg$

Answer: a,b,d,e

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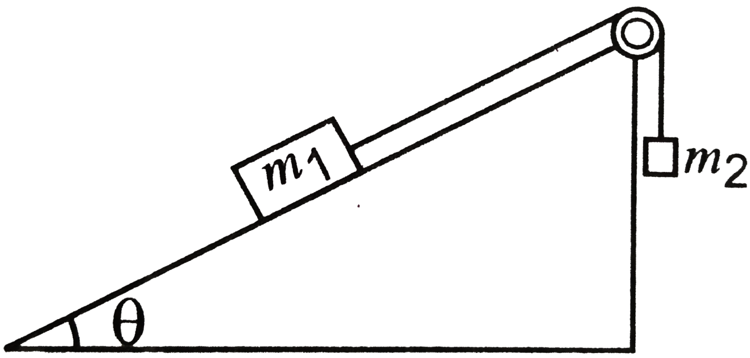
32. Mass m_1 moves on a slope making an angle θ with the horizontal and is attached to mass m_2 by a string passing over a frictionless pulley as shown in The co-efficient of friction between m_1 and the slopping surface is μ

Which of the following statements are true ?



A. If $m_2 < m_1 \sin\theta$ the body will move up the plane

B. If $m_2 > m_1(\sin\theta + \mu\cos\theta)$ the body will move up the plane

C. If $m_2 < m_1(\sin\theta + \mu\cos\theta)$ the body will move up the plane

D. If $m_2 < m_1(\sin\theta - \mu\cos\theta)$ the body will move down the plane

Answer: b,d

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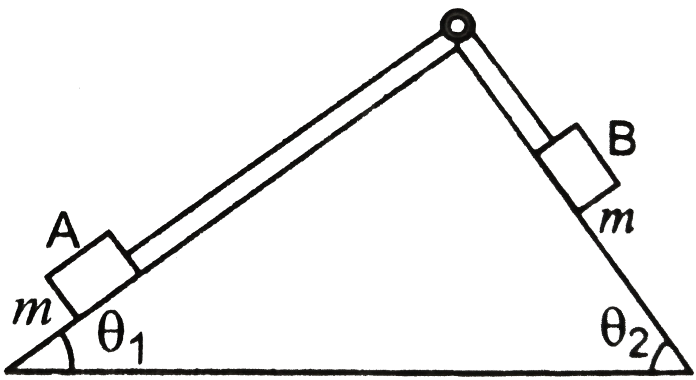
33. A body a of mass m slides on plane inclined at angle θ_0 to the horizontal and μ_1 is the coefficient of friction between A and the plane

A is connected by a light string passing over a frictionless pulley to another body B also of mass m slidding on a frictionless plane inclined at angle θ_2 to the horizontal Which of the following statements are ture ?



A. A will never move up the plane

B. A will just start moving up the plane when $\mu = \dfrac{\sin\theta_2 - \sin\theta_1}{\cos\theta_1}$

C. for A to move up the plane θ_2 must always be greater than θ_1

D. B will always slide down with constant speed

Answer: b,c

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34. Two billiard balls A and B, each of mass 50 kg and moving in oppsite direction with speed of $5ms^{-1}$ each, collide and rebound with the same speed. If the collision lasts for $10^{-3}s$, which of the follwing statements are true?

A. The impulse imparted to each ball is $0.25kgms^{-1}$ and the force on each ball is $250N$

B. The impulse imparted to each ball is $0.25kgms^{-1}$ and the force exerted on each on each ball is `25 xx 10^(-5)N

C. The impulse imparted to each ball is $0.5Ns$

D. The impulse and the force on each ball are equal in magnitude and opposite in direction

Answer: c,d

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35. A body of mass $10kg$ is acted upon by two perpendcular force, $6N$. The resultant acceleration of the body is.

A. $1ms^{-2}$ at an angle of $\tan^{-1}(4/3) w.r.t. 6N$

B. $0.2ms^{-2}$ at angle of $\tan^{-1}(4/3) w.r.t. 6N$

C. $1ms^{-2}$ at an angle of $\tan^{-1}(3/4) w.r.t8N$

D. $0.2ms^{-2}$ at an angle of $\tan^{-1}(3/4) w.r.t. 8N$ force

Answer: a,c

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36. A minimum force of $7N$ is required just to move a body on a rough surface What is the value of static friction when a force of $5N$ is actually applied and there is no movement .

A. $5N$

B. $7N$

C. $2N$

D. $12N$

Answer: a

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37. The force of limiting friction between a body and the surface of contact is $5N$ A force of $7N$ is applied on the body and the actual motion starts The effective force of friction now is .

A. zero

B. $5N$

C. $7N$

D. $< 5N$

Answer: d

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38. When a wheel is rolling on a level, what is the direction of frictional force between the wheel and the road ?

A. backward direction

B. forward direction

C. depends on speed

D. cannot say

Answer: b

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39. The angle of friction between two surface in contact is 60° What is the cofficient of friction between them .

A. $\sqrt{3}$

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

C. 0

D. 1

Answer: a

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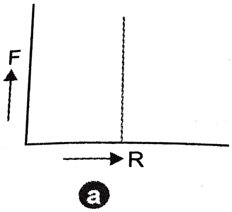
40. In a laboratory experiment four students plotted graphs between force of limiting friction (F) and normal reaction (R) Which one is correct .

A. 

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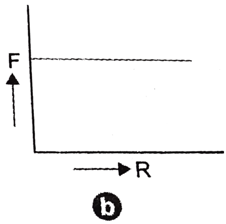
B. 

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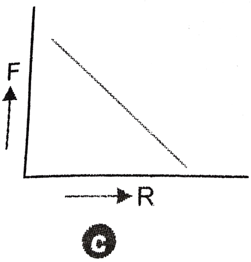
C. 

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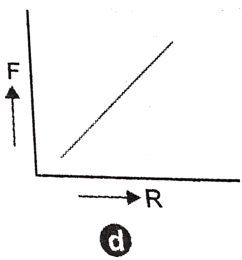
D. 

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Answer: d

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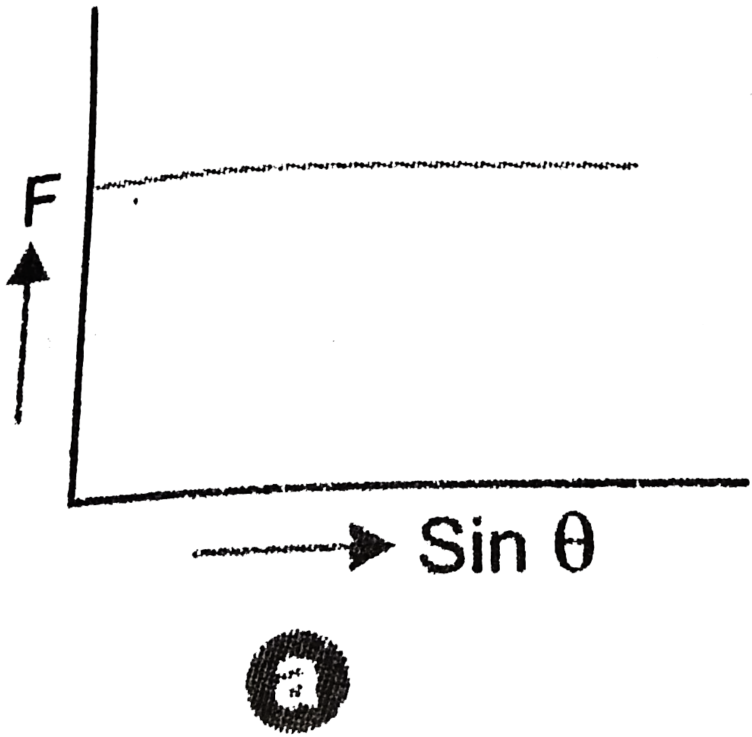
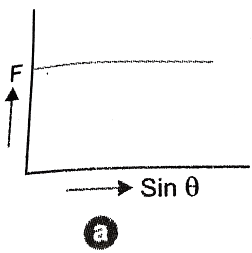
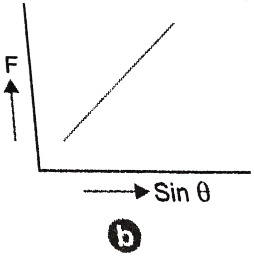
41. The variation of net downward force F on a body on a rough inclined plane versus sine of angle of inclination is shown by the four graphs The correct one is

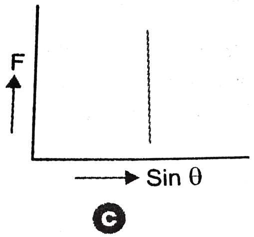




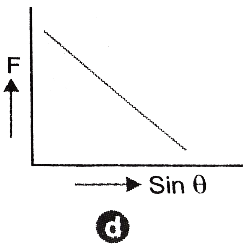
A.



B.



C.



D. .

Answer: b

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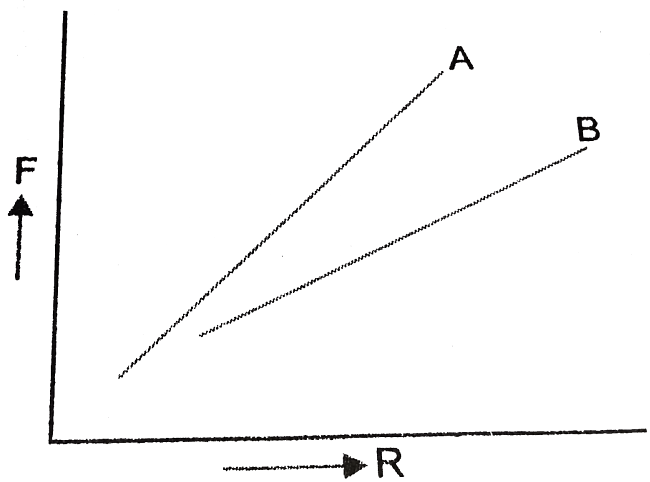
42. For two bodies A and B of same material held on a horizontal plane force of limitting friction F varsus normal reaction R graphs are as shown in Which one has smoother surface in contact with the plane .



A. A

B. B

C. Both A and B

D. Neither A nor B

Answer: b

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Fill in the blanks

1. An external force..... To keep a body.... According to..... .

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2. .... Force is acting on a body ......or in ......with ...... according to....... .

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3. Linear momentum of a body is defined as..... .

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4. The net force on a body is equal to...... and......

.

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5. Acceleration of a body can be....... Only if.......

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6. The inability of a body..... Its state..... Or......is called.......of the body.

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7. One newton force is ....produce an acceleration of.......in a body of....... .

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8. Impulse of a force is ....and...... .

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9. In an isolated system......of......is.....and is not affected by .

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10. Burnt out speed of a rocket .....when...... .

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11. Friction arises on account of........at the ....

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12. When surfaces in contact are.....friction between them....instead of..... .

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13. .... Is a self..... Force .

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14. The magnitude of the force of ..... Between any two bodies in contact is ..... To ....between them.

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15. Coefficient of limiting frictions between any two surfaces in contact is .... force of .... and .... between them.

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16. Angle of friction between any two surfaces in contact is...... of force of limitting friction F and.....makes with.....

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17. Friction always.......

Watch Video Solution

18. Frictions is a...... though it is.......

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19. Centripetal force is ...... to move a body ..... In a.....

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20. Banking of roads is the phenomenon of...... outer edge of the road...... the inner edge.

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Problems for practice

1. A 20 gram bullet moving at $300m/s$ stops after penetrating $3cm$ of bone. Calculate the average force exerted by the bullet .

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2. A ship of mass $3 \times 10^7 kg$ initially at rest, is pulled by a force of $5 \times 10^5 N$ through a distance of 3m. Assuming that the resistance due to water is negligible, the speed of the ship is

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3. A force produces an acceleration $16m^{-2}$ in a mass $0.5kg$ and an acceleration $4ms^{-2}$ in an unknown mass when appied separately If both the masses are tied together what will be the acceleration under same force ? .

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4. A stone of mass $5kg$ falls from the top of a cliff $50m$ high and buries $1m$ deep in sand . Find the average resistance offered by the sand and the time it takes to penetrate .

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5. A man in a circus show jumps from a height of $10m$ and is caught by a net spred below him The net sags down $2m$ due to impact Calculate average force exerted by the net on the man stop his fall Take mass of man = 60 kg and acc. During free fall $= 10m/s^2$.

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6. A block of metal weighing $4kg$ is resting on a frictionless plane . It is struck by a jet of releasing water at the rate of $1kgs^{-1}$ and at a speed of $10ms^{-1}$ Calculate the intial acceleration of the blocks .

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7. A force of $50N$ is inclined to the vertical at an angle of 30° Find the acceleration it produes in a body of mass $2kg$ which moves in the horizontal direction .

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8. In an $X - ray$ machine an electron is subjected to a force of $10^{23}N$ In how much time will the electron a distance of $0.1m$? Take mass of electron $= 10^{-30}kg$.

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9. A force of $10N$ gives a mass m_1 an acceleration of $10m/s^2$ and a mass m_2 an acceleration of $20m/s^2$ What acceleration would it give if both the masses are tid together ?

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10. A body of mass m moves along X-axis such that its position coordinate at any instant t is

$x = at^4 - bt^3 + 2ct^2 - (3d)t$ where a,b,c,d are constants What is the force acting on the particle at instant ?

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11. A machine gun has a mass of $20kg$ It fires $30g$ bullets at the rate of 400 bullets/s with a sped of $400m/s$ What force must be applied on the gun to keep it in position ?

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12. A machine gun fires a bullet of mass 40 g with a velocity $1200 ms^{-1}$. The man holding it can exert a maximum force of 144 N on the gun. How many bullets can be fire per second at the most?

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13. While lauching a rocket of mass $2 \times 10^4 kg$ a force of $5 \times 10^5 N$ is applied for $20s$ Calculate the velocity attained by the rocket at the end of $20s$.

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14. A ball moving with a momentum of $5kgms^{-1}$ strikes against a wall at an angle of 45° and is reflected at the same angle Calculate the impulse .

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15. Two billiard balls each of mass $50g$ moving in opposite directions with a speed of

$36km/h$ colide and rebound with the same velocity What is the impulse imparted to each ball due to other ?

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16. A ball of mass 20 gram hits a smooth wall at an angle of 45°) with a velocity of $15m/s$ If ball rebounds at 90° to the direction of incidence, calculate the impulse received by the ball.

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17. A rubber ball of mass $50g$ falls from a height of $100cm$ and rebounds to a height of $50cm$ Find the impulse and average force between the ball and the ground, if time of contact is $0.1s$.

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18. A bullet of mass $50g$ moving with a speed of $500ms^{-1}$ is brought to rest in $0.01s$ Find the impulse and the average force .

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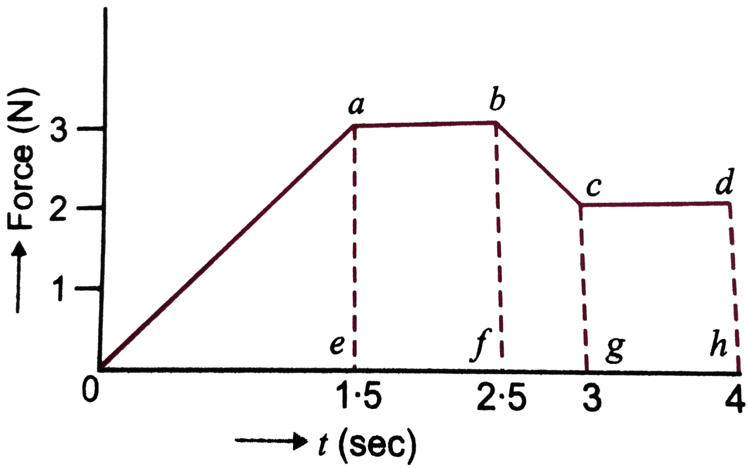
19. The initial speed of a body of mass $2kg$ is $5ms^{-1}$ A force acts for 4 seconds in the direction of motion of the body. The force time graph is shown in Calculate impulse of the force and also find the speed of the body .



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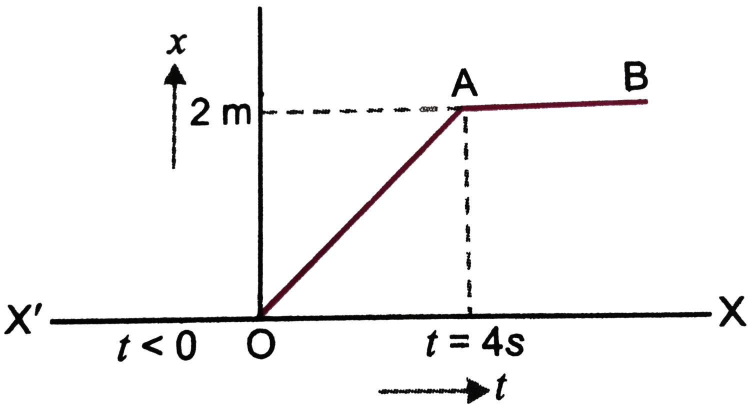
20. Shows position time graph of a particle of mass $100g$ Find the impulse at $t = 0$ and at $t = 4s$



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21. The strings of a parachute can bear a maximum tension of $72kg$ wt . By what minimum acceleration can a person of 90 kg descend by means of this parachute ?

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22. A body of mass $30kg$ is hung by a spring balance in a lift. What would be the reading of the balance when the lift is

(i) descending with a constant velocity of

$5m / s$

(ii) ascending with a constant velocity of $10m / s$.

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23. An elevator starts from rest with a constant downward acceleration and covers $2.5m$ in first second If the lift weighs $200kg$ what would be the tension in the ropes of the lift ?

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24. An elevator weighs $4000kg$ When the upward tension in the supporting cable is $48000N$ what is the upward acceleration? Starting from rest, how far does it rise in 3 seconds ?

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25. An elevator and its load weigh a total of $800kg$ Find the tension T in the supporting cable when the elevator originally moving downwards at $20m/s$ is brought to rest with constant retardation in a distnce of $50m$.

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26. A boy holding a spring balance in his hand suspends a weight of $1kg$ from it The balance slips from his hands and falls down . What will be the reading of the balance while it is in air. ?

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27. A man of mass $85kg$ stands on a lift of mass $30kg$ When he pulls on the rope he exerts a force of $400N$ on the floor of the lift Calculate acceleration of the lift Given $g = 10m/s^2$.

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28. A body of mass $50kg$ is put on a spring weighing machine in a lift What is the reading of the machine when (i) Lift ascends with a unifrom velocity of $10m/s$ (ii)descends with an acceleration of $5m/s^2$? Take $of = 10m/s^2$.

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29. A $40kg$ shell is flying at a speed of $72km/h$ It explodes into two pieces One piece of mass $15kg$ just stops . What is the speed of the other ?

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30. A truck of mass $2 \times 10^4 kg$ travelling at $1.5 m / s$ collindes with another truck of mass $3 \times 10^4 kg$ moving with a velocity of $2.5 m / s$ in opposite direction If the trucks couple on collision what is their velocity?

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31. A gun weighing $9 kg$ fires a bullet of $30 g$ with a velocity of $300 m / s$ What is the recoil velocity of the gun? What is the combined momentum of gun and the bullet before and after firing ?

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32. A machine gun has a mass of $20kg$ If fires $25g$ bullets at the rate of 600 bullets per minute with a speed of $200ms^{-1}$ Calculate (i) recoil velocity of the gun (ii) force required to keep the gun in position .

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33. A stream of water flowing horizontal with a speed of $15ms^{-1}$ gushes out of tube of cross sectional area 10^2m^2 and hits at a vertical wall nearby . What is the force exerted by the impact of water, assuming that water rebounds with the same speed.

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34. A bullet of mass $7kg$ is fired into a block of metal weighing $7kg$ The block is free to move Caluculte initial velocity of the bullet if the velocity of the block with the bullet in is $0.7m/s$.

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35. A bomb at rest explodes into three fragments of equal massses Two fragments fly off at right angles to each other with velocities of $9m/s$ and $12/s$ Calculate the speed of the third fragment.

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36. A bomb at rest explodes into three parts of the same mass. The linear momenta of the two parts are $-2p\hat{i}$ and $p\hat{i}$ Calculate the magnitude of momentum of third part .

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37. A body of mass $1kg$ initially at rest explodes and breaks into threee fragments of masses in the ration breaks into three fragments of masses in the ration $1:1:3$. The two pieces of equal masses fly off perpendicular to each other with a speed of $30m/s$ each What is the velocity of heavier fragments ? .

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38. A balloon with mass m is descending down with an acceleration a $(where a < g)$. How much mass should be removed from it so that it starts moving up with an acceleration a?

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39. In the first second of its flight a rocket ejects $\frac{1}{60}$ of its mass with a reative velocity $2073ms^{-1}$ What is the initial acceleration of the rocket ? .

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40. A rocket is going upwards with accelerated motion A man sitting in the rocket feels his weight becomes 5 times If mass of rocket inculding that of the man is $0.1 \times 10^4 kg$ how much force is beigh applied by rocket engine?

Take $g = 10m / s^2$.

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41. Fuel is consumed at the rats of $100kg / s$ in a rocket The exhaust gases are ejected at a speed of $4.5 \times 10^4 ms^{-1}$ w.r.t the rocket What is the thrust experienced by the rocket Also calculate velocity of the rocket at the instant when its mass is reduced of rocket to be zero .

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42. Calculate the ratio m_0/m for a rocket to attain the escape velocity of $11.2 kms^{-1}$ after starting from rest, when maximum exhaust velocity of gases is $1.6 km/s$.

Watch Video Solution

43. A rocket of initial mass $6000 kg$ ejects mass at a constant rate of $16 kg/s$ with constant relative speed of $11 m/s$ What is the acceleration of the rocket one mnute after blast ?

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44. If the maximum possible exhaust velocity of a rocket be $2km/s$ calculate the ratio m_0/m for it to acquire a veocity of $11.2km/s$ after starting from rest .

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45. A rocket consumes $24kg$ of fuel per second The burnt gases escape the rocket at a speed of $6.4km/s$ relative to the rocket Calculate the upthrust recevied by the rocket Also calculate the velocity acquired by the rocket when the mass redues to $1/100th$ of its initial mass.

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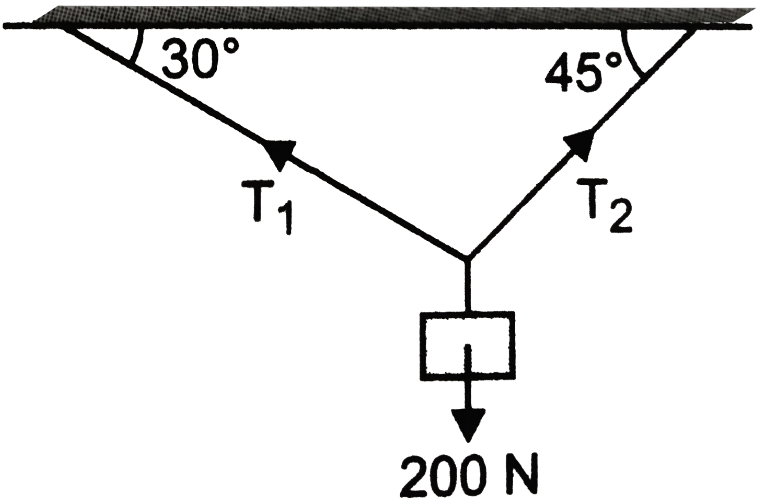
46. A body of weight $200N$ is suspended with the help of strings as show in Find the tensions in the strings



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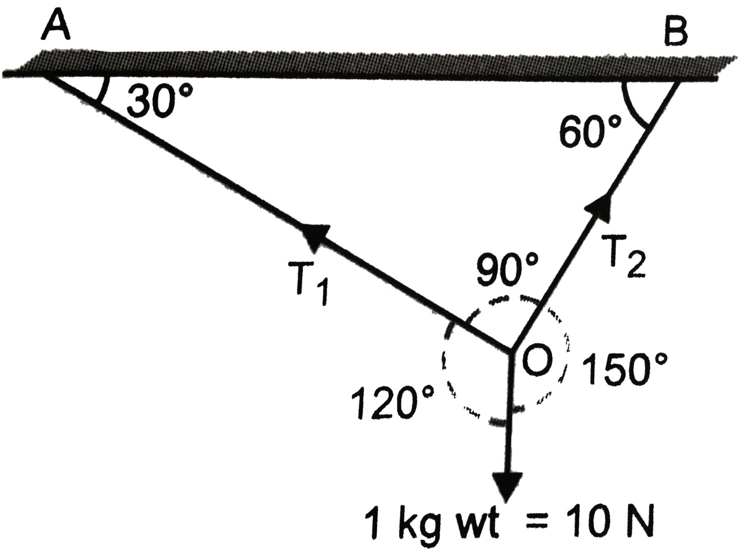
47. A ball of mass $1kg$ hangs in equilibrium from two strings as shown in If $g = 10m/s^2$ what are the valuse of tension in strings OA and OB



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48. Two bodies of masses $11kg$ and $11.5kg$ are connected by a long light string passing over a smooth pulley Calculate velocity and height ascended/descended by each body at the end of $4s$.

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49. A rope of mass $0.5kg$ is pulling a block of mass $10kg$ under the action of force of $31.5N$ If the block is resting on a smooth horizontal surface calculate the force of reaction exerted by the block on the rope .

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50. Two bodies of masses $4kg$ and $3kg$ respectively are connected by a light string passing over a smooth frictionless pulley Calculate the acceleration of the masses and tension in the string .

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51. Two bodies whose masses are $m_1 = 50kg$ and $m_2 = 150kg$ are tied by a light string and are placed on a frictionless horizontal surface When m_1 is pulled by force F an acceleration of $5ms^{-2}$ is produced in both the bodies Calculate the value of F What is the tension in the string 1 ?

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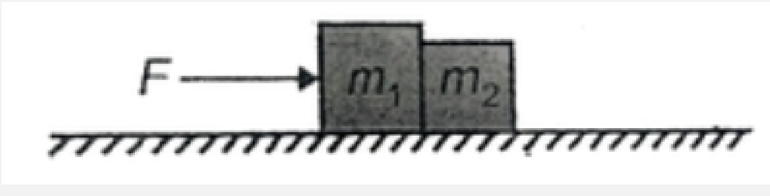
52. Two blocks of mass m_1 and m_2 lie on smooth horizontal table in contact with each other as shown in figure



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

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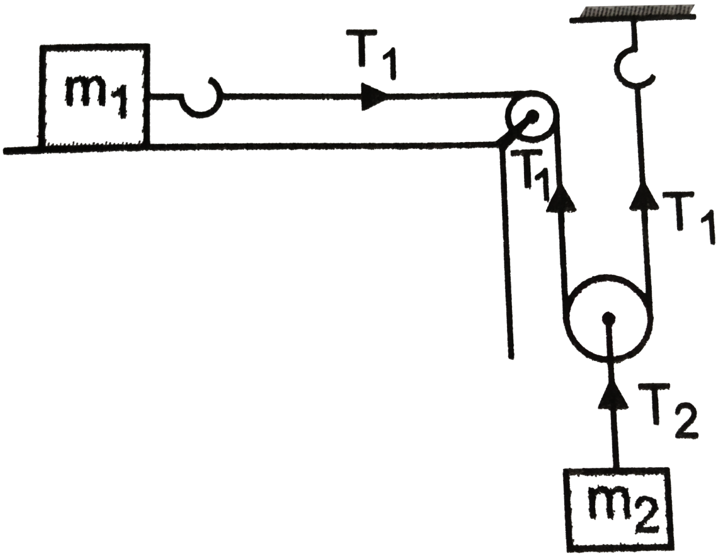
53. When we ignore friction and mass of pulley what would be the accelerations of the two blocks m_1 and m_2



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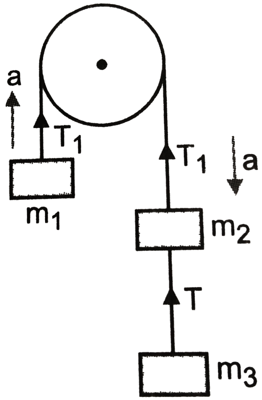
54. In the arrangement shown in show that tension in the string between masses m_2 and

m_3 is $T = \dfrac{2m_1 m_3 g}{m_1 + m_2 + m_3}$



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55. A car of mass one metric ton travelling at $32m/sc$ dashes into the rear of a truck of mass $8000kg$ moving in the same direction with a velocity of $4m/s$ After the collision the car bounces back wards with a velocity of

$8m/s$ What is the velocity of the truck after the impact ?

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56. The force on a particle of mass $10g$ is $\left(\hat{i}10+\hat{j}5\right)$N If it starts from rest what would be its position at time $t=5s$?

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57. A suitcase is gently dropped on a conveyor belt moving at $3ms^{-1}$ If the coefficient of friction between the belt and suitcase is 0.5 how far will the suitcase move on the belt before coming to rest ?

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58. An engine of $100H.P$ draws a train of mass 100 metic ton with a velocity of $36kmh^{-1}$ Find the coefficient of friction.

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59. A force ofv $3kg$ wt is just sufficient to pull a block of $4kg$ over a horizontal surface .What is the angle of friction ?

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60. An automobile is moving on a horizontal road with a speed v If the coefficient of friction between the tyres and the road is μ

show that the shortest distance in which the automobile can be stooped is $v^2 / 2\mu g$.

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61. A motor car running at the rate of $7ms^1$ can be stooped by applying brakes in $10m$ Show that total resistance to the motion when brakes are on is one fourth of the weight of the car .

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62. A horizontal force of $1.2kg$ is applied on a $1.5kg$ block, which rests on a horizontal surface If the coefficient of friction is 0.3 find the acceleration produced in the block.

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63. A car starts with a velocity of $100m/s$ on a half kilometre long bridge The coefficient of friction between the tyres and road is 0.1 Show that one cannot drive throught the bridge in less than $10s$ Take $g = 10m/s^2$.

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64. A train weighing 1000 quintals is running on a level road with a unifrom speed of $72km/h$ If the frictional resistance amounts to 50g wt. per quintal find power in watt, take $g = 9.8ms^2$.

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65. A body moving on the ground with a velocity of $15m/s$ comes to rest after covering a distance of $25m$ If acceleration due to gravity is $10m/s^2$ Calculate the coefficient of friction between the ground and the body .

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66. A box of mass $4kg$ rests upon an inclined plane This inclination is gradually incresed till the box starts sliding down the plane. At this stage slope of the plane is 1 in 3 Find coefficient of friction between the box and the plane What force applied to the box parallel to the plane will just make the box move up the plane ?

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67. When a car moving with a speed of $36 km / h$ reaches an upwards inclined road of angle 30° its engine is switched off If coefficient of frition involved is 0.1 how much distance will the car move before coming to rest $Giveng$ = 10m//s^(2)`.

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68. An engine of mass 6.5 metric ton is going up an incline of 5 in 13 at the rate of $9km/h$ Calculate the power of the engine if $\mu = 1/2$ and $g = 9.8m/s^2$.

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69. A body of mass m is released from the top of a rough inclined plane of length l and height h If f is the force of friction prove that the body will reach the bottom with a velocity $v=\sqrt{\frac{2}{m}(mgh-fl)}$.

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70. A block slides down an incline of 30° with the horizontal starting from rest it covers $8m$

in the first two seconds Find the coefficient of kinetic friction between the two .

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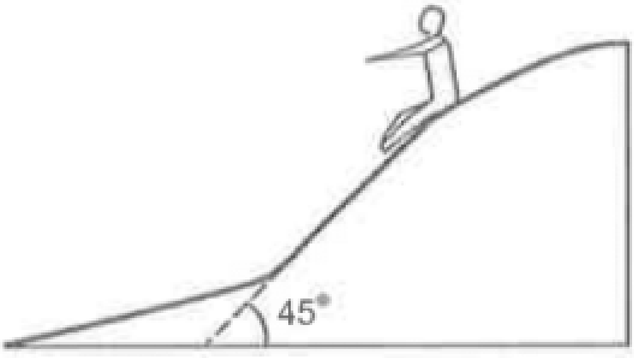
71. In a children park an inclined plane is constructed with an angle of incline 45^0 in the middle part figure. Find the acceleration of a boy sliding on it if the friction coefficient between the cloth of the boy and the incline is

0.6 and g=10 m/s^2.



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72. A block slides down an incline of angle 30° with an acceleration of $g/4$ Find the coefficient of kinetic friction .

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73. A force of $98N$ is just able to move a body of weight $45kg$ on a rough horizontal surface What are the coefficient of friction and angle of friction ? .

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74. A block of mass 2kg rests on a rough inclined plane making an angle of 30° with the horizontal. The coefficient of static friction

between the block and the plane is 0.7. The frictional force on the block is

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75. An engine draws a train up an incline of 1 in 100 at the rate $36km/h$ If the resistance due to friction is $5kg$ per metric ton calculate the power of the engine given mass of train and engine is 100 metic ton .

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76. Calculate the power of an engine which can pull a train of mass 25000 quintal up an incline of 1 in 100 at the rate of $10.8 km / h$ Resistance due to friction is $2N / \text{guintal}$.

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77. A mass of $100 kg$ is resting on a rough inclined plane of angle 30° If the coefficient of friction is $1 / \sqrt{3}$ find the greatest and the least forces that acting parallel to the plane in both cases just maintain the mass in equilibrium .

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78. A truck tows a trailor of mass $1200kg$ at a speed of $10m/s$ on a level road The tension in the coupling is $1000N$

(i) What is power expended on the trailor ?

(ii) Find tension in the coupling when the truck accends a road having an inclination of 1 in 6 Assume that the frictional resistance of the incline is same as that on the level road .

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79. An engine of one metric ton is going up an inclined plane of slope 1 in 2 at the rate of $36kmh^{-1}$ If the coefficient of friction is $1/\sqrt{3}$ calculate the power of the engine in k W .

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80. A particle of mass 21 g attached to a string of $70cm$ length Keeping the string always taut the ball describes a horizontal circle of radius $15cm$ Calculate the angular speed of the ball .

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81. A ball of mass $0.1kg$ is suspended by a string $30cm$ long Keeping the string always taut the ball describe a horizontal circle of radius $15cm$ Calculate the angular speed of the ball .

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82. A car of mass $1500kg$ is moving with a speed of $12.5ms^{-1}$ on a circular path of radius $20m$ on a level road What should be the frictional force to avoid slipping of car Calculate the cofficient of friction .

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83. What is the angular velocity in rad s^{-1} of the hour minute and second hand of a clock ?

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84. What is the greatest speed at which a car having a track width of $1.5m$ can turn in a circular path of radius $24.5m$ without overturning ? Assume that the center of gravity of the car is $0.49m$ above the ground. Take $g = 9.8m/s^2$.

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85. One end of a massless sprinf of spring constant 100 N/m and natural length 0.5 m is fixed and the other end is connected to a particle of mass 0.5 kg lying on as frictionless horizontla table. The spring remains horizontal. If the mass is made to rotate at an angular velocityof 2 rad/s, find the elongation of the spring.

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86. A body of mass $0.5kg$ is wirled in a circle with a velocity of $2ms^{-1}$ using $0.5m$ length of a string which can withstand a tension of $15N$ Neglecting the force of gravity on the body predict whether or not the string will break Give reasons for your answer .

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87. The blades of an aeroplane propeller are $2m$ long and rotate at the rate of $300r \pm$ Calculate (i) the frequency (ii) the period of rotation (iii) the angular velocity (iv) the linear velocity of a point $0.5m$ from the tip of the blade .

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88. Find the maximum speed at which a car can turn round a curve of $30m$ radius on a level road if coefficient of friction between the tyres and road is $0.4. Take g = 10m/s^2$.

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89. A bend in a level road has a radius of 100 m Find the maximum speed which a car turning this bend may have without skidding if coefficient of friction between the tyres and the road is 0 .8 S .

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90. An aeroplane travelling at a speed of $500 km h^{-1}$ tilts at an angle of 30° as it makes a safe turn What is the radius of the curve ?

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91. A curve in a road froms an arc of radius $800m$ If the road is $19.6m$ wide and outer edge is $1m$ higher than the inner edge calculate the speed for which it is banked.

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92. For traffic moving at $60km/h$ if the radius of the curve is $0.1km$ what is the correct angle of banking of the road Given $g = 10m/s^2$.

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93. A cyclist goes round a circular track of 440 metres length in 20 seconds Find the angle that his cycle makes with the verticle.

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94. A cyclist speeding at $18km/h$ on a level road takes a sharp circular turn of radius 3 m without reducing the speed . The coefficient of static friction between the tyres and the road is 0.1 Will the cyclist slip while taking the turn ?

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95. An electric bulb suspended from the roof of a railway train by a flexible wire shifts through an angle of $19^{\circ}48$ when the train goes horizontally round a curved path of $200m$ radius Find the speed of the train .

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96. A 2000 kg car has to go over a turn whose radius is $750m$ and the abgle of slopw is 5°. The coefficient of friction between the wheels and the road is 0.5. What should be the maximum speed of the car so that it may go over the turn without slipping ?

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97. A motore cyclist goes round a circular race course of diameter $320m$ at $144km/h$ How far from the verticle must he lean inwards to keep his balance ? Take $g = 10ms^{-2}$.

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98. The radius of curvature of railway track at a place where the train is moving at a speed of $72kmh^{-1}$ is $625m$ The distance between the rails is $1.5m$ Find the angle and the elevation of the outer rail so that there may be no side pressure on the rails Take $g = 9.8ms^{-2}$.

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99. The railway bridge over a canal is in the from of an arc of a circle of radius $20m$ What is the minimum speed with which a car can cross the bridge without eving contact with the ground at the highest point Take $g = 9.8ms^{-2}$.

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100. A weightless thread can bear tension upto $3.7kg$ wt A stone of mass $500g$ is tied to

it and revolves in a verticle circle of radius $4m$

What will be the maximum angular velocity of

the stone if $g = 10m/s^2$.

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101. The speed limit of a car over a roadways bridge in circle making $2rps$ If radius of the circle is $1.2cm$ find the tension in the string at I) top of the circle (ii) bottom of the circle .

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102. A body weighing $0.4kg$ is whirled in a verticle circle making $2rps$ If the radius of the circle is $1.2m$ find the tension in the stringat (i) top of the circle (ii) bottom of the circle .

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103. A fighter plane is pulling out for a dive at a speed of $900km/h$. Assuming its path to be a vertical circle of radius $2000m$ and its mass to be $16000kg$, find the force exerted by the air on it at the lowest point. Take $g = 9.8m/s^2$

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104. A stone of mass $100g$ is suspended from the end of a weightless string of length $100cm$ and is allowed to swing in a verticle plane The speed of the mass is $200cm^{-1}$ when the string makes an angle of 60° Also calculate the speed of the stone when it is in the lowest position Given $g = 980cms^{-2}$.

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105. A stone of mass $0.3g$ is tied to one end of string $0.8m$ long and rotated in a vertical circle At what speed of the stone will the tension in the string be zero at the highest point of the circle ? What will be the tesion at the lowest point in this case ? Take $g = 980cm^{-2}$.

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106. A block of mass 2.5 Kg is kept on a rough horizontal surface. It is found that the block

does not slide if a horizontal force less than 15 N is applied to it. Also it is found that it takes 5 seconds to slide through the first 10 m if a horizontal force of 15 N is applied and the block is gently pushed to start the motion. Taking $g = 10\frac{m}{s^2}$, calculate the coefficient of static and kinetic friction between the block and the surface.

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107. Find the force required to move a train of mass 5000 quintal up an incline of 1 in 50 with an acceleration of $2m/s^2$ Take force of friction = 0.2 N quintal and $g = 10ms^{-2}$.

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108. A cyclist speeding at $18km/h$ on a level road takes a sharp circular turn of radius 3 m without reducing the speed . The coefficient of static friction between the tyres and the road is 0.1 Will the cyclist slip while taking the turn ?

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109. A small block of mass $100g$ moves with uniform speed in a horizontal circular groove, with vertical side walls of radius $25cm$. If the block takes $2.0s$ to complete one round, find the constant force by the side wall of the groove.

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110. What is the greatest speed at which a car having a track width of $1.5m$ can turn in a circular path of radius $24.5m$ without overturning ? Assume that the center of gravity of the car is $0.49m$ above the ground. Take $g = 9.8m/s^2$.

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111. A sphere of mass $0.1kg$ is attached to an inextensible string of length $1.3m$ whose upper end is fixed to the ceilling The sphere is made to describe a horizontal circle of radius $0.5m$ Calculate time period of revolution and tension in the string .

Watch Video Solution

112. A car of mass m moves with a constant speed v over (a) horizontal flat surface (b) convex bridge (c) concave bridge What force is exerted by the car on the bridge as it passes the middle point of bridge Radius of curvature of bridge is R .

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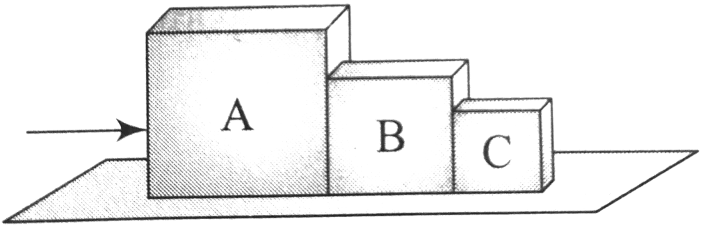
JEE (Main and Advanced)/ Medical Entrance Special

1. Three blocks A , B and C of masses $4kg$, $2kg$ and $1kg$ respectively are in contact on a frictionless surface, as shown. If a force of $14Nisappliedonthe$4kg

$block, thenthecontactf$ or $cebetween$A and

B` is.



A. 6 6N

B. 8 N

C. 18 N

D. 2 N

Answer: a

Watch Video Solution

2. A balloon has $8g$ of air A small hole is pierced into it The air escapes at a unifrom rate of $7m/s$ If the ballon shrinks in $5.6s$ then the average force acting on the ballon is.

A. $10^{-4}N$.

B. 10^{-2}dyne

C. 56dyne .

D. $10^{-6}N$.

Answer: a

Watch Video Solution

3. A force produces an acceleration of $4m/s^2$ in a body of $m_1 kg$ in another body of mass $m_2 kg$ If the same force is applied to $(m_1 + m_2)$ then the acceleration will be

A. $10m/s^2$

B. $2m/s^2$

C. $2.4m/s^2$

D. $5.4m/s^2$

Answer: c

Watch Video Solution

4. A ball weighing $10g$ hits a hard surface vertically with a speed of $5m/s$ and rebounds with the same speed The ball remains in contact with the surface speed The ball remains in contact with the surface for $0.01s$

The average force exerted by the surface on the ball is .

A. $100N$

B. $10N$

C. $1N$

D. $0.1N$

Answer: b

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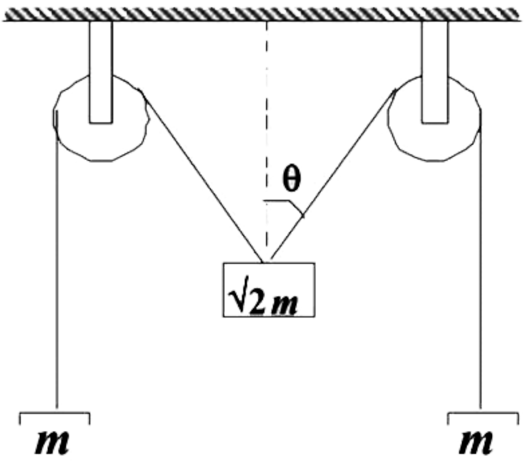
5. The pulleys and strings shown in the figure are smooth and of negligible mass. For the system to remain in equilibrium, the angle θ should be



A. 0°

B. 30°

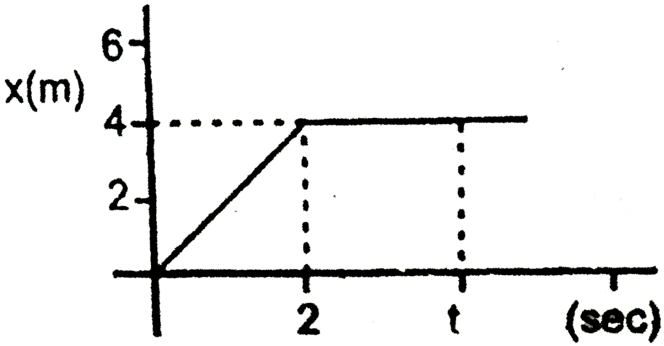
C. 45°

D. 60°

Answer: c

Watch Video Solution

6. In the figure given below, the position time graph of a particle of mass 0.1kg is shown. The impulse at t=2 sec is



A. $0.2kgms^{-1}$

B. $0.02kgms^{-1}$

C. $0.1kgms^{-1}$

D. $0.4kgms^{-1}$

Answer: a

Watch Video Solution

7. A mass of M kg is suspended by a weightless string. The horizontal force that is required to displace it until the string makes an angle of 45° with the initial vertical direction is

A. Mg

B. $Mg/\sqrt{2}$

C. $Mg(\sqrt{2}-1)$

D. $Mg(\sqrt{2}+1)$

Answer: a

Watch Video Solution

8. A ball of mass 0.2 kg is thrown vertically upwards by applying a force by hand. If the hand moves 0.2 m while applying the force and the ball goes upto 2 m height further, find the magnitude of the force. (Consider $g = 10m/s^2$).

A. $16N$

B. $20N$

C. $22N$

D. $4N$

Answer: b

Watch Video Solution

9. A particle of mass m is projected with velocity upsilon making an angle of 45° with the horizontal When the particle lands on the level ground the mag nitude of the change in its momentum will be .

A. $2mv$

B. $mv / \sqrt{2}$

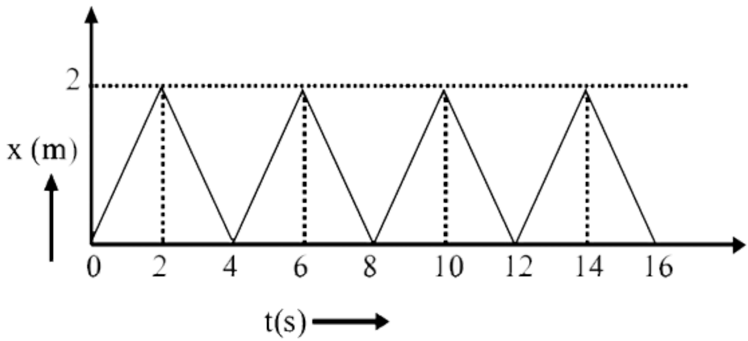
C. $mv\sqrt{2}$

D. zero

Answer: c

Watch Video Solution

10. The figure shows the position-time (x-t) graph of one-dimensional motion of a body of mass 0.4kg. The magnitude of each impulse is



A. $0.8Ns$

B. $1.6Ns$

C. $0.2Ns$

D. $0.4Ns$

Answer: a

Watch Video Solution

11. A stone is dropped from a height h . It hits the ground with a certain momentum P . If the same stone is dropped from a height 100% more thanthe preyiious height, the momentum when it hits the ground will change by

A. 68%

B. 41%

C. 200%

D. 100%

Answer: b

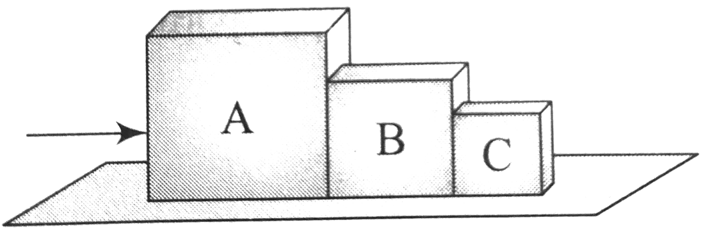
Watch Video Solution

12. Three blocks A, B and C of masses $4kg$, $2kg$ and $1kg$ respectively are in contact on a frictionless surface, as shown. If a force of

$14 Nisappliedonthe$4kg

$block, thenthecontactf$ or $cebetween$A and

B` is.



A. 2N

B. 6N

C. 8N

D. 18N

Answer: b

Watch Video Solution

13. A sparrow flying in air sits on a stretched telegraph wire If weight of the sparrow is W which of the following is true about the tension T produced in the wire ?

A. $T = W$

B. $T < W$

C. $T = 0$

D. $T > W$

Answer: d

Watch Video Solution

14. A heavy iron bar of weight W is having its one end on the ground and the other on the shoulder of a man The rod makes an angle θ with the horizontal What is the weight experienced by the man ?

A. $W \sin \theta$

B. $W \cos \theta$

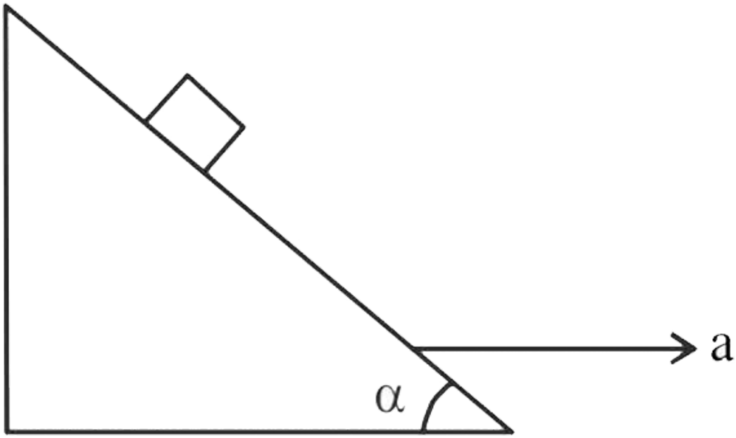
C. W

D. $W/2$

Answer: d

Watch Video Solution

15. A block is kept on a frictionless inclined surface with angle of inclination α. The incline is given an acceleration 'a' to keep the block stationary. Then a is equal to



A. $g \tan \alpha$

B. g

C. $g \cos ec\alpha$

D. $g/\tan\alpha$

Answer: a

Watch Video Solution

16. A balloon with mass m is descending down with an acceleration a $(where a < g)$. How much mass should be removed from it so that it starts moving up with an acceleration a?

A. $\dfrac{2ma}{g+a}$

B. $\frac{2ma}{g-a}$

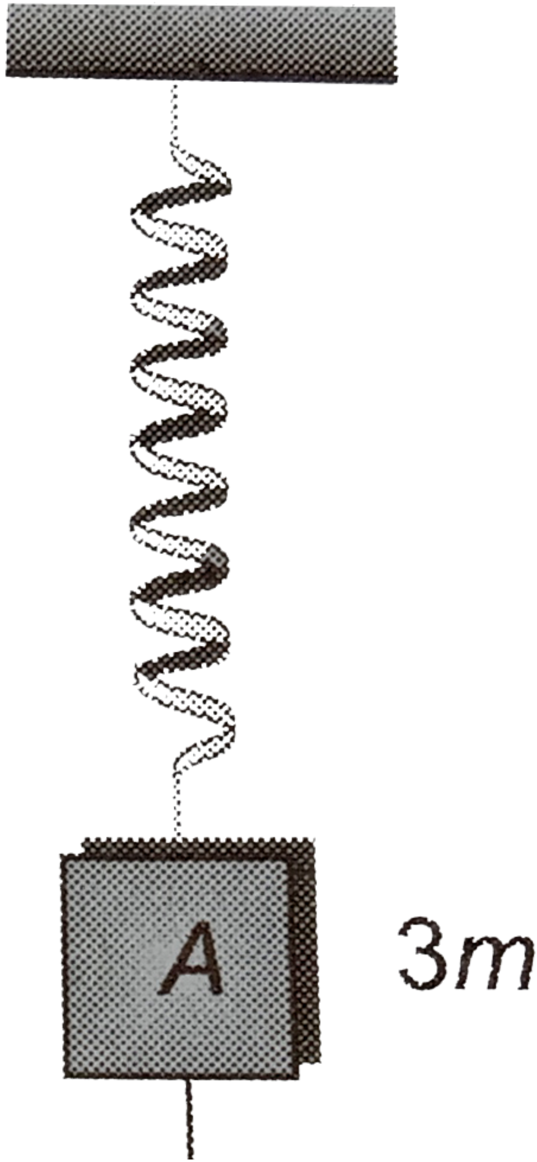
C. $\frac{ma}{g+a}$

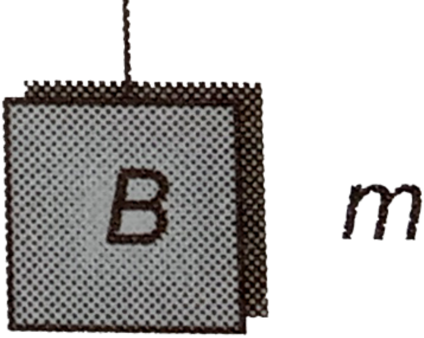
D. $\frac{ma}{g-a}$

Answer: a

Watch Video Solution

17. Two block A and B of masses $3m$ and m respectively are connected by a massless and nextensible string. The whole system is suspended by a massless spring as shown in figure. The magnitudes of acceleration of A and B immediately after the string is cut, are resectively





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

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

C. g, g

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

Answer: b

Watch Video Solution

18. A man of $50kg$ mass is standing in a gravity free space at a height of $10m$ above the floor. He throws a stone of $0.5kg$ mass downwards with a speed $2m/s$. When the stone reaches the floor, the distance of the man above the floor will be

A. $20m$

B. $9.9m$

C. $10.1m$

D. $10m$

Answer: c

Watch Video Solution

19. A body of mass $1kg$ initially at rest explodes and breaks into three parts of masses in the ration $1:2:3$. If the two pieces of equal masses fly off perpendicular to each other with a speed of $30m/s$ The speed of third piece will be .

A. $10\sqrt{2}m/s$

B. $20\sqrt{2}m/s$

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

D. $40\sqrt{2}m/s$

Answer: a

Watch Video Solution

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

A. p

B. $\sqrt{3}p$

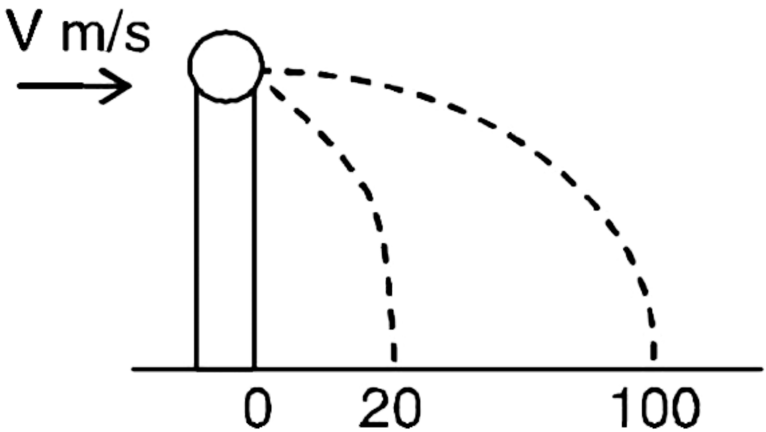
C. $p\sqrt{5}$

D. zero

Answer: c

Watch Video Solution

21. A ball of mass 0.2 kg rests on a vertical post of height 5 m. A bullet of mass 0.01 kg, travelling with a velocity $V m / s$ in a horizontal direction, hits the centre of the ball. After the collision, the ball and bullet travel independently. The ball hits the ground at a distance of 20 m and the bullet at a distance of 100 m from the foot of the post. The velocity V of the bullet is



A. $250 m / s$

B. $250\sqrt{2}m/s$

C. $400m/s$

D. $500m/s$

Answer: d

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22. A $600kg$ rocket is set for a vertical firing If the exhaust speed is $100m/s$ the gas ejected per sec to supply the thrust needded to overcome the weigth of rocket is .

A. $117.6kg/s$

B. $58.8kg/s$

C. $6kg/s$

D. $76.4kg/s$

Answer: c

Watch Video Solution

23. A light string passing over a smooth light pulley connects two blocks of masses m_1 and

m_2 (vertically). If the acceleration of the system is $g/8$, then the ratio of the masses is

A. $8:1$

B. $9:7$

C. $4:3$

D. $5:3$

Answer: b

Watch Video Solution

24. A lift is moving down with an acceleration a. A man in the lift drops a ball inside the lift. The acceleration of the ball as observed by the man in the lift, and a man standing stationary on the ground are, respectively.

A. g, g

B. a, a

C. $(g - a), g$

D. a, g

Answer: c

Watch Video Solution

25. The line of action of the resultant of two like parallel forces shifts by one-fourth of the distance between the forces when the two forces are interchanged. The ratio of the two forces is:

A. $3:4$

B. $1:2$

C. $3:5$

D. $2:3$

Answer: c

Watch Video Solution

26. A mass of $3kg$ descending vertically downwards supports a mass of $2kg$ by means of a light string passing over a pulley At the end of $5s$ the stringbreaks How much high from now the $2kg$ mass will go $\left(g = 9.8m/^2\right)$.

A. $9.8m$

B. $19.6m$

C. $2.45m$

D. $4.9m$

Answer: d

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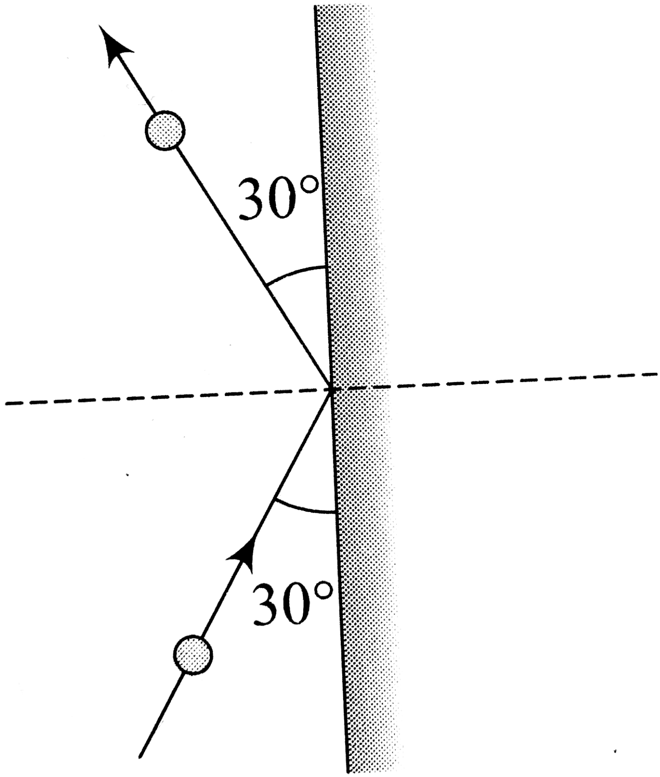
27. A $0.5kg$ ball moving with a speed of $12m/s$ strikes a hard wall at an angle of 30° with the wall. It is reflected with the same speed and at the same angle . If the ball is in contact with the wall for $0.25s$, the average force acting on the wall is



A. $96N$

B. $48N$

C. $24N$

D. $12N$

Answer: c

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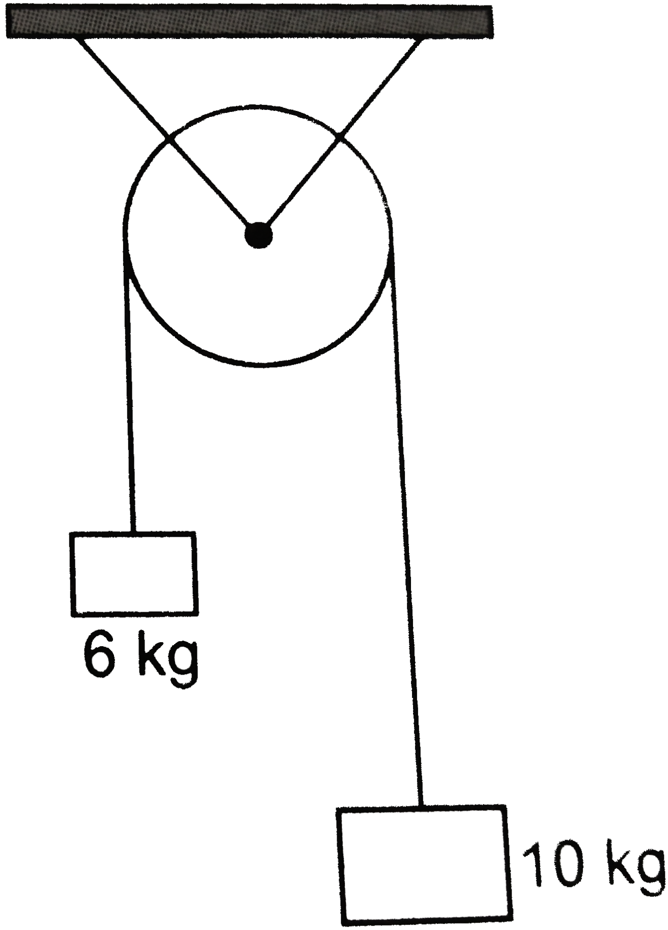
28. The tension in the string in the pulley system shown in



A. $5.7N$

B. $7N$

C. $7.5N$

D. $73.5N$

Answer: d

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29. A shell of mass $200g$ is ejected from a gun of mass $4kg$ by an explosion that generate $1.05kJ$ of energy. The initial velocity of the shell is

A. $100ms^{-1}$

B. $80ms^{-1}$

C. $40ms^{-1}$

D. $120ms^{-1}$

Answer: a

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30. An explosion blows a rock into three parts. Two parts go off at right angles to each other . These two are $1kg$ first part moving with a velocity of $12ms^{-1}$ and $2kg$ second part moving with a velocity of $8ms^{-1}$. If the third part flies off with a velocity of $4ms^{-1}$. Its mass would be

A. $3kg$

B. $5kg$

C. $7kg$

D. $12kg$

Answer: b

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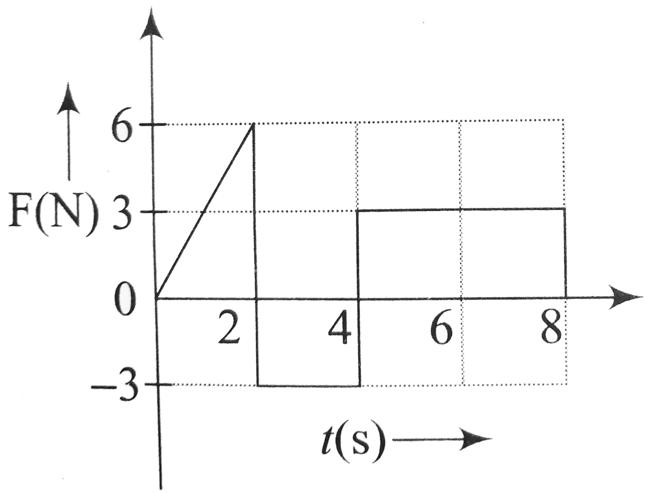
31. The force F acting on a partical of mass m is indicated by the force-time graph shown below. The change in momentum of the particle over time interval from zero to 8 s is.



A. $24 Ns$

B. $20 Ns$

C. $12 Ns$

D. $6Ns$

Answer: c

Watch Video Solution

32. A block A of mass m_1 rests on a horizontal table. A light string connected to it passes over a frictionless pulley at the edge of table and from its other end another block B of mass m_2 is suspended. The coefficient of knetic friction between the block and table is

μ_k . When the block A is sliding on the table, the tension in the string is.

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

B. $\dfrac{m_1 m_2 (1 + \mu_k) g}{m_1 + m_2}$

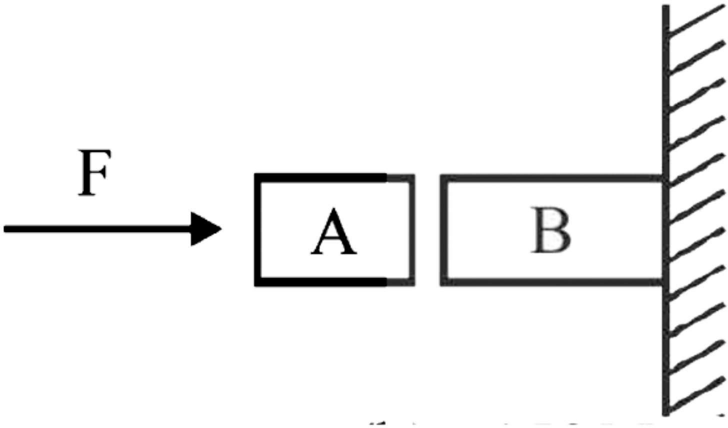
C. $\dfrac{m_1 m_2 (1 - \mu_k) g}{m_1 + m_2}$

D. $\dfrac{(m_2 + \mu_k m_1)g}{(m_1 + m_2)}$

Answer: b

Watch Video Solution

33. Given in figure are two blocks A and B of weight 20N and 100N, respectively. These are being pressed against a wall by a force F as shown. If the coefficient of friction between the blocks is 0.1 and between block B and the wall is 0.15, the frictional force applied by the wall on block B is:



A. $100N$

B. $80N$

C. $120N$

D. $150N$

Answer: c

Watch Video Solution

34. A weight w is suspended from the mid - point of a rope, whose ends are at the same level In order to make the rope perfectly horizontal, the force applied to each of its ends must be

A. less than W

B. equal to W

C. equal to 2W

D. infinitely large

Answer: d

Watch Video Solution

35. A block has been placed on an inclined plane with the slope angle θ. Block slide down the plane at constant speed. The cofficient of Kinetic friction is equal to

A. $\sin\theta$

B. $\cos\theta$

C. g

D. $\tan\theta$

Answer: d

Watch Video Solution

36. A block A of mass m_1 rests on a horizontal table. A light string connected to it passes over a frictionless pulley at the edge of table and from its other end another block B of mass m_2 is suspended. The coefficient of knetic friction between the block and table is μ_k . When the block A is sliding on the table, the tension in the string is.

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

B. $\frac{m_1 m_2 (1 + \mu_k)g}{m_1 + m_2}$

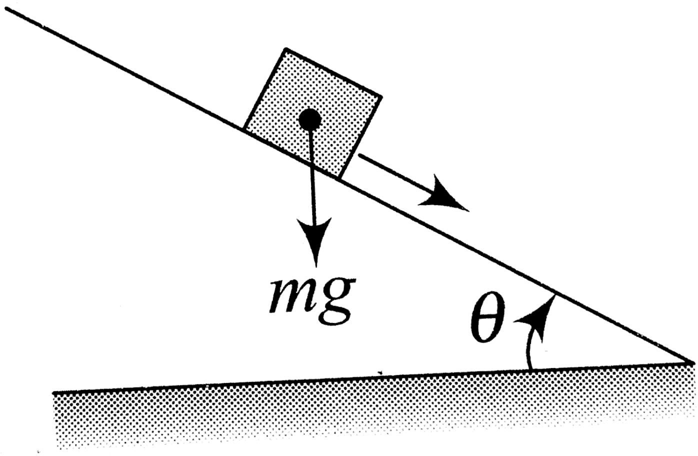
C. $\frac{m_1 m_2 (1 - \mu_k)g}{m_1 + m_2}$

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

Answer: b

Watch Video Solution

37. A plank with a box on it at one end is gradually raised about the other end. As the angle of inclination with the horizntal reaches 30°, the box starts to slip and slide $4.0m$ down the plank in $4.0s$. The coefficients of static and knitic friction between the box and the plank will be, respectively.



A. 0.4 and 0.3

B. $0.6$and 0.6

C. 0.6 and 0.5

D. 0.5 and 0.6

Answer: c

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38. A body of mass 40kg resting on a rough horizontal surface is subjected to a force P which is just enough to start the motion of the body. If $\mu_s = 0.5\mu_k = 0.4, g = 10ms^{-2}$ an dthe force P is continuously applied on the body, then the accceleration of the body is.

A. zero

B. $1m/s^2$

C. $2m/s^2$

D. $2.4m/s^2$

Answer: b

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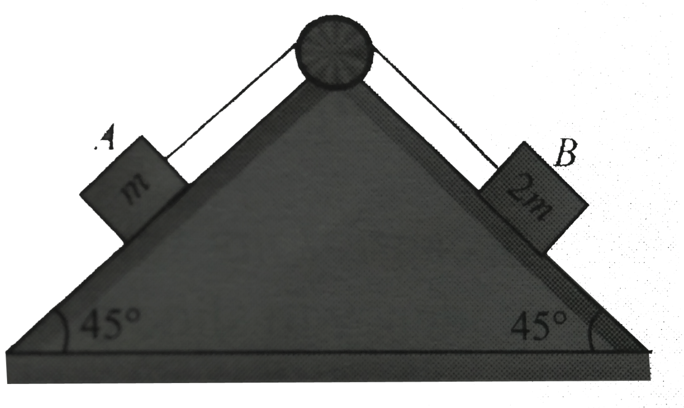
39. Block A of mass m and block B of mass $2m$ are placed on a fixed triangular wedge by means of a light and inextensible string and a frictionless pulley as shown in fig . The wedge is inclined at 45° to the horizontal on both sides . The coefficient of friction between the block $A$and the wedge is $2/3$ and that between the block B and the wedge is $1/3$ .If the system of A and B is released from rest then find .

a. the acceleration of A

b. tension in the string

c.the magnitude and direction of the frictional force acting on A



A. $zero$

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

C. $\frac{4m^2}{3}g$

D. $\frac{m^2}{\sqrt{2}}g$

Answer: a

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40. A block of mass is placed on a surface with a vertical cross section given by $y = \frac{x^3}{6}$. If the coefficient of friction is 0.5, the maximum height above the ground at which the block can be placed without slipping is:

A. $\frac{1}{3}m$

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

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

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

Answer: c

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41. A uniform wooden stick of mass 1.6 kg and length l rests in an inclined mannar on a smooth, vertical wall of height $h(<l)$ such that a small portion of the stick extends beyond the wall. The reaction force of th wall on the stick is perpendicular to the stick. The stick makes an angle of 30° with the wall and the bottom of the stick is on a rough floor. The reaction of the wall on the stick is equal in magnitude to the reaction of the floor on the stick. The ratio h/l and the friectional force f at the bottom of the stick are $\left(g=10ms^{2}\right)$

A. $\frac{h}{l} = \frac{\sqrt{3}}{16}, f = \frac{16\sqrt{3}}{3}N$

B. $\frac{h}{l} = \frac{3}{16}, f = \frac{16\sqrt{3}}{3}N$

C. $\frac{h}{l} = \frac{3\sqrt{3}}{16}, f = \frac{8\sqrt{3}}{3}N$

D. $\frac{h}{l} = \frac{3\sqrt{3}}{16}, f = \frac{16\sqrt{3}}{3}N$

Answer: d

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42. A block of mass $4kg$ is placed on a rough horizontal plane A time dependent force $F = kt^2$ acts on the block where $k = 2N/s^2$

Coefficient of friction $\mu = 0.8$ force of friction between the block and the plane at $t = 2s$ is

A. $32N$

B. $4N$

C. $2N$

D. $8N$

Answer: d

Watch Video Solution

43. A block is gently placed on a conveyor belt moving horizontal with constant speed After $t = 4s$ the velocity of the block becomes equal to velocity of the belt If the coefficient of friction between the block and the belt is $\mu = 0.2$, then the velocity of the conveyor belt is .

A. $8/s$

B. $6m/s$

C. $4m/s$

D. $2m/s$

Answer: a

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44. A $30kg$ block rests on a rough horizontal surface A force of $200N$ is applied on the block The block acquires a speed of $4m/s$ starting from rest in $2s$ What is the value of coefficient of friction ? .

A. $\sqrt{3}/10$

B. $10/3$

C. 0.47

D. 0.185

Answer: c

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45. A wooden box of mass $8kg$ slides down an inclined plane of inclination 30° to the horizontal with a constant acceleration of

$0.4 ms^{-2}$ What is the force of friction between the box and inclined plane ? $\left(g = 10 m / s^2\right)$.

A. $36.8 N$

B. $65.6 N$

C. $76.8 N$

D. $63.8 N$

Answer: a

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46. The upper half of an inclined plane with inclination ϕ is perfectly smooth while the lower half is rough. A body starting from rest at the top will again come to rest at the bottom if the coefficient of friction for the lower half is given by

A. $\mu = \dfrac{1}{\tan\theta}$

B. $\mu = \dfrac{2}{\tan\theta}$

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

D. $\mu = \tan\theta$

Answer: c

Watch Video Solution

47. A body takes time t to reach the bottom of a smooth inclined plane of angle θ with the horizontal. If the plane is made rough, time taken now is $2t$.The coefficient of friction of the rough surface is

A. $\frac{3}{4}\tan\theta$

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

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

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

Answer: a

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48. A given object taken n time more time to slide down 45° rough inclined plane as it taken to slide down a perfectly smooth 45° incline The coefficient of kintic friction between the object and the incline is .

A. $\dfrac{1}{2-n^2}$

B. $1-\dfrac{1}{n^2}$

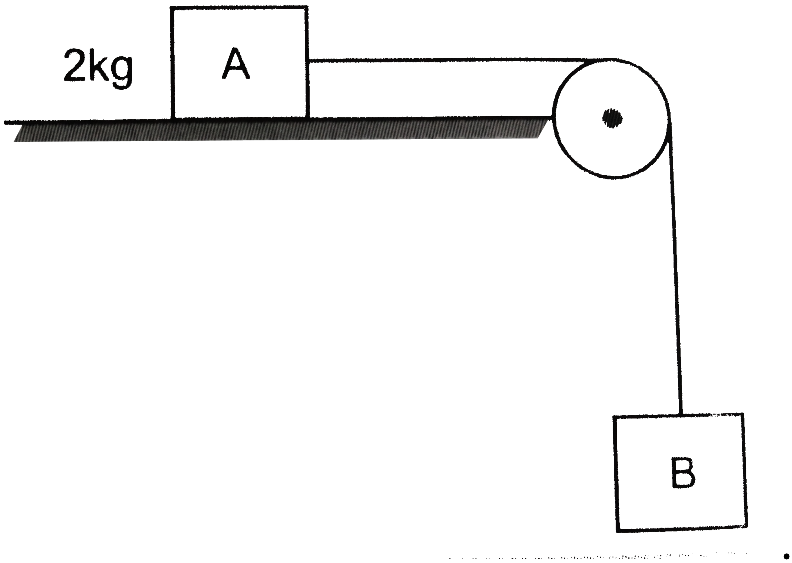
C. $\sqrt{1-\dfrac{1}{n^2}}$

D. $\sqrt{\dfrac{1}{1-n^2}}$

Answer: b

Watch Video Solution

49. The coefficient of static friction μ_s between block A of mass $2kg$ and the table as shown in is 0.1 What would be the maximum mass value of blocks B so that the two bloks do not move ? The string and the pulley are assumed to be smooth and massless $\left(g = 10m / s^2\right)$



A. $0.2kg$

B. $0.4kg$

C. $2.0kg$

D. $4.0kg$

Answer: a

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50. The rear side of a truck is open and a box of mass $20kg$ is placed on the truck $4m$ away from the open end $\mu = 0.15$ and $g = 10m/s^2$ The truck starts from rest with an acceleration of $2m/s^2$ on a straight road The box will fall off the truck when it is at a distance from the starting point equal to .

A. $14m$

B. $8m$

C. $16m$

D. $4m$

Answer: c

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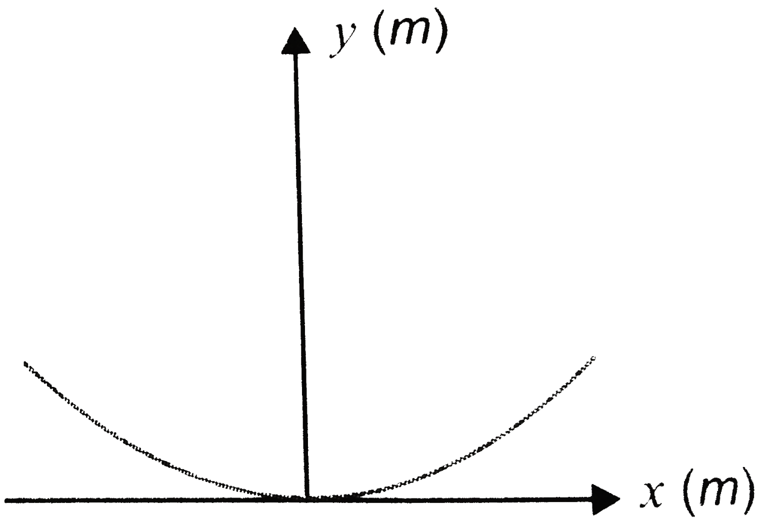
51. A parabolic bow1 with its bottom at origin has the shape $y = \frac{x^2}{20}$ where x and y are in metre The maximum height at which a small mass m can be placed on the bowl without slipping is (coeff of static friction 0.5



A. $1.25 Nm$

B. $2.5m$

C. $1.0m$

D. $4.0m$

Answer: a

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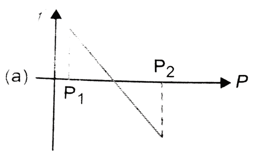
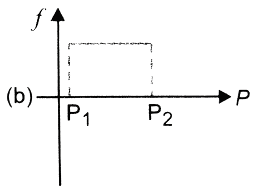
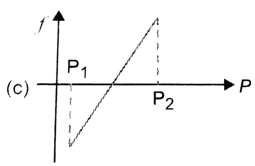
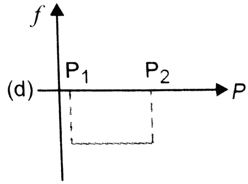
52. A block of mass m is on an inclined plane of angle θ. The coefficient of friction between the block and the plane is μ and $\tan\theta > \mu$. The block is held stationary by applying a force P parallel to the plane. The direction of force pointing up the plane is taken to be positive. As P is varied from $P_1 = mg(\sin\theta - \mu\cos\theta)$ to $P_2 = mg(\sin\theta + \mu\cos\theta)$, the frictional force f versus P graph will look like

A. 

B. 

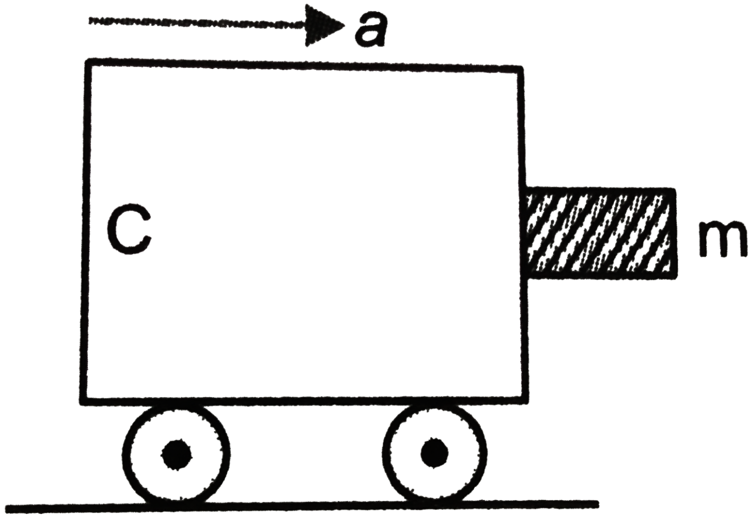
C. 

D. 

Answer: a

Watch Video Solution

53. A block of mass m is in contact with the cart C as shown in The coefficient of static friction between the block and the cart is μ The acceleration a of the cart that will prevent the block from falling satisfies



.

A. $a > \frac{mg}{\mu}$

B. $a > \frac{g}{\mu m}$

C. $a > \frac{g}{\mu}$

D. $a < \frac{g}{\mu}$

Answer: c

Watch Video Solution

54. A block is moving on an inclined plane making an angle 45° with the horizontal and the coefficient of friction is μ. The force required to just push it up the inclined plane is 3 times the force required to just prevent it from sliding down. If we define $N = 10\mu$, then N is

A. 3

B. 4

C. 5

D. 6

Answer: c

Watch Video Solution

55. A mas m hangs with help of a string wraped around a pulley on a frictionless bearling. The pulley has mass m and radius R. Assuming pulley to be a perfect uniform circular disc, the acceleration of the mass m, if the string does not slip on the pulley, is:

A. g

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

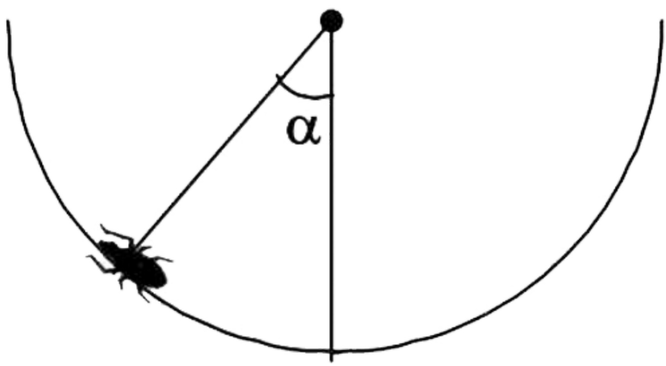
C. $\frac{g}{3}$

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

Answer: b

Watch Video Solution

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



A. $\cot\alpha = 3$

B. $\sec\alpha = 3$

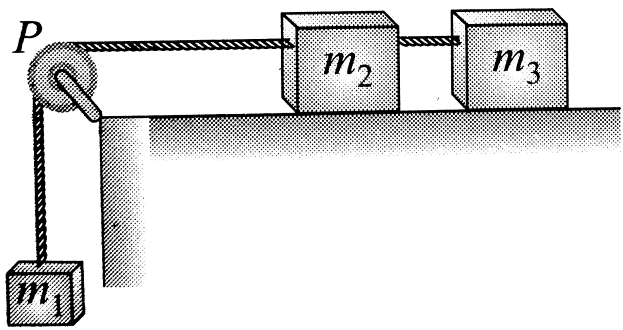
C. $\cos\alpha = 3$

D. None

Answer: a

Watch Video Solution

57. A system consists of three masses m_1 , m_1 , m_1 , m_2 and m_3 connected by a string passing over a pulley P . The mass m_1 hangs freely and m_2 and m_3 are on a rough horizontal table (the coefficient of friction=mu) The pulley is frictionless and of negligible mass. The downward acceleration of m1 is (Assume $m_1 = m_2 = m_3 = m$).



A. $\frac{g(1-3\mu)}{9}m$

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

C. $\frac{g(1-2\mu)}{3}$

D. $\dfrac{g(1-2\mu)}{2}$

Answer: c

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58. A block of mass is placed on a surface with a vertical cross section given by $y=\dfrac{x^3}{6}$. If the coefficient of friction is 0.5, the maximum height above the ground at which the block can be placed without slipping is:

A. $\dfrac{1}{3}m$

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

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

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

Answer: c

Watch Video Solution

59. What is the minimum velocity with which a body of mass m must enter a vertical loop of radius R so that it can complete the loop?

A. $\sqrt{2gR}$

B. $\sqrt{3}gR$

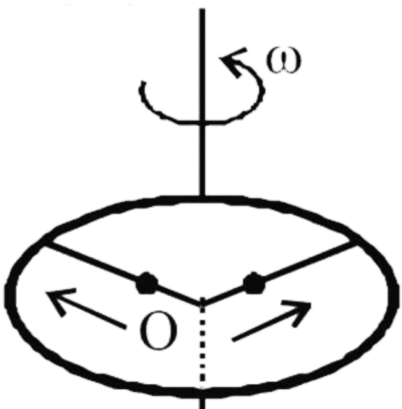
C. $\sqrt{5gR}$

D. $\sqrt{g}R$

Answer: c

Watch Video Solution

60. A ring of mass M and radius R is rotating with angular speed ω about a fixed vertical axis passing through its centre O with two point masses each of mass $\frac{M}{8}$ at rest at O. These masses can move radially outwards along two massless rods fixed on the ring as shown in the figure. At some instant the angular speed of the system is $\frac{8}{9}\omega$ and one fo the masses is at a distance of $\frac{3}{5}R$ from O. At this instant the distance of the other mass from O is



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

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

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

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

Answer: d

Watch Video Solution

61. A gramphone record is revolving with an angular velocity ω. A coin is placed at a distance R from the centre of the record. The static coefficient of friction is μ. The coin will revolve with the record if

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

B. $r < \dfrac{\omega^2}{\mu g}$

C. $r < \dfrac{\mu g}{\omega^2}$

D. $r \geq \dfrac{\mu g}{\omega^2}$

Answer: c

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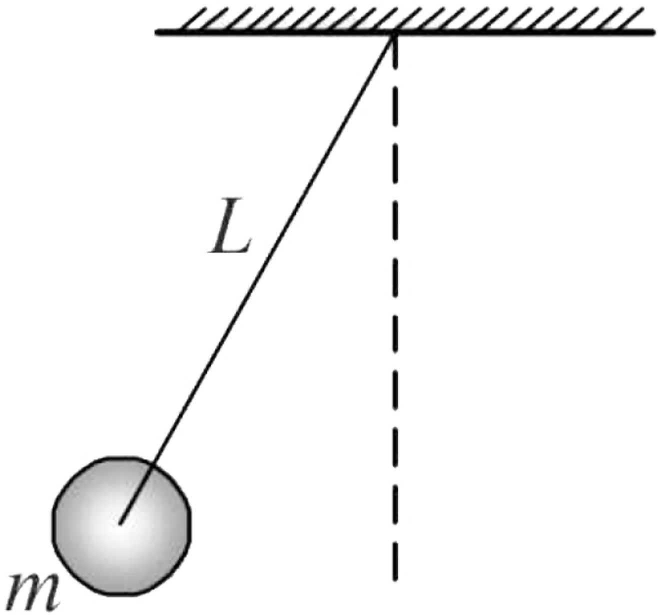
62. A ball of mass (m) 0.5g is attached to the end of a string having length (L) 0.5m. The ball is rotated on a horizontal circular path about vertical axis. The maximum tension that the string can bear is 324N. The maximum possible value of anguar velocity of ball(in radian/s) is



A. 9

B. 18

C. 27

D. 36

Answer: d

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63. A car of mass $1000 kg$ negotiates a banked curve of radius $90 m$ on a fictionless road. If the banking angle is 45° the speed of the car is:

A. $20 ms^{-1}$

B. $30ms^{-1}$

C. ms^{-1}

D. $10ms^{-1}$

Answer: b

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64. A car of mass m is moving on a level circular track of radius R if μ_s represents the static friction between the road and tyres of the car, the maximum speed of the car in circular motion is given by.

A. $\sqrt{\mu_s m R g}$

B. $\sqrt{Rg/\mu_s}$

C. $\sqrt{mRg/\mu_s}$

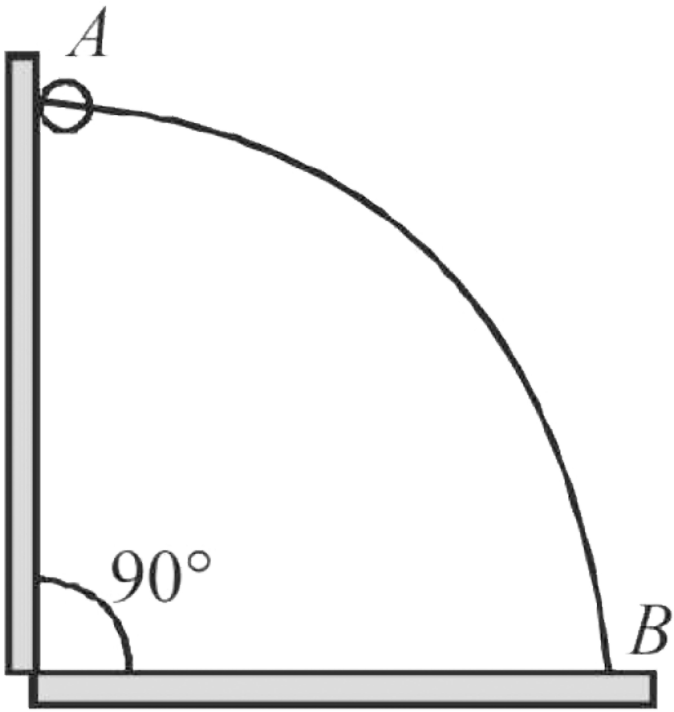
D. $\sqrt{\mu_s R g}$

Answer: d

Watch Video Solution

65. A wire, which passes through the hole in a small bead, is bent in the form of quarter of a circle. The wire is fixed vertically on ground as shown in the figure. The bead is released from near the top of the wire and it slides along the wire without friction. As the bead moves from

A to B, the force it applies on the wire is



A. always radially outwards

B. always radially inwards

C. radially outwards initially and radially inward later

D. radially inwards initially and radially outwards later

Answer: d

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66. In an elevator the actual weight of a person is equal to the apparent weight when .

A. elevator is at rest

B. elevator is accelerating upwards

C. elevator is accelerating downwards

D. elevator is in uniform motion

Answer: a,d

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

A. going up and slowing down

B. going up and speeding up

C. going down and slowing down

D. going down and speeding up

Answer: b,c

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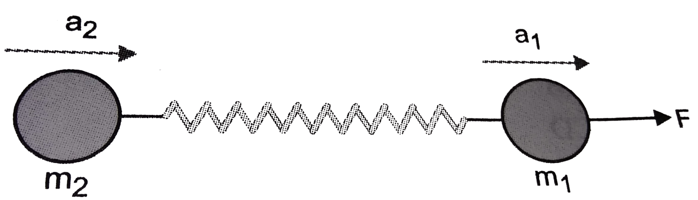
68. A spring connects two particles of masses m_1 and m_2 A horizontal force F acts on m_1 Ignoring friction when the elongation of the spring is x then [when the spring has maximum elongation]



A. $a_2 = Kx\,/\,m_2$

B. $a_1 = (F - Kx)\,/\,m_1$

C. $F = m_1 a_1 + m_2 a_2$

D. $a_1 = a_2 = \frac{F}{(m_1 + m_2)}$

Answer: a,b,c,d

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69. A body is in translatory equilibrium when .

A. resultant force on it is zero

B. it at rest

C. it is in unifrom motion

D. it is in an accelerated motion

Answer: a,b,c,

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70. In which of the following cases the net force is zero .

A. a drop of rain falling down with terminal velocity

B. a cork of mass $20g$ floating in water

C. a car moving with constant speed of $60km/h$ on a rough road

D. in a tug of war game if one team applies more force than other

Answer: a,b,c

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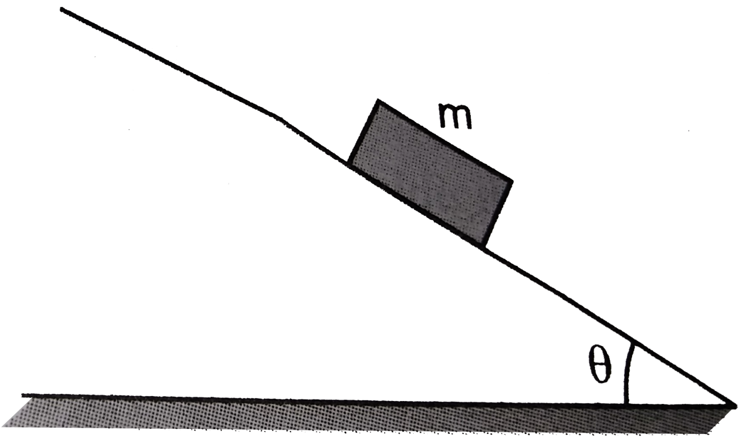
71. A block is stationary on an inclined plane If the coefficient of friction between the block and the plane is μ then



A. $\mu > \tan\theta$

B. $f = mg\sin\theta$

C. $f = \mu mg\cos\theta$

D. the reaction of the ground on the block

is mg cos θ

Answer: a,b

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72. Which of the following statement (s) is (are) correct ?

A. If there is no friction work needs to be done to move a body up an inclined plane

B. If there were no friction moving vehicles could not be stoped even by locking the brakes

C. As the angle of inclination is increased the normal reaction on the body placed on it increases

D. A duster weighing $0.5kg$ is pressed against a verticalboard with a force of $11N$ if the coefficient of friction is 0.5

the work done in rubbing it upward through a distance of $10cm$ is $0.55j$

Answer: a,b

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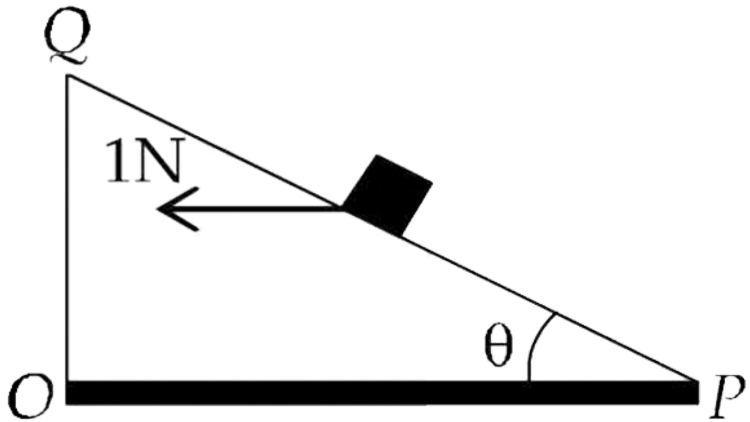
73. A small block of mass of 0.1 kg lies on a fixed inclined plane PQ which makes an angle θ with the horizontal. A horizontal force of 1N acts on the block through its centre of mass as shown in figure.



The block remains stationary if (take $g = 10m/s^2$)

A. $\theta = 45^\circ$

B. $\theta > 45^\circ$ and a frictional force acts on the block towards p

C. $\theta > 45^\circ$ and a frictional force acts on the block towards Q

D. $\theta < 45^\circ$ and a frictional force acts on the block towards Q

Answer: a,c

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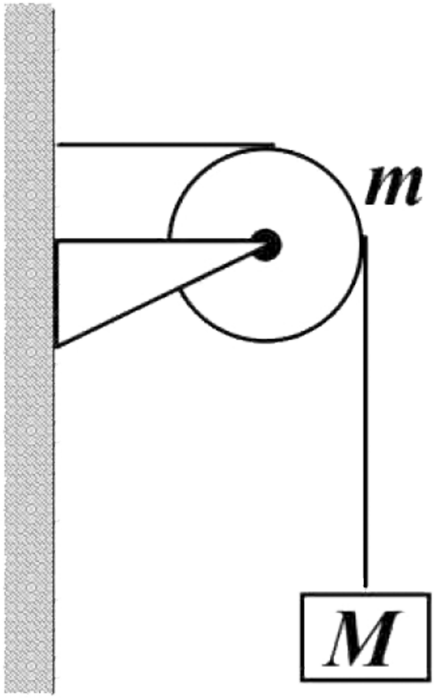
74. A string of negligible mass going over a clamped pulley of mass m supports a block of mass M as shown in the figure. The force on the pulley by the clamp is given by



A. $\sqrt{2}mg$

B. $\sqrt{2}mg$

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

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

Answer: c

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75. Mark the correct statements .

A. The electromagnetic force between two protons is always greater than the gravitational force between them

B. The nuclear force between two protons is always greater than the electromagnetic force between them

C. The gravitational force between two protons may be greater than the nuclear force between them

D. Electromagnetic force between two protons may be greater than the nuclear force acting between them

Answer: a,b

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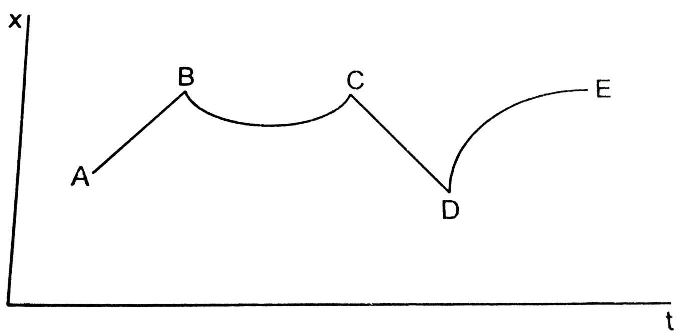
76. Figure shows the displacement of a particle going along the X-axis as a function of time. The force acting on the particle is zero in the region



A. AB

B. BC

C. CD

D. DE

Answer: a,c

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77. A particle stays at rest as seen in a frame. We can conclude that

A. the frame is inertial

B. resultant force on the particle is zero

C. the frame may be inertical but resultant force on the particle is zero

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

Answer: c,d

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

A. going up with unifrom speed

B. going down with unifrom speed

C. going up with increasing speed

D. going down with increasing speed

Answer: a,b

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79. If all matter were made of electrically neutal particles such as neutrons.

A. there would be no force of friction

B. there would be no tension in the string

C. It would not be possible to sit on a chair

D. the earth could not move around the sun

Answer: a,b,c

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80. A cylinder rolls up an inclined plane, reaches some height, and then rolls down (without slipping throughout these motions). The directions of the frictional force acting on the cylinder are.

A. up the incline while ascending and down the incline while descending

B. up the incline while ascending as well as descending .

C. down the incline while ascending and upto the incline while descending

D. down the incline while ascending as well as descending

Answer: b

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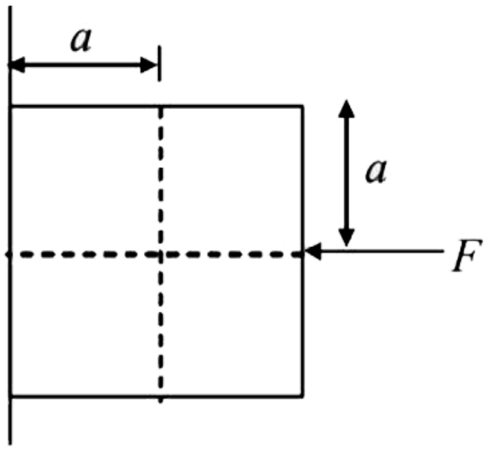
81. A block of mass m is at rest under the action of force F against a wall as shown in figure. Which of the following statement is incorrect?



A. $F = mg$ [where f is the friction force]

B. $F = N$ [where N is the normal force]

C. F will not produce torque

D. N will not produce torque

Answer: c,d

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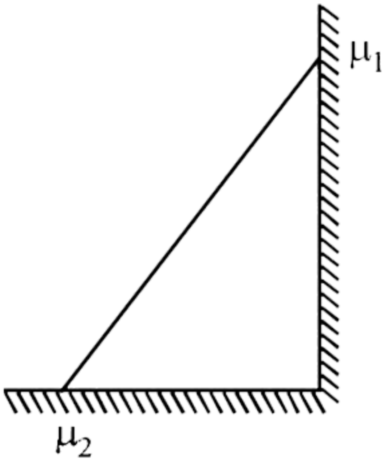
82. In the figure, a ladder of mass m is shown leaning against a wall. It is in static equilibrium making an angle θ with the horizontal floor. The coefficient of friction between the wall and the ladder is μ_1 and that between the floor and the ladder is μ_2. the normal reaction of the wall on the ladder is N_1 and that of the floor is N_2. if the ladder is about to slip. than



A. $\mu_1 = 0, \mu_2 \neq 0$ and $N_2 \tan\theta = mg/2$

B. $\mu_1 \neq 0, \mu_2 = 0$ and $N_1 \tan\theta = mg/2$

C. $\mu_1 \neq 0, \mu_2 \neq 0$ and $N_2 = \dfrac{mg}{1 + \mu_1\mu_2}$

D. $\mu_1 = 0, \mu_2 \neq 0$ and $N_1 \tan\theta = \dfrac{mg}{2}$

Answer: c,d

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

A. is towards east if the vechicle is moving with a unifrom velocity

B. is towards east if the vehicle is accelerating

C. must be towards east

D. must be towards west

Answer: b,d

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84. When a bicycle is in motio, the force of friction exerted by the ground on the two wheels is such that it acts

A. In the backward direction on the front wheel and in the forward direction on the front wheel and in the forward direction on the rear wheel when cycle is being pedalled

B. In the forward direction on the front wheel and in the backward direction on the rear wheel

C. In the backward direction on both the wheels when pedalling is stopped .

D. In the forward direction on both the wheels

Answer: a,c

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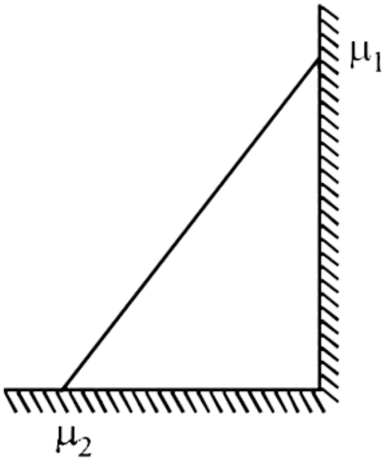
85. In the figure, a ladder of mass m is shown leaning against a wall. It is in static equilibrium making an angle θ with the horizontal floor. The coefficient of friction between the wall and the ladder is μ_1 and that between the floor and the ladder is μ_2. the normal reaction of the wall on the ladder is N_1 and that of the floor is N_2. if the ladder is about to slip. than



A. $\mu_1 = 0, \mu_2 \neq 0$ and $N_2 \tan\theta = mg/2$

B. $\mu_1 \neq 0, \mu_2 = 0$ and $N_1 \tan\theta = mg/2$

C. $\mu_1 = 0, \mu_2 \neq 0$ and $N_2 = \dfrac{mg}{1+\mu_1\mu_2}$

D. $\mu_1 = 0, \mu_2 \neq 0$ and $N_1 \tan\theta = \dfrac{mg}{2}$

Answer: c,d

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86. According to Newton s second law of motion $F = ma$ where F is the force required to produce an acceleration a in a body of mass m If a = 0 then $F = 0$ no external force is required to move a body uniformly along a straight line If a force F acts on a body for t seconds the effect of the force is given by Impulse =F $\times$ t = change in linear momentum of the body

A cricket ball of mass $150g$ is moving with a velocity of $12m/s$ and is hit by a bat so that the ball is turned back with a velocity of $20m/s$ if duration of contact between the ball and the bat is $0.01\sec$ The impulse of the force is .

A. $7.4N-s$

B. $4.8N-s$

C. $1.2N-s$

D. $4.7N-s$

Answer: b

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87. According to Newton s second law of motion $F = ma$ where F is the force required to produce an acceleration a in a body of mass m If a = 0 then $F = 0$ no external force is required to move a body uniformly along a straight line If a force F acts on a body for t seconds the effect of the force is given by Impulse =F $\times$ t =change in linear momentum of the body

Average force exerted by the bat is .

A. $480N$

B. $120N$

C. $1200N$

D. $840N$

Answer: a

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88. According to Newton s second law of motion $F = ma$ where F is the force required to produce an acceleration a in a body of mass m If a = 0 then $F = 0$ no external force is required to move a body uniformly along a straight line If a force F acts on a body for t seconds the effect of the force is given by Impulse =F $\times$ t = change in linear momentum of the body

The retardation of the ball is .

A. $1600m/s^2$

B. $320m/s^2$

C. $3200m/s^2$

D. $160m/s^2$

Answer: c

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89. An impulsive force of 100 N acts on a body for 1 s What is the change in its linear momentum ?

A. $10N - s$

B. $100N - s$

C. $1000N - s$

D. $1N - s$

Answer: b

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90. Friction between any two surfaces in contact is the force that opposes the relative motion between them The force of limiting friction (F) between any two surfaces in contact is directly proportional to the normal reaction (R) between them $F \propto R$ or $F = \mu R$ where μ is coefficient of limiting friction If θ is angle of friction then $\mu = \tan\theta$

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

A. 0.5

B. 4.9

C. $10/49$

D. $49/9.8$

Answer: a

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91. Friction between any two surfaces in contact is the force that opposes the relative motion between them The force of limiting friction (F) between any two surfaces in contact is directly proportional to the normal reaction (R) between them $F \propto R$ or $F = \mu R$ where μ is coefficient of limiting friction If θ is angle of friction then $\mu = \tan \theta$

The angle of friction in the above question is .

A. $34^{\circ} 26'$

B. 30°

C. $26^\circ 34'$

D. 45°

Answer: d

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92. Friction between any two surfaces in contact is the force that opposes the relative motion between them The force of limiting friction (F) between any two surfaces in contact is directly proportional to the normal reaction (R) between them $F \propto R$ or $F = \mu R$

where μ is coefficient of limiting friction If θ is

angle of friction then $\mu = \tan\theta$

A horizontal force of $1.2kg$ is applied on a $1.5kg$ block which rests on a horizontal surface If the coefficient of friction is 0.3 force of friction is .

A. $0.45kgf$

B. $1.2kgf$

C. $1.5kgf$

D. $0.3kgf$

Answer: a

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93. Friction between any two surfaces in contact is the force that opposes the relative motion between them The force of limiting friction (F) between any two surfaces in contact is directly proportional to the normal reaction (R) between them $F \propto R$ or $F = \mu R$ where μ is coefficient of limiting friction If θ is angle of friction then $\mu = \tan\theta$

The acceleration produce in the block in the above question is .

A. $9.8ms^{-2}$

B. $0.3ms^{-2}$

C. $1.5ms^{-2}$

D. $4.9ms^{-2}$

Answer: d

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Integer Type Questions

1. A ship of mass $3 \times 10^{7} kg$ initially at rest, is pulled by a force of $5 \times 10^{5} N$ through a distance of 3m. Assuming that the resistance due to water is negligible, the speed of the ship is:

A. $1.5 m / \sec$

B. $60 m / \sec$

C. $0.1 m / \sec$

D. $5 m / \sec$

Answer: C

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2. A block is released from top of a smooth inclined plane It reaches the bottom of the plane in $\sqrt{2}s$ The time taken (in second) by the body to cover Ist half of inclined plane is .

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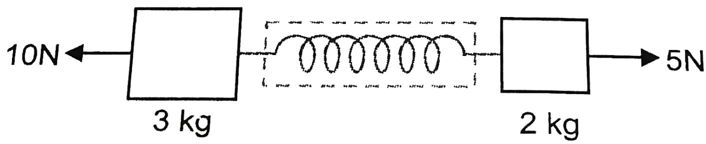
3. Two bodies of masses $3kg$ and $2kg$ are connected by a spring balance Two forces of $10N$ and $5N$ are applied on the blocks as shown The reading of the spring balance (in newton) would be



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4. A block weighing $4N$ is supported by two ropes Once rope is horizontal and the other makes an angle of 30° with the ceilling The tension (in newton) in the rope attached to the ceilling is .

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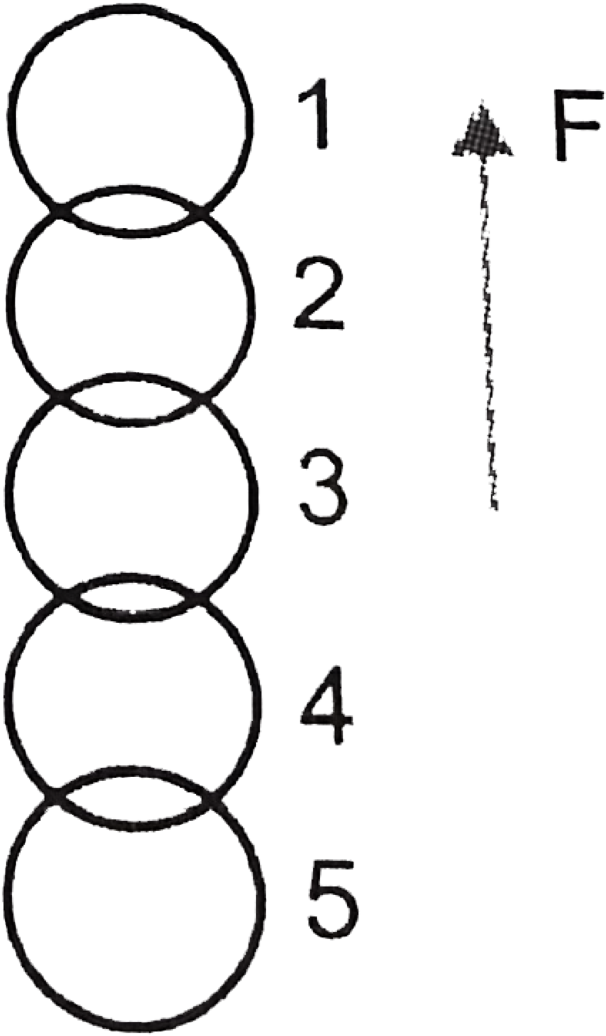
5. A chain consisting of 5 links each of mass $0.1kg$ is lifted vertically with a constant acceleration of $2m/s^2$ as shown in The force of interaction (in newton) between the top link and the link immediately below it will be

Take $g = 10m/s^2$



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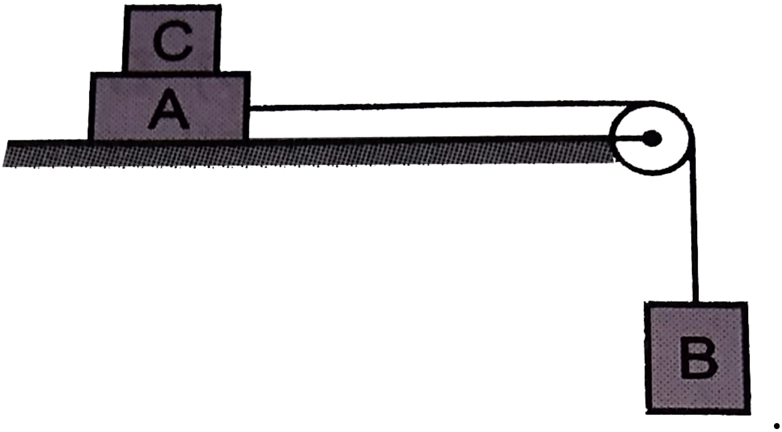
6. Two masses A and B of mass $15kg$ and $6kg$ are connected by a string passing over a friction pulley fixed at the corner of a table as shown in The coefficient of friction between A and table is 0.3 the minimum mass (in kg) of that must be placed on A to prevent it from moving is



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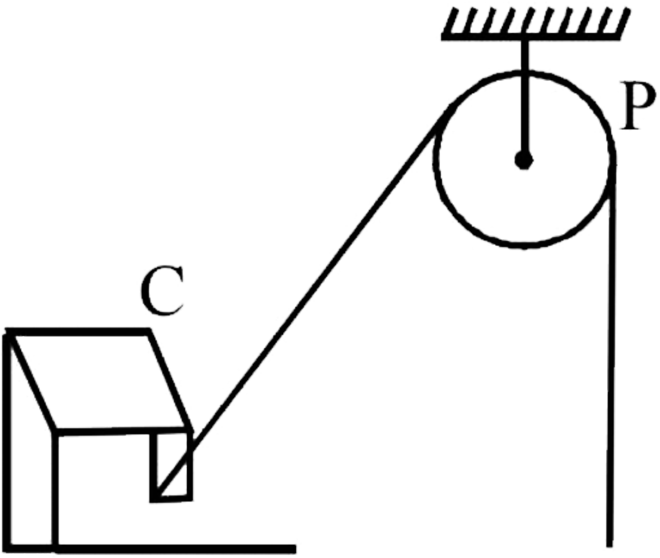
7. One end of a massless rope, which passes over a massless and frictionless pulley P is tied to a hook C while the other end is free. Maximum tension that the rope can bear is

360 N. With what value of maximum safe acceleration (in ms^{-2}) can a man of 60kg climb on the scope?



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Assertion- Reason Type Questions

1. Assertion : A person receive more injury when he falls from a height on a concrete pavement than when he falls from the same hight on a bed of sand

Reason : The force exerted on the person by the concrete pavement is more than that exerted by the bed of sand .

A. If both, Assertion and Reason are true and the Reason is the correct explanation of the Assertion

B. If both, Assertion and Reason are true but Reason is not a correct explanation of the Assertion

C. If Assertion is ture but the Reason is false

D. If both, Assertion and Reason are false

Answer: a

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2. Assertion : Slope of momentum - time graph gives acceleration

Reason : Acceleration is given by rate of change of momentum .

A. If both, Assertion and Reason are true and the Reason is the correct explanation of the Assertion

B. If both, Assertion and Reason are true but Reason is not a correct explanation of the Assertion

C. If Assertion is ture but the Reason is false

D. If both, Assertion and Reason are false

Answer: d

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3. Assertion : The work done in bringing a body down from the top to the base along a frictionless inclined plane is the same as the work done in bringing it down along the vertical side .

Reason : The gravitational force on the body along the inclined plane is the same as that along the vertical side.

A. If both, Assertion and Reason are true and the Reason is the correct explanation of the Assertion

B. If both, Assertion and Reason are true but Reason is not a correct explanation of the Assertion

C. If Assertion is ture but the Reason is false

D. If both, Assertion and Reason are false

Answer: c

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4. Assertion: A rocket moves forward by pushing the surrounding air backwards.

Reason: It derives the necessary thrust to move forward according to Newton's third law of motion.

A. If both, Assertion and Reason are true and the Reason is the correct explanation of the Assertion

B. If both, Assertion and Reason are true but Reason is not a correct explanation of the Assertion

C. If Assertion is ture but the Reason is false

D. If both, Assertion and Reason are false

Answer: d

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5. Assertion : No force is required to move a body unifromly along a straight line

Reason : Because $F = ma = m(0) = 0$.

A. If both, Assertion and Reason are true and the Reason is the correct explanation of the Assertion

B. If both, Assertion and Reason are true but Reason is not a correct explanation of the Assertion

C. If Assertion is ture but the Reason is false

D. If both, Assertion and Reason are false

Answer: a

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6. Assertion : A rocket in flight is an illustration of projectile

Reason : Because roket is not projected with some initial veloctity .

A. If both, Assertion and Reason are true and the Reason is the correct explanation of the Assertion

B. If both, Assertion and Reason are true but Reason is not a correct explanation of the Assertion

C. If Assertion is ture but the Reason is false

D. If both, Assertion and Reason are false

Answer: d

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7. Assertion : A body droped from a given height and another body projected horizontal from the same height strike the ground simultaneously

Reason : Because horizontal velocity has no effect in the vertical direction .

A. If both, Assertion and Reason are true and the Reason is the correct explanation of the Assertion
B. If both, Assertion and Reason are true but Reason is not a correct explanation of the Assertion
C. If Assertion is ture but the Reason is false

D. If both, Assertion and Reason are false

Answer: a

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8. Assertion : A body can be at rest even when it is under the action of may number of external forces

Reason : Because vector sum of the all external forces is zero .

A. If both, Assertion and Reason are true and the Reason is the correct explanation of the Assertion

B. If both, Assertion and Reason are true but Reason is not a correct explanation of the Assertion

C. If Assertion is ture but the Reason is false

D. If both, Assertion and Reason are false

Answer: a

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9. Assertion: Friction is a self-adjusting force.

Reason: Friction does not depend upon mass of the body

A. If both, Assertion and Reason are true and the Reason is the correct explanation of the Assertion

B. If both, Assertion and Reason are true but Reason is not a correct explanation of the Assertion

C. If Assertion is ture but the Reason is false

D. If both, Assertion and Reason are false

Answer: d

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10. Assertion : The value of dynamic friction is less than the limiting friction.

Reason : Once the motion has started, the inertia of rest has been overcome.

A. If both, Assertion and Reason are true and the Reason is the correct explanation of the Assertion

B. If both, Assertion and Reason are true but Reason is not a correct explanation of the Assertion

C. If Assertion is ture but the Reason is false

D. If both, Assertion and Reason are false

Answer: a

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11. Assertion : Force of friction depends on the actual area of contact

Reason : Smoother the surfaces of contact smaller is opposition to motion .

A. If both, Assertion and Reason are true and the Reason is the correct explanation of the Assertion

B. If both, Assertion and Reason are true but Reason is not a correct explanation of the Assertion

C. If Assertion is ture but the Reason is false

D. If both, Assertion and Reason are false

Answer: d

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12. Assertion : Thrust on a rocket depends only on velocity of exhaust gases Rate of decrease of mass is irrelevant

Reason : Larger the velocity greater is the thrust .

A. If both, Assertion and Reason are true and the Reason is the correct explanation of the Assertion

B. If both, Assertion and Reason are true but Reason is not a correct explanation of the Assertion

C. If Assertion is ture but the Reason is false

D. If both, Assertion and Reason are false

Answer: d

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13. Assertion : A horse cannot run a cart in empty space

Reason : A cart runs only on account of reaction of the ground on the feet of the horse .

A. If both, Assertion and Reason are true and the Reason is the correct explanation of the Assertion

B. If both, Assertion and Reason are true but Reason is not a correct explanation of the Assertion

C. If Assertion is ture but the Reason is false

D. If both, Assertion and Reason are false

Answer: a

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14. Assertion : A force of $1kg$ f produces an acceleration of $1m/s^2$ in a body of mass $1kg$

Reason : It follows from a $= f/m$.

A. If both, Assertion and Reason are true and the Reason is the correct explanation of the Assertion

B. If both, Assertion and Reason are true but Reason is not a correct explanation of the Assertion

C. If Assertion is ture but the Reason is false

D. If both, Assertion and Reason are false

Answer: d

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15. Assertion : A ball of mass $100g$ hits a bat with a speed of $72km/hr$ and bounces back with the same speed in one second The force exerted by the bat on the ball is $4N$

Reason : It follows from $F = ma$.

A. If both, Assertion and Reason are true and the Reason is the correct explanation of the Assertion

B. If both, Assertion and Reason are true but Reason is not a correct explanation of the Assertion

C. If Assertion is ture but the Reason is false

D. If both, Assertion and Reason are false

Answer: b

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16. Assertion : The maximum speed with which a vehicle can go round a level curve of diameter $20m$ without skidding is $\sqrt{10}m/s$ given $\mu = 0.1$

Reason : If follows from `upsilon le sqrt(mu r g)

.

A. If both, Assertion and Reason are true and the Reason is the correct explanation of the Assertion

B. If both, Assertion and Reason are true but Reason is not a correct explanation of the Assertion

C. If Assertion is ture but the Reason is false

D. If both, Assertion and Reason are false

Answer: a

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17. Assertion : Centripetal and centrifugal forces always cancle eachother

Reason : The is because the two forces act on different bodies .

A. If both, Assertion and Reason are true and the Reason is the correct explanation of the Assertion

B. If both, Assertion and Reason are true but Reason is not a correct explanation of the Assertion

C. If Assertion is ture but the Reason is false

D. If both, Assertion and Reason are false

Answer: d

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