PHYSICS

BOOKS - KUMAR PRAKASHAN KENDRA PHYSICS (GUJRATI ENGLISH)

LAW OF MOTION

Section A Try Yourself Vsqs

1. Define force

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2. What is contact force ?

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3. Write two example of field force.

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4. Write similarity and difference between contact force and field force.

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5. Out of contact force and field force which force is conservative and w hich force is n o n-conservative ?

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6. Write Aristotle's law regarding motion.

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7. What was mistake in Aristotle's idea regarding motion ?

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8. What is called inertia

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9. What is inertia ?

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10. What do mass of body measure

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11. Ns is unit of which quantity ?

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12. Write dimensional formula of momentum

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13. Which parameter is used to determine effect of force on body ?

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14. Write Newton's second law of motion.

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15. Define SI unit of force N.

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16. Define CGS unit of force dyne.

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17. Explain the following (AS_1)

(a) Static Inertia

(ii) Inertia of motion

(c) momentum

(d) impulse (e) impulsive force

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18. Time derivative of momentum gives which physical quantity ?

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19. What is impulsive force

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20. Write Newton's third law of motion

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21. Resultant of action and reaction is zero. (True or False)

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22. Which force act on body first action or reaction

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23. In Newtonian mechanics which parameter apply external force ?

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24. Write the law of conservation of linear momentum.

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25. Law of conservation of linear momentum is derived by using Newton's which laws ?

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26. Why law of conservation of linear momentum is universal and fundamental law ?

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27. What are concurrent forces ?

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28. Write condition for equilibrium when two force act on a particle.

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29. Write condition of equilibrium when three force act on a particle.

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30. Write condition of translational equilibrium of particle.

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31. What is friction ?

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32. What is impending motion

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33. How do static friction oppose motion

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34. Write unit of coefficient of static friction.

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35. Value of coefficient of friction depend on which factors

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36. What is kinetic friction ?

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37. What is rolling friction

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38. Write relation between coefficient of static friction, kinetic friction and rolling friction.

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39. Impending relative motion is opposed by which type of friction ?

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40. For a given mass rolling friction is how many times static friction and kinetic friction

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41. Write equation of centripetal acceleration and centripetal force for uniform circular motion.

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42. How centripetal is provided while taking turn on level circular track ?

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43. Do motion of vehicle on level circular path depend on mass of vehicle ?

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44. What is optimum speed ? Write its equation.

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45. Write condition that vehicle can be parked on circular road with slope.

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46. On which road we get maximum speed ?

Circular road with slope or level circular road

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47. How centripetal is provided while taking turn on level circular track ?

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48. What is Free body diagram ?

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49. How can we draw a two objects FBD according to Newton's third law ?

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Section A Question Paper

1. What is dynamics?

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2. Write day to day life example in which motion is controlled.

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3. Explain primary concept of force.

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4. Explain main type of force with suitable example.

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5. Write similarity and difference between contact force and field force.

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6. What was mistake in Aristotle's idea regarding motion ?

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7. Describe Galileo's experiment of inclined plane regarding motion.

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8. Why state of body and body at rest and body moving with constant velocity are equal ? What is inertia ?

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9. Write and explain Newton's first law of motion

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10. When body is at rest or it is in uniform motion, no force act on it.

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11. Explain -For car moving with constant (uniform) velocity resultant force is zero".

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12. We are standing in a stationary bus. When bus suddenly start why we are thrown in backward direction ?

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13. We are standing in a bus moving with constant velocity. When brakes are applied to bus we are thrown in forward direction ? Why ?

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14. What is linear momentum ? Write its SI unit

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15. Explain “Momentum gives more information than velocity alone”

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16. Write Newton's second law of motion.

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17. Write Newton's second law of motion.

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18. What is impulse of force ? Write its unit and dimension.

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19. “A seasoned (experienced) cricketer catches a cricket ball coming in with great speed where as a novice (unexperienced) can hurt his hand in same act” - Explain

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20. Explain - product of mass and velocity is important in producing effect of force.

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21. “Momentum and changes in momentum are not always in same direction”. Explain by suitable example.

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22. Write Newton’s third law of motion

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23. Write important points of Newton's third law of motion.

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24. Explain conservation of linear momentum by suitable example.

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25. What are concurrent forces ?

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26. Write different type of common forces.

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27. What is friction ? Explain static frictional force is caused due to roughness of force at microscopic level.

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28. Explain Kinetic friction. Write laws of kinetic friction. Define coefficient of kinetic friction.

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29. Explain - “Static friction force opposes impending motion”

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30. What is rolling friction ? Write laws of rolling friction. Define coefficient of rolling friction.

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31. Write advantages and disadvantages of friction

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32. Write remedies to reduce friction.

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33. Write equation of centripetal acceleration and centripetal force for uniform circular motion.

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34. Obtain the formula for the maximum safe speed $(v_{\max})$ of a vehicle on a level curved road

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35. For a vehicle moving on a banked curved road, using free body diagram (FBD), obtain the formula for the maximum safe speed $v_{\max}$.

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36. Write the formula for the maximum permissible speed of a vehicle moving on smooth circular balanced tracks.

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37. What is optimum speed ? Write its equation.

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38. Write condition that vehicle can be parked on circular road with slope.

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39. Write important guidance for solving problems in mechanics

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Section B Numerical From Textual Illustration

1. An astronaut accidentally gets separated out of his small spaceship accelerating in inter stellar 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 gravitational force on him.)

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2. A bullet of mass 0.04 kg moving with a speed of $90ms^{-1}$ enters a heavy wooden

block and is stopped after a distance of 60 cm. What is the average resistive force exerted by the block on the bullet?

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3. 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.

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4. 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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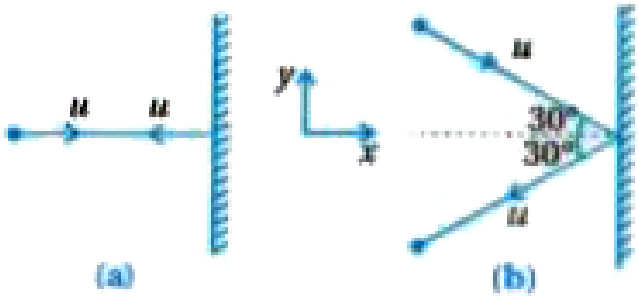
5. Two identical billiard balls strike a rigid wall with the same speed but at different angles, and get reflected without any change in speed,

as shown in figure. 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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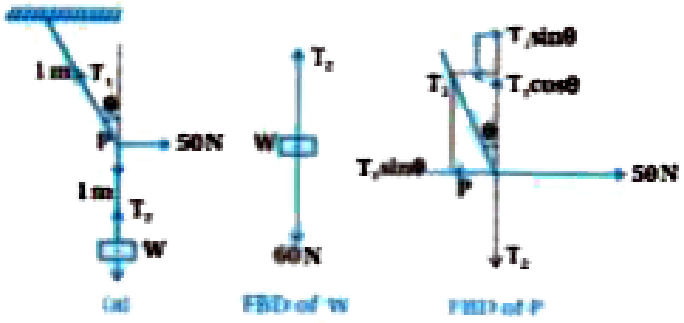
6. A mass of 6 kg is suspended by a rope of length 2 m from the ceiling. A force of 50 N in

the horizontal direction is applied at the midpoint P of the rope, as shown. What is the angle the rope makes with the vertical in equilibrium ? (Take g = 10 ms-2). Neglect the mass of the rope.



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7. Determine the maximum acceleration of the train in which a box lying on its floor will remain stationary, given that the co-efficient of static friction between the box and the train's floor is 0.15.

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8. A mass of 4 kg rests on a horizontal plane. The plane is gradually inclined until at an angle $0 = 15^{\circ}$ with the horizontal, the mass

just begins to slide. What is the coefficient of static friction between the block and the surface

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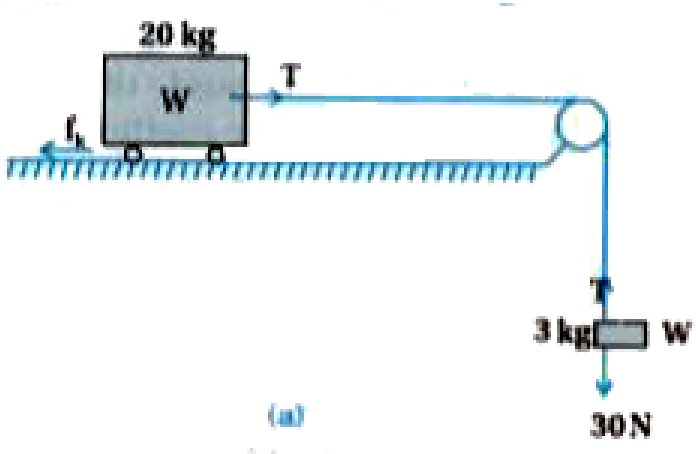
9. What is the acceleration of the block and trolley system show n in a figure, if the coefficient of kinetic friction betw een the trolley and the surface is 0.04 ? What is the tension in the string ? (Take g = 10 ms^2).

Neglect the mass of the string.



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10. A cyclist speeding at 18 km/h on a level road takes a sharp circular turn of radius 3 m without reducing the speed. The co-efficient of

static friction between the tyres and the road is 0.1. Will the cyclist slip while taking the turn?

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11. 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 avoid slipping ?

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12. A wooden block of mass 2 kg rests on a soft horizontal floor. When an iron cylinder of mass 25 kg is placed on top of the block, the floor yields steadily and the block and the cylinder together 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.

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Section B Numerical From Textual Exercise

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 cork of mass 10 g floating on water, (c) a kite skillfully held stationary in the sky, (d) a car moving with a constant velocity of 30 km/h on a rough road, (e) a high-speed electron in space far from all material objects, 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 direction and magnitude of the net force on the pebble, (a) during its upward motion, (b) during its downward motion, (c) at the highest point where it is momentarily at rest. Do your answers change if the pebble was thrown at an angle of 45° with the horizontal direction? Ignore air resistance.

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3. Give the magnitude and direction of the net 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/h, (c) just after it is dropped from the window of a train accelerating with $1ms^{-2}$, (d) lying on the floor of a train which is accelerating with $1ms^{-2}$, the stone being at rest relative to the train. Neglect air resistance throughout.

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

$(i)T, (ii)T - \frac{mv^2}{l}, (iii)T + \frac{mv^2}{l}, (iv)0$

T is the tension in the string. [Choose the correct alternative].

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5. A constant retarding force of 50 N is applied to a body of mass 20 kg moving initially 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 3.0 kg changes its speed from $2.0ms^{-1}$ to $3.5ms^{-1}$ in 25 s. The direction of the motion

of the body remains unchanged. What is the magnitude 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 4.0 s just in time to save the child. What is the average retarding force on the vehicle ? The mass of the three-wheeler is 400 kg and the mass of the driver is 65 kg.

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9. A rocket with a lift-off mass 20,000 kg is blasted upwards with an initial acceleration of 5.0 ms^2 . Calculate the initial thrust (force) of the blast.

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10. A body of mass 0.40 kg moving initially with a constant speed of $10ms^{-1}$ to the north is subject 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, the position of the body at that time to be x = 0, and predict its position at t = –5 s, 25 s, 100 s.

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11. A truck starts from rest and accelerates uniformly at $2.0ms^{-2}$. At t = 10 s, a stone is dropped by a person standing on the top of the truck (6 m high from the ground). What are the (a) velocity, and (b) acceleration of the stone at t = 11s ? (Neglect air resistance.)

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12. A bob of mass 0.1 kg hung from the ceiling of a room by a string 2 m long is set into oscillation. The speed of the bob at its mean position is $1ms^{-1}$. What is the trajectory of the bob if the string is cut when the bob is (a) at one of its extreme positions, (b) at its mean position.

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13. A man of mass 70 kg stands on a weighing scale in a lift which is moving

(a) upwards with a uniform speed of 10 m s 1,

(b) downwards with a uniform acceleration of 5 ms^2 ,

(c) upwards with a uniform acceleration of 5 ms^2 . What would be the readings on the scale in each case ?

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

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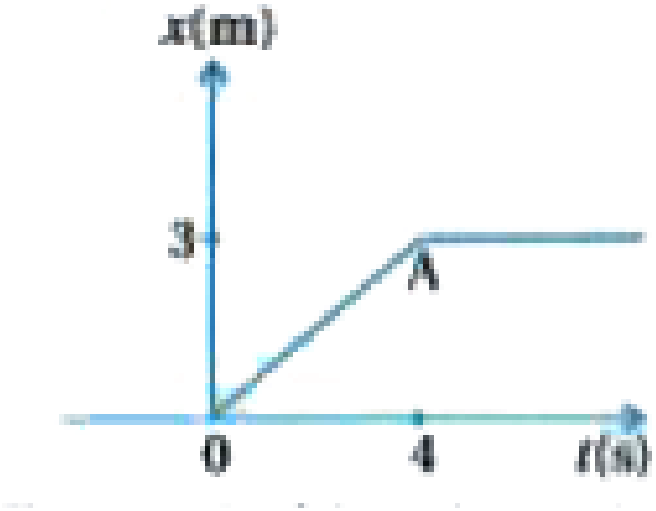
14. Shows the position-time graph of a particle of mass 4 kg. What is the (a) force on the particle for $t < 0, t > 4s, 0 < t < 4$ s ? (b) impulse at t = 0 and t = 4 s ? (Consider one-dimensional motion only).



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15. Two bodies of m asses 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, (ii) B along 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 goes over a frictionless pulley. Find the acceleration of the masses and the 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 disintegrates into

two smaller nuclei the products must move in opposite directions.

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18. Two billiard balls each of mass 0.05 kg moving in opposite directions with speed 6 ms-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 0.020 kg is fired by a gun of mass 100 kg. If the muzzle speed of the shell is $80ms^{-1}$, what is the recoil speed of the gun ?

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20. A batsman deflects a ball by an angle of 45° without changing its initial speed which is equal to 54 km/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 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 , 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 moves 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 particle ?

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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) it is easier to pull a lawn mower than to push it,

(d) a cricketer moves his hands backwards while holding a catch.

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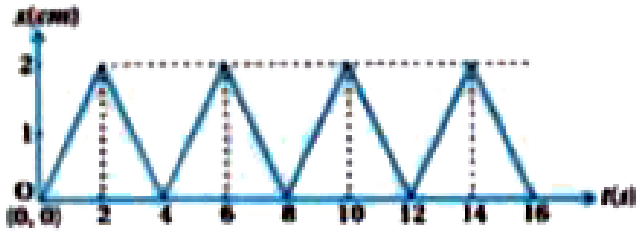
Section B Additional Exercise

1. The position-time graph of a body of mass 0.04 kg. Suggest a suitable physical context for this motion. What is the time between two consecutive impulses received by the body? What is the magnitude of each impulse ?



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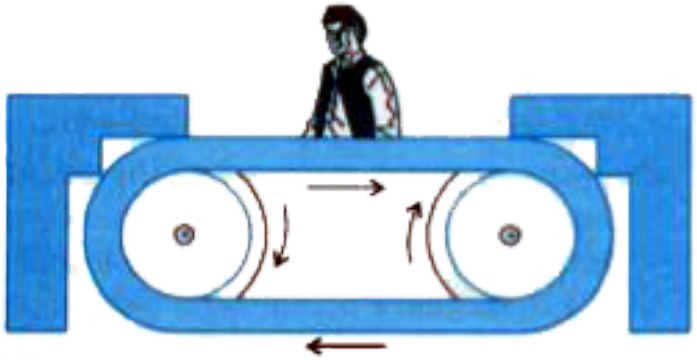
2. A man standing stationary with respect to a horizontal conveyor belt that is accelerating with 1 m s- 2 . What is the net force on the m an ? If the coefficient of static friction between the man's shoes and the belt is 0.2 up to what acceleration o f the belt can the man continue to be stationary relative to the belt ? (Mass of the man = 65 kg).



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3. A stone of m ass m tied to the end of a string revolves in a vertical circle of radius R. The net force at the lowest and highest points of the circle d irected vertically dow nw ards are : [Choose the correct alternative]

Lowest Point (a) mg - T_1

(b) $mg + T_1$

(c) $mg + T_1 - \left(mv_1^2\right) / R$

(d) $mg - T_1 - \left(mv_1^2\right) / R$ Highest Point $mg + T_2$

mg - T_2

$mg - T_2 + \left(mv_1^2\right) / R$

$mg + T_2 + \frac{mv_1^2}{R}$

T_1 and denote the tension and speed at the lowest point. T_2 and v_2 denote corresponding values at the highest point.

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4. A helicopter of m ass 1000 kg rises with a vertical a c c ele ra tio n o f 15 ms^{-2} . The crew an d th e passengers weigh 300 kg. Give

the magnitude and direction of the,

(a) Force on th e floor by th e crew and passengers.

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

(c) Force on the helicopter due to the surrounding air.

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5. A stream of water flowing horizontally with a speed of 15 m s'1 gushes out of a tube of

cross-sectional area 10-2 m_2 and hits a vertical wall nearby. What is the force exerted on the wall by the impact of water assum ing it does not rebound ?

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6. 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 7th coin (counted from the bottom) due to all the coins on its top, (b) the force on

the 7th coin by the eighth coin, (c) the reaction of the 6th coin on the 7th coin

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7. An aircraft executes a horizontal loop at a speed of 720 km/h with its wings banked at 15°. What is the radius of the loop

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8. A train runs along an unbanked circular track 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 wearing out of the rail ?

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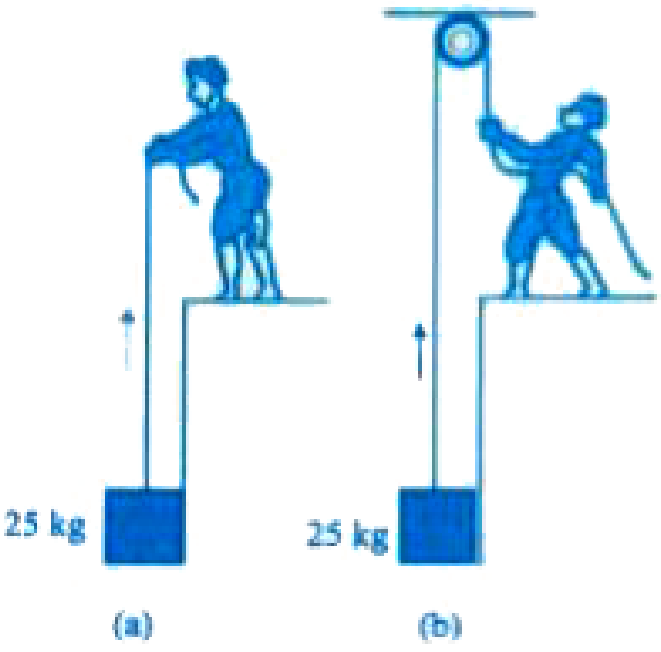
9. A block of mass 25 kg is raised by a 50 kg man in two different ways as shown in figure. What is the action on the floor by the man in the two cases ? If the floor yields to a normal force of 700 N, which mode should the man adopt to lift the block without the floor

yielding ?



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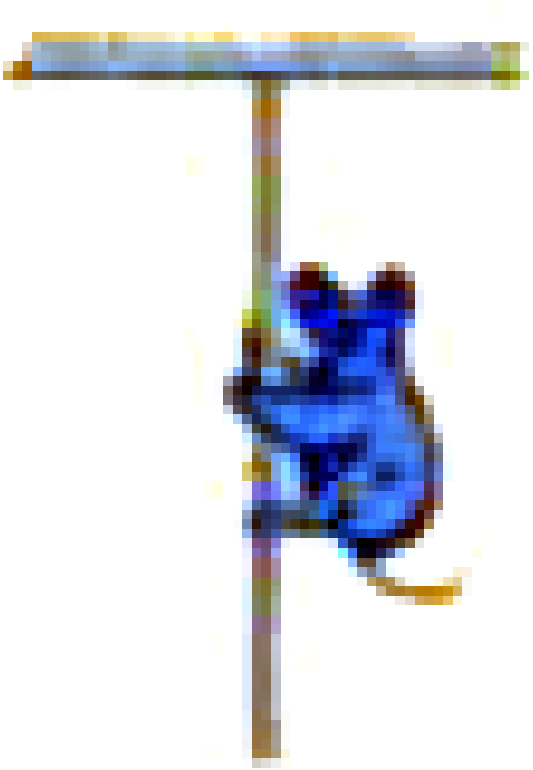
10. A monkey of mass 40 kg climbs on a rope as shown in figure which can stand a

maximum tension of 600 N. In which of the following cases will the rope break the monkey.



(a) Climbs up with an acceleration of 6 ms^2.

(b)Climbs down with an acceleration of 4 ms^2 .

(c)Climbs up with a uniform speed of 5 ms^1 .

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

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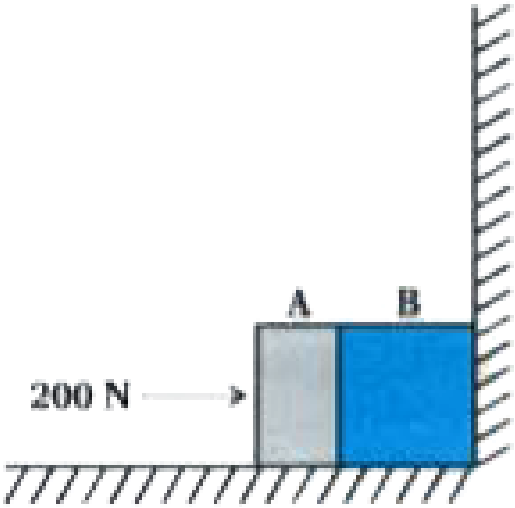
11. Two bodies A and B of masses 5 kg and 10 kg in contact with each other rest on a table against a rigid wall as shown in figure. The coefficient of friction between the bodies and the table is 0.15. A force of 200 N is applied horizontally to A. What are (a) the reaction of

the partition, (b) The action-reaction forces between A and B ? What happens when the wall is removed ? Does the answer to (b) change, when the bodies are in motion ? Ignore the difference between p_s and p_k.



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12. A block of mass 15 kg is placed on a long trolley. The coefficien t of static friction between the block and the trolley is 0.18. The trolley accelerates from rest with 0.5 ms^2 for 20 s and then moves with uniform velocity. Discuss the motion of the block as viewed by (a) a stationary observer on the ground, (b) an observer moving with the trolley.

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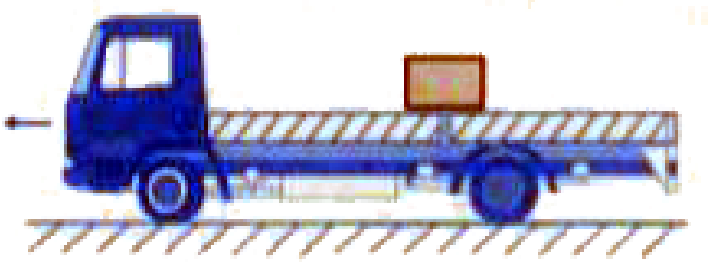
13. The rear side of a truck is open and a box of 40 kg mass is placed 5 m away from the open end as shown in figure. The coefficient of friction between the box and the surface below it is 0.15. On a straight road, the truck starts from rest and accelerates with 2 ms^2 . At what distance from the starting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



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14. A disc revolves with a speed of $33\frac{1}{3}$ rev/min. 3 and has radius of 15 cm. Two coins are placed at 4 cm and 14 cm away from the centre of the record. If the co-efficient of friction between the coins and the record is 0.15 which of the coins will revolve with the record ?

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15. You may have seen in a circus a motorcyclist driving in vertical loops inside a 'deathwell' (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 with no support from below. What is the minimum speed required at the uppermost position to perform a vertical loop if the radius of the chamber is 25 m

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16. A 70 kg man stands in contact against the inner wall of a hollow cylindrical drum of radius 3 m rotating about its vertical axis with 200 rev/min. 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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17. A circular coil of radius 8.0 cm and 20 turns is rotated about its vertical diameter with an angular speed of 50 rad s^{-1} in a uniform horizontal magnetic field of magnitude 3.0×10^{-2} T. Obtain the maximum and average emf induced in the coil. If the coil forms a closed loop of resistance 10Ω, calculate the maximum value of current in the coil. Calculate the average power loss due to Joule heating. Where does this power come from ?

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Section B Numerical From Darpan Based On Textbook

1. A soldier fires bullets, each of mass 50 g, from his automatic rifle with a velocity of 1000 m/s. If he can bear a maximum force of 200 N on his shoulder, find the number of bullets which he can fire in a second.

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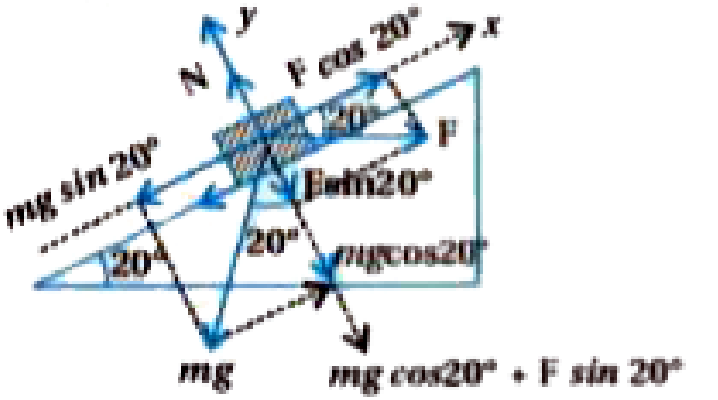
2. A block of mass 15 kg is lying on an inclined plane of angle 20°. In order to make it move upward along the slope with an acceleration of 25 cm / s^2 a horizontal force of 200 N is required to be applied on it. Calculate (i) frictional force on the block and (ii) co-efficient of kinetic friction.



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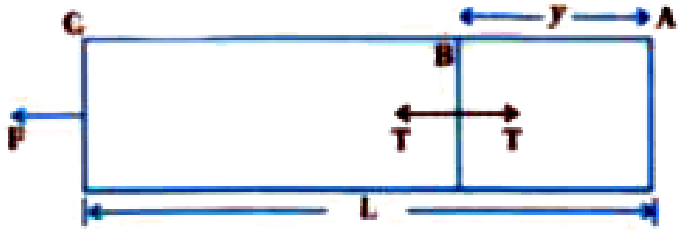
3. As , unequal forces F_1 and $F_2(F_2 < F_1)$ act on a rod of length L. Calculate the tension at a point situated at a distance y from end A.



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4. The energy of hydrogen atom in the nth orbit is En, then the energy in the nth orbit of single ionised helium atom is

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5. Two blocks of m asses 6 kg and 2 kg are placed in contact on a horizontal frictionless surface. If a horizontal force of 2N is applied to m ass 6 kg to move them together, what will be the acceleration of 2 kg block ? What will be the force on this block ?

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6. Two balls, each of m ass 80 g, moving towards each other with a velocity 5 msA^1, collide and rebound with the sam e speed. What will be the im pulse o f force on each ball due to the oth er ? W hat is th e valu e of mom entum of each ball

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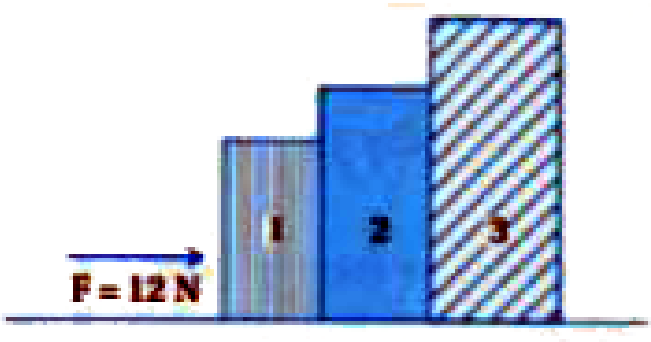
7. Three blocks of m asses 1 kg, 2 kg and 3 kg are placed in contact w ith each other on a

horizontal frictionless surface, as show n in figure. A force of 12 N is applied as shown in the figure. Calculate (i) the acceleration of the system o f these three blocks, (ii) the contact force acting on 2 kg block by first block of 1 kg and (iii) the contact force on 3 kg block.



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8. An object starting from rest slide on slope with 45°. If co-efficient of friction between object and surface is 0.3 x where x is distance covered then at what distance speed will be maximum ?

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Section C Objective Questions Vsqs

1. Area of F $\rightarrow$ t graph gives which physical quantity ?

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2. Momentum of two object with different mass is equal. Which object have more speed ?

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3. Why athlete taking long jump run for some distance before taking jump

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4. When mass of person is doubled, what will change in coefficient of friction ?

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5. If co-efficient of friction is $\sqrt{3}$ then what will be the angle between two surface ?

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6. What is angle between instantaneous velocity and frictional force for object moving on rough surface ?

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7. A bus of mass 1000 kg is standing stationary on bus station what is its linear momentum ?

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8. When direction of object moving on circular path is changed what will be change in direction of motion

Watch Video Solution

9. How friction force is provided on vehicle taking turn on level circular path ?

Watch Video Solution

10. On which place on the surface of the earth, centripetal force is maximum ?

Watch Video Solution

11. On which place on the surface of the earth, centripetal force is maximum ?

Watch Video Solution

12. Why curved road are provided with slope ?

Watch Video Solution

13. An object is subjected to num ber of external forces. Can this object remain

stationary

Watch Video Solution

14. Why more force is needed to bring heavier mass in motion with definite acceleration ?

Watch Video Solution

15. An object of 18 gram mass is lying on slope of 60°. If 36 dyne force act on it what will be its acceleration in horizontal direction ?

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16. A 10 kg wooden block is lying stationary on rough horizontal surface. To pull this block 49 N force is req u ired . Find value of co-efficient of friction and angle of friction.

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17. What is the acceleration of train moving with speed of 50 ms^{-1} on circular path of

radius 250 m ?

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18. A stone is tied at end of string and whirled in horizontal plane with circular path of radius 20 cm. If its acceleration is 980 cms^{-2}, then what will be its angular speed ?

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19. Because of which property of the object it tries to oppose the change ?

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20. W hen body is said to be in equilibrium condition ?

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21. Momentum is product of velocity and magnitude of velocity". True or False ?

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22. "If a body do not have kinetic energy, then it do not have momentum also". Agree or disagree ?

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23. Give dimensional formula of impulse of force.

Watch Video Solution

24. Time rate of change of momentum gives which physical quantity

Watch Video Solution

25. Which physical quantity represents the differentiation of linear momentum ?

Watch Video Solution

26. How we can find impulse of force when very small force act on body for very small time interval ?

Watch Video Solution

27. Explain - “To hit sixer the cricketer hit the ball by whirling the bat”.

Watch Video Solution

28. While catching the ball, the cricketer takes his hand in backward direction

Watch Video Solution

29. Velocity of body of 50 gram is 20 cm/s. When 50 dyne force act on it what will be its velocity at end of 5 sec.

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30. Write condition for equilibrium of a particle when more than one force act on it.

Watch Video Solution

31. What is magnitude of normal force on a body lying stationary on slope with angle θ

Watch Video Solution

32. What is magnitude of normal force on a body lying stationary on slope with angle θ

Watch Video Solution

33. What can be said from $fs < \mu_s N$?

Watch Video Solution

34. Write equation of maximum safe speed on level circular track

Watch Video Solution

35. Write equation of maximum safe speed on smooth banked road with angle θ

Watch Video Solution

36. Write value of safe speed on frictionless level circular track.

Watch Video Solution

37. For a vehicle moving on a banked curved road, using free body diagram (FBD), obtain the formula for the maximum safe speed $v_{\max}$.

Watch Video Solution

38. What is level of wear and tear for vehicle moving on banked curved road with optimum speed ?

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39. Write condition that vehicle can be parked on circular road with slope.

Watch Video Solution

40. If vehicle is moving on banked curved road and $v < v_0$, then what will be direction of frictional force ?

Watch Video Solution

41. Which component of force provide centripetal force to vehicle moving with optimum speed ?

Watch Video Solution

42. Why isolated (single) force does not exist in nature ?

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43. Can we get out of smooth surface by taking jump on it ?

Watch Video Solution

44. “When a person walk on rough surface then frictional force act in opposite direction of motion” - True or false ?

Watch Video Solution

45. Radius of level circular track is 20 m. If co-efficient of friction is 0.25, then what will be maximum safe speed ? (g = 9.8 ms^2)

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46. Area enclosed by $F \rightarrow t$ graph for given body in 1 sec. interval is 100 Ns. What will be magnitude of force ?

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47. A vehicle of 100 kg is moving with velocity of 5 m/s. How much force will be required to stop in $\frac{1}{10}$ sec ?

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48. Is equation $\vec{f} = ma$ valid in each and every case ? Why ?

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49. A ball of mass 0.2 kg is thrown in the vertical direction with a velocity of 2 m/s. At the top of its path.

(1) What is the value of its velocity ?

(2) What is the value of its acceleration ?

(3) What is the value of the force acting on it ?

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50. What is similar from the dynamics point of view between a book lying stationary on the horizontal table and a raindrop falling downward with constant speed

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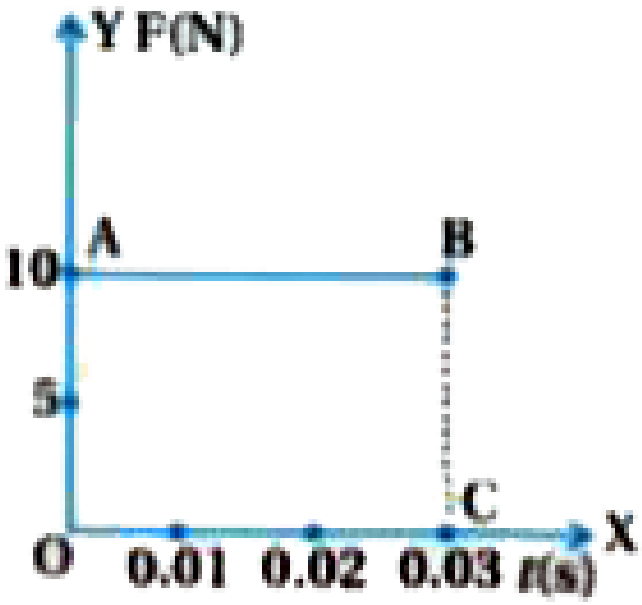
51. $F \rightarrow t$ graph for a body is shown in the . What is the change in the value of momentum

in the intital tie interval of 0.03 sec .



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52. Give dimensional formula of impulse of force.

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53. As per Bohr model, the minimum energy (in eV) required to remove an electron from the ground state of double ionized Li atom (Z = 3) is

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54. In uniform circular motion

(i) only the value of velocity is constant.

(ii) velocity vector is constant.

(iii) direction of velocity is constant. Select the correct one.

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55. Which out of

(i) value of velocity,

(ii) value of acceleration,

(iii) value of force,

(iv) the momentum vector of the body is not constant during uniform circular motion ?

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Section D Ncert Exemplar Solutions

1. A ball is moving 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 uniform speed

C. all parts of the ball have the same velocity and the velocity is constatn

D. the cnetre of the ball moves with constant velcoity and the ball spins about its centre uniformly

Answer: C

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

A. the force acting on the scale is zero, but a torque about the centre 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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3. A cricket ball of mass 150 g has an initial velocity $\mu = \left(3\hat{i} + 4\hat{j}\right)ms^{-1}$ and a final velocity $v = -\left(3\hat{i} + 4\hat{j}\right)ms^{-1}$, after being hit. The change in momentum (final momentuminitial momentum) is (in $kgms^{-1}$)

A. zero

B. $-\left(0.5\vec{i} + 0.6\vec{j}\right)$

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

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

Answer: C

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4. In the previous problem (3), the magnitude of the momentum transferred during the hit is

A. zero

B. 0.75 kg $-ms^{-1}$

C. 1.5 kg $-ms^{-1}$

D. 14 kg $-ms^{-1}$

Answer: C

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5. 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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6. A hockey player is moving northward and suddenly turns westward with the same speed to avoid an opponent. 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-wes

Answer: C

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7. A body of mass 2 kg travels according to the law x (t) = $pt + qt^2 + rt^3$ where,

$q = 4ms^{-2}, p - 3ms^{-1}$ and r = $5ms^{-3}$. The force acting on the body at t = 2s is

A. 136 n

B. 134 n

C. 158 n

D. 68 n

Answer: A

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

A. never

B. 10 s

C. 2 s

D. 15 s

Answer: B

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9. 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 uniform 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. $\frac{mv}{2}$ exerted by the engine

Answer: B

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10. The motion of a particle of mass m is given by x = 0 for $t < 0$ s, 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 which of the following statements is true ?

A. The force at $t = \left(\frac{1}{8}\right)$ on the particle is

$-16\pi^2 A - m$

B. The particle is acted upon by on impulse of magnitude $4\pi^2$ A - m at t = 0 s and $t = \left(\frac{1}{4}\right) s$

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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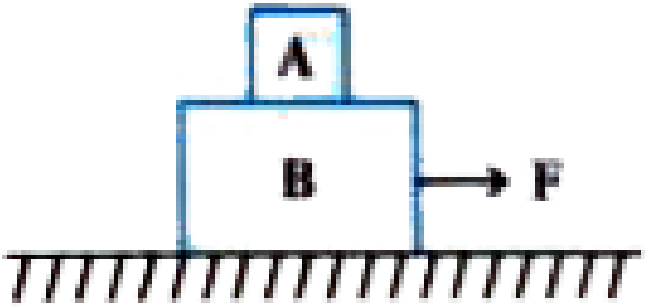
11. In the coefficient of friction between the floor and the body B is 0.1. The coefficient of friction between the bodies B and A is 0.2. A force F is applied as shown on B. The mass of m A is $\frac{1}{2}$ and of B is m. Which of the following

statements are true ?



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

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

C. The bodies will move together if F = 0.5 mg

D. The bodies will be at rest if F = 0.1 mg

Answer: A::B::D

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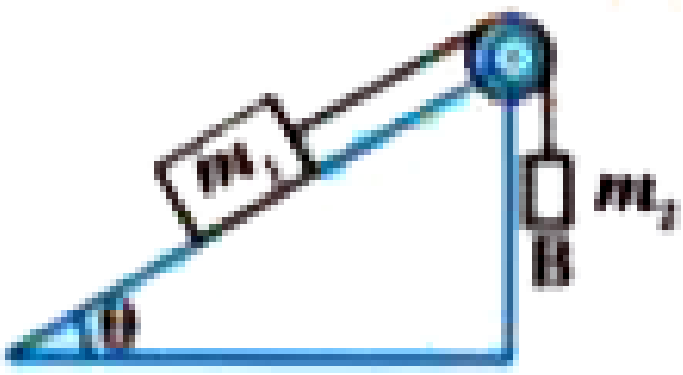
12. Mass moves on a slope making an angle 9 with the horizontal and is attached to mass m_2 by a string passing over a frictionless pulley . The coefficient of friction between nq and the sloping surface is μ. Which of the

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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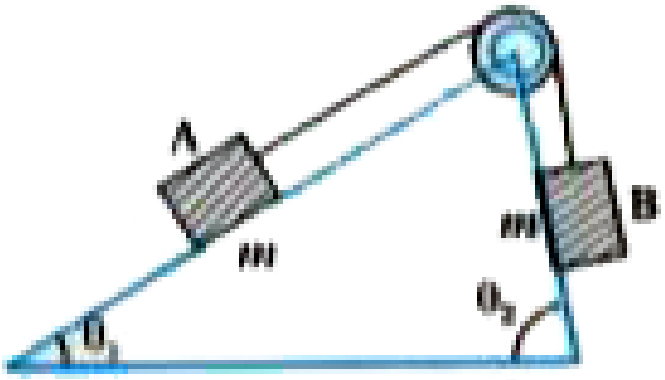
13. In a body A of mass tn slides on plane inclined at angle θ_1, to the horizontal and p is the coefficent of friction between A and the plane. A is connected by a light string passing over a frictionless pulley to another body B,

also of mass m, sliding on a frictionless plane inclined at an angle θ_2 to the horizontal. Which of the following statements are true ?



A. a will never move up the plane

B. a will just start moving up the plane when

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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14. Two billiard balls A and B, each of mass 50g and moving in opposite directions with speed of 5 ms^1 each, collide and rebound with the

same speed. If the collision lasts for 10^{-3} s, which of the following statements are true ?

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

B. The impulse imparted to each ball is 0.25 kg - ms^{-1} and the force exerted on each ball is 25×10^{-5} N

C. The impulse imparted to each ball is 0.5 N - s

D. The impulse and the force on each ball are equal in m agnitude and opposite in directions.

Answer: C::D

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15. A body of mass 10 kg is acted upon by two perpendicular forces, 6N and 8N. The resultant acceleration of the body is

A. 1 ms^{-2} at an angle of $\tan^{-1}\left(\frac{4}{3}\right)$ w.r.t 6n force

B. 0.2 ms^{-2} at an angle of $\tan^{-1}\left(\frac{4}{3}\right)$ w.r.t 6n force

C. 1 ms^{-2} at an angle of $\tan^{-1}\left(\frac{4}{3}\right)$ w.r.t 6n force

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

Answer: A::C

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16. A girl riding a bicycle along a straight road with a speed of 5 ms^{-1} throws a stone of mass 0.5 kg which has a speed of 15 ms^{-1} with respect to the ground along her direction of motion. The mass of the girl and bicycle is 50 kg. Does the speed of the bicycle change after the stone is thrown ? What is the change in speed, if so

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

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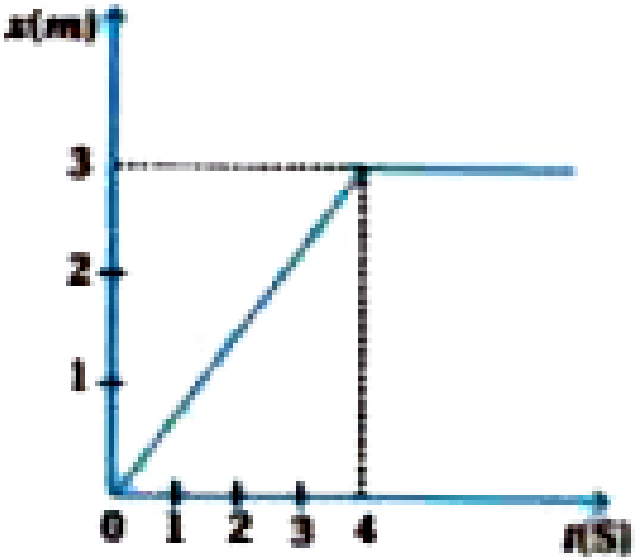
18. The position-time graph of a body of mass 2 kg is as given in figure. What is the impulse

on the body at t = 0 s and t = 4s.



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19. 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 wheel. Why

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

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21. 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.

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

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23. 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 ?

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24. A women throws an object of mass 500 g with a speed of 25 ms- 1 .

(a) W hat is the im pulse im parted to the object ?

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

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

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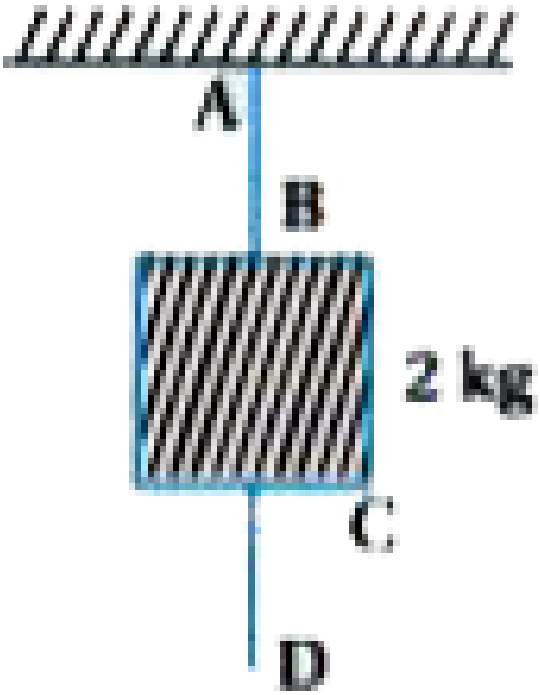
26. A mass of 2 kg suspended with thread AB (figure). Thread CD of the same type is attached to the other end of 2 kg mass. Lower thread is pulled gradually, harder and harder in the downward direction, so as to apply force on AB.

Which of the threads will break and why ?



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

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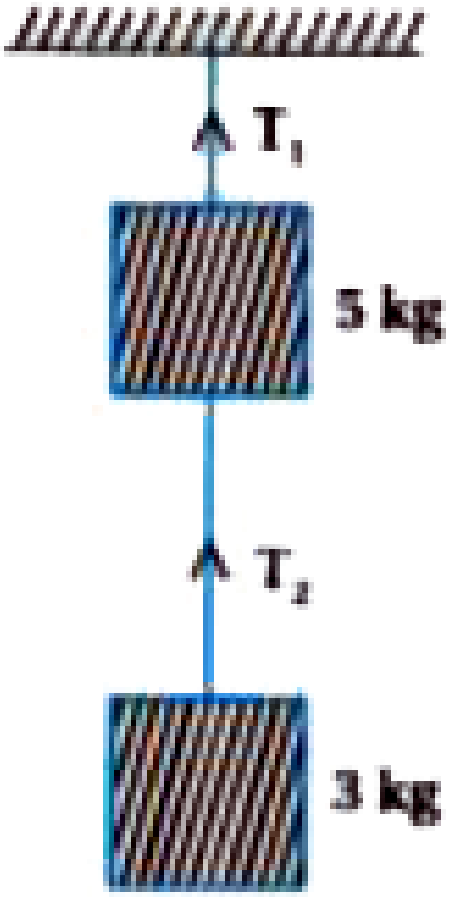
28. Two masses of 5 kg and 3 kg are suspended with help of massless inextensible strings as shown in figure. Calculate T_1 and T_2 when whole system is going upwards with

acceleration = 2 $\frac{m}{s^2}$ 2 (use g = 9.8 ms^{-2}).



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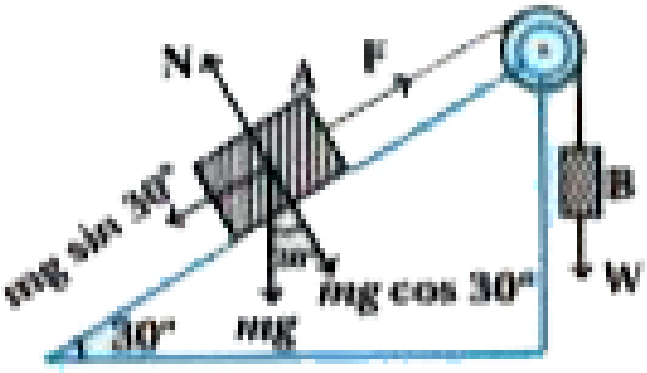
29. Block A of weight 100 N rests on a frictionless inclined plane of slope angle 30°. A flexible cord attached to A passes over a frictionless pulley and is connected to block B of weight w. Find the weight w for which the system is in equilibrium



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

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31. A 100 kg gun fires a ball of 1 kg horizontally from a cliff of height 500 m. It falls on the

ground at a distance of 400 m from bottom of the cliff. Find the recoil velocity of the gun. (acceleration due to gravity = 10 ms^{-2})

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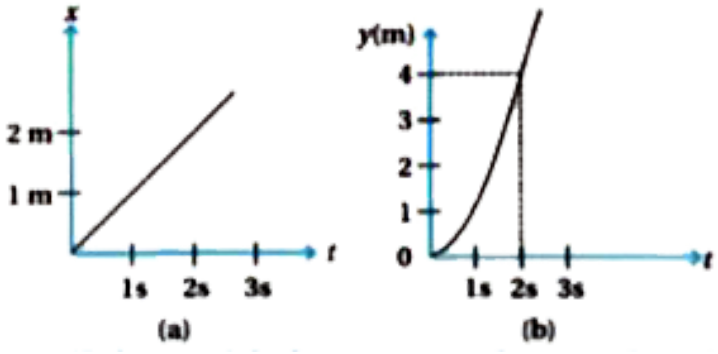
32. (x, t), (y, t) diagram of a particle moving in 2-dimensions



If the particle has a mass of 500 g, find the force

(direction and magnitude) acting on the particle.

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33. A person in an elevator accelerating upwards with an acceleration of $2\frac{m}{s^2}$, 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)

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34. 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 move with uniform speed.

(a) Show that the forces are coplanar.

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

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35. When a body slides down from rest along a smooth inclined plane making an 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 than 1. Calculate the coefficient of friction between the body and the rough plane.

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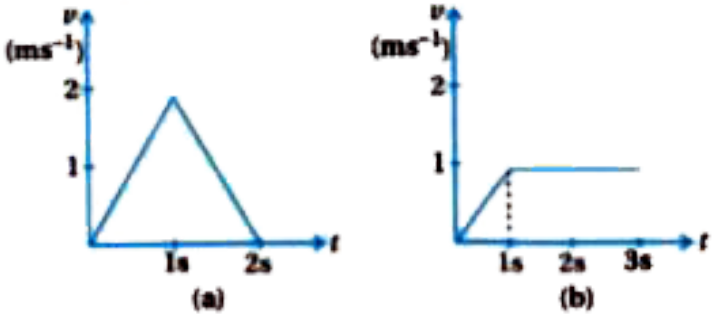
36. (v_x, t), and $(v_y t)$ diagram for a body of unit mass. Find the force as a function of time.



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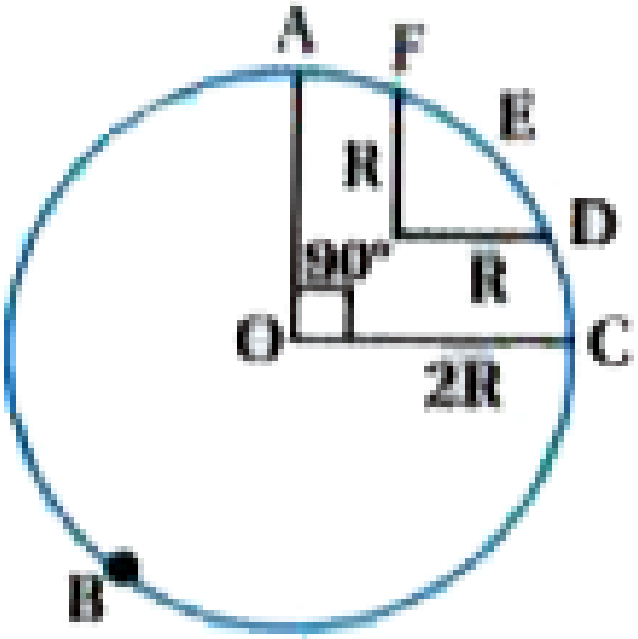
37. A racing car travels on a track (without banking) ABCDEFA. ABC is a circular arc of radius 2 R. CD and FA are straight paths of length R and DEF is a circular arc of radius R =

100 m. The coefficient of friction on the road is $\mu = 0.1$. The maximum speed of the car is $50ms^{-1}$. Find the minimum time for completing one round.



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38. 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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39. 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 Vs 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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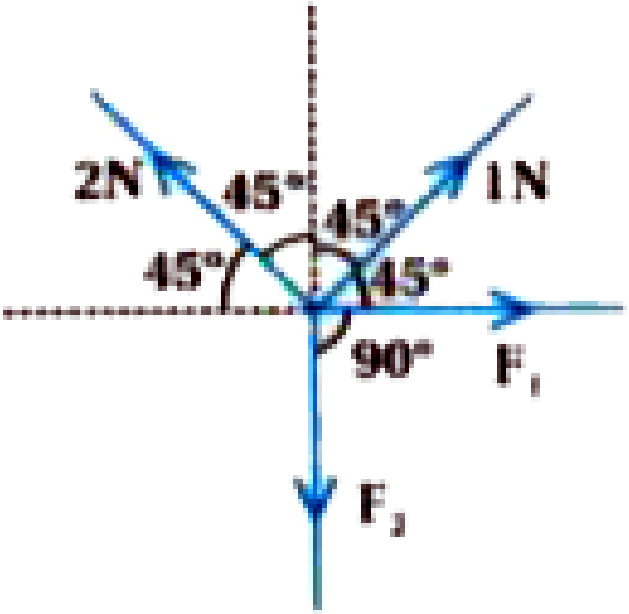
40. There are four forces acting at a point P produced by strings as shown in figure. Which

is at rest ? Find the forces F_1 and F_2 .



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41. 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 0 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 $a > \theta$

(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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42. A helicopter of m ass 1000 kg rises with a vertical a c c ele ra tio n o f 15 ms^{-2} . The crew an d th e passengers weigh 300 kg. Give the magnitude and direction of the,

(a) Force on th e floor by th e crew and passengers.

(b) Action of the rotor of the helicopter on the

surrounding air.

(c) Force on the helicopter due to the surrounding air.

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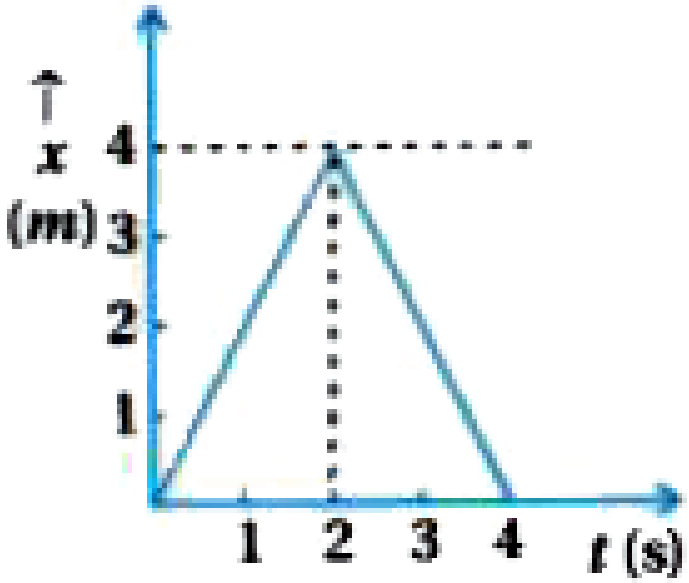
Section E Multiple Choice Questions Mcqs

1. The position (x) $\rightarrow$ time (t) graph of one dimensional motion of a body of mass 0.4 kg.

What is the magnitude of impulse of force



A. 1.6 Ns

B. 0.8 Ns

C. 0.4 Ns

D. 0.2 Ns

Answer: A

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2. What is time period of a simple pendulum in a freely falling lift ?

A. zero

B. infinite

C. 2s

D. none of the given

Answer: B

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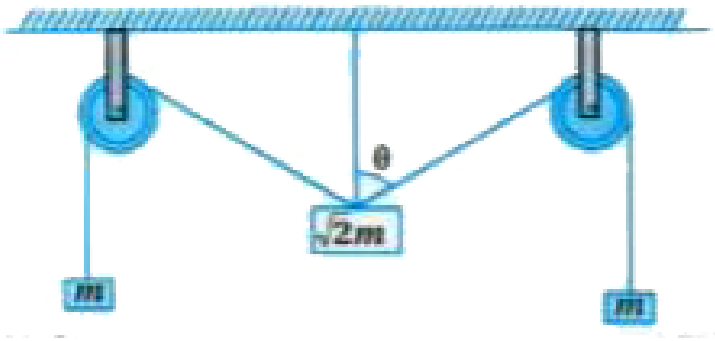
3. Arrangem ent in which the pulley are smooth and strings are of negligible mass. For the system to remain in equilibrium, the angle 0 should be .....



A. 30°

B. 45°

C. 0°

D. 60°

Answer: B

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4. A circular racetrack of radius 300 m is banked at an angle of 20°. If the coefficient of friction between the wheels of the race car

and the road is 0.2, what is the approximate maximum permissible speed of the race car ? `

A. $88.2ms^{-1}$

B. $86.4ms^{-1}$

C. $42.3ms^{-1}$

D. none of the given

Answer: C

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5. When 20 N force is applied on a body of mass m, acceleration 8.0 ms^2 is produced in it. The same force when applied on a body of mass m', acceleration of 24 ms^2 is produced. What will be acceleration produced by the same force applied on these two bodies tied togather.....

A. $2ms^{-2}$

B. $8ms^{-2}$

C. $6ms^{-2}$

D. $4ms^{-2}$

Answer: C

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6. A bomb in the steady state explodes into three fragments. Two fragments of equal masses move with velocity 15 ms^{-1} in mutually perpendicular directions. The mass of the third fragment is equal to three times the mass of each of these two fragments. The

magnitude of velocity of third fragment is ms^{-1}.

A. 20

B. $10\sqrt{2}$

C. $5\sqrt{2}$

D. none of these

Answer: C

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7. 6 bullets are fired in a second from a machine gun with velocity of 400 ms^{-1}. The mass of machine gun and bullet are 10 kg and 30g respectively. What is the value of force is to be exerted on machine gun to keep it stationary ?

A. 72 N

B. 7200 N

C. 2N

D. 12N

Answer: A

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8. A ball of mass of 150g and velocity 12 ms^{-1} coming towards a batsman is hit by him with a force in such a way that the ball moves with velocity 30 ms^{-1} in the direction opposite to its original one. The time of contact between the ball and the bat is 0.01 s. Then the force applied on it by the batsman i s .....

A. 63000 N

B. 480 N

C. 270 N

D. 630 N

Answer: D

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9. A block of mass 15 kg is lying on an inclined plane of angle 30°. In order to make it move upward along the slope with an acceleration

25 cms^2, a horizontal force of 200 N is required to be applied on it. Then the frictional force on the block i s (g = 9.8 ms 2)

A. 95.95 n

B. 134 n

C. 99.70 n

D. 90 n

Answer: C

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10. If P, v and E denotes the momentum, velocity and K.E. of a particle then .....

A. $p = \frac{d^2E}{dt^2}$

B. $p = \frac{dv}{dt}$

C. $p = \frac{dE}{dv}$

D. $P = \frac{dE}{dt}$

Answer: D

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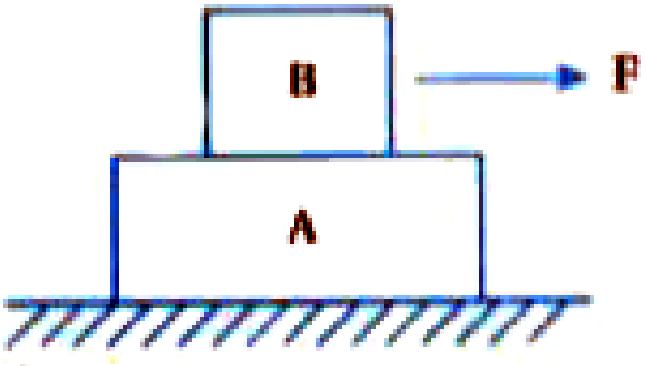
11. A block (A) of mass 20 kg is put on a frictionless surface and another object (B) of mass 2 kg is placed over it. The coefficient of friction between the surface of A and B is 0.25. If a horizontal force of 10 N applied on B, then acceleration of A and B are respectively.....



A. $5m/s^2$ and $0.91m/s^2$

B. $5m/s^2$ and $0.5m/s^2$

C. $2.5m/s^2$ and $0.2m/s^2$

D. $2.5m/s^2$ and $0.25m/s^2$

Answer: C

View Text Solution

12. force F = 100 N is applied horizontally on a block of mass 4 kg. Which is in contact with a wall. Such that it does not fall. The coefficient of friction between the block and the wall is

A. 0.8

B. 0.5

C. 0.4

D. 0.3

Answer: A

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13. The SI unit of time rate of change of momentum is .....

A. ms^{-2}

B. N

C. dyne

D. $kgms^{-1}$

Answer: C

Watch Video Solution

14. A stationary bomb explodes into three fragments. If the linear momentum of two A

pieces are $4\hat{i}$ and $3\widehat{J}$ unit respectively, then what is the value of the third fragment ?

A. 7 unit

B. $\sqrt{13}$ unit

C. 5 unit

D. 6 unit

Answer: B

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15. The linear momentum of a particle at time t is given by the equation P = x + yt^2, where x and y are constants. The instantaneous force acting on the particle during its motion is .....

A. inversely proportioal to t^2

B. inversely proportioal to t

C. directly proportioal to t

D. directly proportioal to t^2

Answer: B

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16. If linear momentum of a body is increased by 0.5% its kinetic energy increases b y ..

A. 0.1

B. 0.01

C. 0.02

D. 0

Answer: B

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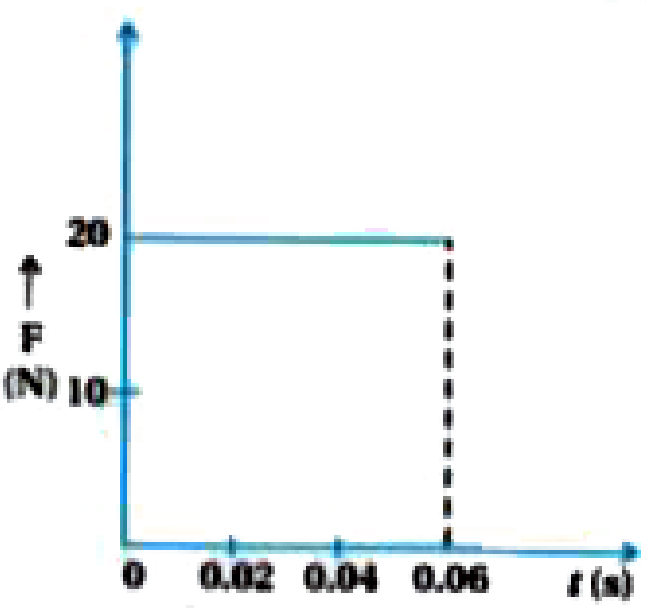
17. F $\rightarrow$ t graph for a body is shown in figure. The change in value of momentum of the body in the interval 0.02 s to 0.06 s is ..



A. 1.2 kg ms^{-1}

B. 0.3 kg ms^{-1}

C. 0.8 kg ms^{-1}

D. 0.4 kg ms^{-1}

Answer: C

Watch Video Solution

18. When a force acts on a body of mass 200 gram the change in its velocity is 15 cm s^{-1} per second. The magnitude of this force is .....Newton.

A. 0.3

B. 0.003

C. 0.03

D. 3

Answer: C

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19. A car of mass 1000 kg is moving with a velocity 20m /s on a horizontal straight road. If the driver applies brakes to produce a

constant breaking force of 5000 Newton, the acceleration of the car i s ..... m $/s^2$.

A. -5

B. 50

C. 5

D. none

Answer: A

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20. The value of co-efficient of static friction (μ_s) is in the range between.

A. 0.01 to 1.5

B. 0.01 to 0.15

C. 0.1 to 1.5

D. 0.01 to 15

Answer: A

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21. A force acts on an object of mass 2 kg at rest, for 0.5 s. After the force stops acting, the object travels a distance of 5 m in 2 s. Hence the magnitude of the force will be ...

A. 5N

B. 10 N

C. 7.5 N

D. 12.5 N

Answer: B

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22. A person of mass 60 kg is standing on a raft of mass 40 kg in a lake. The distance of the person from the bank is 30 m. If the person starts running towards the bank with velocity 15 m/s, then what will his distance be from the bank after two second

A. 26 m

B. 18 m

C. 21m

D. 12m

Answer: B

Watch Video Solution

23. A block of 50 kg on a smooth plane inclined at 60° and another block of 30 kg on a smooth plane inclined at 30° with horizontal are connected by a light string passing over a frictionless pully as shown in the figure. Take g = $10ms^{-2}$, $\sqrt{3} = 1.7$. The acceleration of the blocks and tension in the string are.

A. $3.437ms^{-2}$ and $25.311N$

B. $34.37ms^{-2}$ and $253.11N$

C. $3.437cms^{-2}$ and $25.311dy \neq$

D. $3.437ms^{-2}$ and $253.\ 11N$

Answer: D

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24. If the speed of a vehicle become 3 times for a given deceleration its stopping distance become .....

A. two

B. three

C. nine

D. four

Answer: C

Watch Video Solution

25. If vectors are $\vec{A} = 2\hat{i} + 3\hat{J} - \hat{k}$ and $\hat{B} = 4\hat{i} + 6\hat{J} - 2\hat{k}$, then they are .....

A. equal

B. perpendicualr

C. anti parallel

D. parallel

Answer: D

Watch Video Solution

26. $\vec{A} = 2\hat{i} + 3\hat{J} + 4\hat{k}$ and $\vec{B} = 4\hat{i} + 5\hat{j} + 3\hat{k}$, then the magnitudes of $\vec{A} - \vec{B}$ ...unit

A. 21

B. 8.9

C. 3

D. 12.2

Answer: C

Watch Video Solution

27. Find the vector product of vectors $\vec{A} = 4\hat{i} + 2\hat{J} - \hat{k}, \vec{B} = \hat{i} + 3\hat{J} + 4\hat{k}$

A. $3\hat{i} - htj - 5\hat{k}$

B. $11\hat{i} - 17htj + 10\hat{k}$

C. $4\hat{i} + 6htj - 4\hat{k}$

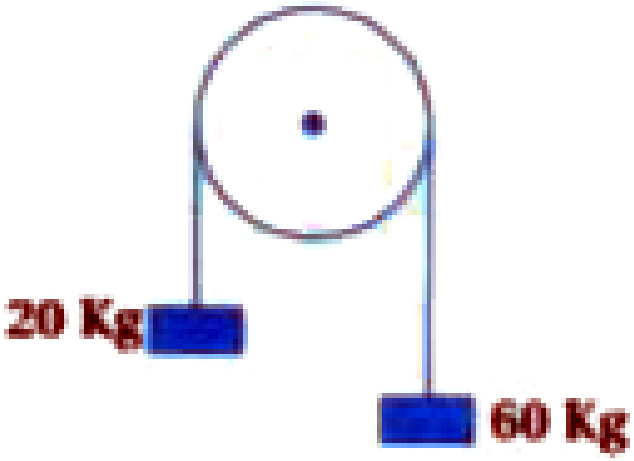
D. $5\hat{i} + 5htj + 3\hat{k}$

Answer: B

Watch Video Solution

28. A body of mass 20 kg at one end and another of 60 kg at the other end of a string passing over a frictionless pully are suspended

as shown in the figure. Acceleration of this system is $\frac{m}{s^2}$.



A. 4.44

B. 2.5

C. 3

D. 5

Answer: D

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29. If vector $\vec{A} = 4\hat{i} - 6\hat{J} + 2\hat{k}$ and $\vec{B} = 6\hat{i} + 8\hat{j} + m\hat{k}$ are mutually perpendicular, m = ...

A. 24

B. 12

C. 20

D. 36

Answer: B

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30. Ramesh with mass of 65 kg stands on a spring balance in a lift. If the lift moves in upward direction with an acceleration of 3 m/s^2, then the weight of Ramesh will becom e.....

A. 195 N

B. 845 N

C. 480 N

D. 720 N

Answer: B

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31. The potential energy of a projectile at its highest point is $\frac{3}{4}$ of the value of its initial kinetic energy. Therefore its angle of projection is .....

A. 45°

B. 30°

C. 75°

D. 60°

Answer: D

Watch Video Solution

32. A block of mass 20 kg is lying on an inclined plane of angle 30°. In order to make it move upward along the slope with an acceleration of 25 cm/s^2, a horizontal force of

400 N is required to be applied on it. (i) Frictional force on the block is .....N. (ii) Co-efficient of kinetic friction i s .....

A. 134,0.56

B. 207,1.52

C. 243.41, 0.66

D. 400,0.42

Answer: C

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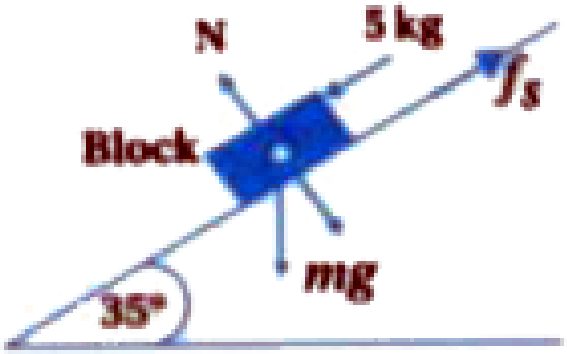
33. M = 5 kg. The co-efficient of static friction between the block and the surface



A. 0.7

B. 0.27

C. 0.35

D. 0.47

Answer: A

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34. A body of mass 10 kg at rest is applied with perpendicular force of 4 N and 3 N at the same time, then at the end of 10 seconds its kinetic energy = ...

A. 25j

B. 250 j

C. 125 j

D. 400 j

Answer: C

Watch Video Solution

35. The angle between $\vec{F} = (1, -3, 1)$ and $\vec{d} = (2, -3, -11)$ will b e ..... rad.

A. 0

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

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

D. π

Answer: C

Watch Video Solution

36. A disc is rotatin g aro u n d its cen tre in a horizontal plane at the rate of 60 rotation/ minute. A coin $\left(1A^{st}\right)$ is placed at a distance of 18 cm and 2^{nd} similar coin 20 cm from its centre. The co-efficient of static friction between the disc and the coins is 0.2. Which

coin will be thrown away from the disc ? Which coin will keep rotating with the disc ?

A. both coins thrown away

B. 2nd coin keep rotating 1st coin thrown away

C. both coins keep rotating

D. 1st coin keep rotating 2nd coin thrown away

Answer: A

Watch Video Solution

37. A bomb in the steady state explodes into three fragments. Two fragm ents of equal masses move w ith velocity 30 m /s in m utually perpendicular direction. The mass of the third fragment is equal to five times the mass of each of these two fragm ents. Find the magnitude and direction of the velocity of this third fragment.

A. $6\sqrt{2}m/s, \theta = 45^\circ$ with -x and -y direction

B. $5\sqrt{2}m/s, \theta = 45^\circ$ with +x and +y direction

C. $6\sqrt{2}m/s, \theta = 45^\circ$ with +x and -y direction

D. $5\sqrt{2}m/s, \theta = 45^\circ$ with -x and -y direction

Answer: A

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38. Block of mass m is placed on frictionless slope with angle 0. Normal force acting on block due to surface will be .....

A. mg

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

C. $mg\cos\theta$

D. $mg\sin\theta$

Answer: C

Watch Video Solution

39. The upper half of an in clin ed plane of inclination 30° is perfectly smooth, while the lower half is rough. A block starts from rest from the top of the plane and if it comes back to rest at the bottom, what is the co-efficient of kinetic friction between the surface of block and the rough surface of the inclined plane ?

A. 2

B. $2\sqrt{3}$

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

D. $\sqrt{3}$

Answer: C

Watch Video Solution

40. When a force acts on a body of mass 0.1 kg, the change in its velocity is 20 cm s^{-1} per second. The magnitude of this force is ..... N

A. 0.02

B. 0.002

C. 20

D. 0.2

Answer: A

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41. A force of 8 N acts on an object of mass 2 kg in X-direction and another force of 6 N acts on it in Y -direction. Hence, the magnitude of acceleration of the object will be ....

A. $7.0ms^{-2}$

B. $5ms^{-2}$

C. $1ms^{-2}$

D. $2.5ms^{-2}$

Answer: B

Watch Video Solution

42. Three blocks with masses m, 2m and 3m are connected by strings as shown in the figure. After an upward force F is applied on

block m, the masses move upward at constant speed v. What is the net force on the block of mass 2m

A. 6mg

B. zero

C. 2mg

D. 3 mg

Answer: B

Watch Video Solution

43. A rod PQ of mass M and length L is hinged at end P. The rod is kept horizontal by a massless string tied to point Q as shown in figure. When string is cut, the initial angular acceleration of the rod is

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

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

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

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

Answer: B

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44. An explosion breaks a rock into three parts in a horizontal plane. Two of them go off at right angles to each other. The first part of mass 1 kg moves with a speed of 12 ms^{-1} and the second part of mass 2 kg moves with 8

ms^{-1} speed. If the third part flies off with 4 ms^{-1} speed, then its mass i s .....

A. 17 kg

B. 3 kg

C. 5 kg

D. 7 kg

Answer: C

Watch Video Solution

45. The u p p er half of an in clin ed p lane of inclination θ is perfectly smooth while lower half is rough. A block starting from rest at the top of the plane will again come to rest at the bottom, if the coefficient of friction between the block and lower half of the plane is given by

A. $\mu = \tan\theta$

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

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

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

Answer: D

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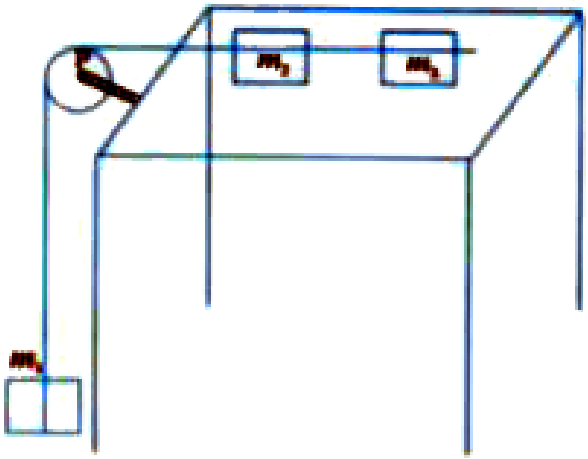
46. A system consists of three masses $m_1 m_2$ and m_3 connected by a string passing over a pulley P. The mass m_1 hangs freely and m_2 and m_3 are on a rough horizontal table (the co efficient of fircition = p). The pulley is frictionless and of negligible mass. The

downward acceleration of mass m_1 is (Assume $m_1 - m_2 = m_3 = m$)



A. $\frac{g(1-g\mu)}{g}$

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

C. $\frac{g(1-2\mu)}{3}$

D. $\frac{g(1-2\mu)}{2}$

Answer: C

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47. The force ‘F’ acting on a particle o f mass ‘m ’ is indicated by the force-time graph shown below.

The change in momentum of the particle over the time interval from zero to 8 s is

A. 24 ns

B. 20 ns

C. 12 ns

D. 6 ns

Answer: C

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48. A ballon with mass 'm' is descending down with an acceleration 'a' (where $a \leq g$). How much mass should be removed from it so that is starts moving up with an acceleration 'a ' ?

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

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

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

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

Answer: A

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49. A body of m ass (4m) is lying x-y p lan e at rest. It su d d en ly explodes in to th re e pieces. Two pieces, each of m ass (m) m ove p

erp en d icu lar to each o th er w ith equal speeds (p). The total kinetic energy g en erated due to explosion is

A. mv^2

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

C. $2mv^2$

D. $4mv^2$

Answer: B

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50. Three blocks A, B and C of m asses 4kg, 2kg and lkg respectively are in con tact on a frictionless surface, as show n. If a force of 14 N is applied o n th e 4kg b lo ck , th e n th e c o n ta c t fo rce betw een A and B is

A. 2n

B. 6n

C. 8n

D. 18n

Answer: B

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51. A block A of m ass rests on a horizontal table. A lig h t strin g connected to it passesover a frictionless pulley at the edge of table an d from its other end another block B of mass m_2 is su sp en d e d . The co efficien t of k in eticfriction between the block and the table is μ_k hen the block A is sliding on the table, the ten sio n in the string i s :

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

B. $\frac{m_1\mu_2 m(1+\mu_k)g}{m_1+m_2}$

C. $\frac{m_1\mu_2 m(1-\mu_k)g}{m_1+m_2}$

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

Answer: B

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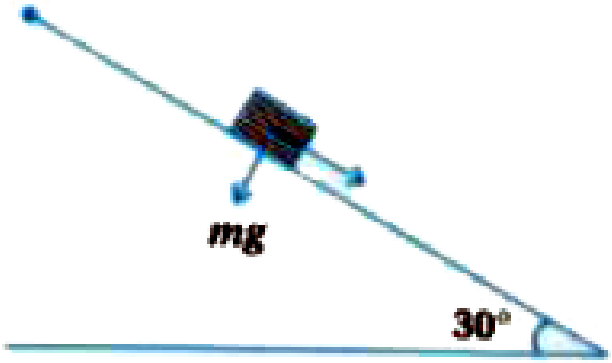
52. A plank w ith a box on it atone end is gradually raised about the other end . As the ang le of in clin ation with the horizontal reaches 30°, the box starts to slip and slides

4.0 m down the plan k in 4.0s. The coefficients of static and k inetic 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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53. A particle moves so th at its p o sitio n vector is ω Where is a constant which of the following is true

A. velcocity and acceleration both are perpendicular to $\overrightarrow{r}$

B. velocity and acceleration both are parallel to $\overrightarrow{r}$

C. velocity is perpendicualr to $\vec{r}$ and acceleratio is directed towards the origin

D. velcocity is perpendicular to $\vec{r}$ and acceleration is directed away from the origin

Answer: B

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54. 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. $\sqrt{3gR}$

C. $\sqrt{5gR}$

D. $\sqrt{gR}$

Answer: C

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55. A rigid ball of mass m strikes a rigid wall at 60° and gets reflected without speed shown in the figure below .The value of impulse imparted by the wall on the ball will be ....

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

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

C. mv

D. 2 mv

Answer: C

View Text Solution

56. A bullet of m ass 10 g m oving horizontal w ith a velocity of 400 ms^{-1} strikes a w ood block of m a ss 2 kg w h ic h is s u s p e n d e d by lig h t inex ten sib le strin g of length 5 m. As resu lt the c e n tre of gravity of th e block fo und to rise a v ertical distan ce of 10 cm . The sp eed of the bullet after it em erges on horizontally from the block will b e .....

A. 120 ms^{-1}

B. 160 ms^{-1}

C. 100 ms^{-1}

D. 80 ms^{-1}

Answer: A

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57. A stationary object is divided into two fragment of mass 2M and 3M. Total energy of both fragment is E. Find energy of fragment with mass 2M.

A. $\frac{2E}{5}$

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

C. $\frac{E}{5}$

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

Answer: D

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58. A cyclist on a level road takes a sharp circular tu rn of rad iu s 3 m (g = 10 ms^{-2}). If th e coefficient of static friction between the

cycle tyres and the road is 0.2, at which of the following speeds will the cyclist not skid while taking the turn ?

A. 14.4 km h^{-1}

B. 7.2 km h^{-1}

C. 9 km h^{-1}

D. 10.8 km h^{-1}

Answer: C

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59. When forces F_1, F_2 and F_3 are acting on a particle of mass m such that F_2 and F_3 are m utually perpendicular, then the particle remains stationary. If the force F x is now removed, then the acceleration of the particle is .....

A. $\frac{f_1}{m}$

B. $\frac{f_2 f_3}{m f_1}$

C. $\frac{f_2 - f_3}{m}$

D. $\frac{f_2}{m}$

Answer: A

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60. When forces F_1, F_2 and F_3 are acting on a particle of mass m such that F_2 and F_3 are m utually perpendicular, then the particle remains stationary. If the force F x is now removed, then the acceleration of the particle is .....

A. $\frac{R_3}{m}$

B. $\frac{R_1 + R_2}{m}$

C. $\frac{R_1 - R_2}{m}$

D. $\frac{R_1}{m}$

Answer: A

Watch Video Solution

61. Two masses m_1 = 4.8 kg and m_2 = 5 kg tied to a string are hanging over a light frictionless pully. What is the acceleration of masses when they are free to move ?

A. 0.2 m/s^2

B. 9.8 m/s^2

C. 5 m/s^2

D. 4.8 m/s^2

Answer: A

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62. A block 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 0.8. If the frictional force on the block is 10 N, the mass of the block ((in kg) is ..... (Take g = 10 m / s^2)

A. 2.0 kg

B. 4.0 kg

C. 1.6 kg

D. 2.5 kg

Answer: A

Watch Video Solution

63. A person fire bullet of 40 g w ith speed of 1200 m /s from his rifle. If rifle can w ithstant maximum recoil force of 144 N. How many bullet he can fire every second ?

A. 1

B. 2

C. 3

D. 4

Answer: C

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64. A player caught a cricket ball of m ass 150 g moving at a rate of 20 m/s^{-1} . If the catching process is com pleted in 0.1 s, the force of the blow exerted by the ball on the hand of the player is equal to .....

A. 0.3 N

B. 3 N

C. 30 N

D. 300 N

Answer: C

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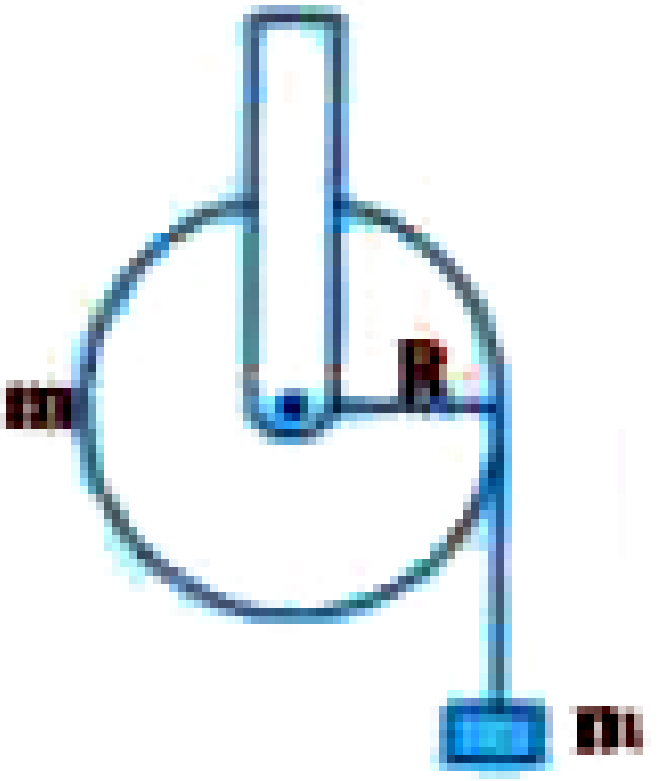
65. A mass ‘m’ is supported by a massless string wound around a uniform hollow cylinder of mass m and radius R. If the string does not slip on the cylinder, with what

acceleration will the mass fall on release ?



A. $\frac{5g}{6}$

B. g

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

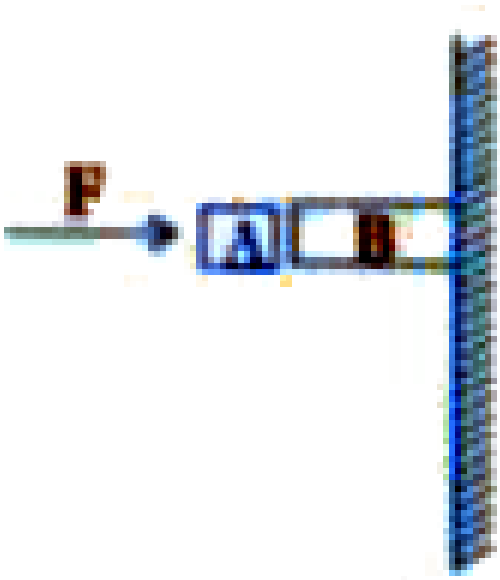
D. $\frac{g}{2}$

Answer: D

Watch Video Solution

66. Given in the figure are two blocks A and B of weight 20 N and 100 N 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. 100 N

B. 80 N

C. 120 N

D. 150 N

Answer: C

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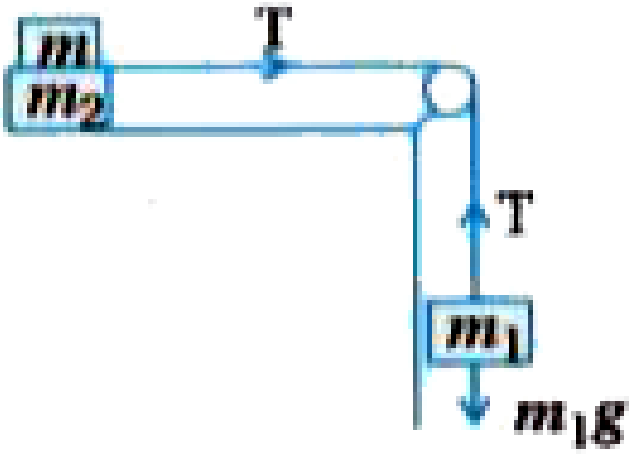
67. Two masses m_1 = 5 kg and m_2 = 10 kg, connected by an inextensible string over a frictionless pulley are moving as shown in the figure. The coefficient of friction of horiztonal surface is 0.15. The minimum height m that should be put on top of m_2 to stop the

motion is



A. 18.3 kg

B. 27.3 kg

C. 43.3 kg

D. 10.3 kg

Answer: C

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68. Which one of the following statem ents is incorrect?

A. rolling fricition is smaller than sliding friction

B. limiting value of static friction is directly proportional to normal reactions

C. frictional force oppose the relative motion

D. coefficient of sliding friction has dimensions of length

Answer: A

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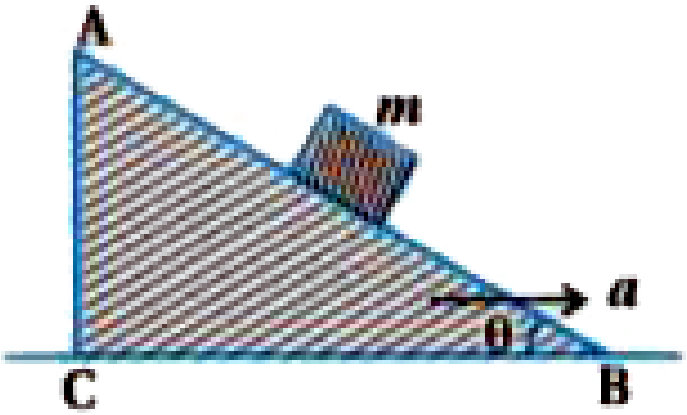
69. A block of mass m is place on a sm ooth inclined wedge ABC of inclination 0 as shown in figure. The wedge is given an acceleration ‘a’

towards the right. The relation between a and θ for the block to rem ain stationary on the wedge is



A. $a = g\tan\theta$

B. $a = \frac{g}{\cos ec\theta}$

C. $a = g\cos\theta$

D. $a = \frac{g}{\sin\theta}$

Answer: A

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Section F Questions From Module

1. A block 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 0.8. If the frictional force

on the block is 10 N, the mass of the block ((in kg) is ..... (Take g = 10 m / s^2)

A. 2.0 kg

B. 4.0 kg

C. 1.6 kg

D. 2.5 kg

Answer: A

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2. A player caught a cricket ball of mass 150 g moving at a rate of 20 m/s . If the catching process is completed in 0.1 s, the force of the blow exerted by the ball on the hand of the player is equal to .....

A. 0.3 N

B. 3 N

C. 30 N

D. 300 N

Answer: C

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3. A water jet sprinkle water around it. If speed of water is v, then maximum area covered by water jet will b e .....

A. $\frac{\pi v^2}{g^4}$

B. $\frac{\pi v^2}{2g^2}$

C. $\frac{\pi v^4}{g^2}$

D. $\frac{\pi v^2}{g}$

Answer: C

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4. A cyclist moving on level circular path of radius 4 m with speed of 4.9 m/s takes sharp turn. Co-efficient of friction between tyre and road will b e .....

A. 0.51

B. 0.41

C. 0.71

D. 0.61

Answer: D

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5. Two spring balances each of mass 2 kg are connected to ceiling of a lift. To the lowest spring a mass of 10 kg is attached. What will be reading of upper spring if lift is moving with g downward acceleration $\frac{g}{6}$?

A. 12 kg

B. 6 kg

C. 14 kg

D. 10 kg

Answer: D

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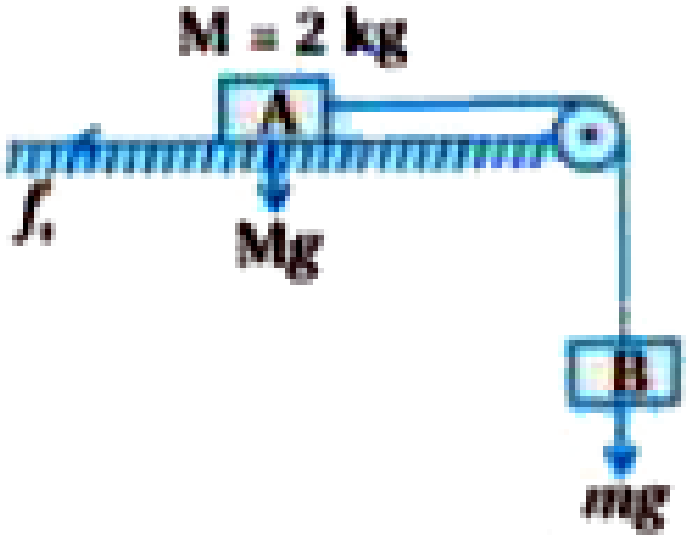
6. The coefficient of static friction μs, between block A of mass 2 kg and the table as shown in the figure is 0.2. What would be the maximum mass value of block B, so that two blocks do not move ? The string and the pully are

assumed to be smooth and massless.



A. 4.0 kg

B. 0.2 kg

C. 0.4 kg

D. 2.0 kg

Answer: C

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7. A block B is pushed momentarily along a horizontal surface with an initial velocity V. If mu is the coefficient of sliding friction between B and the surface, block B will come to rest after a time ?

A. $\frac{g\mu}{v}$

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

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

D. $\frac{v}{g\mu}$

Answer: D

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8. A ball of mass of 150g and velocity 12 m/s coming towards a batsman is hit by him with a force in such a way that the ball moves with velocity 20 m/s in the direction opposite to its original one. The time of contact between the

ball and the bat is 0.01 s. Then the force applied on it by the batsman i s .....

A. 120 n

B. 480 n

C. 240 n

D. 680 n

Answer: B

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9. A stationary bomb of mass 10 kg suddenly explode in two fragment of 4 kg and 6 kg. Ratio of their velocity will b e .....

A. $3:2$

B. $2:5$

C. $3:5$

D. $12:5$

Answer: A

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10. A car of mass 1000 kg moves on horizontal road with velocity of 30 m/s. When driver applies brake, constant retarding force of 40 kN is applied, retardation of car will b e .....

A. $2\ m/s^2$

B. $-2m/s^2$

C. $4\ m/s^2$

D. $-4m/s^2$

Answer: D

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11. As, block of mass 5 kg is attached to spring balance reading of spring balance will be

A. 50 n

B. 25 n

C. 500 n

D. 10 n

Answer: B

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12. Periodic time of a simple pendulum suspended in stationary lift is T. Now when lift moves in upward direction with acceleration $\frac{g}{3}$. New periodic time will be

A. $\sqrt{3T}$

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

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

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

Answer: B

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13. A block of mass m is placed on a smooth slope of angle θ. The whole system (slope + block) is moved horizontally with acceleration

a in such a way that the block does not slip on the slope. Hence, a =.....

A. $g \tan \theta$

B. $g \sin \theta$

C. $g \cos \theta$

D. $\frac{g}{\sin \theta}$

Answer: A

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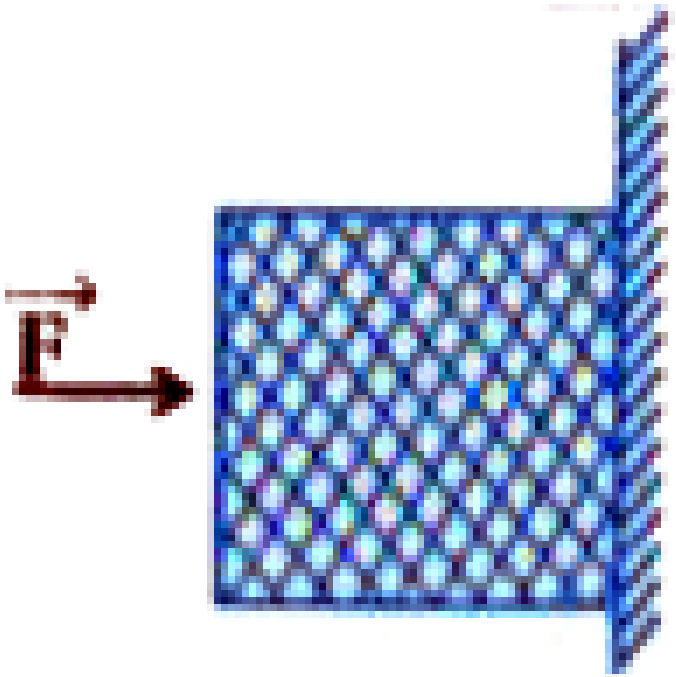
14. What is the value of the force $\vec{F}$ to be applied horizontally on a block of mass 5 kg which is in contact with a wall, as shown in the figure. (Take g = 10 m/s^2) such that it does not fall down. The coefficient of friction between the block and the wall is 0.4.



A. 200 n

B. 20 n

C. 12.5 n

D. 125 n

Answer: D

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15. A block of mass 100 g is lying on an inclined plane of angle 30^{o}. The frictional force on this block .....N.

A. 4.9×10^{2}

B. 4.9×10^{-1}

C. 4.9×10^{-1}

D. 4.9×10^{1}

Answer: B

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16. The u p p er half of an in clin ed p lane of inclination θ is perfectly smooth while lower half is rough. A block starting from rest at the

top of the plane will again come to rest at the bottom, if the coefficient of friction between the block and lower half of the plane is given by

A. $2\tan\phi$

B. $\tan\phi$

C. $2\sin\phi$

D. $2\cos\phi$

Answer: A

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17. Linear momentum of a particle given by relation $p = a + bt^2$, where a, b are constant and t is time, then force acting on particle is .....

A. propotional to t

B. propotional to t^2

C. zero

D. constant

Answer: A

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18. A boy while catching a ball experiences impulse of 6 Ns. If mass of ball is 200 gram, then what will be speed of ball during catch

A. 10 m/s

B. 20 m/s

C. 30 m/s

D. 40 m/s

Answer: C

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19. Mass of a rocket is 100 kg. When 0.1 kg fuel is burnt every second, velocity of exhaust gas coming out of it is 1Km/s.Acceleration of rocket will be .....

A. $1000m/s^2$

B. $100m/s^2$

C. $10m/s^2$

D. $1m/s^2$

Answer:

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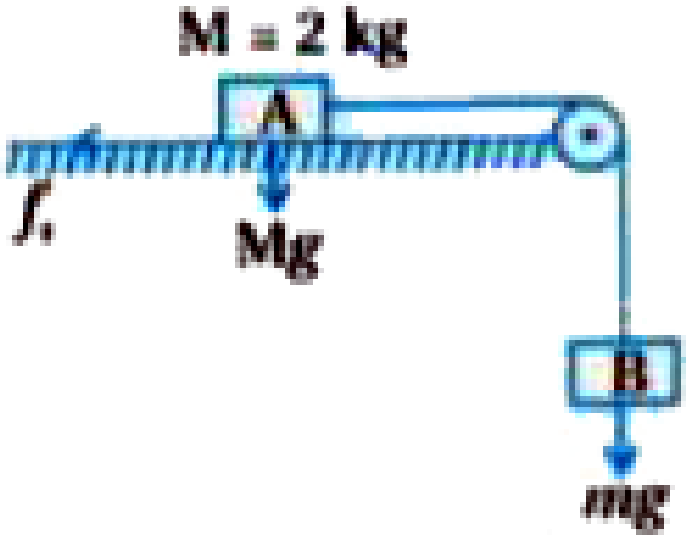
20. The coefficient of static friction μs, between block A of mass 2 kg and the table as shown in the figure is 0.2. What would be the maximum mass value of block B, so that two blocks do not move ? The string and the pully

are assumed to be smooth and massless.



A. 4.0 kg

B. 0.2 kg

C. 0.4 kg

D. 2.0 kg

Answer: D

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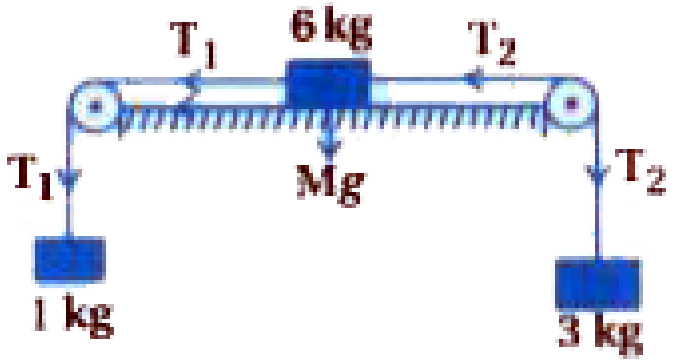
21. Three masses 1kg,6kg and 3kg are of connected to each other with thread and are placed on a table as shown in figure. If g - 10 m / s^2, the acceleration with which the system

is moving is ..... m/s^2.



A. 0

B. 1

C. 2

D. 3

Answer: C

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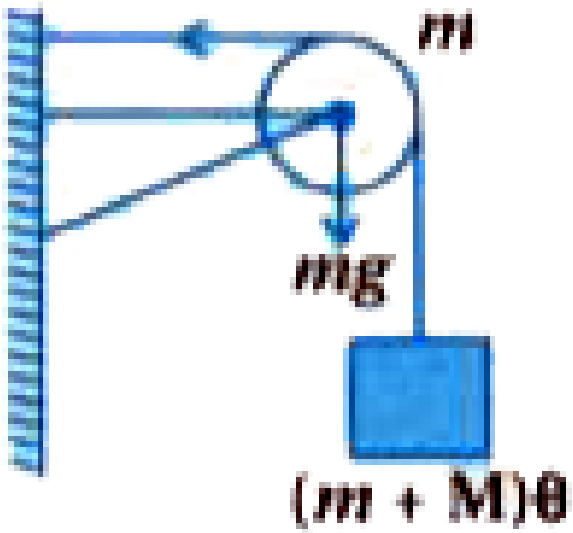
22. A string of negligible mass passing over a clamped pulley of mass m supports a block of mass M as shown in figure. The force on the pulley by the clamp is given b y .....



A. $\sqrt{2}$ mg

B. $\sqrt{2}$ mg

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

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

Answer: C

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Question Paper Section A

1. What is dynamics?

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2. Define inertia.

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3. Give dimensional formula of impulse of force.

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4. What is similar from the dynamics point of view between a book lying stationary on the horizontal table and a raindrop falling downward with constant speed

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5. During uniform circular motion of object out of (i) magnitude of velocity (ii) magnitude

of force (iii) acceleration (iv) momentum vector is not constant.

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Question Paper Section B

1. What are concurrent forces ?

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2. Write equation of maximum safe speed on level circular track

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Question Paper Section C

1. 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 4.0 s just in time to save the child.

What is the average retarding force on the vehicle ? The mass of the three-wheeler is 400 kg and the mass of the driver is 65 kg.

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2. A truck starts from rest and accelerates uniformly at $2.0ms^{-2}$. At t = 10 s, a stone is dropped by a person standing on the top of the truck (6 m high from the ground). What are the (a) velocity, and (b) acceleration of the stone at t = 11s ? (Neglect air resistance.)

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Question Paper Section D

1. A 70 kg man stands in contact against the inner wall of a hollow cylindrical drum of radius 3 m rotating about its vertical axis with 200 rev/min. 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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