PHYSICS

BOOKS - MTG IIT JEE FOUNDATION

FORCE AND LAWS OF MOTION

Illustration

1. Can you forces acting in perpendicular directions remain balanced

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2. A block of weight 5 units is placed on a horizontal table. A person pushes the block from top by exerting a downward force of 3 units on it. Find the force exerted by the table on the block.

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3. A ball of mass 10g is initially moving with a velocity of $50ms^{-1}$ On applying a constant

force a ball for 2.0s, it acquires a velocity of $70ms^{-1}$ calculate

the initial momentum of ball

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4. A ball of mass 10g is initially moving with a velocity of $50ms^{-1}$ On applying a constant force a ball for 2.0s, it acquires a velocity of $70ms^{-1}$ calculate

the final momentum of ball

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5. A hammer of mass $500g$, moving at $50m/s$, strikes a nail. The nail stops the hammer in a very short time of $0.01s$. What is the force of the nail on the hammer?

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6. A ball of mass 10g is initially moving with a velocity of $50ms^{-1}$ On applying a constant force a ball for 2.0s, it acquires a velocity of $70ms^{-1}$ Calculate the acceleration of ball

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

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8. A 1.2 kilogram basketball travelling at 7.5 metres per second hits the back of a 12 kilogram wagon and bounces off a 3.8 meters per second, sending the wagon off in the original direction of travel of the ball. How fast in the wagon going.

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9. A bullet of mass 100g is fixed from a gun of mass 20kg with a velocity of $100ms^{-1}$

Calculate the velocity of recoil of the gun.

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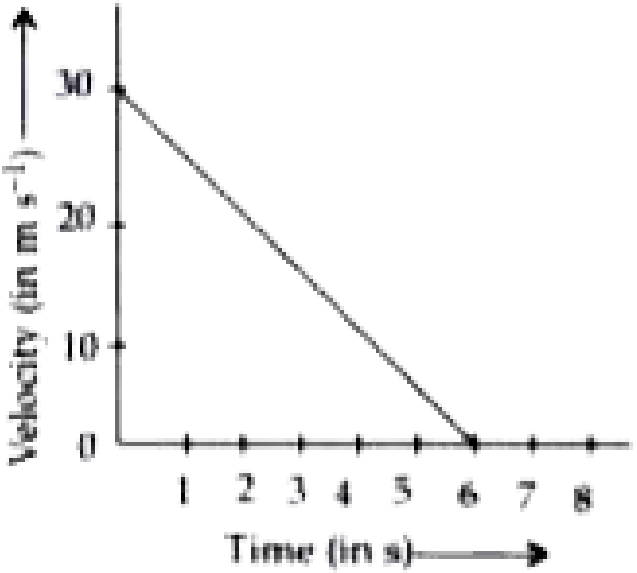
Solved Examples

1. The velocity time graph of a ball moving on the surface of a floor is shown in figure. Find the force acting on the ball if the mass of the

ball is 50g.



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2. A car of mass 1000kg and a bus of mass 8000kg are moving with same velocity of

$36kmh^{-1}$ Find the forces to stop both the car and the bus in 5s.

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3. How does rocket accelerate In space?

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4. A man weighing 60 kg runs along the rails with a velocity of $18kmh^{-1}$ and jumps into a car of mass 1 quintal standing on the rails.

Calculate the velocity which the car will start travelling along the rails.

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5. A hocket ball at rest is hit by a stick such that the force acts on the ball for 0.15 s. IF the ball is of mass 100g and covers a distance of 100m in 2 seconds, find the magnitude of the force applied by the hocket stick. Assume no friction is acting on the ball while rolling on the ground.

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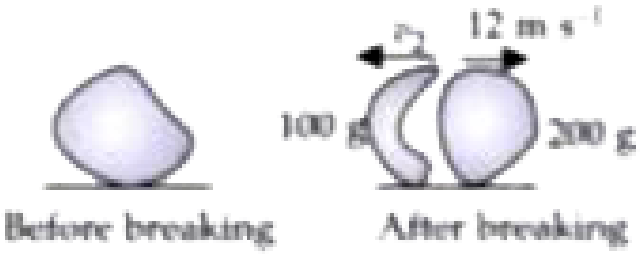
6. A body of mass 300g kept at rest breaks into two parts due to internal forces.

One part of mass 200g is found to move at a speed of $12ms^{-1}$ towards the east. What will be the velocity of the other part?



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7. A bullet of mass 20g moving with a speed of $120ms^{-1}$ hits a thick muddy will and penetrates into it. It takes 0.03 to stop in the wall. Find (a) the accleration of the bullet in the wall. (b)the force exerted by the wall on the bullet , (c) the force exerted by the bullet on the wall and (d) the distance covered by the bullet in the wall

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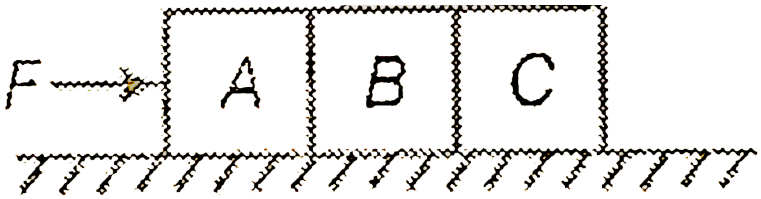
8. Three identical blocks each of mass M are along a frictionless table and a force F is acting as shown. Which of the following statements is false ?



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9. Three identical blocks, each having a mass m are pushed by a force F on the Frictionless

table as shown in figure.

What is the net force on the block A?

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10. Three identical blocks, each having a mass m are pushed by a force F on the Frictionless table as shown in figure.

What force does A apply on B?

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11. Three identical blocks, each having a mass m are pushed by a force F on the Frictionless table as shown in figure.

What force does B apply on C?

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12. The coefficient of friction between the ground and the wheels of a car between the

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

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13. A block of mass 10 kg is moving horizontally with a speed of 1.5 ms^{-1} on a smooth plane. If a constant vertical force 10N acts on it, the displacement of the block from the point of

application of the force at the end of 4 second

is

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Ncert Section

1. Which of the following has more inertia ?

(a) a rubber ball and a stone of the same size.

(b)a bicycle and a train.

(c) a five rupee coin and a one-rupee coin.

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4. In the following example,try to identify the number of times the velocity of the ball changes:

"A football player kicks a football to another player of his team who kicks the football towards the goal. The goalkeeper of the opposite team collects the football and kicks it towards a player of his own team"?

Also identify the agent supplying the force in each case.

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5. Explain why some of the leaves may get detached from a tree if we vigorously shake its branch.

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6. Why do you fall in the forward direction when a moving bus brakes to a stop and fall backwards when it accelerates from rest?

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7. If action is always equal to the reaction, explain how a horse can pull a cart.

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8. Explain, why is it difficult for a fireman to hold a hose, which ejects large amount of water at a high velocity?

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9. From a rifle of mass 4kg a bullet of mass 50g is fired with an initial velocity of $35ms^{-1}$ calculate the initial recoil velocity of the rifle.

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10. Two objects of masses $100g$ and $200g$ are moving along the same line in the same direction with velocities of $2m/s$ and $1m/s$, respectively. They collide and after the collison, the first object moves at a velocity of $1.67m/s$

in the same direction. Determine the velocity of the second object.

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11. An object experiences a net zero external unbalanced force. Is it possible for the object to be travelling with a non-zero velocity? If yes, state the conditions that must be placed on the magnitude and direction of the velocity. If no, provide a reason.

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12. Two forces 3N and 4N are acting perpendicular to each other. The magnitude of the resultant force is

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

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14. A batsman hits a cricket ball which then rolls on a level ground . After covering a short distance, the ball comes to rest, The ball slows to a stop because

A. the batsman did not hit the ball hard enough

B. velocity is proportional to the force exerted on the ball

C. there is a force on the ball opposing the motion

D. there is no unbalanced force on the ball, so the ball would wan to come to rest.

Answer:

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15. When two equal forces act on an object in opposite directions it is called?

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16. A stone of 1 kg is thrown with a velocity of $20ms^{-1}$ across the frozen surface of a lake and comes to rest after travelling a distance of 50 m. What is the force of friction between the stone and the ice?

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17. A $8000kg$ engine pulls a train of $5wagons$, each of $2000kg$, along a horizontal track. If the engine exerts a force of $40000N$ and the track

offers a frictional force of $5000N$, then calculate:

(a) the net accelerating force, (b) the acceleration of the train, and

(c) the force of wagon 1 on wagon 2.

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18. A $8000kg$ engine pulls a train of $5wagons$, each of $2000kg$, along a horizontal track. If the engine exerts a force of $40000N$ and the track offers a frictional force of $5000N$, then

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(a) the net accelerating force, (b) the acceleration of the train, and

(c) the force of wagon 1 on wagon 2.

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20. An automobile vehicle has a mass of 1500 kg. What must be the force between the vehicle and road if the vehicle is to be stopped with a negative acceleration of 1.7 ms^2?

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21. What is the momentum of an object of mass m , moving with a velocity$v$?

A. $(mv)^2$

B. mv^2

C. $\frac{1}{2}mv^2$

D. mv

Answer:

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22. Using a horizontal force $200N$, we intend to move a wooden cabinet across a floor at constant velocity. What is the frictional force that will be exerted on the cabinet?

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23. Two object, each of mass $1.5kg$, are moving in the same straight line but in opposite directions, The velocity of each object is $2.5ms^{-1}$ before the collision during which

they stick together. What will be the velocity of the combined object after collision?

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24. According to the third law of motion, when we push on an object, the object pushes back on us with an equal and opposite force. If the object is a massive truck parked along the roadside, it will probably not move. A student justifies this by answering that the two opposite and equal forces cancel each other.

Comment on this logic and explain why the truck does not move.

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25. A hockey ball of mass $200g$ travelling at $10m/s$ is struck by a hockey stick so as to return it along its original path with a velocity of $5m/s$. Calculate the change in momentum of the hockey ball by the force applied by the hockey stick.

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26. A bullet of mass $10g$ travelling horizontally with a velocity of $150ms^{-1}$ strikes a stationary wooden block and come to rest in $0.03s$. Calculate the distance of penetration of the bullet into the block. Also, Calculate the magnitude of the force exerted by the wooden block on the bullet,

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27. An object of mass $1kg$ travelling in a straight line with a velocity of $10m/s$ collides with, and sticks to, a stationary wooden block of mass $5kg$. Then, they both move off together in the same straight line. Calculate the total momentum just before the impact and just after the impact. Also, calculate the velocity of the combined object.

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28. An object of mass $100kg$ is accelerated uniformly from a velocity of $5m/s$ to $8m/s$ in $6s$. Calculate the initial and final momentum of the object. Also, find the magnitude of the force exerted on the object.

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29. Akhtar, Kiran and Rahul were riding in a motorcar that was a high velocity on an expressway when an insect hit the windshield

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

a change in their momentum. Comment on these suggestions.

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30. How much momentum will a dumb-bell of mass $10kg$ transfer to the floor if it falls a height of $80cm$? Take its downward acceleration to be $10m / s^2$.

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31. The following is the distance-time table of an object in motion:

Time in seconds	Distance in metres
0	0
1	1
2	8
3	27
4	64
5	125
6	216
7	343

(a) What conclusion can you draw about the acceleration? Is it constant, increasing, decreasing, or zero?

(b) What do you infer about the forces acting on the object?

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32. Two persons manage to push a motorcar of mass $1200kg$ at a uniform velocity along a level road. The same motorcar can be pushed by three persons to produce an acceleration of $0.2m/s^2$. With what force does each person push the motorcar? (Assume that all persons push the motorcar with the same muscular effort).

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33. A motorcar of mass $1200kg$ is moving along a straight line with a uniform velocity of $90km/h$. Its velocity is slowed down to $18km/h$ in $4s$ by an unbalanced external force. Calculate the acceleration and change in momentum. Also, calculate the magnitude of the force required.

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34. A large truck and a car both moving with a velocity of magnitude v have a head on collision and both of them come to a halt after that. If the collision lasts for 1s :

Which vehicle experiences the greater force of impact

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35. A large truck and a car both moving with a velocity of magnitude v have a head on

collision and both of them come to a halt after that. If the collision lasts for 1s :

Which vehicle experiences the greater change in momentum

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36. A large truck and a car, both moving with a velocity of magnitude v, have a head- on collision and both of them come to a halt after that. If the collision lasts for 1s:

(a) Which vehicle experiences the greater force

of impact?

(b) Which vehicle experiences the greater change in momentum?

(c) Which vehicle experiences the greater acceleration?

(d)Why is the car likely to suffer more damage than the truck?

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37. A large truck and a car, both moving with a velocity of magnitude v, have a head- on

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(a) Which vehicle experiences the greater force of impact?

(b) Which vehicle experiences the greater change in momentum?

(c) Which vehicle experiences the greater acceleration?

(d)Why is the car likely to suffer more damage than the truck?

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Exercise Multiple Choice Questions

1. A field gun of mass 1.5 tonne fires a shell of mass 15kg with a velocity of $150ms^{-1}$. Calculate the velocity of the recoil of the gun

A. $1ms^{-1}$

B. $1.5ms^{-1}$

C. $3ms^{-1}$

D. $5ms^{-1}$

Answer: B

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Exercise Multiple Choice Questions

1. A rocket driven sledge speeds up from 40 metres per second to 55 metres per second in 5.0 seconds, using an engine that produces 3500 newtons of thrust. How much thrust would be needed to get the same increase in speed in 2.0 seconds

A. 8550

B. 8750

C. 8700

D. 8500

Answer: B

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2. Choose the wrong statement

A. Unit of force is newton

B. Force changes shape of body

C. Force is always conserved

D. Force is vector quantity.

Answer: C

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3. Balanced forces may..... A body.

A. move

B. accelerated

C. retard

D. deform

Answer: D

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4. A number of forces acting on a body changes velocity of the body. The forces are

A. parallel

B. unbalanced

C. balanced

D. inclined

Answer: B

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5. External forces

A. always balanced

B. never balanced

C. may or may not be balanced

D. none of these

Answer: C

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6. A man is standing on a boat in still water. If he walks towards the shore the boat will

A. move away from the shore

B. remain stationary

C. move towards the shore

D. sink

Answer: A

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7. A bullet is fired horizontally and gets embedded in a block kept on a table. If table is frictionless, then

A. kinetic energy is conserved

B. momentum is conserved

C. both a and b

D. none of these

Answer: C

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8. How much force acts on a body whose momentum is constant

A. zero

B. $p/2t$

C. $2p/t$

D. none of these

Answer: A

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9. The principle of conservation of linear momentum states that the linear momentum of a system

A. cannot be changed

B. cannot remain constant

C. can be changed if only internal forces act

D. can be changed only if external forces act

Answer: D

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10. A person is standing in an elevator. In which situation he finds his weight less than actual when:

A. the elevator moves upward with constant acceleration

B. the elevator moves downward with constant acceleration

C. the elevator moves upward with uniform velocity

D. the elevator moves downward with uniform velocity

Answer: B

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11. A body, whose momentum is constant, must have constant

A. force

B. velocity

C. acceleration

D. all of these

Answer: B

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12. A body of mass m kg starts from rest and travels a distance of s m in t seconds. The force acting on it is

A. $\frac{2ms}{t^2}N$

B. $\frac{ms}{t}N$

C. $\frac{ms^2}{2t}N$

D. $\frac{ms^2}{t}N$

Answer: A

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13. A mass of 100g strikes the wall with speed $5ms^{-1}$ at an angle as shown in figure and it rebounds With the same speed . If the contact time is 2×10^{-3} sec , what is the force applied by the wall?

A. $250\sqrt{3}$ to right

B. 250N to right

C. $250\sqrt{3}N$ to left

D. 250 N to left

Answer: C

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14. A rocket of mass 1000 kg exhausts gases at a rate of 4 kg /sec with a velocity 3000 m/s . The thrust developed on the rocket is

A. 12000N

B. 120N

C. 800N

D. 200N

Answer: A

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15. A gun of mass 10kg fires 4 bullets per second. The mass of each bullet is 20 g and the velocity of the bullet when it leaves the gun is $300ms^{-1}$. The force required to hold the gun while firing is

A. 24N

B. 28N

C. 32N

D. 10N

Answer: A

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16. the 35 kilogram girl is standing on a 20 kilogram wagon and jumps off. Giving the wagon a kicks that sends it off at 3.8 metres per second. How fast is the girl moving just after the jump off

A. $1.2ms^{-1}$

B. $3ms^{-1}$

C. $4ms^{-1}$

D. $2.2ms^{-1}$

Answer: D

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17. 9.8N is equal to

A. 1kg f

B. 1 kg wt

C. both a and b

D. neither a nor b

Answer: C

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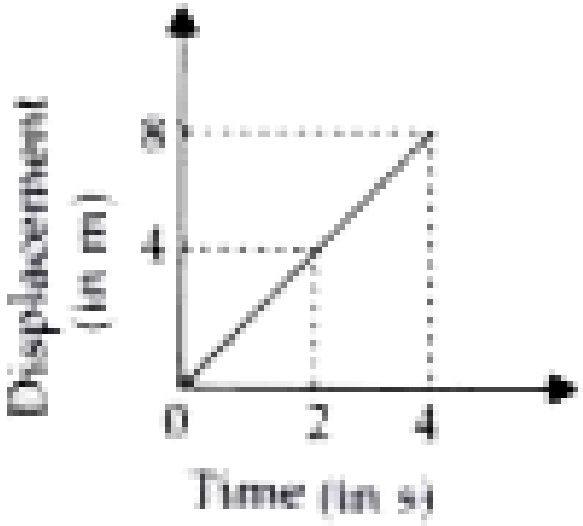
18. Displacement time graph of an object of mass 2kg is shown in figure. The force required

to move the object for first four seconds is



A. 0

B. 4N

C. 2N

D. 8N

Answer: A

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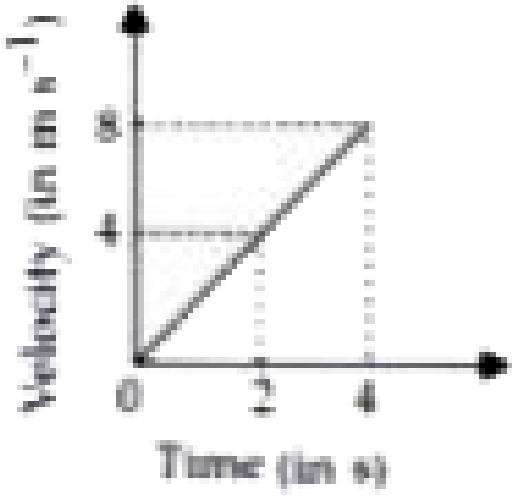
19. Velocity time graph of an object of mass 2kg is shown in figure. The force required to move the object for first four seconds is



A. 0N

B. 4N

C. 2N

D. 8N

Answer: B

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20. A car and a motorcycle are moving with the same momentum. When equal retarding forces are applied, the car comes to halt in t_1

seconds and the motorcycle in t_2 seconds. If the mass of the car is five times more than the mass of the motorcycle then

A. $t_1 = t_2$

B. $t_1 = 5t_2$

C. $t_1 = \frac{1}{5}t_2$

D. $t_1 = 25t_2$

Answer: A

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21. If a constant force acts on a body initially at rest, the distance moved by the body in time t is proportional to

A. t

B. t^2

C. t^3

D. t^4

Answer: B

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22. The unit of force in SI system is newton (N) and in CGS system is dyne. One newton is equal to 1 kg m s^{-2} and 1 dyne is equal to 1 g cm s^{-2}. How many dynes make one newton?

A. 10^5 dyne

B. $10kgms^{-2}$

C. 10^3 dyne

D. $100kgms^{-2}$

Answer: A

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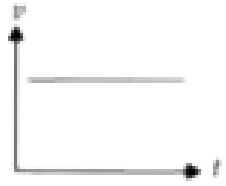
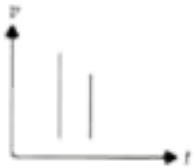
23. Which is velocity time graph of a moving particle on which net external force is zero

A. 

B. 

C. 

D. 

Answer: A

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24. A force of 100N acts on a ball moving on a surface. The force of friction that must act between the surface of the ball and the surface so that the ball keeps on moving with constant velocity over the surface must be

A. 0

B. 100N

C. 200N

D. 300N

Answer: B

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25. A particle of mass 0.3kg is subjected to a force F=kx with $k = 15N/m$ and x being its distance from the origin. What will be its

initial acceleration if it is released from a point 20cm away from the origin.

A. $5ms^{-2}$

B. $10ms^{-2}$

C. $3ms^{-2}$

D. $15ms^{-2}$

Answer: B

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26. A ship of mass $3 \times 10^7 kg$ initially at rest is pulled by a force of $5 \times 10^4 N$ through a distance of 3m. Assume that the resistance due to water is negligible, the speed of the ship is

A. $1.5ms^{-1}$

B. $60ms^{-1}$

C. $0.1ms^{-1}$

D. $5ms^{-1}$

Answer: C

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27. A body of mass m is at rest. Another body of same mass moving with velocity V makes head on elastic collision with the first body. After collision the first body starts to move with velocity

A. v

B. 2v

C. remain at rest

D. not predictable

Answer: A

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28. In a rocket, fuel bums at the rate of 1 kg/s. This fuel is ejected from the rocket with a velocity of 60 km/s. This exerts a force on the rocket equal to

A. 6000N

B. 60000N

C. 60N

D. 600N

Answer: B

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29. During a football match, the ball shot towards the goal struck the defender foot at the speed of $10ms^{-1}$ and it bounces back at $20ms^{-1}$ IF the time of impact was 0.2s and

mass of the ball is $1/2kg$ then average force exerted by defender on the ball is

A. 75N

B. 35N

C. 50N

D. 40N

Answer: A

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30. the breaking strength of a steel cable is 20kN. If one pulls horizontally with this cable, what is the maximum horizontal acceleration which can be given to an 8 ton body resting on a rough horizontal surface if the coefficient of kinetic friction is 0.15

A. $1.03ms^{-2}$

B. $4.02ms^{-2}$

C. $2.98ms^{-2}$

D. $3.90ms^{-2}$

Answer: A

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31. A moving truck crashes into a stationary car. The truck's mass is ten times that of the car. How does the magnitude of the force exerted by the truck on the car compared with the exerted by the car on the truck

A. The force the truck exerts on the car is ten times bigger.

B. the force that the truck exerts on the car is ten times smaller

C. The ratio depends on the speed of the truck

D. They are the same

Answer: D

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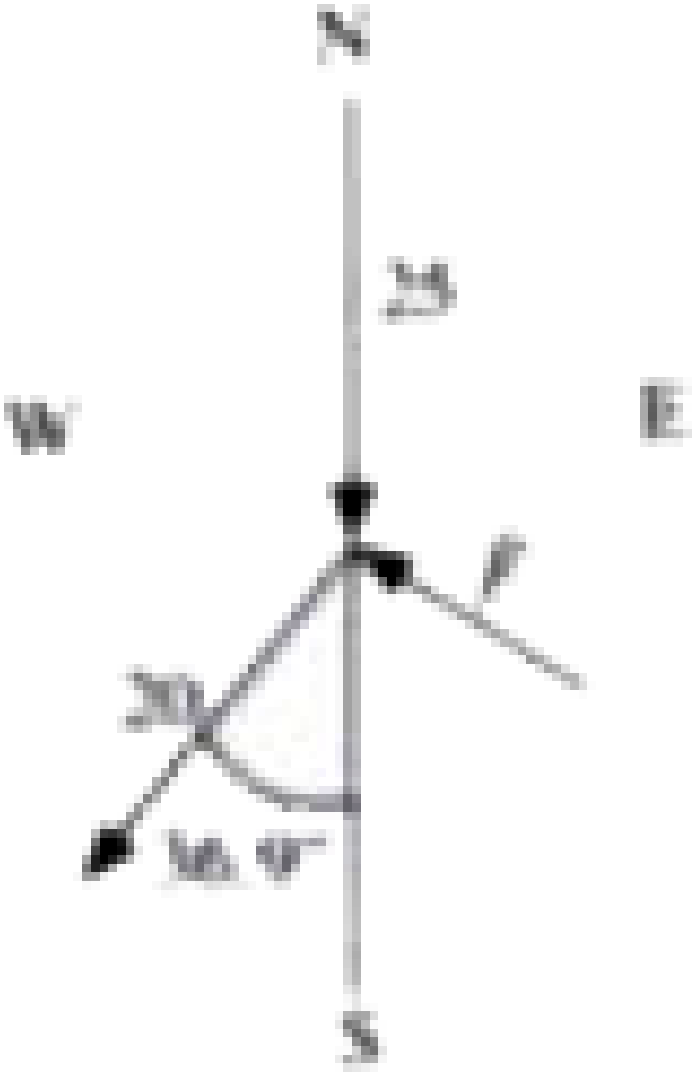
32. A football of mass 0.42kg is passed with a velocity of $25ms^{-1}$ due south. A defending player lunges at the ball and deflects it so that the new velocity is $20ms^{-1}$ 36.9° west of south . If the player is in contact with the ball for 0.05s , what is the magnitude of the

average force he exerts



A. 63N

B. 126N

C. 75N

D. 105N

Answer: B

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33. Two billiard balls A and B, each of mass 50 kg and moving in oppsite direction with speed of $5ms^{-1}$ each, collide and rebound with the

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

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

B. the impulse imparted to each ball is $0.25kgs^{-1}$ and the force exerted on each ball is $25 \times 10^{-5}N$

C. The impulse imparted to each ball is 0.5 Ns

D. The impulse and the force on each ball are different in magnitude and acts in same direction.

Answer: C

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34. 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

A. $2.0ms^{-1}$

B. $0.1ms^{-1}$

C. $0.5ms^{-1}$

D. $5.2ms^{-1}$

Answer: B

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35. A block of mass 1 kg starts from rest at x = 0 and moves along the X - axis under the action of a force F = kt, where t is time and $k = 1\ \mathrm{Ns}^{-1}$. The distance, the block will travel in 6 seconds is

A. 36m

B. 72m

C. 108m

D. 18m

Answer: A

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36. A block of mass M is pulled along a horizontal frictionless surface by a rope of mass m. If a force P is applied at the free end of the rope, the force exerted by the rope on the block is

A. $\frac{Pm}{(M+m)}$

B. $\frac{Pm}{(M-m)}$

C. P

D. $\frac{PM}{(M+m)}$

Answer: D

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37. A constant retarding force of 80 N is applied to a body of mass 50 kg which is moving initially with a speed of 20 m/s. What would be the time required by the body to come to rest ?

A. 15s

B. 14s

C. 12.5s

D. 18s

Answer: C

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38. The velocity of a body of mass 20 kg decreases from $20m/s$ to $5m/s$ in a distance of 100 m. Force on the body is:

A. $-27.5N$

B. $-47.5N$

C. $-37.5N$

D. $-67.5N$

Answer: C

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39. Which of the following is not an illustration of Newton's third law?

A. Flight of a jet

B. A cricket player lowering his hand while catching a cricket ball

C. Walking on a floor

D. Rebounding of a rubber ball

Answer: B

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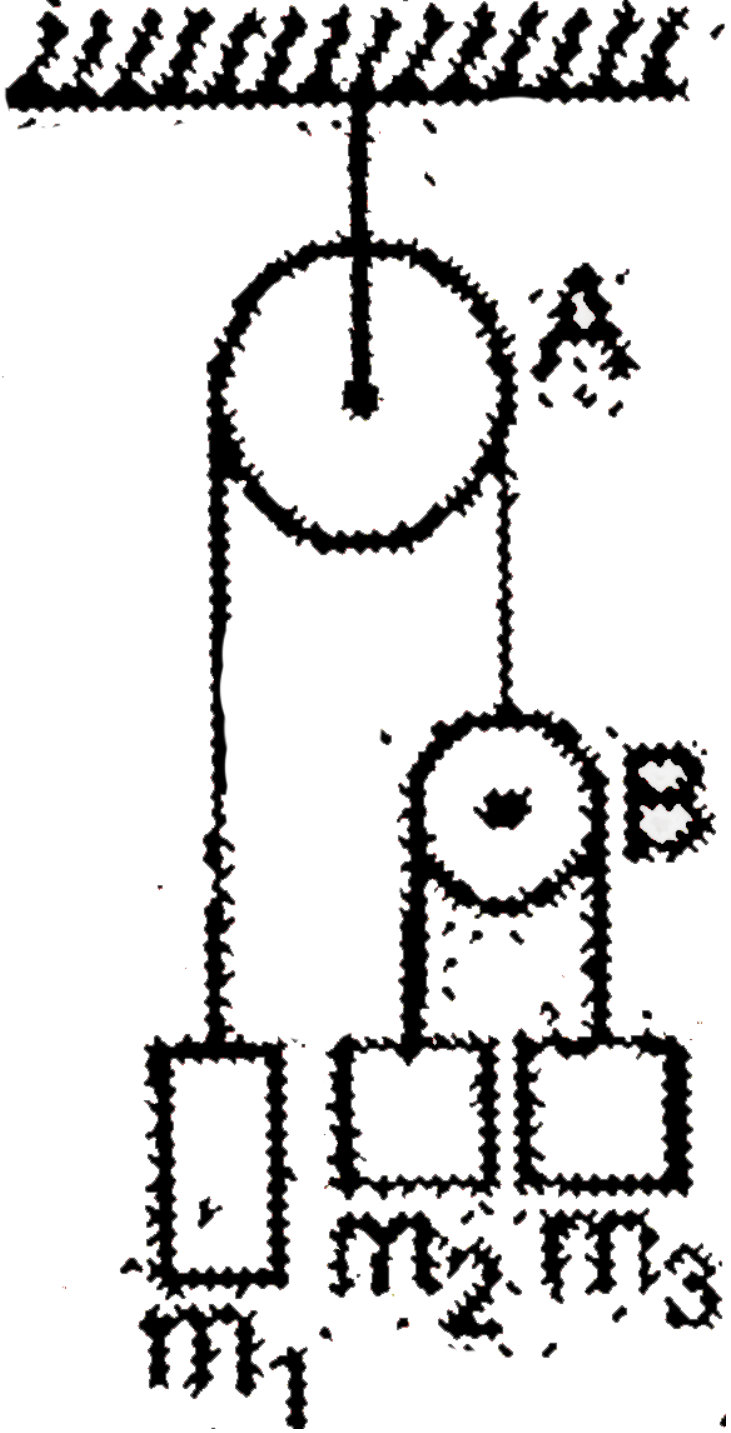
40. In the arrangement shown below, pulleys are mass-less and friction-less and threads are in-extensible. Block of mass m_1 will remain at

rest if :


m1
m2
m3

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

B. $m_1 = m_2 = m_3$

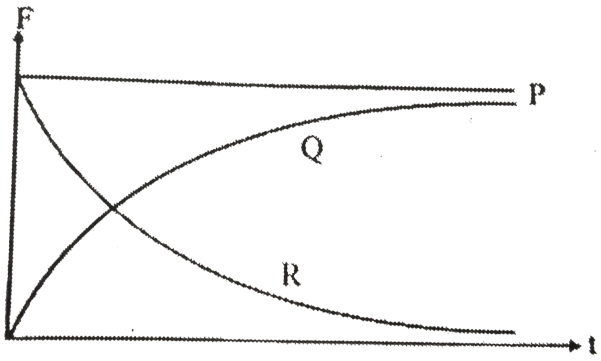
C. $\frac{1}{m_1} = \frac{1}{m_2} + \frac{1}{m_3}$

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

Answer: A

Watch Video Solution

41. A spherical ball is dropped in a long column of viscous liquid. Which of the following graphs represent the variation of



(I) gravitational force with time

(ii) viscous force with time

(iii) net force acting on the ball with time

A. Q,R,P

B. R,Q,P

C. P,Q,R

D. P,R,Q

Answer: C

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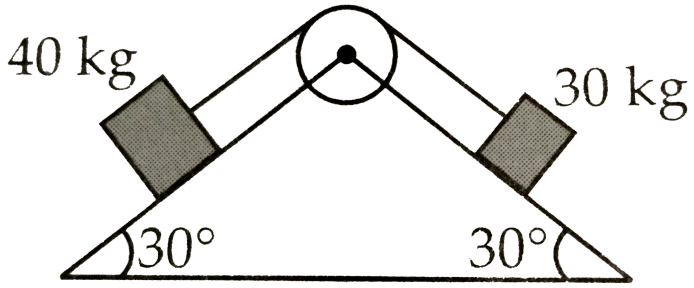
42. Two blocks of masses of 40 kg and 30 kg are connected by a weightless string passing over a frictionless pulley as shown in the figure.



A. $0.7ms^{-2}$

B. $0.8ms^{-2}$

C. $0.6ms^{-2}$

D. $0.5ms^{-2}$

Answer: A

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43. A block of mass 2 kg is at rest on a floor . The coefficient of static friction between block and the floor is 0.54. A horizonatl force of 2.8

N is applied to the block . What should be the frictional force between the block and the floor ? (take , $g = 10m/s^2$)

A. 8.8N

B. 5.8N

C. 2.8N

D. 10.8N

Answer: C

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44. A machine gun is mounted on a 2000kg car on a horizontal frictionless surface. At some instant, the gun fires 10 bullets/second and each of mass 10g with a velocity of $500ms^{-1}$ the acceleration of the car is

A. $0.025ms^{-2}$

B. $0.25ms^{-2}$

C. $0.50ms^{-2}$

D. $500ms^{-2}$

Answer: A

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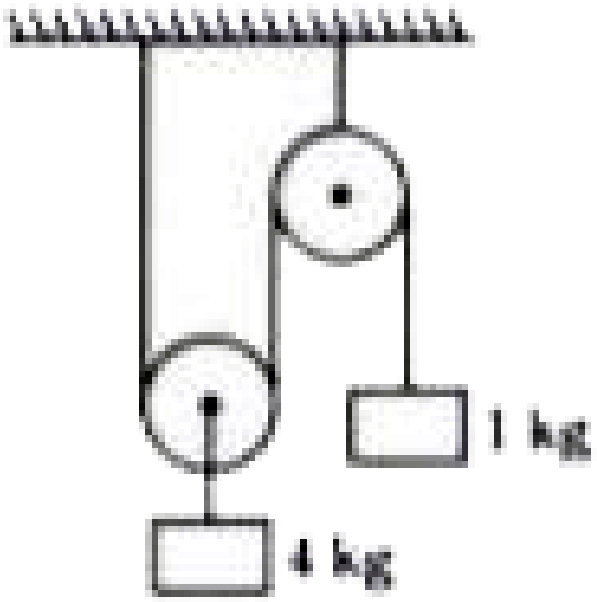
45. In the system shown in the figure the acceleration of 1kg mass is



A. $\frac{g}{4}$ downwards

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

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

D. $\frac{g}{4}$ upwards

Answer: C

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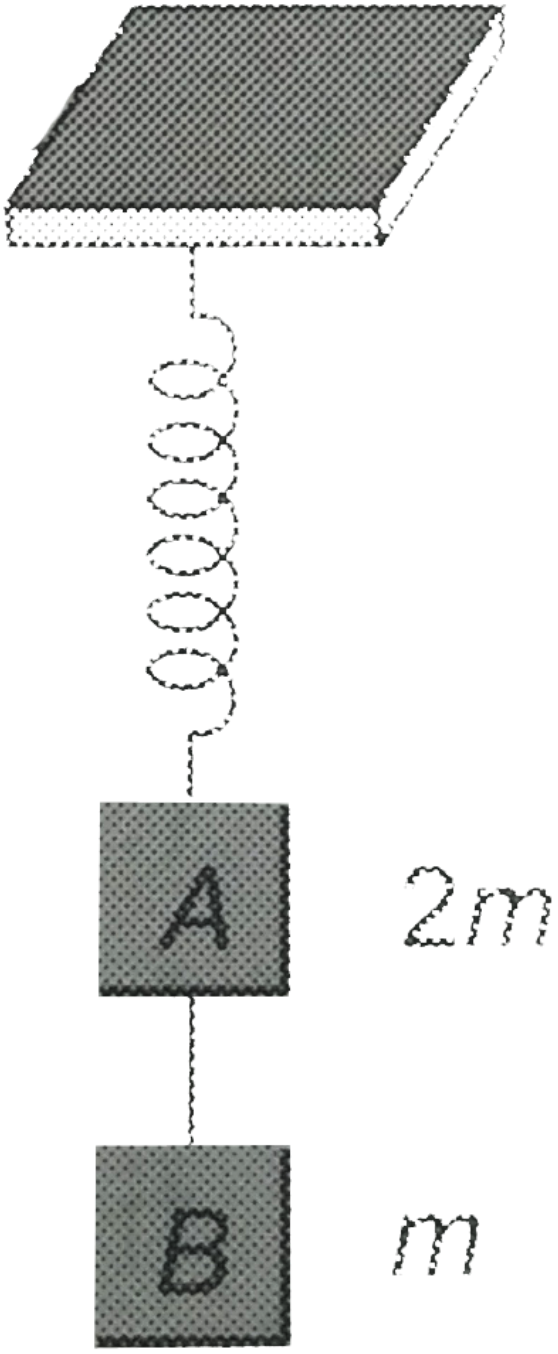
46. Two blocks A and B of masses 2m and respectively, are connected by a massless and inextensible string. The whole system is suspended by a masslessspring as shown in

the figure. The magnitude of acceleration of A and B, immediately after the string is cut, are

respectively


A
2m
B
m

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

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

C. g, g

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

Answer: B

Watch Video Solution

47. A particle undergoes uniform circular motion. About which point on the plane of the

circle, will the angular momentum of the particle remain conserved?

A. centre of the circle

B. on the circumference of the circle

C. Inside the circle

D. Outside the circle

Answer: A

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48. A thin uniform rod of mass m moves translationally with acceleration a due to two antiparallel forces of level arm I. One force is of magnitude F and acts at one extreme end. The length of the rod is

A. $\frac{mal}{ma+F}$

B. $\frac{2(F+ma)l}{ma}$

C. $l\left(l+\frac{F}{ma}\right)$

D. $\frac{(F+ma)l}{2ma}$

Answer: B

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49. An object initially at rest explodes into three fragments A, B and C.The momentum of A is $p\hat{i}$ and that of B is $\sqrt{3}p\hat{j}$

where p is $a + ve$ number. The momentum of C will be

A. $\left(1 + \sqrt{3}\right)P$ in a direction making 120° with A

B. 2P in a direction making 150° with A

C. 2P in a direction making 150° with B

D. $\left(1+\sqrt{3}\right)P$ in a direction making 150° with B

Answer: C

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List-I	List-II
(P) Newton's first law	1. Quantitative definition of force
(Q) Newton's second law	2. Qualitative definition of force
(R) Newton's third law	3. Oppose relative linear motion
(S) Friction force	4. Define nature of force

50.

A. P -3 Q -2 R -4 S -1

B. P-3 Q -4 R -2 S-1

C. P-2 Q-1 R -4 S-3

D. P-4 Q-3 R-1 S-2

Answer: C

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Exercise Match The Following

1.

List-I	List-II
(P) Momentum	1. $m\ s^{-2}$
(Q) Velocity	2. $m\ s^{-1}$
(R) Acceleration	3. $kg\ m\ s^{-1}$
(S) Force	4. newton

A. P -3 Q -2 R -4 S -2

B. P-3 Q -4 R -2 S-2

C. P-2 Q-1 R -4 S-4

D. P-4 Q-3 R-1 S-3

Answer: A

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List-I		List-II
(P) Momentum	1.	$m\frac{dv}{dt}$
(Q) Impulse	2.	mv
(R) Force	3.	$\frac{dp}{dt}$
(S) Acceleration	4.	$\frac{dv}{dt}$

2.

A. P -3 Q -2 R -4 S -3

B. P-3 Q -4 R -2 S-3

C. P-1 Q-3 R-4 S-2

D. P-2 Q-3 R-1 S-4

Answer: D

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Exercise Assertion And Reason

1. Assertion: When a car crashed head on into a heavy truck, the car experiences

Reason: Newton second law states that the change in momentum is equal to impulse

A. IF both assertion and reason are true and reason is the correct explanation of assertion

B. If both assertion and reason are true but reason is not the correct explanation of assertion

C. If assertion is true but reason is false

D. If assertion is false but reason is true

Answer: D

View Text Solution

2. Assertion: A boy facing forward in a bus throws a ball straight up. At the same instant the bus begins to accelerate. The ball goes up and falls in front of the boy.

Reason: As the ball rises, it does not continue at a constant velocity

A. IF both assertion and reason are true and reason is the correct explanation of assertion

B. If both assertion and reason are true but reason is not the correct explanation of assertion

C. If assertion is true but reason is false

D. If assertion is false but reason is true

Answer: D

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3. Assertion: A body at rest or a body in uniform motion is always in equilibrium

Reason: No net forces act on a body in equilibrium.

A. IF both assertion and reason are true and reason is the correct explanation of assertion

B. If both assertion and reason are true but reason is not the correct explanation of

assertion

C. If assertion is true but reason is false

D. If assertion is false but reason is true

Answer: D

View Text Solution

4. Assertion: The rate of change of momentum

Reason: Speed is a constant in uniform circular motion

A. IF both assertion and reason are true and reason is the correct explanation of assertion

B. If both assertion and reason are true but reason is not the correct explanation of assertion

C. If assertion is true but reason is false

D. If assertion is false but reason is true

Answer: D

View Text Solution

5. Assertion: Friction can occur only between two surfaces that are moving relative to each other.

reason: Friction opposes relative motion between two surfaces in contact.

A. IF both assertion and reason are true and reason is the correct explanation of assertion

B. If both assertion and reason are true but reason is not the correct explanation of assertion

C. If assertion is true but reason is false

D. If assertion is false but reason is true

Answer: D

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6. Assertion: Action and reaction forces act on two different objects

Reason: Action and reaction have zero resultant.

A. IF both assertion and reason are true and reason is the correct explanation of assertion

B. If both assertion and reason are true but reason is not the correct explanation of assertion

C. If assertion is true but reason is false

D. If assertion is false but reason is true

Answer: C

7. Assertion: Linear momentum is conserved in both elastic and inelastic collisions.

Reason: Total energy is conserved in all collisions.

A. IF both assertion and reason are true and reason is the correct explanation of assertion

B. If both assertion and reason are true but reason is not the correct explanation of assertion

C. If assertion is true but reason is false

D. If assertion is false but reason is true

Answer: B

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8. Assertion: A quick collisions between two bodies is more violent than a slow collisions even when the initial and the final velocities are identical

Reason: Because the rate of change of momentum which determines the force is greater in the first case.

A. IF both assertion and reason are true and reason is the correct explanation of assertion

B. If both assertion and reason are true but reason is not the correct explanation of assertion

C. If assertion is true but reason is false

D. If assertion is false but reason is true

Answer: A

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9. Assertion : Impulse and momentum have different dimensions.

Reason : From Newton's second law of motion, impulse is equal to change in momentum.

A. IF both assertion and reason are true and reason is the correct explanation of assertion

B. If both assertion and reason are true but reason is not the correct explanation of assertion

C. If assertion is true but reason is false

D. If assertion is false but reason is true

Answer: D

10. Assertion : Linear momentum of a body changes even when it is moving uniformly in a circle.

Reason : Force required to move a body uniformly along a straight line is zero.

A. IF both assertion and reason are true and reason is the correct explanation of assertion

B. If both assertion and reason are true but reason is not the correct explanation of assertion

C. If assertion is true but reason is false

D. If assertion is false but reason is true

Answer: B

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Exercise Comprehension Type

1. A helicopter of mass 1000kg rises with a vertical acceleration of $15ms^{-2}$ The crew and the passengers weigh 300kg.

Force on the floor by the crew and passengers

A. 7500N

B. 1500N

C. 2500N

D. 5000N

Answer: A

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

Action of the rotor of the helicoper on the surrounding air

A. 32500N

B. 75200N

C. 22200N

D. 23200N

Answer: A

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3. A helicopter of mass 1000kg rises with a vertical acceleration of $15ms^{-2}$ The crew and the passengers weigh 300kg.

Action of the rotor of the helicoper on the surrounding air

A. 25000N

B. 36000N

C. 32500N

D. 2000N

Answer: C

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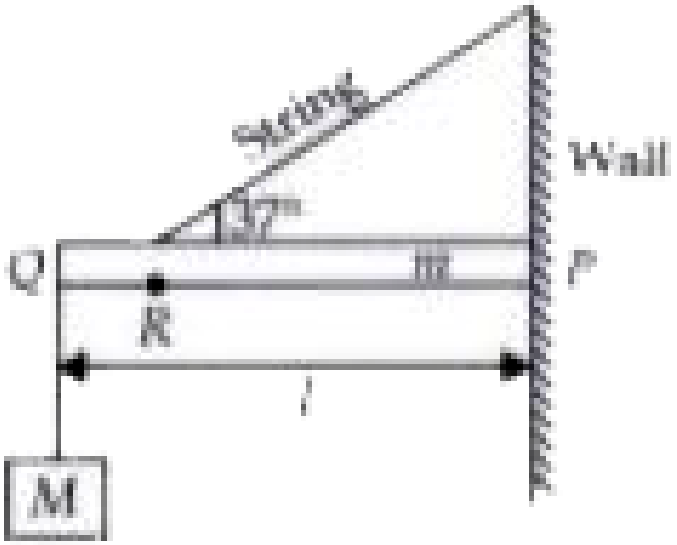
4. Figure shows a rod of length l= 1m and mass m=8kg. It is hinged at the end P . At the end Q a block of mass M=50kg is suspended at the point R which is at a distance equal to 25cm from end Q, a string is connected whose other end is connected to the wall.



The tension in the string is

A. 600N

B. 80N

C. 1200N

D. 800N

Answer: C

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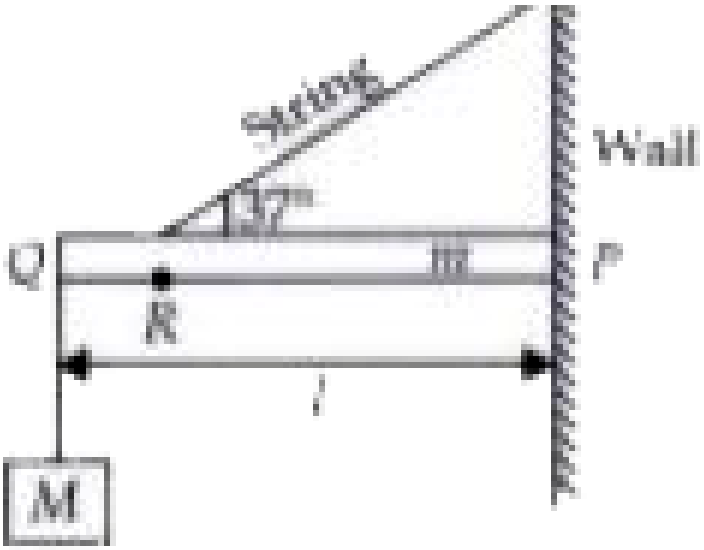
5. Figure shows a rod of length l= 1m and mass m=8kg. It is hinged at the end P . At the end Q a block of mass M=50kg is suspended at the

point R which is at a distance equal to 25cm from end Q, a string is connected whose other end is connected to the wall.



The horizontal component N_2 and vertical component N_y of the reaction at the end P are given by

A. $N_x = 1300N, N_y = 960N$

B. $N_x = 960N, N_y = 140N$

C. $N_x = 960N, N_y = 960N$

D. $N_x = 1300N, N_y = 1300N$

Answer: B

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Exercise Very Short Answer Question

1. What do you mean by inertia

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2. What force accelerates a 20kg mass at $2ms^{-2}$ on a frictionless surface

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3. When a ball is dropped from a height , its speed increase gradually. Name the force which causes this change in speed.

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4. A plastic ball and a clay ball of equal masses, travelling in the same direction with equal speeds, strike against a vertical wall. From which ball does the wall receive a greater amount of momentum?

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5. Define 1 newton force.

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6. A motocycle of mass 2000kg is moving over a horizontal road with uniform velocity. If this motorcycle has to be stopped with a negative acceleration of $1.5ms^{-2}$ then what is the force of friction between the tyres of the motorcycles and the road?

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7. A man pushes a box of mass $50kg$ with a force of $80N$. What will be the acceleration of

the box? What would be the acceleration if the mass were halved?

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8. Which would requires a greater force: accelerating a $2kg$ mass at $5m/s^2$ or a $4kg$ mass at $2m/s^2$?

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9. A certain force exerted for $1.2s$ raises the speed of an object from $1.8m/s$ to $4.2m/s$. Later, the same force is applied for $2\,\text{seconds}$. How much does the speed change in $2s$?

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10. Two forces 3N and 4N are acting on a point O. if angle between these two forces is 90° find the resultant of these two forces.

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11. A motor car is moving with a velocity of $108 km/h$ and it takes $4 \sec ond$ to stop after the brakes are applied. Calculate the force exerted by the brakes on the motorcar if its mass along with the passenger is $1000 kg$.

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12. A feather of mass 10g is dropped from a height. It is found to fall down with a constant velocity. What is the net force acting on it

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13. A lift is moving down with acceleration a. A man in the lift drops a ball inside the lift. Find the acceleration of the ball as observed bt the man in the lift and a man standing stationary on the ground

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14. A block of mass M is pulled along a horizontal frictionless surface by a rope of mass m. If a force P is applied at the free end of the rope , the force exerted by the rope on the block .

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15. A spring balance carries a load, when the load is pulled aside so that the balance makes

an angle of 30° with the vertical , the balance reads 4kg wt. What is the mass of the load.

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Exercise Short Answer Question

1. A ship has two engines, one producing a thrust of 300 newtons and the other 750 newtons . Firing the smaller engine for 10s speeds the ship up from 80 metres per second to 95 meters per second, and the large engine

is then fired for 12 seconds. How fast is the ship then going.

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2. A car of mass 1000g is brought to rest from a speed of $40ms^{-1}$ in a distance of 80m. Find the braking force of the car assuming that it is constant and that there is a constant resistance of motion of 100N

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3. Two persons manage to push a motorcar of mass $1200kg$ at a uniform velocity along a level road. The same motorcar can be pushed by three persons to produce an acceleration of $0.2m/s^2$. With what force does each person push the motorcar? (Assume that all persons push the motorcar with the same muscular effort).

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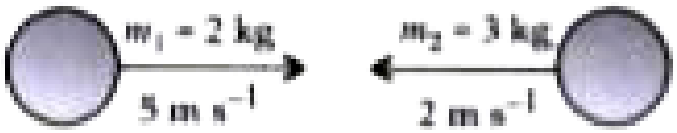
4. Two objects m_1 and m_2 are moving in the straight line approaching each other as shown. After collisions these objects together. What will be the velocity of the combined object after collisions?



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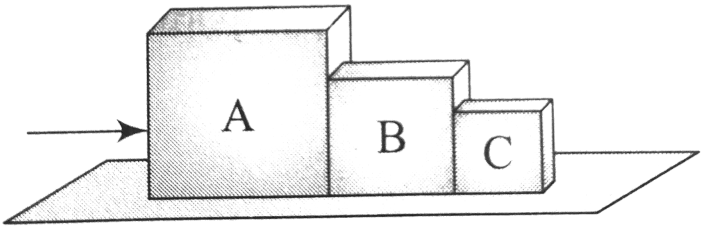
5. A machine gun fires $25g$ bullet at the rate of 600 bullets per minutes with a speed of $200m/s$. Calculate the force required to keep the gun in position.

Watch Video Solution

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

$block, then the contact f$ or $ce between$A and B` is.



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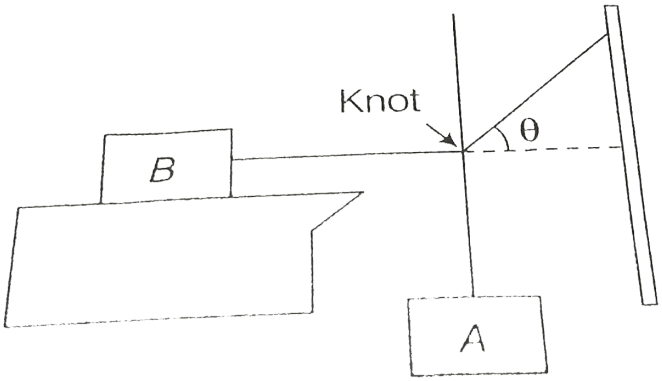
7. Block B lying on a table weighs w. The coefficient of static friction between the block and the table is mu. Assume that the cord between B and the knot is horizontal. The

maximum weight of the block A for which the system will be stationary is



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8. A uniform chain of length L is lying partly on a table, the remaining part hanging down from the edge of the table. If the coefficient of

friction between the chain and the table is 0.5 what is the minimum length of the chain that should lie on the table, to prevent the chain from slipping down to the ground.

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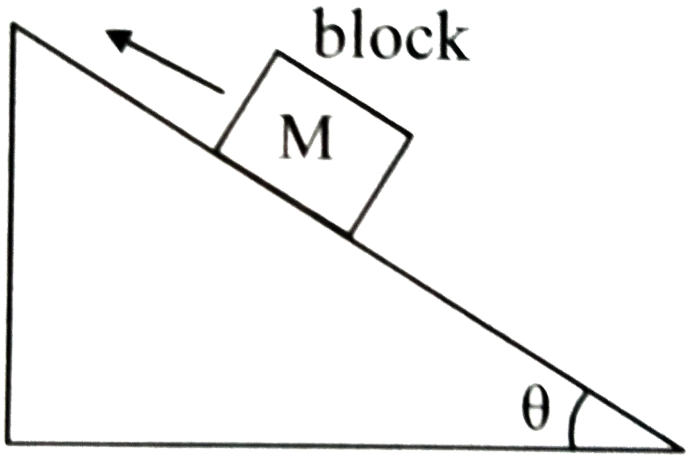
9. A block of mas M is resting on an inclined plane as shown in the figure. The inclination of the plane to the horizontal is gradually increased. It is found that when the angle of inclination is θ the block just begins to slide

down the plane. What is the minimum force F applied parallel to the plane that would just make the block move up the plane ?



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10. A pendulum is hanging from the ceiling of a car having an acceleration a_0 with respect to

the road. Findthe angle made by the string with the vertical.

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Exercise Long Answer Type

1. A horse develops a momentum of 3000Ns, while running at $15ms^{-1}$ Calculate the mass of the horse.

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2. A bullet of mass 10g is fired with a rifle. The bullet takes 0.003s to move through the barrel and leaves with a velocity of $300ms^{-1}$ What is the force exerted on the bullet by the rifle.

View Text Solution

3. Calculate the momentum of an electron of mass $9 \times 10^{-31}kg$ moving with a velocity of $6 \times 10^{7}ms^{-1}$

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4. what will be the acceleration of a body of mass 5kg, if a force of 200N is applied on it.

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5. A boy of mass 30kg while running, develops a mometum of 180Ns Calculate the velocity of the boy

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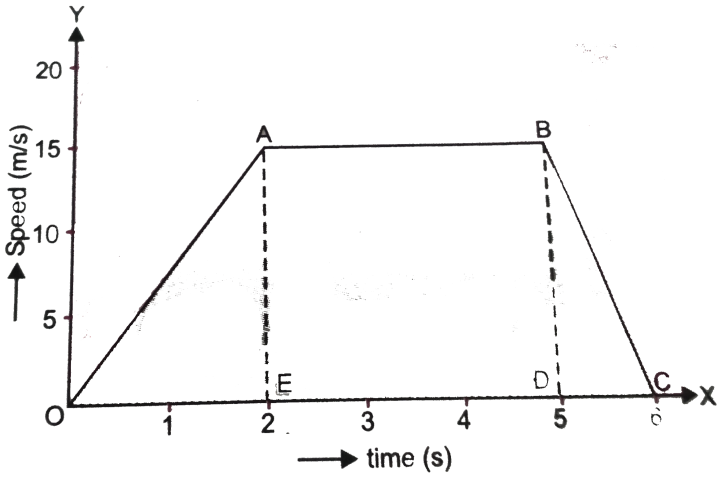
6. The speed- time graph of a car is given in (figure) The car weights $1000kg$

(a) What is the distance travelled by the car in first two seconds?

(b) What is the braking force applied at the end of $5\,\text{sec}\,onds$ to bring the car to a stop within one second?



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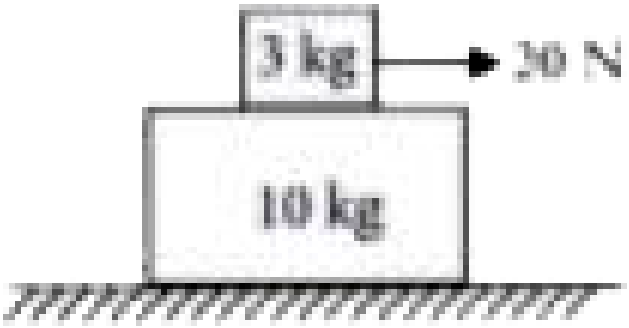
7. A 3kg block is placed over a 10kg block and both are placed on a smooth horizontal surface. The coefficient of friction between the blocks is 0.2. IF a horizontal force of 20N is applied to 3kg block. Find the acceleration of the two blocks.



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8. A 5kg shell kept at rest suddenly splits up into three parts. If two parts of mas 2kg each are found flying due north and east with a velocity of $5m/s$each, what is the velocity of the third part after explosion.

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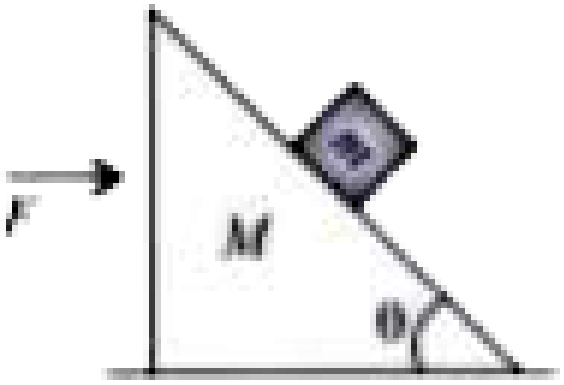
9. For what value of F will the block of mass m remains at rest with respect to the wedge. All

surfaces are frictionless.



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Exercise Integer Value Type

1. A block of mass m_1 rests on a horizontal table. A string tied to the block is passed on a

frictionless pulley fixed at the end of the table and to the other end of string is hung another block of mass m_2. The acceleration of the system is

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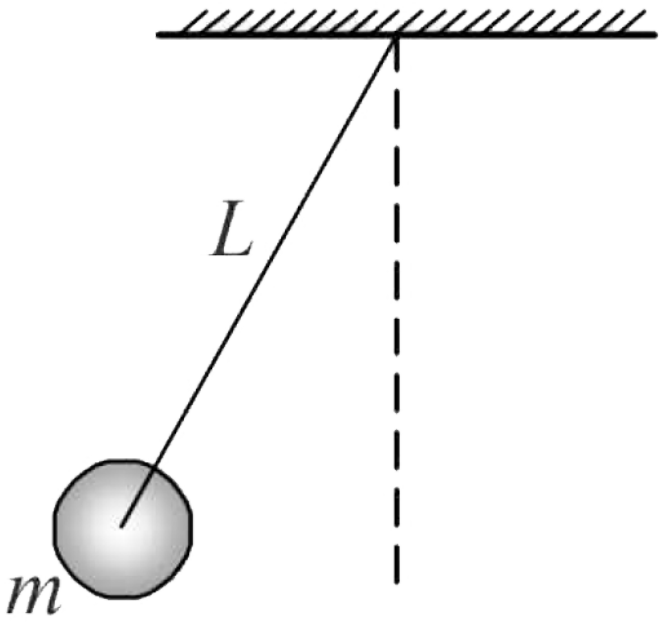
2. A ball of mass (m) 0.5g is attached to the end of a string having length (L) 0.5m. The ball is rotated on a horizontal circular path about vertical axis. The maximum tension that the string can bear is 324N. The maximum possible

value of anguar velocity of ball(in radian/s) is



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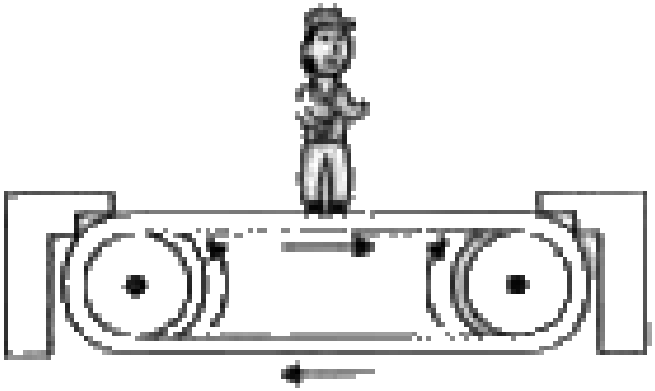
3. Figure shows a man standing stationary with respect to a horizontal conveyer belt that is accelerating with 1 ms^{-2} What is the net force on the man? (Mass of the man = 65 kg)



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4. A player caught a cricket ball of mass 15g moving at a rate of $20m/s$. IF the catching process is completed in 0.1s, find the force of the blow exerted by the ball on the hand of the player.

View Text Solution

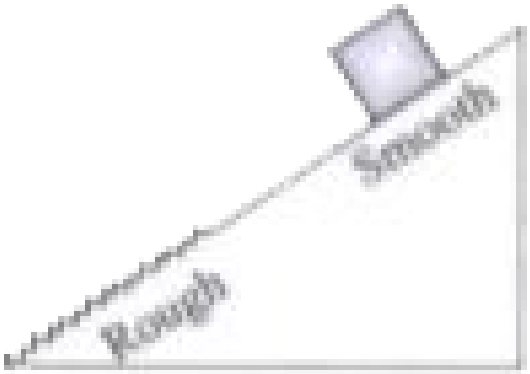
5. A wheel is subjected to uniform angular acceleration about its axis, Initially , its angular velocity is zero. In the first 2s, it rotates

through an angle θ in the next 2s it rotates through an angle θ_2 Find the ratio of $\frac{\theta_2}{\theta_1}$

View Text Solution

Olympiad Hots Corner

1. A block accelerates down a slope, as shown in the figure. The upper portion of the slope is smooth and lower portion is rough. On the lower portion



(i) the speed of the block may increase, decrease or remain same

(ii) the acceleration of block reduces.

(iii) the mass of block reduces

What of the following is/are correct

A. I only

B. I,ii only

C. ii,iii only

D. I,ii,iii

Answer: B

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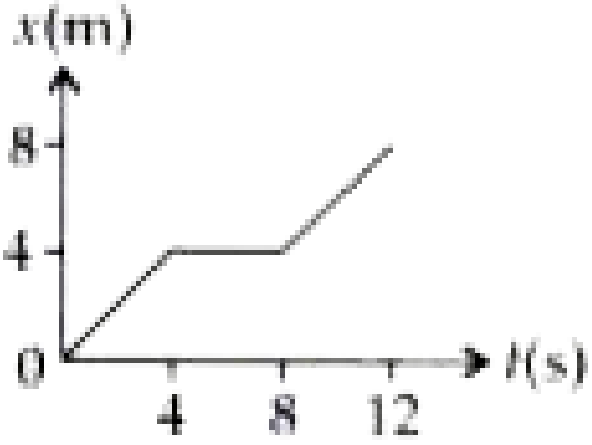
2. Figure shows the position time graph of a particle of mass 5kg. The force acting on the particle for $0 < t < 4s$ and $8s < t < 12s$

respectively are,



A. 5N,5N

B. 5N.7.5N

C. 5N,10N

D. 0N,0N

Answer: D

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3. Statement 1: Force of friction between two surfaces depends on the area of contact common to the two surfaces.

Statement 2: More than area of contact common to the two surfaces, more is the opposition to the motion.

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4. Match the following

	Column I		Column II
(p)	A child running to catch the school bus	(i)	Force can make a stationary object move
(q)	A man blowing a balloon	(ii)	Force can stop a moving object
(r)	A woman pushing a table	(iii)	Force can change the shape of an object
(s)	A cricketer catching a ball	(iv)	Force can make an object move faster

A. p -iv q -iii r-I s-ii

B. p-iii q-ii r-I s-iv

C. p-I q-ii r-iii s-iv

D. p-ii q-iv r-I s-iii

Answer: A

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5. Statement 1: The force of action and reaction always appear due to actual physical contact of two bodies.

Statement 2: A particle can move only under the action of a force.

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6. A bicycle moves on a horizontal road with some acceleration. The forces of friction between the road and the front and rear wheels are F_1 and F_2 respectively.

A. Both F_1 and F_2 act in the forward direction

B. Both F_1 and F_2 act in the backward direction

C. F_1 acts in the forward direction F_2 acts in the backward direction

D. F_1 acts in the backward direction F_2 acts in the forward direction.

Answer: D

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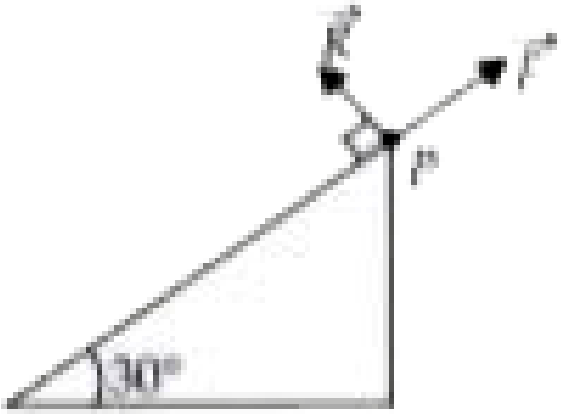
7. In the following figure , an object of mass 1.2kg is at rest at point P. IF R and F are the reaction and the frictional force respectively

then



A. $R = 6NF = 6\sqrt{3}N$

B. $R = 3N, F = 3\sqrt{3}N$

C. $R = 6NF = 3N$

D. $R = 6\sqrt{3}F = 6N$

Answer: D

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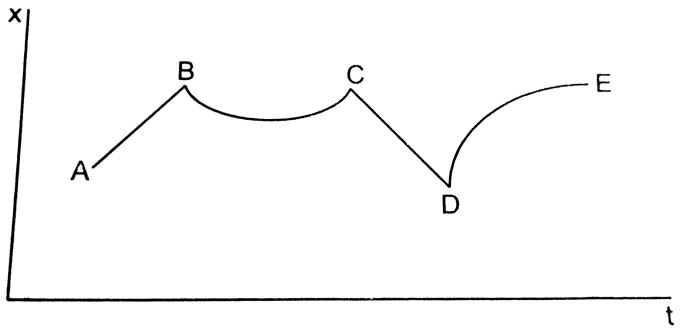
8. Figure shows the displacement of a particle going along the X-axis as a function of time. The force acting on the particle is zero in the region



A. AB

B. BC

C. CD

D. DE

Answer: A

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9. Two cars of unequal masses use similar tyres. If they are moving at the same initial speed, the minimum stopping distance

A. is smaller for the heavier car

B. is smaller for the lighter car

C. is same for both the cars

D. depends on the volume of the car

Answer: C

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10. According to Newton second law of motion

A. $F = m \times v$

B. $f = m \times a$

C. $f = \frac{m}{a}$

D. $f = \frac{m}{v}$

Answer: B

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11. A body of mass 2kg is moving on a smooth floor in straight line with a uniform velocity of $10m/s$ Resultant force on the body is

A. 20N

B. 10N

C. 2N

D. Zero

Answer: D

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12. A football has lesser inertia than a stone of the same size because:

A. football has more air inside than the stone

B. football has less air inside than the stone

C. football has less mass than the stone

D. football has more mass than the stone

Answer: C

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13. the force experienced by a body in the merry go-round is

A. centripetal

B. centrifugal

C. gravitational

D. magnetic

Answer: A

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14. Which law of Newton gives the value of force

A. First law

B. Second law

C. Third law

D. all of these

Answer: B

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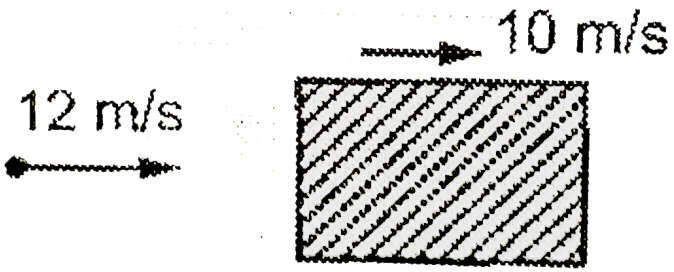
15. A light particle moving horizontally with a speed of $12m/s$ strikes a very heavy block moving in the same direction at $10m/s$. The collision is one-dimensional and elastic. After the collision, the particle will



A. move at $12m/s$ opposite to its original direction

B. move at $8m/s$ in its original direction

C. move at $8m/s$ opposite to its original direction

D. move at $2m/s$ in its original direction

Answer: B

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16. Pick the fundamental law of motion

A. Newton first law of motion

B. Newton second law of motion

C. Newton third law of motion

D. All laws of motion

Answer: D

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17. A particle starts its motion from rest under the action of a constant force. If the distance covered in first $10s$ is s_1 and the covered in the first $20s$ is s_2, then.

A. $S_2 = S_1$

B. $S_2 = 2S_1$

C. $S_2 = 3S_1$

D. $S_2 = 4S_1$

Answer: D

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18. The momentum of an object at a given instant is independent of its

A. inertia

B. speed

C. velocity

D. acceleration

Answer: D

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19. A car of mass one metric ton accelerates from rest at the rate of $2m/s^2$ from t=0 sec to t=10sec. There after it travels with a uniform

velocity. The measure of net retarding force acting on the car after 10 sec is

A. 4000N

B. 2000N

C. 0N

D. $-2000N$

Answer: C

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20. A machine gun of mass 10 kg fires 20 g bullets with speed of 500 m/s at the rate of 10 bullets per second. To hold the gun steady in its position how much force is necessary?

A. 200N

B. 500N

C. 100N

D. 250N

Answer: C

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