PHYSICS

BOOKS - PRADEEP PHYSICS (HINGLISH)

FORCES AND LAWS OF MOTION

Solved Problems

1. What is acceleration produced by a force of 12 newton excerted on an object of mass $3kg$?

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2. What force would be needed to produce an acceleration of $4m/s^2$ on a ball of mass $6kg$

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3. A force of $5N$ gives a mass m_1, an acceleration of m/s^2, and a mass m_2, an acceleration of $24m/s^2$. What acceleration

would it give if both the masses are tied together?

A. 5 m/s2

B. 10 m/s2

C. 6 m/s2

D. NOne

Answer: C

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4. A motorcycle is moving with a velocity of $90 km/h$ and it takes $5 \sec ond$ to stop after the brakers are applied. Calculate the force exerted by the brakers on the motorcycle if its mass alongwith the rider is $200 kg$

A. -100 N

B. 500 N

C. 200 N

D. -1000 N

Answer: D

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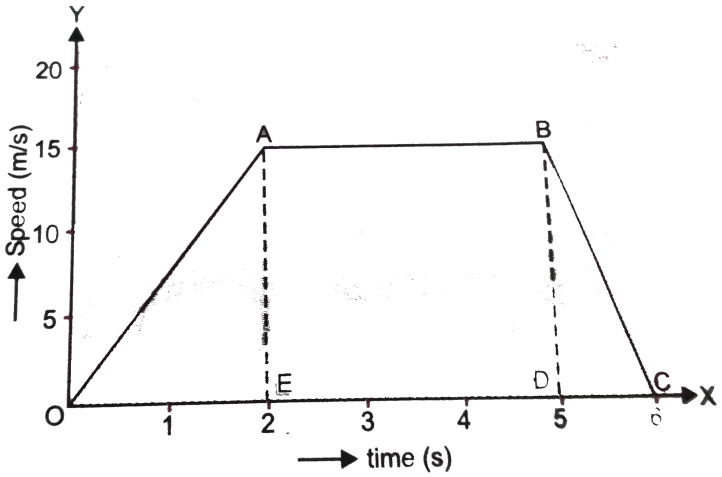
5. The speed- time graph of a car is given in (figure) The car weights $1000kg$

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

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

within one second?



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6. Calculate the force required to impact a car a velocity of $30m/s$, in 10 seconds. The mass of the car is $1500kg$

A. 5000 N

B. 7500 N

C. 4500 N

D. NONE

Answer: C

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7. When two bodies A and B interact with each other, A exerts a force of $10N$ on B,

towards east. What is the force exerted by B on A?

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8. A $10g$ bullet is short from a $5kg$ gun with a velocity of $400m/s$. What is the speed of recoil of the gun?

A. -0.8 m/s

B. 80 m/s

C. 0.4 m/s

D. 20 m/s

Answer: A

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

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

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11. The car A of mass $1500kg$, travelling at $25m/s$ collides with another car B of mass $1000kg$ travelling at $15m/s$ in the same

direction. After collision, the velocity of car A becomes $20m/s$. Calcualte the velocity of car B afrer collison.

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Ncert Questions

1. Which of the following has more interia: (a) a rubber ball and a stone of the same size? (b) a bicycle and a train (c) a five-repees coin and a one-rupee coin?

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

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

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6. 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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7. From a rifle of mass $4kg$, a bullet of mass $50kg$ is fired with an initial velocity of $35m/s$. Calculate the initial recoil velocity of the rifle.

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8. Two objects of masses $100g$ and $200g$ are moving along the same line in 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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9. 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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10. When a carpet is beaten with a stick, dust comes out of it, Explain.

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

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12. 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 forcr on the ball, so the ball would want to come to rest.

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13. A truck starts from rest and rolls down a hill with a constant acceleration. It travels a distance of $400m$ in $20s$. Find its acceleration. Find the force acting on it if its mass is 7 metric tonnes (Hint.1 metric tonne=1000kg)

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14. A stone of $1kg$ is thrown with a velocity of $20ms^{-1}$ across the frozen surface of lake and comes to rest after travelling a distance of

$50m$. What is the force of friction between the stone and the ice?

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15. 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.

A. `50000 N, 2.0 m/s2, 15000 N

B. 35000 N, 1.94 m/s^2, 15520 N

C. 50000 N, 2.5 m/s^2, 9000 N

D. NONE

Answer: B

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16. An automobile vehcile has a mass of $1500kg$ What must be the force between the vehcile and road if the vehcile is to be stopped with a negative acceleration of $1.7m/s^2$?

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

A. $(mv)^2$

B. mv^2

C. $1/2mv^2$

D. mv

Answer: D

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18. 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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19. 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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20. 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.

21. 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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22. 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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23. 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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24. 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 exerted on the object.

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25. 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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26. 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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27. 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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28. 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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29. 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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30. A car and a truck moving with the same velocity in opposite directions collide and collision lasts for $2s$.

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

(ii) Which vehicle has the smaller change in momentum?

(iii) Which one undergoes greater acceleration?

(iv) Which one is pushed farther?

(v) Which one is likely to suffer more damage?

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Short Answer Questions

1. There are three solids made up of aluminum, steel and wood, of the same shape and same volume. Which of them would have highest inertia?

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2. Two balls of the same size but different matetials, rubber and iron are kept on the smooth floor of a moving train. The brakers are applied suddenly to stop the train . Will the balls start rolling? If so, in which direction? Will they move with the same speed? Give reasons for your answers.

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3. Two identical bullets are fired one by a light rifle and another by a heavy rifle with the same force. Which rifle will hurt the shoulder and why?

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4. A horse continues to apply a force in order to move a cart with a constant speed. Explain why?

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5. Suppose a ball of mass m is thrown vertically upward with an initial speed v, its speed decreases continuously till it becomes zero. Thereafter, the ball beigns to fall downward and attains the speed v again before striking the ground. It implies that the magnitude of initial and final momentums of the ball are same. Yet, it is not an example of conservation of momentum. Explain why?

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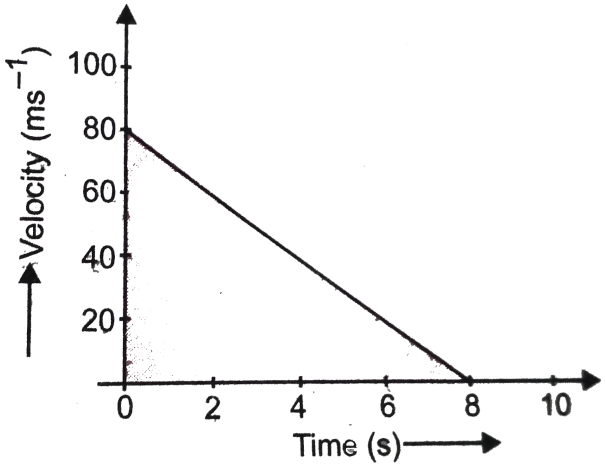
6. Velocity versus time graph of a ball of mass $50g$ rolling on a concrete floor shown in (figure) Calcualte the acceleration and frictional force of the floor on the ball.



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7. A truck of mass M is moved under a force F. If the truck is then loaded with an object equal to the mass of the truck and the driving force is halved, then how does the acceleration change?

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8. Two friends on roller-skates are standing $5m$ apart facing eachother. One of them throws a ball of $2kg$ towards the other, who catches it.

How will this activity affect the position of the two? Explain your answer.

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9. Water sprinkler used for grass lawns beigns to rotate as soon as the water is supplied. Explain the principle on which it works.

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10. Define force.

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11. Name the various effects of force.

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12. Name the three types of inertia.

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13. A person in a bus tends to fall backward, when it starts suddenly?

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14. Why does a person in a bus tends to fall forward when it stops suddenly?

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15. What happens to a person travelling in a bus when the bus takes a sharp turn? Give reason.

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16. Define momentum of a body.

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17. It is easier to stop a tennis balll than a cricket ball moving with the same speed. Why?

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18. Why are road accidents at high speeds very much worse than accidents at low speeds?

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19. Calculate momentum of a toy car of mass $300g$ moving with a speed of $18km/h$.

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20. A body of mass $30kg$ has a momentum of $150kgm/s$. What is the velocity?

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21. A ball is thrown vertically upwards. What is its momentum at the highest point?

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22. What is one Newton force?

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23. What acceleration is produced by a force of $5N$ acting on a body of mass $20kg$?

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24. An unloaded truck weighing $2000kg$ has a maximum acceleration of $0.4m/s^2$. What is the maximum acceleration, when it carries a load of $2000kg$?

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25. Why is it difficult to walk on a slippery road?

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26. Why does a gunman get a jerk on a firing a bullet?

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27. State the law of conservation of liner momentum.

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28. Name any two applications of the law of conservation of liner momentum.

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29. It is easier to push an empty box than to push the box full of books.Why?

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30. When a car rounds a curve suddenly, the person inside is pushed outwards.Why?

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31. A bullet thrown with a hand can be stopped eaisly, but it may kill a person when fired from a gun. Why?

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32. Show that $kg - ms^{-1}$ and $N - s$ represent the same quantity. Which is that quantity?

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33. No force is required to move a body uniformly along a straight line. Comment.

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34. A feather of mass $5g$ is dropped from a height. It is observed to fall down with a constant velocity. What is the net force acting on it?

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35. What is force ? What is inertia ? How is inertia measured ?

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36. Explain what is meant by momentum of a body. Is it a scalar or a vector? What are its units?

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37. Derive the relation $F = ma$, where the symbols have their usual meanings.

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38. Discuss briefly Gelileo's ideas about motion.

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39. State Newton's third law of motion and principle of conservation of momentum.

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40. Eastablish relation between inertia and mass.

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41. Explain the use of seat belts of cars.

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42. Explain why a player lowers his hands while catching a cricket ball.

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43. Why does a gun recoil on firing? Obtain an expression for recoil velocity of gun.

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44. A car weigh $1500kg$. Its speed time graph is shown in (figure). Calculate the force required at the end of $5\,\mathrm{sec}\,onds$ to bring the car to a stop within one second.

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Long Answer Questions

1. Using second law of motion, derive the relation between force and acceleration. A

bullet of $10g$ strikes a sand-bag at a speed of $10^3 ms^{-1}$ and gets embedded after travelling $5cm$.Calculate

(i) the resistive force exerted by the sand on the bullet (ii) the time taken by the bullet to come to rest.

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2. Derive the unit of force using the second law of motion. A force of $5N$ produces an acceleration of $8ms^{-2}$ on a mass m_1 and an

acceleration of $24ms^{-2}$ on a mass m_2. What acceleration would the same force provide if both the masses are tied together?

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3. What is momentum? Write its SI unit. Interpret force in term of momentum. Represent of the following graphically

(a) momentum versus velocity when mass is fixed.

(b) momentum versus mass when velocity is constant.

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4. State `Newton's three law of motion.

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5. state Newton's first law of motion. Hence define forece and inertia.

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

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7. Give atleast four applications of Newton's second law of motion.

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8. State and explain Newton's third law of motion. How will you prove it experimentally?

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

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10. Explain briefly any three applications of Newton's third law of motion.

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Very Short Answer Questions

1. What is the SI unit of force?

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2. Is force a scalar or Vector?

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3. What are balanced forces?

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4. Can balanced forces move a body at rest?

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5. Can balanced forces stop a mooving body?

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6. Can balanced forces change the shape and size of a body?

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7. What are unbalanced forces?

 Watch Video Solution

8. When we talk of force acting on a body, do we mean unbalanced force or balanced force?

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9. Name the unbalanced force that stops a ball rolling on the ground.

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10. A rubber ball is pressed. Which force: balanced or unbalanced, is applied?

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11. Name the property of bodies due to which they resist change in their state of rest or state of uniform motion along a straight line.

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12. On what factor does inertia of a body depend?

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13. The masses of two objects are $2kg$ and $20kg$. Which has greater inertia?

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14. What is the other name for Newton's first law of motion?

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15. When a branch of a tree is shaken, some of the fruits may fall down. Why?

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16. What is the SI unit of displacement ?

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17. Is momentum is scalar or vector?

Watch Video Solution

18. What is the total momentum of the bullet and the gun before firing?

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19. What is the total momentum of the bullet and the gun on firing?

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20. Name the physical quantity whose unit is $kgms^{-1}$.

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21. Which physical quantity corresponds to rate of change of momentum?

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22. Mass of a body is doubled. What happens to its acceleration under a given force?

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23. Are action-reaction forces simultaneous?

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24. How are action-reaction forces related in magnitude and direction?

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25. Do action reaction forces act on the same body?

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26. Do action-reaction forces produce the same magnitude of acceleration?

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27. In collision between a heavier body and a lighter body, which body experiences greater force?

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28. In the above question, which body undergoes greater change in momentum?

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29. In the above question, which body is damaged more?

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Highet Order Thinking Skills

1. When a ball is thrown upwards, its momentum first decreases and then increases. Is conservation of linear momentum violated in this process?

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2. A ball of mass $0.5kg$ moving with a speed of $10m/s$ rebounds after striking normally a perfectly elastic wall. Find the change in momentum of the ball . If contact time with the wall is $0.1s$, what force is exerted by wall?

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

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

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

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6. A hunter has a machine gun that can fire $50g$ bullet with a velocity of $150m/s$. A $60kg$ tiger springs at him with a velocity of $10m/s$. How many bullets must the hunter fire per second into the tiger in order to stop him in the track?

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Value Based Questions

1. Honey and Sunny are two friends. Both are financially well off. Honey is fond of driving an SUV while Sunny enjoys driving Tata Nano.Honey explains to Sunny the risks of driving a light vehicle and Sunny explains to Honey the cost factor.

Read the above passage and answer the following questions:

(i) With whom do you agree, with Honey or with Sunny?

(ii) Explain why?

(iii) Which values of life do you learn from this discussion?

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2. A body at rest continues to be at rest underless some external force force is applied to move it. Rather, the body at rest opposes the force that tends to move it. Left to itself, the body at rest, will never start moving. This is well known property of inertia of rest of bodies, we study in Physics. ltRead carefully

the above passage and answer the following questions:

(i) When a bus start moving suddenly, the passengers tend to fall backward. Why?

(ii) Give one more example of inertia of rest.

(iii) What values do you inculcate in life from this study?

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3. Impulse of a force measures the effect of the force. It is the product of force (F) and

time (t) for which the force acts. Mathematically, impulse $= F \times t$. It is equal to change in linear momentum of the body.

For a given change in linear momentum, $F \times t = cons\tan t$. If t increases, F decreases and vice-versa. For example, a player lowers his hands while catching a cricket ball. This would be increase t the time of catch. Therefore, F would reduce, i.e., his hands will not get hurt badly.

Read the above passage and answer the following questions:

(i)Why is crockery wrapped in straw or papers

etc.?

(ii) Why are vehicles like scooter, car, bus, trucks provided with shockers?

(iii)What message does this paragraph give you for your day to day life?

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4. The driver of a car travelling with velocity v on a road suddenly sees a broad wall in front of him at a distance r. He has two alternatives: to turn sharply or a brake instantly. The

passenger who is a professor of physics, advises him to brake to avoid collision.

Read the above passage and answer the following questions:

(i) How is the suggestion from Professor of Physics justified?

(ii)Does the suggestion work really?

(iii)What value do you learn from this experience?

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Exercise

1. what is the momentum of a man of mass $75kg$ when he walks with a velocity of $2m/s$?

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2. What would be the force required to produce an acceleration of $2m/s^2$ in a body of mass $12kg$? What would be the acceleration if the force were doubled?

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3. 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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4. 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 $2\,\mathrm{seconds}$. How much does the speed change in $2s$?

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5. A constant force acts on object of mass 5 kg for a duration of 2s It increases the object's velocity from $3m/s$ to $7m/s$ Find the magnitude of the applied force. Now if the force were applied for a duration of $5s$ what would be the final velocity of object?

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6. 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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7. A motor car is moving with a velocity of $108km/h$ and it takes $4\,\text{sec}\,ond$ 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 $1000kg$.

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8. A force of $5N$ gives a mass m_1, an acceleration of $10m/s^2$, and a mass m_2, an acceleration of $20m/s^2$. What acceleration would it give if both the masses were tied together?

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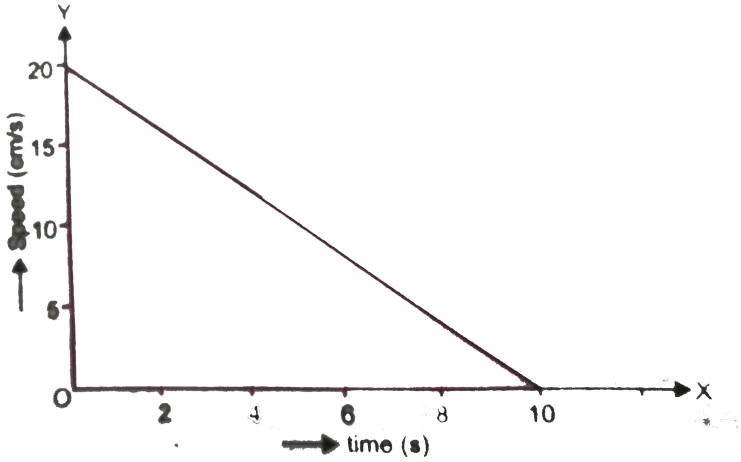
9. The velocity time graph of a ball of mass $20g$ moving along a straight line on a long table is

given in (figure) How much force does the table exert on the ball to bring it to rest?



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10. For how long should a force of $100N$ act on a body of mass $20kg$ so that it aquires a velocity of $100m/s$?

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11. A $150g$ ball travelling at $30m/s$ strikes the plam of a player's hand and is stopped in $0.06\,\text{sec}$. Calculate the force exerted by the ball on the hand.

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12. A body of mass $1kg$ is kept at rest. A constant force of $6.0N$ starts acting on it. Find

the time taken by the body to move through a distance of $12m$.

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13. A force of $4N$ acts on a body of mass $2kg$ for $4s$. Assuming the body to be initially at rest, find (a) its velocity when the force stops acting (b) the distance covered in $10s$ after the force starts acting.

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14. A feather of mass $5g$ is dropped from a height. It is observed to fall down with a constant velocity. What is the net force acting on it?

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15. A bullet of mass $50g$ is fired from a gun of mass $6kg$ with a velocity of $400m/s$. Calculate the recoil velocity of the gun.

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16. 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.

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17. A boy pushes a wall with a force of $20N$. What is the magnitude and direction of the force experienced by the boy?

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18. A bullet of mass $20gram$ moving with a velocity of $300m/s$ gets embedded in a freely suspened wooden block of mass $880gram$. What is the velocity acquired by the blocks?

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19. A girl of mass 50 kg jumps out of a rowing boat of mass 300 kg on to the bank, with a horizontal velocity of 3 m/s. With what velocity does the boat begin to move backwards ?

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20. A truck of mass $2500kg$ moving at $15m/s$ collides with a car of mass $1000kg$ moving at $5m/s$ in the opposite direction . With what velocity would the two move together?

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21. A boy of mass $60kg$ running at $3/s$ jumps on to a trolley of mass $140kg$ moving with a

velocity of $1.5m/s$ in the same direction . What is their common velocity?

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22. A bullet of mass $20g$ is fired horizontly with a velocity of $150ms^{-1}$ from a pistol of maass $2kg$. What is the recoil velocity of the pistol?

A. 1.5 m/s

B. 4 m/s

C. -1.5 m/s

D. -4 m/s

Answer: C

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23. A girl of mass $40kg$ jumps with a horizontal velocity of $5m/s$ onto a stationary cart with frictionless wheels. The mass of the cart is $3kg$. What is her velocity as the cart starts moving? Assume that there is no external unbalanced force working in the horizontal direction.

A. 100/43 m/s

B. 200 m/s

C. 200/43 m/s

D. NONE

Answer: C

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24. Two hockey players of opposite teams, while trying to hit a hockey ball on the ground collide and immediately become entangled.

Once has a mass of $60kg$, and was moving with a velocity $5 \cdot 0m/s$, while the other has a mass of $55kg$ and was moving faster with a velocity of $6 \cdot 0m/s$ towards the first player. In which direction and with what velocity will they move after they become entangled? Assume that the frictional force acting between the feet of the two players and ground is negligible.

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Oral Testing

1. In a tug of war, the rope does not move in any direction. Why?

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2. When the engine of a moving car is switched off, it stops after travelling some distance. Does it violate Newton`s first law?

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3. When a car rounds a curve suddenly, what happens to a person sitting inside the car?

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4. The rate of change of .....of a body.....is ..... Proportional to the .....applied. Fill in the blanks.

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5. A cushioned bed or a sand bed is used in the athletic event high jump. Why?

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6. The velocity of a body is doubled. What happens to its momentum?

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7. When the resultant of forces acting on a body is not Zero, what are they called?

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8. Is some force required to move a body uniformly along a circle?

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9. What are the units of linear momentum?

Watch Video Solution

10. Newton's first law.....force and Newton's second law gives us a .....of force. Fill in the blanks.

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11. Which law tells us about the nature of force?

Watch Video Solution

12. Are the force of action and reaction always equal in magnitude?

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13. A boat is pushed away from the river bank when a sailor jumps from the boat to the bank. Why?

Watch Video Solution

14. While putting out fire, the fire men have hold the hose pipe tightly. Why?

Watch Video Solution

15. Why should a gun be held tightly against the shoulder, while firing?

Watch Video Solution

16. Why is it difficult to walk on a slippery road?

Watch Video Solution

17. What is meant by recoiling of a gun?

Watch Video Solution

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

Watch Video Solution

19. What is the linear momentum of the rocket and escaping gases on firing?

Watch Video Solution

20. Recoil velocity of gun is much smaller than the velocity of bullet. Why?

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Quiz Testing

1. (a) What are balances forces?

(b)What are unbalances forces?

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2. (a)Which forces- balanced or unbalanced can change the state of a body?

(b)what is measure of inertia of a body in linear motion?

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3. (a)which has more inertia: a five rupee coin or a one rupee coin?

(b) You are given a rubber ball and a stone of same size. Which one has greater inertia?

Watch Video Solution

4. (a)What is linear momentum of a heavy object at rest?

(b)what force is required to maintain uniform motion of a body along a straight lline?

Watch Video Solution

5. (a)When a galloping horse stops suddenly, what happens to the riders and why?

(b)Why do some of the leaves get deatched from a tree when we shake its branch vigorously?

Watch Video Solution

6. (a)What wii be the percentage change in momentum of a body when both its mass and velocity are doubled?

(b)A force of $200N$ is required just to move a table floor at a constant speed. What is the frictional force exerted by the floor on the table?

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7. (a)Forces of action and reaction are always equal and opposite. Is it true?

(b)Do forces of action and reaction act on the same body or on two different bodies?

Watch Video Solution

8. (a)Do the forces of action and reaction cancel eachother?

(b)Do the forces of action and reaction alwys produce accelerations of same magnitude?

Watch Video Solution

9. (a)Forces of action and reaction are named arbitrarily. It is true?

(b)Force of reaction appears after sometime of the force of action. It is true?

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10. (a)What is essential condition for the validity of the law of conservation of linear momentum?

(b)In any collision, is total energy conserved?

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11. (a)What is the total linear momentum of a bullet and the gun on firing?

(b)Which law can account for swimming ?

Watch Video Solution

12. (a)What is meant by an isolated system?

(b)Out of mass, speed and momentum, which quantity is same for bullet and the gun on firing?

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Worksheet Testing

1. A hockey ball of mass $200g$ travelling from west to east at $10m/s$ is struck by a hockey stick. As a result, the ball gets turned back and now has a speed of $5m/s$. If the ball and hockey stick were in contact for $0.2s$, Calculate

(i) initial and final momentum of the ball

(ii) rate of change of momentum of the balll

(iii) force exerted by hockey stick on the ball.

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2. A stone of mass $500g$ is thrown with a velocity of $20ms^{-1}$ across the frozen surface of a lake. It comes to rest after travelling a distance of $10 \cdot 1km$. Calculate force of friction between the stone and frozen surface of lake.

Watch Video Solution

3. A body starts from rest and rolls down a hill with a constant acceleration. If it travels $400m$

in $20\,\text{sec}\,onds$, Calcualte the force acting on the body if its mass is $10kg$.

Watch Video Solution

4. A force of $2N$ gives a mass m_1 an acceleration of $5m/s^2$ and a mass m_2 an acceleration of $7m/s^2$. What acceleration would be produced if both the masses are tied together?

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5. From a rifle of mass $5kg$, a bullet of mass $50g$ is fired with an initial velocity of $108km/h$. Calculate initial recoil velocity of the rifle.

Watch Video Solution

6. Two object A and B are moving along the same straight line in opposite directions with velocities $10m/s$ and $5m/s$ respectively. They collide during which they stick to each other. If mass of A is $1.5kg$ and mass of B is $1kg$, what is the velocity of the combinations?

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7. A man weighing $60kg$ runs along the rails with a velocity of $18km/h$ and jumps into a car of mass 10 quintal standing on the rails. Calculate the velocity with which the car will start travelling on the rails .

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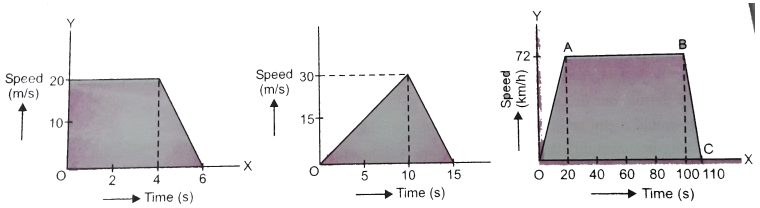
8. A bullet of mass $7g$ is fired into block weighing $7kg$, which is free to move. Calculate initial velocity of bullet if the velocity of the block with the bullet inside is $0.7m/s$.

Watch Video Solution

9. The speed time graph of a body of mass $50kg$ is shown in (figure). Calculate the force acting in the body

(i)from 0 to $4s$ (ii)from 4 to $6s$



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10. A body of mass $10kg$ starting from rest, accelerates uniformly to a speed of $30m/s$ in $10s$. Brakes are applied and the body stops in next $5\,\text{sec}\,onds$, (figure). Calculate the accelerating force and the stopping force

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11. A car of mass $1 metric$ ton starts from rest and accelerates to a speed of $72 km/h$ in $20\,\text{sec}$. It then moves with a constant velocity for $80\,\text{sec}$. And is bought to rest in next $10\,\text{sec}$, (figure). Caculate the force acting on the car from (i) 0 to $20\,\text{sec}$ (ii) 20 to $100\,\text{sec}$ (iii) 100 to $110\,\text{sec}$

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Assesssment Through Paper Pen Test

1. The law that defines force and inertia is

A. Newton's 1st law

B. Newton's 2nd law

C. Newton's 3rd law

D. none of the above.

Answer: A

 Watch Video Solution

2. Momentum of a body of mass $4kg$ is $24kgms^{-1}$ under a force of $250N$?

A. $96m/s$

B. $6m/s$

C. $24.2m/s$

D. none of the above.

Answer: B

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3. What mass of a body can attain an acceleration of $5ms^{-2}$ under a force of $250N$?

A. $5kg$

B. 250kg

C. $50kg$

D. $10kg$

Answer: C

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4. Inertia of a body in linear motion is measured by its

A. velocity

B. momentum

C. mass

D. none of the above.

Answer: C

Watch Video Solution

5. Newton's second law of motion gives us

A. definition of inertia

B. definition of force

C. measure of force

D. none of the above.

Answer: C

 Watch Video Solution

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

A. inertia of rest

B. inertia of direction

C. inertia of motion

D. none of the above.

Answer: B

Watch Video Solution

7. A body of mass $2kg$ moving with a velocity of $10m/s$ is brought to rest in $5\,\text{sec}$. Calculate the stopping force applied.

Watch Video Solution

8. A moving body can be stopped by a force F in time t. How much force will be needed to stop the body in half the time, when its momentum is doubled?

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9. 'An unbalanced external force is needed to initiate the motion from state of rest but no unbalanced net force is needed to sustain the uniform motion.' Read the statement made by Galileo and justify

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10. A body at rest oppose the forces which try to move it. What is this property called? Give at least one example.

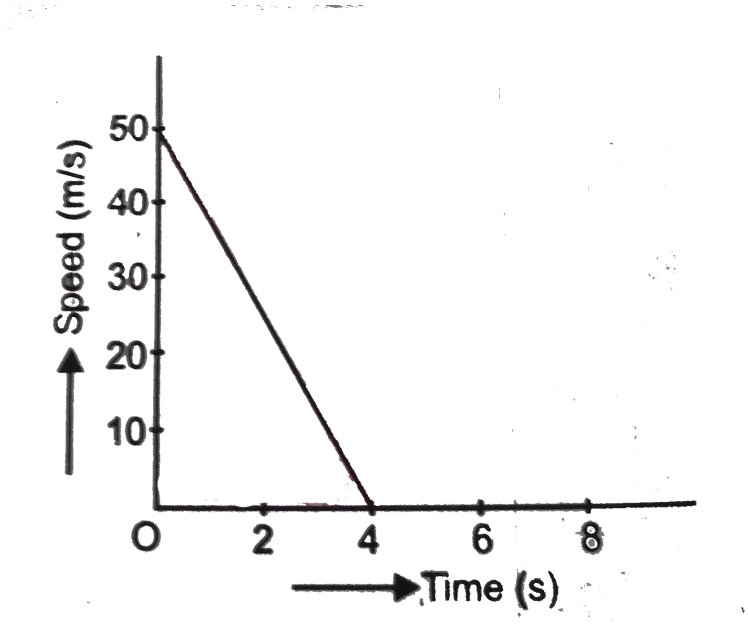
Watch Video Solution

11. Newton's first law of motion defines force and Newton's second law of motion gives us a measure of force. Comment.

Watch Video Solution

12. The speed time graph of a ball of mass $30g$ moving along a straight line is shown in (figure). Calculate the opposing force that

brings the ball to rest.



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13. (a)In 'high jump' event the athletes are made to fall on a cushioned bed. Why?

(b)What is the use of seat belts in cars?

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

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15. Principle of conservation of linear momentum is deduced from

A. Newton's 1st law

B. Newton's 2nd law

C. Newton's 3rd law

D. none of the above.

Answer: C

Watch Video Solution

16. The forces of action and reaction are

A. always equal only

B. always equal and opposite

C. always equal but in same direction

D. always unequal and opposite

Answer: B

Watch Video Solution

17. The action and reaction forces act

A. on different bodies always

B. on same body always

C. on same body sometime,

D. on different bodies, sometimes

Answer: A

Watch Video Solution

18. The force of action and reaction

A. always cancel each other

B. never cancel

C. cancel sometimes

D. can not say

Answer: B

Watch Video Solution

19. The action and reaction forces act on

A. bodies at rest only

B. bodies in uniform motion only

C. bodies in uniformly accelerated motion

D. two bodies irrespective of their positions and state of motion//rest.

Answer:

Watch Video Solution

20. Recoil velocity of gun is

A. equal to velocity of bullet

B. much greater than velocity of bullet

C. much smaller than velocity of bullet

D. can not say

Answer: C

Watch Video Solution

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

Watch Video Solution

22. While putting out fire, the fire men have hold the hose pipe tightly. Why?

Watch Video Solution

23. A bullet of mass $50g$ is fired with an velocity of $150m/s$. If the rifle weights $3kg$. What is its recoil velocity?

Watch Video Solution

24. 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

25. A body of mass $1.5kg$ moving with a velocity of $10m/s$ encounters another body of mass $2.5kg$ moving in opposite direction with a velocity of $16m/s$, and they stick to eachother. What is the velocity of combination?

View Text Solution

26. A car and a truck moving with the same velocity in opposite directions collide and

collision lasts for $2s$.

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

(ii) Which vehicle has the smaller change in momentum?

(iii) Which one undergoes greater acceleration?

(iv) Which one is pushed farther?

(v) Which one is likely to suffer more damage?

Watch Video Solution

27. An object moves under the action of a force such that distance (s) moved by it varies directly as the cube of time taken (t). What is the nature of acceleration of the object? Is it moving under a constant force?

Watch Video Solution

28. 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.

Watch Video Solution

29. State and explain the principle of conservation of linear momentum. Establish the same using Newton's third law of motion.

Watch Video Solution

Multiple Choice Questions

1. The forces of action and reaction are

A. always equal only

B. always opposite only

C. always equal and opposite

D. can not say

Answer: C

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2. The forces of action and reaction act on

A. two different bodies always

B. same body

C. two different bodies sometimes

D. can not say

Answer: A

Watch Video Solution

3. In walking, force of action is provided by

A. backward push on the ground by our foot

B. push of ground on our foot

C. either (a) and (b)

D. neither (a) or (b).

Answer: A

Watch Video Solution

4. A spring balance A is suspended vertically from a rigid support. Another spring balance B is suspended from the hook of A. Now, a weight of $1kg$ is suspended from hook of B The readings of balances A and B would be

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

B. $2kg$ each

C. $1kg$ each

D. none of the above.

Answer: C

Watch Video Solution

5. Walking becomes difficult, When the ground is covered with snow or sand this is because

A. ground become slippery

B. our foot can exert much smaller force in the from of backward action

C. either (a) and (b)

D. neither (a) or (b).

Answer: B

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6. A body of mass $1kg$ is moving along a straight line with a velocity of $1m/s$. The external force acting in the body is

A. $1N$

B. 1 dyne

C. $1J$

D. zero

Answer: D

Watch Video Solution

7. A body of mass $1kg$ is moving with a uniform speed of $1m/s$ in a circular path of radius $1m$. The external force acting on the body is

A. $1N$

B. 1 dyne

C. $1J$

D. zero

Answer: A

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8. In Ques.7, acceleration of the body is

A. $1m/s$

B. $1m/s^2$

C. $1m$

D. zero

Answer: B

Watch Video Solution

9. In Ques.8, the direction of acceleration is

A. away from the centre

B. along the tangent to the circle

C. towards the centre and along the radius of the circle

D. variable

Answer: C

Watch Video Solution

10. A swimmer swims due to

A. forward push of water on the swimmer

B. buoyancy of water

C. either (a) and (b)

D. neither (a) or (b).

Answer:

Watch Video Solution

11. A gun recoils on firing. This is due to

A. force of reaction exerted by the bullet on the gun

B. force exerted by the gun on the bullet

C. either (a) and (b)

D. neither (a) or (b).

Answer: A

Watch Video Solution

12. Velocity of recoil of gun is much smaller than the velocity of bullet. This is beaacuse

A. gun is much heavier than the bullet

B. gun is held tightly

C. either (a) and (b)

D. neither (a) or (b).

Answer: A

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13. What is the total momentum of the bullet and the gun before firing?

A. positive

B. negative

C. zero

D. can not say

Answer: C

Watch Video Solution

14. Total momentum of gun and bullet before firing is

A. positive

B. negative

C. zero

D. can not say

Answer: C

Watch Video Solution

15. A gun fires a bullet with a speed of $400m/s$. What is recoil velocity of the gun if its mass is 200 times the mass of the bullet?

A. $4m/s$

B. $2m/s$

C. $8m/s$

D. can not say

Answer: B

Watch Video Solution

16. When a sailor jumps from a boat to the river bank?

A. boat is pushed away from the bank

B. boat is pushed towards the bank

C. either (a) and (b)

D. neither (a) or (b).

Answer:

Watch Video Solution

17. Flying of rockets and jet planes is explained on the basis of

A. Newton's 3rd law of motion

B. principle of conservation of linear momentum

C. either (a) and (b)

D. neither (a) or (b).

Answer: C

Watch Video Solution

18. While extinguishing fire, the fireman has hold the hose pipe very strongly. This is because as water rushes out at a great speed

A. the hose pipe tends to move backward due to strong force of reaction

B. the hose pipe exerts huge pressure in the forward direction

C. either (a) and (b)

D. neither (a) or (b).

Answer: A

Watch Video Solution

19. When reasultant of all forces acting on a body is zero, the forces are called

A. unbalanced forces

B. balanced force

C. neither (a) nor (b)

D. either (a) or (b)

Answer: B

Watch Video Solution

20. A ball set roilling on the ground stops after sometime. This is due to

A. unbalanced force of friction

B. unbalance force of air resistance

C. both (a) and (b)

D. neither (a) or (b).

Answer: C

Watch Video Solution

21. Which of the following statement is not correct for an object moving along a straight path in an accelerated motion?

A. Its speed keep changing

B. Its velocity always changes

C. It always goes away from the earth

D. A force is always acting it

Answer: C

Watch Video Solution

22. According to the third law of motion , action and reaction

A. always act on same body

B. always act on different bodies in opposite directions

C. have same magnitude and directions

D. acts on either body at normal to each other

Answer: B

Watch Video Solution

23. A goalkeeper in a game of football pulls his hands backwards while holding the ball shot at the goal. This enables the goalkeeper to

A. exert larger force of ball

B. reduce the force exerted by the ball on hands

C. increae the rate of change of momentum

D. decrease the rate of change of momentum

Answer: B::D

Watch Video Solution

24. The inertia of an object tends to cause the object

A. to increase its speed

B. to decrease its speed

C. to resist any change in its state of rest or motion

D. to decrease due to friction

Answer: C

 Watch Video Solution

25. A passenger in a moving train tosses a coin which falls behind him. It means that motion of the train is

A. accelerated

B. uniform

C. retarted

D. along circular tracks

Answer: A

 Watch Video Solution

26. An object of mass $2kg$ is sliding with a constant velocity of $4ms^{-1}$ on a frictionless horizontal table. The force required to keep the object moving with the same velocity is

A. 32N

B. 0 N

C. 2N

D. 8N

Answer: B

Watch Video Solution

27. Rocket works on the principle of coservation of

A. mass

B. energy

C. momentum

D. velocity

Answer: C

Watch Video Solution

28. A water tanker filled up to $\frac{2}{3}$ of its height is moving with a uniform speed. On sudden application of the brake, the water in the tank would

A. move backward

B. move forward

C. be unaffected

D. rise upwards

Answer: B

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Mock Test

1. What force is required to move a body of mass $1kg$ with a uniform velocity of $1m/s$?

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2. A feather of mass $2gram$ is falling vertically downwards with a constant velocity. What is the net force acting on it?

Watch Video Solution

3. When a heavy body collides with a light-body, which one experience greater force?

Watch Video Solution

4. Though action and reaction forces are always equal in magnitude, yet they may not produce acceleration of equal magnitude. Why?

Watch Video Solution

5. A person manages to push a car of mass $800kg$ with a uniform velocity along a level road. When another person joins him and pushes the car with an equal force, the

acceleration produced is $0.5m/s^2$. Calculate the force with which each person pushes the car.

Watch Video Solution

6. A ball of mass $200g$ falls from a height of $80cm$. If $g = 10m/s^2$, what momentum is transferred to the floor by the ball? Assume that the ball does not rebound.

Watch Video Solution

7. A gun fires a shell of mass $1.5kg$ with a velocity of $150m/s$ and recoils with a velocity of $2.5m/s$. Calculate the mass of gun?

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8. While firing, a gun man has to hold the gun tightly against his shoulder. Why?

Watch Video Solution

9. A body at rest oppose the forces which try to move it. What is this property called? Give at least one example.

Watch Video Solution

10. A machine gun fires $25g$ bullets at the rate 600 bullets per minute with a speed of $400m/s$. Calculate the force required to keep the gun position

Watch Video Solution

11. A force of $2N$ acts for $5\,\text{sec}\,onds$ on a particle of mass $0.5kg$ initially at rest. Calculate the distance moved by the particle in (i) these five seconds and (ii) next $5\,\text{sec}\,onds$

Watch Video Solution

12. 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.

Watch Video Solution

13. Seat belts in cars are called safety belts. Why?

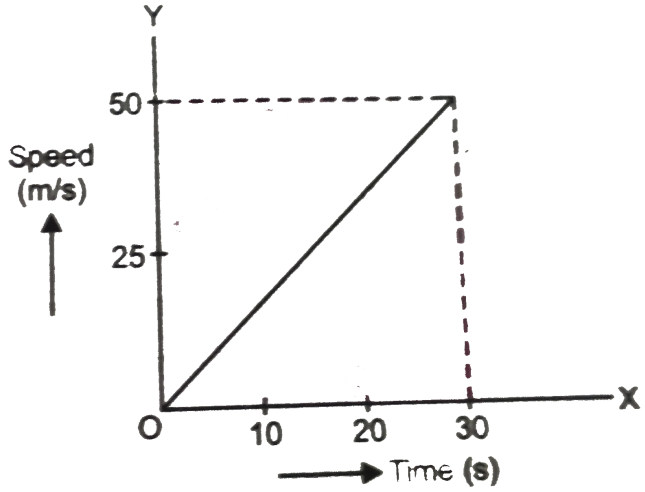
Watch Video Solution

14. A person strikes a nail with a hammer of mass $500g$ moving with a velocity of $10m/s$. The hammer comes to rest in $0.01s$ after striking the nail. Calculate (i) force exerted by the hammer on the nail (ii) distance moved by the nail into the plank.

Watch Video Solution

15. The speed time graph of a body of mass $300g$ is shown in (fugure). Calculate the force

actiong on the body.



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16. A hunter has a machine gun that can fire $50g$ bullet with a velocity of $150m/s$. A $60kg$ tiger springs at him with a velocity of $10m/s$. How many bullets must the hunter fire per

second into the tiger in order to stop him in the track?

Watch Video Solution

17. Two friends on roller-skates are standing $5m$ apart facing eachother. One of them throws a ball of $2kg$ towards the other, who catches it. How will this activity affect the position of the two? Explain your answer.

Watch Video Solution

18. It is a common experience that to initiate motion in a body at rest, force required is much greater than the force required to maintain the motion. Read the above passage and answer the following question:

(i) Do you agree with the statement?

(ii) How do you justify the statement?

(iii) What values of day to day life do you learn from this?

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19. A bullet of $10g$ strikes a sand bag at a speed of $10^3 m/s$ and gets enbedded after a travelling $5cm$. Calculate

(i) the resistive force exerted by sand on the bullet

(ii) the time taken by the bullet to come to rest.

Watch Video Solution

20. Derive the relation $F = ma$, where the symbols have their usual meanings. What is one newton?

Watch Video Solution

21. State Newton's third law of motion and principle of conservation of momentum.

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22. A railway carriage of mass $10g$ 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 with a velocity of $1.67m/s$ in the same direction. Determine the velocity of the second object.

Watch Video Solution

23. 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.

Watch Video Solution

24. (i) 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 $10m/s^2$.

(b) A girl of mass $40kg$ running at a speed of $5m/s$ horizontally jumps onto a stationary cart with frictionless wheels. The mass of the cart is $3kg$. What is her velocity as the cart starts moving?

Watch Video Solution

25. In a tug of war, when the rope does not move in any direcion, the net force is

A. Zero

B. low

C. high

D. can not say

Answer: A

Watch Video Solution

26. When we stops pedalling a bicycle we are riding, the bicycle beigns to slow. This is because

A. We stop applying force

B. of unbalanced force of friction between the tyres and the road

C. either (a) and (b)

D. neither (a) or (b).

Answer: B

Watch Video Solution

27. The function of mud guard is based on

A. inertia of rest

B. inertia of motion

C. inertia of direction

D. none of the above.

Answer: C

Watch Video Solution

28. The SI units of rate of change of momentum are

A. $kg - m$

B. $kg - ms$

C. $kgms^{-1}$

D. newton

Answer: D

Watch Video Solution

29. Which of the following statements is not true in respect of forces of action and reaction?

A. They are always equal

B. they are always opposite

C. They can cancel each other

D. none of these

Answer: C

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30. The force of action and reaction cannot cancel eachother because

A. they are unequal

B. they act in same direction

C. they act upon different bodies

D. none of these

Answer: C

Watch Video Solution

31. A body moving along a straight line is brought to rest in $2\,\text{sec}$ by a force F_1 and in $3\,\text{sec}$. By a force F_2 the ratio F_1 / F_2 is

A. $2:3$

B. $1:1$

C. $3:2$

D. $9:4$

Answer: C

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32. The momentum of a person weighing $60kg$ walking with a velocity of $2m/s$ is

A. $60N - s$

B. $300N - s$

C. $120kgm/s$

D. none of these.

Answer: C

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33. Which of the following can be explained on the basis of Newton's third law?

A. catching a cricket ball

B. high jump

C. person jumping out of speeding train

D. case of hose pipe

Answer: D

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34. Though the force of action and reaction are equal and opposite, yet the acceleration produced by them may be of different magnitudes. Why?

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35. A body of mass $5kg$ is moving along a circle of radius $1m$ with a uniform speed of $5m/s$. The external force acting on the body is

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36. A body of mass $5kg$ is moving along a circle of a radius $1m$ with a uniform speed of 5 $\frac{m}{s}$ .What is the acceleration of body?

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