



# PHYSICS

## BOOKS - MBD -HARYANA BOARD

### FORCE AND LAWS OF MOTION

#### Example

1. Which of the following has more inertia :  
rubber ball and a stone of the same size ?



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2. Which of the following has more inertia : a bicycle and a train ?



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3. Which of the following has more inertia : a five rupees 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  $4\text{kg}$ , a bullet of mass  $50\text{g}$  is fired with an initial velocity of  $35\text{m/s}$ . Calculate the initial recoil velocity of the rifle.



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

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.** When a carpet is beaten with a stick, dust comes out of it, Explain.



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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.

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

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

**Answer:**



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**15.** 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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**16.** A stone of 1 kg is thrown with a velocity of  $20\text{ms}^{-1}$  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 8,000 kg engine pulls a train of 5 wagons, each of 2,000 kg along a horizontal track. If the engine exerts a force of 40,000 N and track offers a force of friction of 5,000 N, then calculate the : net accelerating force.



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**18.** A 8,000 kg engine pulls a train of 5 wagons, each of 2,000 kg along a horizontal track. If the engine exerts a force of 40,000 N and

track offers a force of friction of  $5,000\text{ N}$ , then calculate the acceleration of the train.



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**19.** A  $8000\text{ kg}$  engine pulls a train of  $5$  wagons, each of  $2000\text{ kg}$ , along a horizontal track. If the engine exerts a force of  $40000\text{ N}$  and the track offers a frictional force of  $5000\text{ N}$ , 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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**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  $1.7 \text{ m s}^{-2}$ ?



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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.  $c(1)(2)mv^2$

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  $1\text{kg}$  travelling in a straight line with a velocity of  $10\text{m/s}$  collides with, and sticks to, a stationary wooden block of mass  $5\text{kg}$ . 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  $100\text{kg}$  is accelerated uniformly from a velocity of  $5\text{m/s}$  to  $8\text{m/s}$  in  $6\text{s}$ . 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  $10\text{kg}$  transfer to the floor if it falls a height of  $80\text{cm}$ ? Take its downward acceleration to be  $10\text{m} / \text{s}^2$ .



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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.** What is the distance OA for the square shown in figure :-



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**33.** Two persons manage to push a motorcar of mass  $1200\text{kg}$  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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**34.** 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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**35.** 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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**36.** What is a force? Explain with the help of some examples.



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**37.** State and explain Newton's first law of motion.



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**38.** What are emulsions ? What are their different types ? Give an example of each type ?



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**39.** State Newton's second law of motion. How does it help to measure force? Also state the units of force.



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**40.** Newton's Second Law OF Motion



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



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**42.** What is meant by the Law of Conservation of Momentum ? Deduce this law mathematically with the help of Newton's second and third law of motion.



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**43.** What is force ? Give its units.



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**44.** Why does the horse rider falls forward when a horse at full gallop stops suddenly ?



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**45.** When a horse suddenly gallops, the rider falls backward. Why ?





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**46.** Why does a passenger fall forward when he alights from the moving bus ?



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**47.** Define momentum of a body.



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**48.** A fast moving bullet when hits the window pane makes a round hole while a stone strikes and shatters it, why ?



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**49.** Explain how a dirty blanket becomes dust free if it is jerked once or twice ?



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**50.** Why a fan continues to rotate for sometime even after it is switched off ?



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**51.** Why does a gun recoil When a bullet is fired ?



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



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**53.** What is a balanced and unbalanced force?



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**54.** Find the acceleration produced by a force of 5 N acting on a mass of 1 kg ?



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55. How much force will be required to produce an acceleration of  $4ms^{-2}$  in a ball of mass 6 kg ?



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56. A bullet of mass  $m$  moving with velocity  $v$  strikes a block of mass  $M$  at rest and gets

embedded into it. The kinetic energy of the composite block will be



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**57.** A motor car is moving with a velocity of  $108\text{ km/h}$  and it takes  $4\text{ second}$  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  $1000\text{ kg}$ .



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58. 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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59. 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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**60.** From a rifle of mass 5000 g a bullet of 20 g is fired with a velocity of  $500\text{ms}^{-1}$  with respect to the ground. Find the velocity of recoil of the rifle.



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**61.** To bring a body into motion, what is required to be done ?



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**62.** Why does an object released from the hand , fall on the earth ?



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**63.** Which type of force is required to change the direction of motion of the body - a balanced or unbalanced force ?



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**64.** Why does a body stop after rolling down for some time ?



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**65.** Which scientist postulated the three laws of motion ?



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



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**67.** Of heavy and light objects, which have more inertia ?



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**68.** What is the S.I unit of momentum ?



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**69.** Why is talcom powder sprinkled on carrom board while playing ?



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**70.** Why does an athlete run before taking a high jump ?



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71. What is law of conservation of momentum ?



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72. A bus and a ball are moving with the same speed. To stop which one would require more force ?



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73. 1 kg wt is equal to



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74. 1 newton is equal to how many kg wt ?



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