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## PHYSICS

# BOOKS - S CHAND PHYSICS (HINGLISH)

# FORCE AND LAWS OF MOTION

Solved Examples

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



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

A. 52 N

B. 24 N

C. 12 N

D. NONE

Answer: B





- 3. What is acceleration produced by a force of
- 12 newton exerted on an object of mass 3kg ?

A. 
$$1m/s^2$$

- $\mathsf{B.}\,4m\,/\,s^2$
- C.  $2m/s^2$
- D.  $5m/s^2$

#### Answer: B



**4.** Calculate the force required to impart a car a velocity of 30m/s, in 10 seconds. The mass of the car is 1500kg

A. 1000N

 $\mathsf{B.}\,4500N$ 

 $\mathsf{C.}\,3000N$ 

 $\mathsf{D.}\,6500N$ 

Answer: B

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  $5 \sec onds$  to bring the car to a stop

#### within one second?



**6.** 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)



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



8. Which would require a greater force accelerating a 10 g mass at 5 m/  $s^2$  or 20 g mass at 2 m/ $s^2$ ?

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**9.** A bullet of mass 10 g is fired from a gun of mass 6 kg with a velocity of 300 m/s. Calculate the recoil velocity of the gun.

8 kg 7 300 m/ A. 0.5 m/s

B.1 m/s

C. 10 m/s

D. 5 m/s

Answer: A

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

After collision the velocity of car A becomes 20

m/s. Calculate the velocity of car B after the

#### collision.



**11.** A bullet of mass 10 g moving with a velocity of 400 m/s gets embedded in a freely suspended wooden block of mass 900 g. What is the velocity acquired by the block?



#### A. 44 m/s

#### B. 4.4 m/s

C. 0.44 m/s

D. 440 m/s

#### Answer: B

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1. What name is given to the product of mass

and velocity of a body?

2. Name the physical quantity which is considered to be a measure of the quantity of motion of a body

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## 3. The SI unit of momentum is

A. kg-m/s

B. gm-cm/s

C. gm-cm/min

D. kg-cm/s

#### Answer: A



## 4. State whether momentum is scalar or

vector.

5. What is the total momentum of the bullet

and the gun before firing?

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# 6. Name the physical quantity whose unit is

 $kgms^{-1}$ .

7. What will be the momentum of a body of

mass 'm` which is moving with a velocity

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8. What is the usual name of the forces which cannot produce motion in a body but only change its shape ?

**9.** Name the unbalanced force which slows down a moving bicycle when we stop pedalling it.



10. State whether the following statement is

true or false

Unbalanced forces acting on a body change its

shape.



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



12. Name the property of bodies (or objects) to

resist a change in their state of rest or of motion.



13. What is the other name for Newton's first

law of motion?

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**14.** The mass of object A is 6 kg whereas that of another object B is 34 kg. Which of the two objects, A or B, has more inertia ?

15. Name the scientist who gave the laws of

motion.

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16. State whether force is a scalar or a vector

quantity.

**17.** With which physical quantity should the speed of a running bull be multiplied so as to obtain its momentum ?



**18.** Fill in the following blanks with suitable words:

(a) ..... is a measure of the inertia of a body.

(b) When a running car stops suddenly, the passengers are jerked .....

(c) When a stationary car starts suddenly, the

passengers are jerked....

(d) Newton's first law of motion is also called Galileo's law of....

(e) If there were no unbalanced force of.... and no...... resistance, a moving bicycle would go on moving for ever.

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**19.** It is easier to stop a tennis ball than a

cricket ball moving with the same speed. Why?





# **20.** Explain the meaning of the following equation:

p=m imes v

where symbols have their usual meanings.

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21. Explain how, a karate player can break a pile

of tiles with a single blow of his hand.

22. Calculate the momentum of a toy car of

mass 200 g moving with a speed of 5 m/s.



**23.** What is the change in momentum of a car weighing 1500 kg when its speed increases from 36 km/h to 72 km/h uniformly?

A. 1500 kg.m/s

B. 10000 kg.m/s

C. 15000 kg.m/s

D. 500 kg.m/s

Answer: C

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## 24. A body of mass 25 kg has a momentum of

125 kg.m/s. Calculate the velocity of the body.

**25.** Calculate the momentum of the following:

(a) an elephant of mass 2000 kg moving at 5 m/s

(b) a bullet of mass 0.02 kg moving at 400 m/s



An elephant of mass 2000 kg moving at a speed of 5 m/s



A bullet of mass 0.02 kg moving at a speed of 400 m/s



**26.** Which of the two, balanced forces or unbalanced forces, can change the shape of an

object ? Give an example to illustrate your

answer.



**27.** Describe the term 'inertia' with respect to

motion.

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**28.** On what factor does the inertia of a body depend ? Which has more inertia, a cricket ball





29. A person in a bus tends to fall backward,

when it starts suddenly?

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30. Why does a person in a bus tends to fall

forward when it stops suddenly?

31. When a carpet is beaten with a stick, dust

comes out of it, Explain.



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#### 32. When a branch of a tree is shaken, some of

the fruits may fall down. Why?

33. Explain why, it is dangerous to jump out of

a moving bus.

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**34.** What is the momentum in kg.m/s of a 10 kg car travelling at (a) 5 m/s (b) 20 cm/s, and (c) 36 km/h?

**35.** (a) Define momentum of a body. On what factors does the momentum of a body depend ?

(b) Calculate the change in momentum of a

body weighing 5 kg when its velocity

decreases from 20 m/s to 0.20 m/s.

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**36.** (a) Define the term 'force'.

(b) State the various effects of force.





- **37.** Give one example each where:
- (a) a force moves a stationary body.
- (b) a force stops a moving body
- (c) a force changes the speed of a moving body.
- (d) a force changes the direction of a moving body
- (e) a force changes the shape (and size) of a body.

**38.** (a) What do you understand by the terms "balanced forces" and "unbalanced forces" ? Explain with examples.

(b) What types of forces-balanced or unbalanced-act on a rubber ball when we press it between our hands ? What effect is produced in the ball ?

39. (a) What happens to the passengers travelling in the bus when the bus takes a sharp turn ? Give reasons for your answer.
(b) Why are road accidennts at high speeds very much worse than road accidents at low speeds ?



**40.** When a tooothpaste tube is squeezed, its shape changes. The force responsible for this is an example off :

A. balanced forces

B. centripetal forces

C. unbalanced force

D. centrifugal force

#### Answer: a

**41.** The inertia of an object tends to cause the object

A. to increase its speed

B. to decrease its speed

C. to resist a change in its state of motion

D. to decelerate due to friction

Answer: C
42. When we talk of a force acting on a body, it

usually means:

A. electrical force

B. balanced force

C. unbalanced force

D. nuclear force

Answer: C

**43.** 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. retarded

D. along circular track

Answer: A

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

A. Newton's third law of motion

B. Newton's law of gravitation

C. Newton's first law of motion

D. Newton's second law of motion

Answer: C

**45.** A water tanker filled up to two-thirds of its tank with water is running with a uniform speed. When the brakes are suddenly applied, the water in its tank would:

A. move backward

B. move forward

C. rise upwards

D. remain unaffected

#### Answer: B





**46.** If we release a magnet held in our hand, it falls to the ground. The force which makes the magnet fall down is an example of :

A. balanced force

B. unbalanced force

C. magnetic force

D. muscular force







**47.** The inertia of a moving object depends on:

A. momentum of the object

B. speed of the object

C. mass of the object

D. shape of the object

Answer: C

**48.** When a rubber balloon held between the hands is pressed, its shape changes. This happens because :

A. balanced forces act on the balloon

B. unbalanced forces act on the balloon

C. frictional forces act on the balloon

D. gravitational forces act on the balloon

Answer: A

**49.** Which of the following effect cannot be produced by an unbalanced force acting on a body?

A. change in speed of the body

B. change in shape of the body

C. change in direction of motion of the

body

D. change in state of rest of the body

Answer: B



**50.** 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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**51.** A moving bicycle comes to rest after sometime if we stop pedalling it. But Newton's

first law of motion that a moving body should continue to move for ever, unless some external force acts on it. How do you explain the bicycle case?



52. A man throws a ball weighing 500 g vertically upwards with a speed of 10 m/s(i) What will be its initial momentum?(ii) What would be its momentum at the highest point of its flight?



53. A car is mnoving on a level road, If the driver turns off the engine of the car, the car's speed decreases gradually and ultimately it comes to a stop. A student says that two forces act on the car which bring it to a stop. What could these forces be ? Which of these two forces contributes more to slow down and stop the car?



**54.** There are two types of forces X and Y. The forces belonging to type X can produce motion in a stationary object but cannot change the shape of the object. On the other hand, forces belonging to type Y cannot produce motion in a stationary object but can change the shape of the object. What is the general name of the forces such as (a) X, and (b) Y?

55. Which physical quantity corresponds to

rate of change of momentum?



56. State the relation between the momentum

of a body and the force acting on it.

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57. What is the SI unit of force?

58. What is one Newton force?

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59. What is the relationship between force and

acceleration ?

**60.** If the mass of a body and the force acting on it are both doubled, what happens to the acceleration ?



**61.** Name the physical quantity whose unit is 'newton'.

62. Which physical principal is involved in the

working of a jet aeroplane ?

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# **63.** Name the principal on which a rocket works.



64. Is the following statement true or false :

A rocket can propel itself in a vaccum.



**65.** What is the force which produces an acceleration of  $1 \text{ m/}s^2$  in a body of mass 1 kg?

66. Find the acceleration produced by a force

of 5 N acting on a mass of 1 kg?

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**67.** A girl weighing 25 kg stands on the floor. She exerts a downward force of 250 N on the floor. What force does the floor exert on her ?

68. Name the physical quantity which makes it

easier to accelerate a small car than a large

car.



**69.** Fill in the following blanks with suitable words:

(a) To every action, there is an....and....reaction

(b) Momentum is a.....quantity. Its unit is.....

(c) Newton's second law of motion can be

written as Force=mass  $\times$  ......or Force=......of

change of.....

(d) Forces in a Newton's third law pair have equal.....but act in opposite.....

(e) In collisions and explosions, the total......remains constant, provided that no external......acts.

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**70.** Explain the meaning of the following equation :

F=m imes a

where symbols have their usual meanings.



**71.** To take the boat away from the bank of a river, the boatman pushes the bank with an oar. Why?



72. Why does a gunman get a jerk on firing a

bullet?



A gunman gets a jerk on firing a bullet.



73. If action is always equal to the reaction,

explain how a horse can pull a cart.



# **74.** Name the principal on which a rocket works.



**75.** Do action and reaction act on the same body or different bodies ? How are they related in magnitude and direction ? Are they simultaneous or not ?

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76. If a man jumps out from a boat, the boat

moves backwards. Why?

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



78. Explain why , a runner presses the ground

with his feet before he start his run.

**79.** A 60 g bullet fired from a 5 kg gun leaves with a speed of 500 m/s. Find the speed (velocity) with which the gun recoils (jerks backwards).

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**80.** A 10 g bullet travelling at 200 m/s strikes and remains embedded in a 2 kg target which is originally at rest but free to move. At what speed does the target move off ?



**81.** A body of mass 2 kg is at rest. What should be the magnitude of force which will make the body move with a speed of 30 m/s at the end of 1 s?

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**82.** A body of mass 5 kg is moving with a velocity of 10 m/s. A force is applied to it so

that in 25 seconds, it attains a velocity of 35

m/s. Calculate the value of the force applied.



**83.** A car of mass 2400 kg moving with a velocity of 20 m  $s^{-1}$  is stopped in 10 seconds on applying brakes Calculate the retardation and the retarding force.

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



### 85. How long will it take a force of 10 N to stop

a mass of 2.5 kg which is moving at 20 m/s?



86. The velocity of a body of mass 10 kg increases from 4 m/s to 8 m/s when a force acts on it for 2 s
(a) What is the momentum before the force acts?
(b) What is the momentum after the force acts ?

(c) What is the gain in momentum per second

?

(d) what is the value of the force ?

**87.** A gun of mass 3 kg fires a bullet of mass 30 g. The bullet takes 0.003s to move through the barrel of the gun and acquires a velocity of 100 m/s. Calculate:

(i) the velocity with which the gun recoils

(ii) the force exerted on gunman due to recoil of the gun.

**88.** Draw a diagram to show how a rocket engine provides a force to move the rocket upwards. Label the diagram appropriately



**89.** Name the laws involved in the following situations:

(a) the sum of products of masses and velocities of two moving bodies before and after their collision remains the same. (b) a body of mass 5 kg can be accelerated more casily by a force than another body of mass 50 kg under similar conditions (c) when person A standing on roller skates pushes another person B (also standing on roller skates) and makes him move to the right side, then the person A himself gets moved to the left side by an equal distance (d) if there were no friction and no air resistance, then a moving bicycle would go on moving for ever.



**90.** (a)State and explain Newton's second law of motion.

(b) A 1000 kg vehicle moving with a speed of 20 m/s is brought to rest in a distance of 50 metres:

(i) Find the acceleration.

(ii) Calculate the unbalanced force acting on

the vehicle.



**91.** (a) Explain why, a cricket player moves his hands backwards while catching a fast cricket ball

(b) A 150 g ball, travelling at 30 m/s, strikes the palm of a player's hand and is stopped in 0.05 second. Find the force exerted by the ball on the hand.

92. (a) State Newton's third law of motion and give two examples to illustrate the law.(b) Explain why, when a fireman directs a powerful stream of water on a fire from a hose pipe, the hose pipe tends to go backward.




**93.** (a) State the law of conservation of momentum.

(b) Discuss the conservation of momentum in

each of the following cases :

(i) a rocket taking off from ground.

(ii) flying of a jet aeroplane.



**94.** (a) If a balloon filled with air and its mouth untied, is released with in the downward

direction, it moves. Why?

(b) An acceleration truck weighing 2000 kg has

a maximum acceleration when it is carrying a

load of 2000 kg?

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**95.** The rockets work on the principle of conservation of :

**96.** 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

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**97.** The physical quantity which makes it easier to accelerate a small car than a large car ismeasured in the unit of :

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

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**99.** The unit of measuring momentum of a moving body is :

**100.** A boy of mass 50 kg standing on ground exerts a force of 500 N on the ground. The force exerted by the ground on the boy will be

A. 100 N

:

B. 200 N

C. 50000 N

D. 500 N

Answer: D



**101.** A Honda city car, a Maruti Alto car, a Tata Nano car and a Mahindra Scorpio car, all are running at the same conditions. If all these cars are hit from behined with the same force and they continue to move forward, the maximum acceleration will be produced in :





102. The acceleration produced by a force of 5

N acting on a mass of 20 kg in m/ $s^2$  is :

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103. Which of the following situations involves

the Newton's second law of motion ?

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104. To catch a fast cricket ball, a player pulls

his hands backwards. Why?

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105. Why are car seat-belts designed to stretch

somewhat in a collision ?

**106.** The troops (soldiers) equipped to be dropped by parachutes from an aircraft are called paratroopers. Why do paratroopers roll on landing ?

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107. Why would an aircraft be unable to fly on

the moon ?





**108.** Explain why it is possible for a small animal to fall from a considerable height without any injuries being caused when it reaches the ground.



**109.** A boy of mass 50 kg running at 5 m/s jumps on to a 20 kg trolley travelling in the same direction at 1.5 m/s. What is their common velocity ?

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110. 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?



**111.** A truck of mass 500 kg moving at 4 m/s collides with another truck of mass 1500 kg moving in the same direction at 2 m/s. What is their common velocity just after the collision if they move off together ?



**112.** A ball X of mass 1 kg travellingg at 2 m/s has a head-on collision with an identical ball Y at rest. X stops and Y moves off. Calculate the velocity of Y after the collision.

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113. A heavy car A of mass 2000 kg travelling at

10 m/s has a head-on collision with a sports

car B of mass 500 kg. If both cars stop dead on

colliding, what was the velocity of car B?

**114.** A man wearing a bullet-proof vest stands still on roller skates. The total mass is 80 kg. A bullet of mass 20 grams is fired at 400 m/s. It is stopped by the vest and falls to the ground. What is then the velocity of the man ?

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115. 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.



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

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



## 119. If action is always equal to the reaction,

explain how a horse can pull a cart.



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



**121.** From a rifle of mass 4kg, a bullet of mass

50g is fired with an initial velocity of 35m/s.

Calculate the initial recoil velocity of the rifle.



122. 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/sin the same direction. Determine the velocity of the second object.

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**123.** 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.



124. When a carpet is beaten with a stick, dust

comes out of it, Explain.

125. Why is it advised to tie any luggage kept

on the roof of a bus with a rope?

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**126.** 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.



**127.** 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)



**128.** 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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**129.** 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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130. 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 m $s^2$ ?



**131.** What is the momentum of an object of mass m moving with a velocity v?

A. 
$$rac{1}{2}mv^2$$

 $\mathsf{B}.\,mv^2$ 

 $\mathsf{C}.\,2mv$ 

## Answer: D



**132.** Using a horizontal force 200*N*, 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?



**133.** 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?



**134.** 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.



135. 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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**136.** 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,



**137.** 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.



**138.** 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.



**139.** 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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**140.** 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  $10m/s^2$ .



**141.** 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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**142.** Two persons manage to push a motorcar of mass1200kg 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).



**143.** 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?


**144.** 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.



**145.** 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?

