CBSE

FORCE AND LAWS OF MOTIONS WS 4

Class 09 - Science

Section A

1. A force of 5 N gives a mass m_1 an acceleration of $10ms^{-2}$ and mass m_2 an acceleration of 20 ms^{-2}. What acceleration would if give it both the masses were tied together? **[1]**

   a) 7.65 ms^{-2} b) 7.00 ms^{-2}

   c) 8.25 ms^{-2} d) 6.67 ms^{-2}

2. When no external force acts on an object, the physical quantity that remains conserved is **[1]**

   a) force b) momentum

   c) acceleration d) velocity

3. When a 12 N force acts on 3 kg mass for a second, the change in velocity is (in m/s) **[1]**

   a) 18 b) 36

   c) 2 d) 4

4. A 20 kg gun fires a bullet of mass 20 g with a velocity of 400 m/s. The action on the shoulder of the person per second by the gun is: **[1]**

   a) 8000 N b) 8 N

   c) 4000 N d) 4 N

5. According to second law of Newton, force is the cause and the outcome is: **[1]**

   a) time b) velocity

   c) momentum d) acceleration

6. Which of the following options is correct? **[1]**

   i. Force of gravity on a body is equal to the true weight of the body.

   ii. A person standing in an elevator moving downwards with constant acceleration finds his weight less than actual.

   a) Both (i) and (ii) are correct. b) Only (ii) is correct.

   c) Neither (i) nor (ii) is correct. d) Only (i) is correct.

7. A bullet of mass 10 g is fired from a rifle. The bullet tales 0.003 second to move through its barrel and leaves it with a velocity of 300 m/s. What is the force exerted on the bullet by the rifle? **[1]**

   a) 250N b) 1000 N

   c) 400N d) 200N

8. A goalkeeper in a game of football pulls his hands backwards after holding the ball shot at the goal. This enables the goalkeeper to **[1]**

a) reduce the force exerted by the ball on hands

b) exert larger force on the ball

c) increase the rate of change of momentum

d) decrease the rate of change of momentum

9. A player caught a cricket ball of mass 200 g moving at a rate 60 m/s. If the catching process completes in 0.4 s, the force of the blow exerted by the ball on the hand of the player is equal to **[1]**

a) 300 N

b) 30 N

c) 150 N

d) 3 N

10. The acceleration of a body is to be doubled from its initial value. By what factor is the acting force to be increased? **[1]**

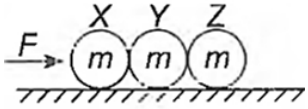
a) half

b) four

c) two

d) one

11. Three identical bodies each of mass m, are pushed by a force F on a frictionless table as shown in figure. **[1]**



a) Net force on X is F.

b) Net force on Y is equal to zero.

c) Force applied by Y on Z is equal to net force on X.

d) Force applied by X on Y is $\frac{F}{3}$.

12. **Assertion (A):** When astronauts throw something in space, that object would continue moving in the same direction and with the same speed. **[1]**

Reason (R): The acceleration of an object produced by a net applied force is directly related to the magnitude of the force, and inversely related to the mass of the object.

a) Both A and R are true and R is the correct explanation of A.

b) Both A and R are true but R is not the correct explanation of A.

c) A is true but R is false.

d) A is false but R is true.

13. **Assertion (A):** While walking on ice, one should take small steps to avoid slipping. **[1]**

Reason (R): This is because smaller steps ensure smaller friction.

a) Both A and R are true and R is the correct explanation of A.

b) Both A and R are true but R is not the correct explanation of A.

c) A is true but R is false.

d) A is false but R is true.

14. **Assertion (A):** If the net external force on the body is zero, then its acceleration is zero. **[1]**

Reason (R): Acceleration does not depend on force.

a) Both A and R are true and R is the correct explanation of A.

b) Both A and R are true but R is not the correct explanation of A.

c) A is true but R is false.

d) A is false but R is true.

15. **Assertion (A):** While catching a fast-moving cricket ball, a fielder in the ground gradually pulls his hands backwards. **[1]**

Reason (R): The fielder increases the time during which the high velocity of the moving ball decreases to zero.

a) Both A and R are true and R is the correct explanation of A.

b) Both A and R are true but R is not the correct explanation of A.

c) A is true but R is false.

d) A is false but R is true.

16. **Fill in the blanks:** **[1]**

(a) _____ are worn to prevent such accidents as they exert a force on our body to make the forward motion slower. **[1]**

17. In the given below image, the goalkeeper held his palm in the path of the moving ball to show that **[1]**

a) A force can change the speed of a moving body

b) A force can move a stationary body

c) A force can stop a moving body

d) A force can change the shape of the object

18. A gun recoiled to _____ the momentum. **[1]**

a) decrease

b) conserve

c) increase

d) change

19. The total _____ contained in a body is called momentum. **[1]**

a) Muscle

b) momentum

c) fat

d) motion

20. The correct statement about the object moving along a straight path with an accelerated motion is **[1]**

A. Its velocity keeps changing

B. Its speed keeps changing

C. A force is always acting on it

D. Its mass keeps on changing

a) B, C and D

b) A, B and C

c) A, B and D

d) All of these

21. Plot a graph between force applied on a body and the acceleration produced in the given mass, assuming that the magnitude of force it constantly changing. **[1]**

22. Write the C.G.S unit of force. **[1]**

23. Suppose a ball of mass 'm' is thrown vertically upwards with an initial speed 'v', its speed decreases continuously till it becomes zero. Therefore, the ball begins to fall downward and attains the speed 'v' again before striking the ground. It implies that the magnitude of initial and final momenta of the ball are same. Yet, it is not an example of conservation of momentum. Explain why. **[1]**

Section B

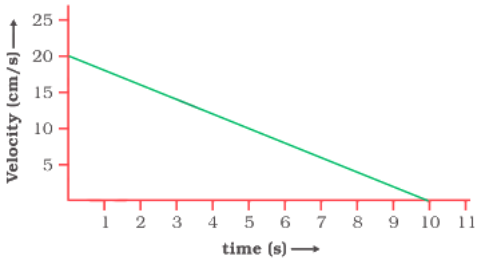
24. **State True or False:** **[2]**

(a) The quantity of motion in a body depends on the product of mass and velocity of the body termed as momentum. **[1]**

(b) The SI unit of acceleration is kg. **[1]**

25. A hockey ball of mass 200 g travelling at 10 ms^{-1} is struck by a hockey stick so as to return it along its original path with a velocity at 5 ms^{-1}. Calculate the magnitude of change of momentum occurred in the motion of the hockey ball by the force applied by the hockey stick. **[2]**

26. The velocity-time graph of a ball of mass 20 g moving along a straight line on a long table is given in Fig. **[2]**



How much force does the table exert on the ball to bring it to rest?

27. Why can a small mass such as a bullet kill a person when fired from a gun? **[2]**

28. From the rifle of mass 4 kg, a bullet of mass 50 g is fired with an initial velocity of 35 ms^{-1}. Calculate the initial recoil velocity of the rifle. **[2]**

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

30. A 8000 kg engine pulls a train of 5 wagons, each of 2000 kg, along a horizontal track. If the engine exerts a force of 40000 N and the track offers a friction force of 5000 N, then calculate: **[2]**

a. the net accelerating force and

b. the acceleration of the train.

31. Explain, why is it difficult for a fireman to hold a hose, which ejects large amounts of water at a high velocity. **[2]**

32. Why does an athlete run a certain distance before taking a leap? **[2]**

33. A truck starts from rest and rolls down a hill with a constant acceleration. It travels a distance of 400 m in 20 s. Find its acceleration. Find the force acting on it if its mass is 7 metric tonnes. **[2]**

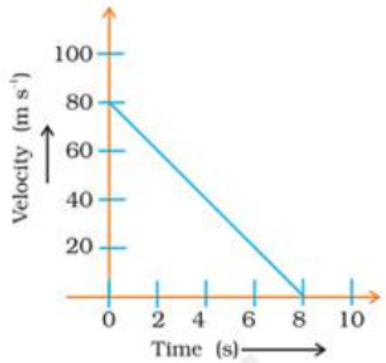
34. An automobile vehicle has a mass of 1500 kg. What must be the force between the vehicle and road if the vehicle is to be stopped with the negative acceleration of 1.7 ms^{-2}? **[2]**

35. Why does a cricket player move his hands backward while catching the ball? **[2]**

36. A man throws a ball of mass 0.4 kg vertically upwards with a velocity of 10 m/s. What will be its initial momentum? What would be its momentum at the highest point of its reach? **[2]**

37. A motorcar is moving with a velocity of 108 km/h and it takes 4 s to stop after the brakes are applied. Calculate the force exerted by the brakes on the motorcar if its mass along with the passengers is 1000 kg. **[2]**

38. Velocity versus time graph of a ball of mass 50 g rolling on a concrete floor is shown in Fig. Calculate the acceleration and frictional force of the floor on the ball. **[2]**



39. A body of mass 500 g is at rest on a frictionless surface. Calculate the distance travelled by it in 10 s when acted upon by a force of 10^{-2}N. **[2]**

40. 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? **[2]**

41. A constant force acts on an object of mass 5 kg for a duration of 2 s. It increases the object's velocity from 3 ms^{-1} to 7 ms^{-1}. Find the magnitude of the applied force. Now, if the force was applied for a duration of 5 s, what would be the final velocity of the object? **[2]**

42. An object undergoes an acceleration of 8 ms^{-2} starting from rest. Find the distance travelled in 1 second. **[2]**

43. Derive the unit of force using the second law of motion. A force of 5 N produces an acceleration of 8 ms^{-2} on a mass 'm_1' and an acceleration of 24 ms^{-2} on a mass' m_2'. What acceleration would the same force provide if both the masses are tied together? **[2]**

44. An iron sphere of mass 1 kg is dropped from a height of 10 m. If the acceleration of sphere is 9.8 ms^{-2}, calculate the momentum transferred to the ground by the ball. **[2]**

45. From a rifle of mass 4 kg, a bullet of mass 50 g is fired with an initial velocity of 35 ms^{-1}. Calculate the initial recoil velocity of the rifle. **[2]**

46. Using second law of motion, derive the relation between force and acceleration. A bullet of mass 10 g strikes a sand bag with a velocity of 10^3 ms^{-1} and gets embedded after travelling 5 cm. Calculate **[2]**

    i. the resistive force exerted by the sand bag on the bullet.

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

47. A bullet of mass 5 g travelling at a speed of 120 ms^{-1} penetrates deeply into the fixed target and is brought to rest in 0.01 s. Calculate: (a) the distance of penetration in the target, (b) the average force exerted on the bullet. **[2]**

48. A car of mass 1000 kg moving with a velocity of 45 km h^{-1} collides with a tree and comes to rest in 5s. What will be the force exerted by the car on the tree? **[2]**

49. What will be acceleration of a body of mass 5 kg, if a force of 200 N is applied on it? **[2]**

50. A truck starts from rest and rolls down a hill with constant acceleration. It travels a distance of 400 metres in 20 s. Find its acceleration. Find the force acting on it, if its mass is 7 metric tons. **[2]**

51. Two persons manage to push a motor car of mass 1,200 kg at a uniform velocity along a level road. The same motor car can be pushed by three persons to produce an acceleration of 0.2 ms^{-2}. With what force does each person push the motor car? Assume that all persons push the motor car with the same muscular effort. **[2]**

52. A motorcar of mass 1200 kg is moving along a straight line with a uniform velocity of 90 km/h. Its velocity is slowed down to 18 km h^{-1} in 4 s by an unbalanced external force. Calculate the acceleration and change in momentum. Also, calculate the magnitude of the force required. **[2]**

53. Which would require a greater force,accelerating a 2 kg mass at 5 ms^{-2} or a 4 kg mass at 2 ms^{-2}?. **[2]**

54. A hammer of mass 500 g, moving at 50 ms^{-1}, strikes a nail. The nail stops the hammer in a very short time of 0.01 s. What is the force of the nail on the hammer? **[2]**

55. Two blocks made of different metals identicals in shape and sizes are acted upon by equal forces which cause them to slide on a horizontal surface. The acceleration of the second block is found to be 5 times that of the first. What is the ratio of the mass of the second to the first? **[2]**

56. It is required to increase the velocity of a scooter of mass 80 kg from 5 to 25 ms^{-1} in 2 second. Calculate the force required. **[2]**

57. An automobile vehicle has a mass of 1500 kg. What must be the force between the vehicle and road if the vehicle is to be stopped with a negative acceleration of 1.7 ms^{-2}? **[2]**

58. How much momentum will a dumbbell of mass 10 kg transfer to the floor, if it falls from a height of 0.8 m? Take acceleration due to gravity as 10 ms^{-2}. **[2]**

Section C

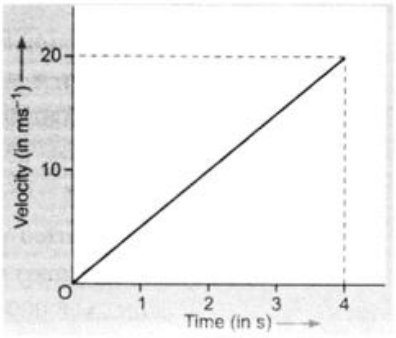
59. The following is the distance-time table of an object in motion: **[3]**

Time (in second)	**Distance (in metre)**
0	0
1	1
2	8
3	27
4	64
5	125
6	216
7	343

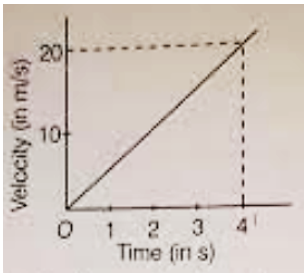
i. What conclusion can you draw about the acceleration? Is it constant, increasing, decreasing or zero?

ii. What do you infer about the force acting on the object?

60. The velocity-time graph of a ball moving on the surface of floor is shown in the figure. Calculate the force acting on the ball, if the mass of the ball is 100 g. **[3]**



61. The velocity-time graph of a ball moving on the surface of the floor is as shown in the figure. Calculate the force acting on the ball, if mass of the ball is 100 g. **[3]**

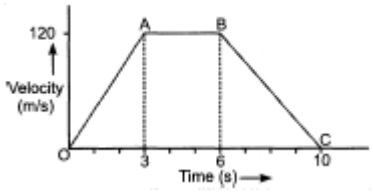


62. The velocity-time graph of an object of mass m = 50 g is shown in the figure. Observe the graph carefully and answer the following questions. **[3]**

i. Calculate the force on the object in time interval 0 to 3 s.

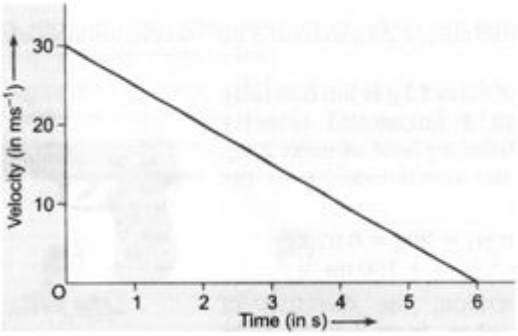
ii. Calculate the force on the object in the time interval 6 to 10 s.

iii. Is there any time interval in which no force acts on the object? Justify your answer.

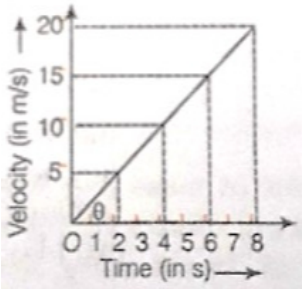


63. Akhtar, Kiran and Rahul were riding in a motor car that was moving with a high velocity on an express way when an insect hit the windshield and got stuck on the windscreen. Akhtar and Kiran started pondering over the situation. Kiran suggested that the insect suffered a greater change in momentum as compared to the change in momentum of the motor car (because the change in the velocity of the insect was much more than that of the motor car). Akhtar said that since the motor car 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 motor car and the insect experienced the same force and a change in their momentum. Comment on these suggestions. **[3]**

64. The velocity-time graph of a ball moving on the surface of a floor is shown in the figure. Find the force acting on the ball if the mass of the ball is 50 g. **[3]**



65. The motion of a body of mass 5 kg is shown in the velocity-time graph. **[3]**



Find from the graph

i. The acceleration.

ii. The force acting on the body.

iii. The change in momentum of the body in 2 s after the start.

66. A bullet travelling at 360 m/s strikes a block of soft wood. The mass of the bullet is 2.0 g. The bullet comes to rest after penetrating 10 cm into the wood. **[3]**

a) Find the average de-accceleration force exerted by the wood.

b) Find the time taken by the bullet to come to rest.

Section D

67. **Read the following and answer any four questions:** **[4]**

While catching a fast-moving cricket ball, a fielder in the ground gradually pulls his hands backward with the

moving ball. This is an application of the second law of motion.

i. Why the fielder lowers his hand while catching the ball?

a. The fielder increases the time duration

b. To reduce the impact of catching the fast-moving ball

c. The high velocity of the moving ball decreases to zero

d. All of these

ii. Which of the following situations involves Newton's second law of motion?

a. A force can stop a lighter vehicle as well as a heavier vehicle which are moving

b. A force can accelerate a lighter vehicle more easily than a heavier vehicle that is moving

c. A force exerted by a lighter vehicle on collision with heavier vehicle results in both the vehicles coming to a standstill

d. A force exerted by the escaping air from a balloon in the downward direction makes the balloon go upwards

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

a. 24N

b. 25N

c. 26N

d. 27N

iv. Which of the following is the incorrect match?

	Column I	Column II
a.	The inertia of a body depends on it	Mass
b.	The tendency of a body to resist change in its state of motion or rest.	Inertia
c.	SI unit of momentum	kg m/s^2
d.	The resultant force is zero	Unbalanced forces

v. When a 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 force acts on the balloon

Section E

68. Derive the mathematical relation of Newton's second law of motion. **[5]**

69. A 8000 kg engine pulls a train of 5 wagons, each of 2000 kg, along a horizontal track. If the engine exerts a force of 40000 N and the track offers a frictional force of 5000 N, then calculate: **[5]**

(a) the net accelerating force;

(b) the acceleration of the train; and

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

70. State and explain along with example Newton’s laws of motion. **[5]**

71. What is momentum? Write its SI unit. Interpret force in terms of momentum. Represent the following graphically: **[5]**

i. Momentum versus velocity when mass is fixed.

ii. Momentum versus mass when velocity is constant.

72. i. State second law of motion. **[5]**

ii. A bus starts from the stop and take 20 second to get the speed of 10m/s. If the mass of the bus along with passengers is 10000 kg, calculate the force applied by the engine of bus to push the bus at the speed of 10m/s.

73. Two hockey players of opposite teams, while trying to hit a hockey ball on the ground collide and immediately become entangled. One has a mass of 60 kg and was moving with a velocity of 5.0 ms^{-1} while the other has a mass of 55 kg and was moving faster with a velocity of 6.0 ms^{-1} 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 the ground is negligible. **[5]**

74. 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 more and why? **[5]**