FORCE AND LAWS OF MOTION

Class 09 - Science

Time Allowed: 3 hours **Maximum Marks: 124**

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. A ball is rolling down a slope at a steady speed. Which of the following statements is correct? **[1]**

   a) There is an unbalanced force downwards. b) The forces acting on the ball are balanced.

   c) There are no forces acting on the ball. d) Frictional force is greater than the forward force.

3. A plate, a ball and child all have the same mass. The one having more inertia is the **[1]**

   a) child b) plate

   c) All have equal inertia d) ball

4. In a rocket, fuel burns at the rate of 1 kg s^{-1}. This fuel is ejected from the rocket with a velocity of 60 km s^{-1}. This exerts a force on the rocket equal to **[1]**

   a) 6000 N b) 600 N

   c) 60000 N d) 60 N

5. Fireman holds a hose by exerting a _____. **[1]**

   a) momentum b) friction

   c) force d) an acceleration

6. Impulse has the S.I. unit of _____ **[1]**

   a) newton b) N-s

   c) joule d) m/s^2

7. 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

8. Which of the following statement is not correct for an object moving along a straight path in an accelerated **[1]**

motion?

a) Its velocity always changes

b) A force is always acting on it

c) It speed keeps changing

d) It always goes away from the earth

9. The unit of momentum can be expressed as **[1]**

a) $\frac{N}{s}$

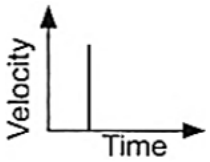
b) N - s

c) kg s^2/m

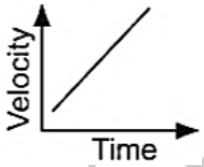
d) kg m/s^2

10. Which of the following is the velocity-time graph of a moving particle on which net external force is zero? **[1]**

a)

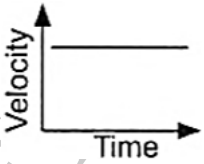


b)



c)

d)



11. An object of mass 2 kg 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 **[1]**

a) 32 N

b) 2 N

c) 0 N

d) 8 N

12. The two states of motion treated alike by Newton's first law, among A, B, C, and D are **[1]**
A : Rest B: Uniform motion C: Uniformly accelerated. D : Non-uniformly accelerated

a) A, D

b) A, C

c) B, C

d) A, B

13. A force of 5 N applied on m_1 produces an acceleration of 8 m/s^2 and when applied on m_2 produces an acceleration of 24 m/s^2. When they are tied together, the acceleration will be **[1]**

a) 3 m/s^2

b) 16 m/s^2

c) 6 m/s^2

d) 8 m/s^2

14. A cup of water holding a steel ball (m) is allowed to fall under gravity. The reaction between the ball and the base of the cup is **[1]**

a) $\frac{mg}{2}$

b) zero

c) mg

d) 2mg

15. A mass M breaks into two pieces in the ratio 1 : 3 while at rest. If the heavier has a speed of v, the speed of the lighter is **[1]**

a) 3v

b) v

c) 4v

d) 2v

16. 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

17. The minimum number of unequal forces that can make zero resultant is **[1]**

a) ten
b) four
c) three
d) two

18. According to the third law of motion, action and reaction **[1]**

a) act on either body at normal to each other
b) always act on different bodies in opposite directions
c) have same magnitude and direction
d) always act on the same body

19. 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.

20. A water tanker filled up to $\frac{2}{3}$rd of its height is moving with a uniform speed. On sudden application of the brake, the water in the tank would **[1]**

a) be unaffected
b) move backwards
c) rise upwards
d) move forwards

21. **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.

22. **Assertion (A):** Mass is a measure of inertia of the body in linear motion. **[1]**
Reason (R): Greater the mass, greater is the force required to change its state of rest or motion.

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.

23. **Assertion (A):** A body is momentarily at rest when it reverses the direction. **[1]**
Reason (R): A body cannot have acceleration if its velocity is zero at a given instant of time.

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.

24. **Assertion (A):** When we sit on a chair, our body exerts a force downward and that chair needs to exert an equal force upward or the chair will collapse. **[1]**
Reason (R): The third law says that for every action there is an equal and opposite reaction.

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.

25. **Assertion (A):** Inertia is that property of the body due to which it resists a change in its state of rest or of uniform motion. **[1]**

Reason (R): Heavy objects have less inertia than lighter objects.

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.

26. **Assertion (A):** If the resultant of all the forces acting on a body is zero, then the forces are called balanced forces. **[1]**

Reason (R): The forces acting on a stationary box is an example of balanced forces.

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.

27. **Assertion (A):** When a bullet is fired from a gun, there is a forward force on the bullet and recoil of gun. **[1]**

Reason (R): Every action has an equal and opposite reaction.

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.

28. **Assertion (A):** In a cricket match, when a cricket ball is hit by a bat, then the direction of the cricket ball changes. **[1]**

Reason (R): It shows that a force can change the shape and size of a moving body.

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.

29. **Assertion (A):** If we kick a football it will move a long way. **[1]**

Reason (R): The inertia of an object is measured by its mass.

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.

30. **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.

31. Which law of motion gives the measure of force? **[1]**

32. Why do bicycles begin to slow down when we stop pedalling? **[1]**

33. Define electrostatic force. **[1]**

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

35. Define 1 newton force. **[1]**

36. Do action and reaction act on the same body? **[1]**

37. State Newton's second law of motion. **[1]**

38. What did Galileo conclude on the basis of his experiments on the motion of objects? **[1]**

39. Does every force produce motion in every object? **[1]**

40. 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]**

Section B

41. A bullet of mass 10 g travelling horizontally with a velocity of 150 ms^{-1} strikes a stationary wooden block and comes to rest in 0.03 s. Calculate a distance of penetration of the bullet into the block. Also calculate the magnitude of the force exerted by the wooden block on the bullet. **[2]**

42. 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]**

43. 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]**

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

45. 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]**

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

47. 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]**

48. 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]**

49. 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]**

50. 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]**

51. 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]**

52. 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]**

53. 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]**

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. 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]**

56. A stone of 1 kg is thrown with a velocity of 20 ms^{-1} across the frozen surface of the lake and comes to rest after travelling a distance of 50 m. What is the force of friction between the stone and the ice? **[2]**

57. 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]**

58. 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]**

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

60. 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]**

61. There are three solids balls made up of aluminium, steel and wood, of the same shape and same volume. Which of them would have highest inertia? **[2]**

62. Deduce Newton's first law from the second law. **[2]**

63. Water sprinkler used for grass lawns begins to rotate as soon as the water is supplied. Explain the principle on which it works. **[2]**

64. Explain why some of the leaves may get detached from a tree if we vigorously shake the branch of the tree. **[2]**

65. Give a few examples of Newton's third law of motion. **[2]**

66. Two balls of the same size of different materials, rubber and iron are kept on the smooth floor of a moving train. The brakes 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 answer. **[2]**

67. When a carpet is beaten with a stick, dust comes out of it. Explain. **[2]**

68. Describe balanced forces with the help of two examples. **[2]**

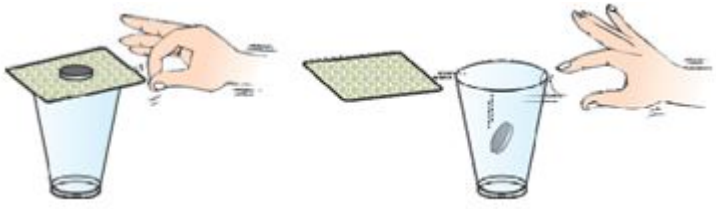
69. Why does a cricket player move his hands backward while catching the ball? **[2]**

70. Why is it difficult to balance our body, when we accidentally step on a peel of banana? **[2]**

Section C

71. **Read the following text carefully and answer the questions that follow:** **[4]**

All objects resist a change in their state of motion. In a qualitative way, the tendency of undisturbed objects to stay at rest or to keep moving with the same velocity is called inertia. The first law of motion is also known as the law of inertia.



i. Which object will have more inertia one is of mass 50kgs and the other is 30kgs? (1)

ii. what is inertia? (1)

iii. What scientific explanation best describes the phenomenon of dust particles coming out of a hanging carpet when beaten with a stick? (2)

OR

Why doesn't an athlete come to rest immediately after crossing the finish line? (2)

Section D

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. 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.

75. A body of mass 2 Kg is at rest at the origin of a frame of reference. A force of 5 N acts on it at t = 0. The force acts for 4 s and then stops. **[5]**

i. What is the acceleration produced by the force on the body?

ii. What is the velocity at t = 4 s

iii. Draw the vt graph for the period t = 0 to t = 6 S.

iv. Find the distance travelled in 6 s.