CBSE

LAWS OF MOTION WS 4

Class 11 - Physics

Section A

1. Mass of 2 kg is moving with a string in horizontal circle with angular velocity 5 cycle/min. Keeping the radius constant, tension in string is doubled. Now, the angular velocity of the mass will be **[1]**

   a) 2.25 cycles/min
   b) 14 cycles/min
   c) 7 cycles/min
   d) 10 cycles/min

2. If Newton's second law is applied to a rigid body: **[1]**

   a) the acceleration is the average of all particles in the body
   b) the acceleration is that of any particle in the body
   c) the acceleration is that of the centre of mass
   d) the acceleration is the higher of all particles in the body

3. Momentum is closely related to **[1]**

   a) velocity
   b) impulse
   c) kinetic energy
   d) force

4. Sand is being dropped from a conveyer belt at the rate of M kg/s. The force necessary to keep the belt moving with a constant velocity of v m/s will be **[1]**

   a) 2Mv newton
   b) Mv newton
   c) $\frac{Mv}{2}$ newton
   d) zero

5. A body of mass 8 kg is moved by a force F = 3x N, where x is the distance covered. Initial position is x = 2 m and the final position is x = 10 m. The initial speed is zero. The final speed is **[1]**

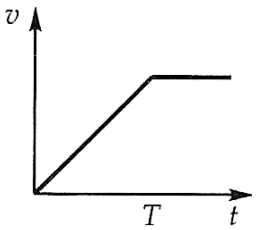
   a) 14 m/s
   b) 18 m/s
   c) 6 m/s
   d) 12 m/s

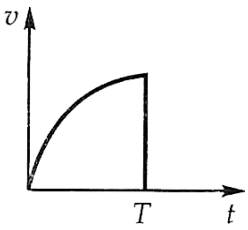
6. A man is standing on a weighing machine placed in a lift. When stationary, his weight is recorded as 40 kg. If the lift is accelerated upward with an acceleration of 2 m/s^2, then the weight recorded in the machine (g = 10 m/s^2) will be **[1]**

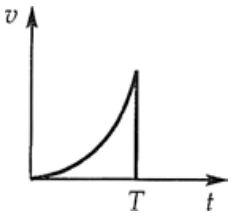
   a) 32 kg wt
   b) 40 kg wt
   c) 42 kg wt
   d) 48 kg wt

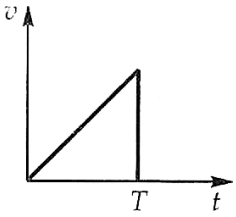
7. A body is acted upon by a constant force from time t = 0 to a time t = T after which it does not experience any force. Which of the following graphs best represents the variation of the velocity of the body with time? **[1]**

   a)
   b)





c) 

d) 

8. Two bodies A (of mass 1 kg) and B (of mass 3 kg) are dropped from heights of 16 m and 25 m, respectively. The ratio of the times taken by them to reach the ground is: **[1]**

a) $\frac{5}{4}$ b) $\frac{5}{12}$

c) $\frac{4}{5}$ d) $\frac{12}{5}$

9. If two balls, each of mass 0.06 kg, moving in opposite directions with speed 4 m/s, collide and rebound with same speed, then impulse imparted to each ball due to other is **[1]**

a) 0.81 kg m/s b) 0.53 kg m/s

c) 0.48 kg m/s d) 0.92 kg m/s

10. A car of mass 400 kg is pulling a coach of mass 300 kg with a force of 4500 N. If the coefficient of friction is 0.001, what is tension? **[1]**

a) 1929 N b) 2100 N

c) 2750 N d) 2126 N

11. A stone is dropped from a height h. It hits the ground with a certain momentum p. If the same stone is dropped from a height 100% more than the previous height, the momentum when it hits the ground will change by **[1]**

a) 68% b) 41%

c) 200% d) 100%

12. **Assertion:** When a man jumps from a boat to the shore, the boat slightly moves away from the shore. **[1]**
Reason: In absence of net force, the total momentum is conserved.

a) Assertion and reason both are correct statements and reason is correct explanation for assertion.

b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

c) Assertion is correct statement but reason is wrong statement.

d) Assertion is wrong statement but reason is correct statement.

13. **Assertion (A):** An athlete runs some distance, before taking a long jump. **[1]**
Reason (R): It is due to inertia of 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.

14. **Assertion (A):** The acceleration produced by a force in the motion of a body depends only upon its mass. **[1]**

Reason (R): Larger is the mass of the body, lesser will be the acceleration produced.

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):** The driver in a vehicle moving with a constant speed on a straight road is a non-inertial frame of reference. **[1]**

Reason (R): A reference frame, in which Newton's laws of motion are applicable, is non-inertial.

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. **Assertion (A):** Acceleration produced by a force in the motion of an object depends on the mass of the object. **[1]**

Reason (R): Larger the mass, more will be the acceleration.

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.

17. **Assertion:** If a particle is found to be in equilibrium in two different frames of reference implies that both frames are inertial. **[1]**

Reason: Newton’s second law can be used for motion of a particle in any reference frame.

a) If both assertion and reason are true and reason is the correct explanation of assertion.

b) If both assertion and reason are true but reason is not the correct explanation of assertion.

c) If assertion is true but reason is false.

d) If both assertion and reason are false.

18. **Assertion (A):**:A seasoned cricketer allows a longer time for his hands to stop the ball, while catching the ball. His hand is not hurt. **[1]**

Reason (R): The novice (new player) keeps his hand fixed and tries to catch the ball almost instantly. He needs to provide a much greater force to stop the ball instantly and this hurts.

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.

19. **Assertion (A):** During the action of an impulsive force, change in the momentum is very high even though force acts for a very short period. **[1]**

Reason (R): The amount of force is very high.

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.

20. **Assertion:** A body is moving along a straight line under a variable force, area under the force-time graph on the time axis will be the 'Impulse'. **[1]**

Reason: Impulse is the total change in linear momentum.

a) If both assertion and reason are true and reason is the correct explanation of assertion.

b) If both assertion and reason are true but reason is not the correct explanation of assertion.

c) If assertion is true but reason is false.

d) If both assertion and reason are false.

21. **Assertion (A):** Impulse and momentum have different dimensions. **[1]**

Reason (R): From Newton's second law of motion, impulse is equal to change in momentum.

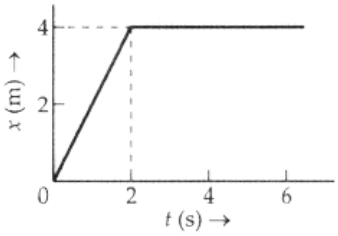
a) Both A and R are true and R is the correct explanation of A.

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. In the figure given, the position-time graph of a particle of mass 0.1 kg is shown. **[1]**



The impulse at t = 2 s is

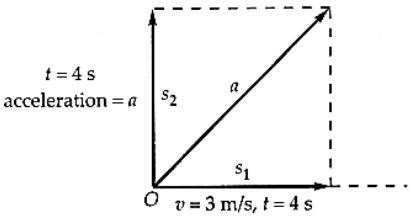
a) $0.1\ kg\ ms^{-1}$

b) $0.2\ kg\ ms^{-1}$

c) $-0.2\ kg\ ms^{-1}$

d) $-0.4\ kg\ ms^{-1}$

23. A body of mass 2 kg has an initial velocity of 3 m/s along OE and it is subjected to a force of 4 N in a direction perpendicular to OE. The distance of body from O after 4 s will be **[1]**



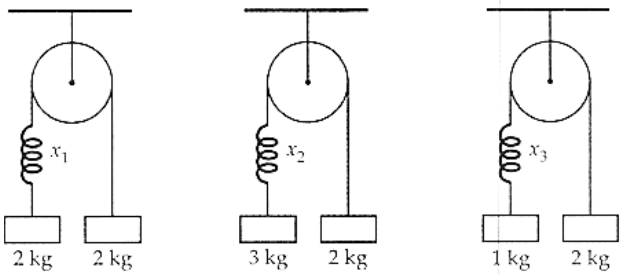
a) 8 m

b) 48 m

c) 12 m

d) 20 m

24. Same spring is attached with 2 kg, 3 kg and 1 kg blocks in three different cases as shown in figure. If x_1, x_2, x_3 be the extensions in the spring in the three cases, then **[1]**



a) $x_3 > x_2 > x_1$

b) $x_1 = 0, x_3 > x_2$

c) $x_1 > x_2 > x_3$

d) $x_2 > x_1 > x_3$

25. Is it correct to say that the second law of motion is the real law of motion? **[1]**

26. The mass of a rocket is 500 kg and relative velocity of gases ejecting out is 250 ms^{-1} with respect to the rocket. **[1]**
Determine the rate of burning of the fuel in order to give the rocket an initial acceleration of 20 ms^{-2} in the upward direction.

27. Fuel is consumed at the rate of 50 g per second in a rocket. The exhaust gases are rejected at the rate of 5×10^5 cms^{-1}. What is the thrust experienced by the rocket? **[1]**

28. Define one-newton force. **[1]**

29. Why does a child feel more pain when she/he falls down on a hard cement floor than when she/he falls on the soft muddy ground in the garden? **[1]**

30. A meteorite burns in the atmosphere before it reaches the earth's surface. What happens to its momentum? **[1]**

31. A force of 36 dyne is inclined to the horizontal at an angle of 60°. Find the acceleration it will produce in a mass of 18 g that moves in a horizontal direction. **[1]**

32. A machine gun fires a bullet of mass 40 g with a speed of 1200 ms^{-1}. The person holding the gun can exert a maximum force of 144 N on it. What is the number of bullets that can be fired from the gun per second? **[1]**

33. The coefficient of friction between the ground and the wheels of a car moving on a horizontal road is 0.5. If the car starts from rest, what is the minimum distance in which it can acquire a speed of 72 kmh^{-1}? Take g =10 ms^{-2}. **[1]**

34. A block of metal weighing 2 kg is resting on a frictionless plane. It is struck by a jet releasing water at the rate of 1 kg $s^{-1}$and at a speed of 5 ms^{-1}. Calculate the initial acceleration of the block. **[1]**

35. The dimensional formula of impulse is MLT^{-1}. Name another physical quantity having the same dimensions. **[1]**

36. Calculate the force acting on a body which changes the momentum of the body at the rate of 1 kg-m/s^2. **[1]**

37. A truck starts from rest and rolls down a hill with constant acceleration. It travels a distance of 400 m in 20 s. Calculate the acceleration and the force acting on it if its mass is 7 metric tonnes. **[1]**

Section B

38. A force is being applied on a body but it causes no acceleration. What possibilities may be considered to explain the observation? **[2]**

39. A person in an elevator accelerating upwards with an acceleration of 2 ms^{-1} , tosses a coin vertically upwards with a speed of 20 ms^{-1}. After how much time will the coin fall back into his hand? (g = 10 m s^{-2}) **[2]**
Main concept used: Effective acceleration (a') when elevator is going upward with acceleration (a)

40. A pull of 15 N is applied to a rope attached to a block of mass 7 kg lying on a smooth horizontal surface. The mass of the rope is 0.5 kg. What is the force exerted by the block on the rope? **[2]**

41. An astronaut accidentally gets separated out of his small spaceship accelerating in inter stellar space at a constant rate of 100 ms^{-2}. What is the acceleration of the astronaut the instant after he is outside the spaceship? **[2]**

(Assume that there are no nearby stars to exert gravitational force on him.)

42. A light string passing over a smooth pulley connects two blocks of masses m_1 and m_2 (vertically). If the acceleration of the system is $\frac{g}{8}$, find the ratio of the two masses. **[2]**

43. A constant retarding force of 50 N is applied to a body of mass 30 kg moving initially with a speed of 18 ms^{-1}. How long does the body take to come to a halt? **[2]**

44. When brakes are applied in a bicycle, the brake shoes apply frictional force on the wheels. The forces are internal for the system (bicycle). For retardation, external forces must act on the system. The force of friction at the road surface remains the same before and after the brakes are applied $(f = \mu R)$. How does the bicycle stop? **[2]**

45. How can you show that Newton's third law of motion follows from the Newton's second law of motion? **[2]**

46. The motion of a particle of mass m is described by $y = ut + \frac{1}{2}gt^2$. Find the force acting on the particle. **[2]**

47. A batsman hits back a ball straight in the direction of the bowler without changing its initial speed of 12 ms^{-1}. If the mass of the ball is 0.15 kg, determine the impulse imparted to the ball. (Assume linear motion of the ball) **[2]**

48. A glass ball whose mass is 10 g falls from a height of 40 m and rebounds to a height of 10 m. Find the impulse and the average force between the glass ball and the floor if the time during which they are in contact is 0.1 s. **[2]**

49. The speed of driving a car safely depends upon the range of headlight. Explain. **[2]**

50. The velocity of a body of mass 2 kg as a function of t is given by $\vec{v}(t) = 2t\hat{i} + t^2\hat{j}$ Find the momentum and the force acting on it, at time t = 2 s. **[2]**

51. A block of mass 0.1 kg is held against a wall by applying a horizontal force of 5 N on the block. If the coefficient of friction between the block and the wall is 0.5, what is the magnitude of the frictional force acting on the block? **[2]**

Section C

52. **State True or False:** **[3]**

    (a) Two balls of different masses are thrown vertically upward with the same speed. During their downward journey, they pass through the point of projection with the same speech. Neglect air resistance. **[1]**

    (b) In all the cases of motion along a straight path, acceleration (a) is inversely proportional to the mass (m) of the body. **[1]**

    (c) Newton's first law can be derived from the second law. **[1]**

53. A helicopter of mass 2000kg rises with a vertical acceleration of 15 ms^{-2}. The total mass of the crew and passengers is 500 kg. Give the magnitude and direction of the **[3]**

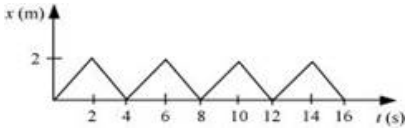
    a. force on the floor of the helicopter by the crew and passengers.

    b. action of the rotor of the helicopter on the surrounding air.

    c. force on the helicopter due to the surrounding air.

    Take (g = 10 ms^{-2}).

54. Figure shows the position-time graph of a body of mass 0.04 kg. Suggest a suitable physical context for this motion. What is the time between two consecutive impulses received by the body? What is the magnitude of each impulse? **[3]**



55. Two identical point masses, each of mass M are connected to one another by a massless string of length L. A constant force F is applied at the mid-point of the string. If l be the instantaneous distance between the two **[3]**

masses, what will be the acceleration of each mass?

56. A truck is moving with a speed of 20 m /s along a straight line. Suddenly, some sand starts falling from the back side of the truck at the rate of 20 g/s. Find the value of external force required to make the truck move with the constant velocity of 20 m/s. **[3]**

57. a. State impulse-momentum theorem. **[3]**
    b. A ball of mass 0.1kg is thrown against a wall. It strikes the wall normally with a velocity of 30m/s and rebounds with a velocity of 20m/s. Calculate the impulse of the force exerted by the ball on the wall.

58. A helicopter of mass 1000 kg rises with a vertical acceleration of 15 ms^{-2}. The crew and the passengers weigh 300 kg. Give the magnitude and direction of the **[3]**
    i. force on the floor by the crew and passengers,
    ii. action of the rotor of the helicopter on the surrounding air,
    iii. force on the helicopter due to the surrounding air.

59. State three basic laws of motion. Show that the first law of motion gives the definition of force and the second law of motion gives the measure of force. **[3]**

60. A stream of water flowing horizontally with a speed of 15 ms^{-1} gushes out of a tube of cross-sectional area 10^{-2} m^2, and hits a vertical wall nearby. What is the force exerted on the wall by the impact of water, assuming it does not rebound? **[3]**

Section D

61. A bullet of mass 0.01 kg is fired horizontally into a 4 kg wooden block at rest on a horizontal surface. The coefficient of the kinetic friction between the block and the surface is 0.25. The bullet gets embedded in the block and the combination moves 20 m before coming to rest. With what speed did the bullet strike the block? **[5]**

62. State Newton's Second law of motion. Derive a mathematical formula to calculate force if mass remains constant. Prove that it contains Newton's first law. **[5]**

63. i. Define impulse. State its S.I. unit. State and prove impulse-momentum theorem. **[5]**
    ii. A batsman deflects a ball by an angle of 45° without changing its initial speed which is equal to 54 km/h. What is the impulse imparted to the ball? (Mass of the ball is 0.15 kg.)

Section E

64. **Fill in the blanks:** **[10]**

(a) In every motion, force $\vec{F}$ is _____ to acceleration $\vec{a}$. **[1]**

(b) _____ is the product of the average force and the time interval for which the force acts on the body. **[1]**

(c) A gravitational unit is _____ times the corresponding absolute unit. **[1]**

(d) The SI unit of impulse is _____. **[1]**

(e) A body weighing 5 kg just slides down a rough inclined plane that rises 4 m in every $4\sqrt{2}$ m. The coefficient of friction is _____. **[1]**

(f) Newton's second law of motion gives the measurement of _____. **[1]**

(g) _____ is an external agency (a pull or a push) which changes or tends to change the state of rest or of uniform motion or the direction of motion of a body. **[1]**

(h) A force of kg wt contains _____ newtons. **[1]**

(i) _____ is the time rate of change in velocity of the body. **[1]**

(j) One newton is that force which produces an acceleration of _____ ms^{-2} in a body of mass **[1]**

_____.