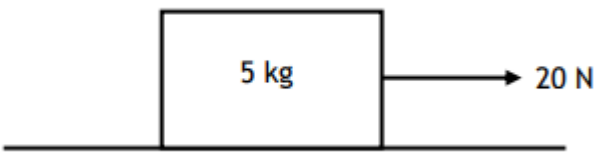
	INDIAN SCHOOL AL WADI AL KABIR	
Class: XI	**Department: Science 2022 – 23** **Subject: Physics**	**Date of submission:** **15-10-2022**
Worksheet No:05 **with answers**	**Topic: CH-5 – Laws of Motion**	**Note:** **A4 FILE FORMAT**

OBJECTIVE TYPE QUESTIONS

1. The mass of a body which is equal to the ratio of the force acting on a body to the acceleration produced in the body is
   (a) the gravitational mass
   (b) the electromagnetic mass
   (c) the internal mass
   (d) the inertial mass
2. A space probe built on Earth has a mass of 750 kg. Calculate the weight of the space probe on Earth.

   (a) 77 N **(b)** 750N **(c)** 7350 N (**d)** 7600N
3. A block is pulled across a horizontal surface as shown.



The mass of the block is 5 kg. The block is travelling at a constant velocity. Calculate the force of friction acting on the block.

(a)5 N

(b) 20 N

(c) 25 N

(d) 0 N

4. A 5 kg mass is hung on a weighing balance and both are allowed to fall freely. State the reading on the balance while the mass and the balance are falling.
   (a) 0 N
   (b) 5 N
   (c) 50 N
   (d) 49 N

5. Far out in space the gravitational field strength experienced is negligible. The rocket motor of a space probe is fired for a short time and the rocket accelerates. Determine what will happen to the rocket when the motor is switched off.

   (a) The rocket decelerates until it comes to rest.

   (b) The rocket will continue to accelerate forward.

   (c) The rocket will change direction.

   (d) The rocket will move at a constant velocity.

6. Determine which of the following an unbalanced force of one newton will cause.

   (a) 0·1 kg mass will accelerate at 1 ms^{-2}

   (b) 1 kg mass will accelerate at 1 ms^{-2}

   (c) 1 kg mass will accelerate at 10 ms^{-2}

   (d) 1 kg mass will move at a constant speed of 10 ms^{-1}

7. A spherical ball of mass 10-6 kg hits a wall 1000 times per second normally with a velocity of 1000 m/s and rebounds with same velocity along the initial direction. The force experienced by the wall is
   (a) 1 N
   (b) 4 N
   (c) 2 N
   (d) 8 N

8. A machine gun fires a bullet of mass 40 g with a velocity of 1200 ms^{-1}. The man holding it can exert a maximum force on 144 N on the gum. How many bullets can he

fire per second at the most?

(a) one

(b) four

(c) two

(d) three

9. A passenger in a moving bus is thrown forward when the bus is suddenly stopped. This is explained

(a) by Newtons first law

(b) by Newtons second law

(c) by Newtons third law

(d) by the principle of conservation of momentum

10. A bullet of mass 25 g moving with a velocity of 200 cm/s is stopped within 5 cm of the target. The average resistance offered by the target is

(a) 1 N

(b) 2 N

(c) 3 N

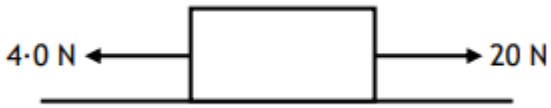
(d) 4 N

Answer key

1. Ans. (d)
2. Ans. (c)
3. Ans. (b)
4. Ans. (a)
5. Ans. (d)
6. Ans. (b)
7. Ans. (c)
8. Ans. (d)
9. Ans. (a)

10. Ans. (a)

11. The diagram shows the horizontal forces acting on a box



The box accelerates at $1{\cdot}6\ ms^{-2}$. Determine the mass of the box.

(a) 0.10kg (b) 10.0kg (c) 15.0 kg (d) 25.6 kg

Ans. (b)

12. Conservation of momentum in a collision between particles can be understood from
(a) conservation of energy.
(b) Newton's first law only.
(c) Newton's second law only.
(d) both Newton's second and third law.

Ans. (d)

13. A ball is travelling with uniform translatory motion. This means that
a) It is at rest.
b) The path can be a straight line or circular and the ball travels with uniform speed.
c) All parts of the ball have the same velocity (magnitude and direction) and the velocity is constant.
d) The center of the ball moves with constant velocity and the ball spins about its center uniformly.

Ans. (c)

14. The forces, which meet at one point but their lines of action do not lie in one plane are called

a. Coplanar concurrent forces. b. Coplanar non-concurrent forces.
c. Non-coplanar concurrent forces. d. Non-coplanar non-concurrent forces.

Ans. (c)

15. If two forces of equal magnitude act simultaneously on a body in the east and the north direction, then

a. The body will get displaced in the north direction.

b. The body will get displaced in the east direction.

c. The body will get displaced in the north-east direction.

d. The body will remain at rest.

Ans. (c)

VERY SHORT ANSWER QUESTIONS (1MARK)

16. Why the wheels of the vehicles are provided with mudguards? (So as to prevent the mud sticking to the wheel flies off tangentially due to inertia of direction)

17. Why are the wheels of the automobiles made circular? (So that rolling friction comes into play. Rolling friction is always less than the sliding friction)

18. What force acting on a mass of 15 kg for a minute can change its velocity from 10m/s to 50 m/s [Ans. F = ma = m $\left(\frac{v-u}{t}\right)$ = 10N]

19. Why cannot a horse pull a cart and run in empty space?

    (Ans. While trying to **pull a cart**, a **horse** pushes the ground backward with some force (action) The reaction force of the ground causes the **horse** to move forward. An **empty space** is devoid of any such reaction force. Therefore, a **horse cannot pull a cart and run in empty space**)

20. Sand is thrown on tracks covered with snow. Why?

    (Ans. This is done to increase the friction)

ASSERTION REASONING QUESTIONS

21. Assertion (A): Newton's laws can be applied to bigger bodies
    Reason (R): During any kind of collision, the center of mass of the system is not accelerated.
    A. Both Assertion and Reason are correct and the reason is the correct explanation
    B. Both Assertion and Reason are correct but the reason does not give the correct explanation
    C. Assertion is true but Reason is false
    D. Assertion is false but Reason is true.
    Ans. **B**

22. Assertion: A rocket moves forward by pushing the surrounding air backwards. Reason: It derives the necessary thrust to move forward according to Newtons third law of motion.

    Ans. **A**

23. Assertion: Frictional forces are conservative forces.

Reason: Potential energy can be associated with frictional forces.

Ans. **D**

24. Assertion: The tendency of skidding or overturning is quadrupled, when a cyclist doubles his speed of turning.
Reason: Angle of bending measured from ground., decreases as velocity of vehicle increases.
Ans. **A**

SHORT ANSWER QUESTIONS (2 MARKS)

25. Two billiard balls each of mass 0.05kg moving in opposite directions with speed 6m/s collide and rebound with the same speed. What is the impulse imparted to each ball due to other? (Ans: - Impulse = change in momentum = mv-mu = 0.6 kg m/s)

26. A bullet mass 10gm is fired from a gun of mass 8kg with a velocity 160m/s. Find the velocity of recoil of the gun. (Ans. V = - m x v/M = -0.01x 160/8 = -0.2m/s)

27. Why are porcelain objects wrapped in paper or straw before packing for transportation? (Application of Newton's second law of motion)

28. Why are mountain roads generally made winding upwards rather than going straight up?

Ans:

The mountain roads are generally constructed in a winding fashion so as to increase fric tion and thereby reduce skidding of vehicles. This comes from the definition of fricti on for an object placed at a slope of angle θ.

$$f = \mu N = \mu mg\cos\theta$$

Here, f is the frictional force, μ is the coefficient of friction, m is the mass of the object, g is the acceleration due to gravity and θ is the angle made by the object with the surfac e.
Now, winding the road means decreasing the θ with respect to ground. This will increas e friction as cosine will increase. Hence the frictional force increases. Going straight up means going at a larger angle so the friction will decrease.

29. Which law of motion is said to be real law of motion? Why?

SHORT ANSWER QUESTIONS (3 MARKS)

30. A bullet of mass 20gms. travelling with a velocity of 15m/s penetrates a sand bag and is brought to rest in 0.05 s. Find the depth of penetration and the average retarding force of the sand. [Ans. m = 0.02kg , a = v-u/t = 0 -15/0.05= -300m/s^2.

$S = \frac{v^2-u^2}{2a}$, S= 0.375 m, F= - 6.0N]

31. A helicopter of mass 2000 kg rises with a vertical acceleration of 15 m s^{-2}. The total mass of the crew and passengers is 500 kg. Give the magnitude and direction of the (g = 10 m s^{-2})
(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

ANSWER

Here,
Mass of the helicopter, $M = 2000Kg$
Mass of the crew and passengers, $m = 500kg$
Vertically upwards acceleration, a= 15 ms^{-2}
g=10ms^{-2}

(i) Force on the floor by the crew and passengers
$= m(g + a) = 500kg(10 + 15)ms^{-2}$
$= 12500N = 1.25 \times 10^4 N$
It acts vertically downwards.

(ii) The action of the rotor of the helicopter on the surrounding air$= (M + m)(g + a)$
$= (2000 + 500)kg(10 + 15)ms^{-2}$
$= 62500N = 6.25 \times 10^4 N$
It acts vertically downwards.

(iii) Force on the helicopter due to the surrounding air is equal and opposite to the action of the rotor of the helicopter on the surrounding air.
∴ Force on the helicopter due to the surrounding air =$6.25 \times 10^4 N$
It acts vertically upwards.

32. It is easier to pull an object than to push it. Explain with the help of a diagram.

33. What is impulse and show that impulse = change in momentum.

34. A car of mass 1500kg is moving with a speed of 12.5m/s on a circular path of radius 20m on a level road. What should be the frictional force between the car and the road so that the car does not slip? What should be the value of the coefficient of friction to attain this force? (Hint- Frictional force=centripetal force.)

The mass of the car is $m = 1500kg$

The radius of the track is $r = 20m$

The speed of the car is $v = 12.5ms^{-1}$

The frictional force is equal to the centripetal force to prevent slipping

$$F_r = m\frac{v^2}{r} = 1500 \cdot \frac{12.5^2}{20} = 11718.75N$$

(μ=0.8)

LONG ANSWER QUESTIONS (5 MARKS)

35. Derive an expression for the maximum velocity of a vehicle while taking a curve of radius 'r'[i] on a level road [ii] on a banked road

36. State and prove the law of conservation of momentum.

37. Two masses of 80 kg and 140 kg hang from a rope that runs over a pulley. You can assume that the rope is massless and inextensible, and that the pulley is frictionless. Find the upward acceleration of the smaller mass and the tension in the rope.

Ans.

$$a = \frac{M - m}{M + m} g$$

$$a = \frac{140\ \text{kg} - 80\ \text{kg}}{140\ \text{kg} + 80\ \text{kg}} (9.8\ \text{m/s}^2)$$

$$a = \frac{60\ \text{kg}}{220\ \text{kg}} (9.8\ \text{m/s}^2)$$

$$a = 2.7\ \text{m/s}^2$$

CASE STUDY BASED QUESTIONS

38. Newton's first law of motion states that If the net external force on a body is zero, its acceleration is zero. Acceleration can be non-zero only if there is a net external force on the body. To summaries, if the net external force is zero, a body at rest continues to remain at rest and a body in motion continues to move with a uniform velocity. This property of the body is called inertia. Inertia means 'resistance to change'. A body does not change its state of rest or uniform motion, unless an external force compels it to change that

state. In other words, 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. Consider a book at rest on a horizontal surface. It is subject to two external forces: the force due to gravity (i.e. its weight W) acting downward and the upward force on the book by the table, the normal force R. R is a self-adjusting force. This is an example of the kind of situation mentioned above. The forces are not quite known fully but the state of motion is known. We observe the book to be at rest. Therefore, we conclude from the first law that the magnitude of R equals that of W. A statement often encountered is: Since W = R, forces cancel and, therefore, the book is at rest". This is incorrect reasoning. The correct statement is: "Since the book is observed to be at rest, the net external force on it must be zero, according to the first law. This implies that the normal force R must be equal and opposite to the weight W*"*.

1) The book on table is at rest. The force of gravity here is balanced by

a) Force of friction

b) Normal reaction by table on book

c) Weight of table

d) none of these

Ans.b) Normal reaction by table on book

2) If no external force acts on object which is at rest. it will

a) remain at rest

b) start to move

c) both a and b can possible

d) none of these

Ans.a) remain at rest

3) Define inertia.

4) State Newton's first law of motion.

5) Explain why book on table remains at rest.

39. **Conservation of Momentum**

This principle is a consequence of Newton's second and third laws of motion.

In an isolated system (i.e., a system having no external force), mutual forces (called internal forces) between pairs of particles in the system causes momentum change in individual particles. Let a bomb be at rest, then its momentum will be zero. If the bomb explodes into two equal parts, then the parts fly off in exactly opposite directions with same speed, so that the total momentum is still zero. Here, no external force is applied on the system of particles (bomb).

(i) A shell of mass 10 kg is moving with a velocity of 10 ms^{-1} when it blasts and forms two parts of mass 9 kg and 1 kg respectively. If the first mass is stationary, the velocity of the second is

(a) 1 m/s
(b) 10 m/s
(c) 100 m/s
(d) 1000 m/s

Ans. c

(ii) A bullet of mass 10 g is fired from a gun of mass 1 kg with recoil velocity of gun 5 m/s. The muzzle velocity will be

(a) 30 km/min
(b) 60 km/min
(c) 30 m/s
(d) 500 m/s

Ans. d

(iii) A bullet of mass 0.1 kg is fired with a speed of 100 m/s. The mass of gun being 50 kg, then the velocity of recoil becomes

(a) 0.05 m/s
(b) 0.5 m/s
(c) 0.1 m/s
(d) 0.2 m/s

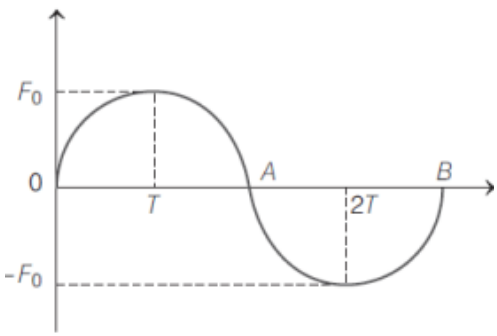
Ans. d

(iv) Two masses of M and 4M are moving with equal kinetic energy. The ratio of their linear momenta is

(a) 1:8
(b) 1:4
(c) 1:2
(d) 4:1

Ans. c

(v) A unidirectional force F varying with time T as shown in the figure acts on a body initially at rest for a short duration 2T. Then, the velocity acquired by the body is



(a) $\pi F_0 T/4m$
(b) $\pi F_0 T/2m$
(c) $F_0 T/4m$
(d) zero

Ans.d

(Hint-Area under the F-T graph gives the impulse or the change in momentum.

Net area is zero. So, change in momentum is zero or change in velocity is zero. Initial velocity is zero. Therefore, V is also equal to zero.)

Ans. d

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