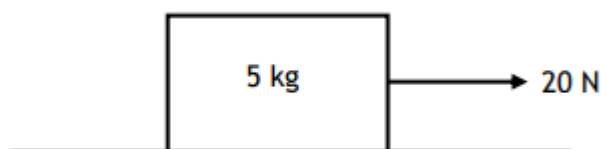




CLASS: XI	DEPARTMENT: SCIENCE 2024 – 2025 SUBJECT: PHYSICS	DATE: 20.08.24
WORKSHEET NO. 4	TOPIC: LAWS OF MOTION	NOTE: A4 FILE FORMAT
NAME OF THE STUDENT:	CLASS & SEC:	ROLL NO.

OBJECTIVE TYPE QUESTIONS

1. 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
2. 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
3. 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
 4. 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.

5. 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}

Answer key

- 1. Ans. (c)
- 2. Ans. (b)
- 3. Ans. (a)
- 4. Ans. (d)
- 5. Ans. (b)

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



The box accelerates at 1.6 ms^{-2} . Determine the mass of the box.

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

Ans. (b)

7. 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)

8. 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)

9. 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)

10. 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)

11. 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)

12. 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)

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

14. 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**)

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

(Ans. This is done to increase the friction)

SHORT ANSWER QUESTIONS (2 MARKS)

16. 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 = $mv - mu = 0.6 \text{ kg m/s}$)

17. 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. $V = -m \times v/M = -0.01 \times 160/8 = -0.2\text{m/s}$)

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

19. 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 friction and thereby reduce skidding of vehicles. This comes from the definition of friction 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 surface.

Now, winding the road means decreasing the θ with respect to ground. This will increase friction as cosine will increase. Hence the frictional force increases. Going straight up means going at a larger angle so the friction will decrease.

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

SHORT ANSWER QUESTIONS (3 MARKS)

21. 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. $m = 0.02\text{kg}$, $a = v-u/t = 0 - 15/0.05 = -300\text{m/s}^2$.

$$S = \frac{v^2 - u^2}{2a}, S = 0.43 \text{ m}, F = -6.0\text{N}]$$

22. 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 ($g = 10 \text{ m s}^{-2}$)

(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, $M = 2000\text{Kg}$

Mass of the crew and passengers, $m = 500\text{kg}$

Vertically upwards acceleration, $a = 15\text{ ms}^{-2}$

$g = 10\text{ms}^{-2}$

(i) Force on the floor by the crew and passengers

$$= m(g + a) = 500\text{kg}(10 + 15)\text{ms}^{-2}$$

$$= 12500\text{N} = 1.25 \times 10^4\text{N}$$

It acts vertically downwards.

(ii) The action of the rotor of the helicopter on the surrounding air = $(M + m)(g + a)$

$$= (2000 + 500)\text{kg}(10 + 15)\text{ms}^{-2}$$

$$= 62500\text{N} = 6.25 \times 10^4\text{N}$$

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.

$$\therefore \text{Force on the helicopter due to the surrounding air} = 6.25 \times 10^4\text{N}$$

It acts vertically upwards.

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

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

25. 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 $m = 1500\text{kg}$

The radius of the track is $r = 20\text{m}$

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

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

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

($\mu=0.8$)

LONG ANSWER QUESTIONS (5 MARKS)

26. 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

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

28. 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.

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

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

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

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

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