[PHYSICS CHAPTER:04 MOTION AND FORCE]

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Questions

i) State Newton's three laws of motion, giving examples from everyday life.

Answer:

Newton's First Law of Motion:

"Every object continues its state of rest or of uniform motion in a straight line unless it is acted upon by an external force which changes its state of rest or of uniform motion."

Examples:

i) A book lying on the table cannot change its position by itself unless a force is applied to change its position.

ii) If we push a ball on the ground, it should continue its uniform motion indefinitely but it stops after covering a certain distance. As soon as the ball starts moving, a force (force of friction) comes into play, which opposes the motion of the ball.

Newton's Second Law of Motion:

"When a force acts on an object, it produces acceleration in the object in its own direction. This acceleration is directly proportional to the magnitude of the applied force."

If a force "F" is applied on an object of mass "m" which produces acceleration "a" in the direction of the applied force then the relationship between acceleration and force can be mathematically expressed as:

$$a \propto F \quad \text{.....(1) (for constant mass)}$$

Similarly, for acceleration and mass the relationship can be written as:

$a \propto 1/m$ ..... (2) (for constant force)

Combining equations (1) and (2) we get:

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$$a \propto F/m$$

$$a = K.(F/m)$$

Where K is constant of proportionality

$$ma = K F \qquad \ldots\ldots\ldots\ldots(3)$$

Irrespective of any system of units, if the acceleration produced in a body of unit mass is unity when a force of unit magnitude is applied, then obviously K = 1 and so

$$F = ma$$

Examples:

i) If we increase the force applied to a body, it moves faster which means more acceleration is produced and if a small force is applied then the acceleration produced is small.

ii) If equal forces are applied on two bodies of different masses, then the acceleration produced in the body of smaller mass will be more than the acceleration produced in the body of large mass

Newton's Third Law of Motion:

"Action and reaction are equal in magnitude but opposite in direction."

Examples:

i) When a rubber ball hits the ground, it bounces back in the upward direction. The force, which the ball exerts downward while hitting the ground, is called "Action" of the ball. At the same time, the Earth exerts a force on the ball in the upward direction due to which the ball rises up. This force is called the "Reaction" of the Earth.

ii) When a bullet is fired from a gun, the bullet moves in the forward direction while the gun recoils in the backward direction. The forward motion of the bullet is "Action" while the backward motion of the gun is "Reaction"

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ii) Define force. How does the second law of motion help in the measurement of force?

Answer:

Force:

"Force is an external agency which produces motion in the object on which it is applied."

Calculation of Force:

From Newton's second law of motion, we can measure force as

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$$ma = K F \qquad \ldots\ldots\ldots\ldots (3)$$

Irrespective of any system of units, if the acceleration produced in a body of unit mass is unity when a force of unit magnitude is applied, then obviously K = 1 and so

$$F = ma$$

This is the required force measured from Newton's second law of motion.

iii) Explain why it is dangerous to jump from a fast moving train?

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Answer:

It is dangerous to jump from a fast moving train because when we are moving in the train we are in a state of inertia. But, when we jump from the train our body wants to maintain its state of motion due to inertia so we don't fall on the point where we jump and may roll and get hit by something and hurt ourselves.

iv) Explain the force of action and reaction in the following:

a) A bullet is fired from a gun

b) A person sitting on a chair

c) A motion of moon around the earth

Answer:

a) When a bullet is fired from a gun, the bullet moves in the forward direction while the gun recoils in the backward direction. The forward motion of the bullet s "Action" while the backward motion of the gun is "Reaction"

b) A person sitting on the chair exerts force on the chair in the downward direction this downward force is called "Action" whereas the chair exerts force on the person in the upward direction. This force exerted by the chair on the person in the upward direction is called "Reaction".

c) Earth and moon exert force of attraction on each other as a result the Earth is attracted toward the Moon and therefore a little away from the path it would otherwise follow around the Sun in the absence of the Moon, and the Moon is attracted toward the Earth and therefore a little away from the independent path it would otherwise follow around the Sun in the absence of the Earth. If one or the other did not exist, the remaining object would orbit the Sun in an orbit nearly identical to the path the pair currently follows around the Sun, but since both exist they each follow a path that is

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roughly the same as their imaginary independent paths, but not quite the same paths as a result of their interaction with each other.

v) Differentiate between mass and weight.

Answer:

Weight	Mass
i) Weight is the force with which earth attracts a body towards its centre and mathematically is given as W = mg	**i)** The quantity of matter in a body is called mass and mathematically is given as m = F/a
ii) Weight does not remain constant because it depends on value of 'g' which varies with altitude.	**ii)** Mass remains constant everywhere
iii) It is a vector quantity.	**iii)** Mass is a scalar quantity
iv) S.I unit of weight is newton.	**iv)** S.I unit of mass is kg

:

vi)Define momentum. Explain the law of conservation of momentum with the help of an example.

Answer:

Momentum:

The product of mass and velocity is called momentum.

Mathematical form:

Mathematically momentum is defined as

$$P = mv$$

Law of Conservation of momentum:

It is defined as

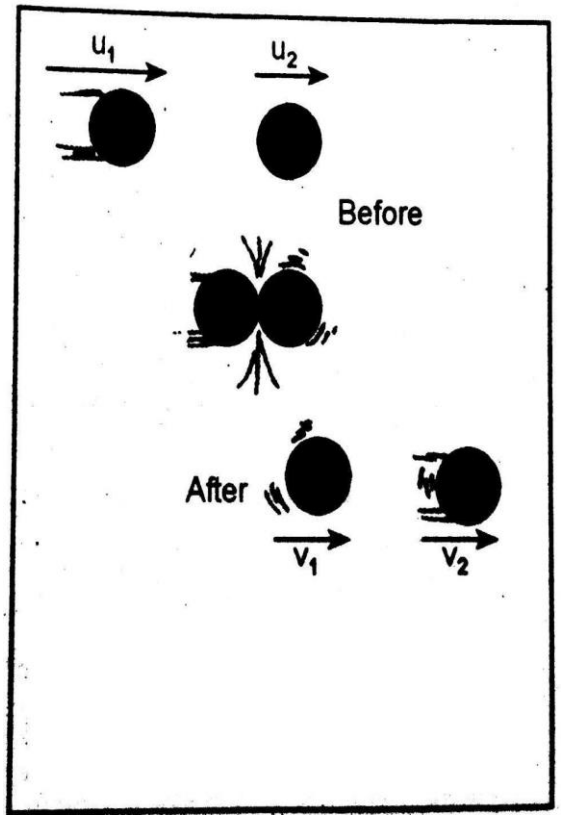
“That the momentum of an isolated system always remains constant (or conserved).”

OR

"The total momentum of the balls before collision = total momentum after collision".

Explanation:

Consider a system of two non-rotating colliding balls A and B having masses m_1 and m2 respectively. Let the balls A and B be moving along the line joining their centers in the same direction with velocities u_1 and u_2 respectively such that u_1 is greater than u_2 as shown in the figure.



Suppose the balls A and B acquire velocities V_1 and V_2 respectively after collision, as shown in figure above. Then

Momentum of the system before collision = $m_1u_1 + m_2u_2$

Momentum of the system after collision = $m_1V_1 + m_2V_2$

According to the law of conservation of momentum

Total momentum of the balls before collision = Total momentum after collision

Therefore

$$m_1u_1 + m_2u_2 = m_1V_1 + m_2V_2$$

This is the law of conservation of momentum.

vii) Describe briefly the main cause of friction. Give three methods of reducing friction.

Answer:

Cause of friction:

Friction is due to the roughness of two surfaces so it is unavoidable because there is no perfect smooth surface. When an object rubs against another, the roughness of their surfaces prevent them from sliding freely over one another.

Methods of Reducing Friction:

a) Use of ball or roller-bearing:

In machines, the sliding of various parts is usually replaced by rolling and this is done by using a ball bearing. Rolling friction is less than the sliding friction.

b) Use of Lubricants:

The various parts of the machines, which are moving over one another, are properly lubricated. The friction in different sliding surfaces can be reduced by putting fine chalk powder or any other powder or some liquid (oil) between them. The presence of dust or liquid keeps the sliding surfaces separated from each other and thus lessens the friction between them. This is the reason why oil, grease, and air are used as lubricants.

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c) By Polishing:

If we polish the rough surfaces, they become smooth and friction is reduced.

viii) Why is the rolling friction less than the sliding friction?

Answer:

Since friction depends on the area of contact between the surfaces. The greater the area of contact between the surfaces greater will be the friction and vice versa. The rolling friction is less than the sliding friction because the rolling friction area of contact is smaller than sliding friction.

Fill in the Blanks

1. Motion cannot be produced in body without **force.**
2. No moving object can be stopped without applying **force.**
3. The property of the matter by virtue of which it resists any attempt to change its state of rest or of uniform motion is called **inertia.**
4. The acceleration produced in ab boy under the influence of an external force is **directly** proportional to the magnitude of the force.
5. when external force act upon a body then it produces an **acceleration** in the body in its own direction.
6. the quantity of matter in a body is called **mass.**
7. the force which the earth attracts a body toward its Centre is called **Weight** o the body.
8. every action has reaction, there are **equal** in magnitude but **opposite** in direction.
9. the product of mass and velocity is called **momentum.**

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10. Rolling friction is much **less** than sliding friction

MCQs

The range of the projectile at 30 deg and 60 deg are_____?

A. equal to 45 deg
B. equal to 90 deg
C. equal to each other
D. none of the above

The force beared by a wall on which water strikes normally at a speed of 10m/sec and at a discharge of 0.0001m3/sec is_____?

A. 1 N
B. 10 N
C. 100 N
D. none

The trajectory (or path) of a projectile is_____?

A. straight line
B. parabola
C. hyperbola
D. circle

The distance covered by a body in time t starting from rest is_____?

A. at2/2
B. Vt
C. a2t/2
D. at2

When two bodies move toward each other with constant speeds the distance between them decreases at the rate of 6m / sec. If they move in the same direction the distance between them increases at the rate of 4m/sec. Then their speeds are_____?

A. 5m/s, 1m/s
B. 3m/s, 3m/s
C. 6m/s, 1m/s
D. 4m/s, 2m/s

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The thrust on the rocket in the absence of gravitational force of attraction is_____?

A. Constant
B. not constant
C. constant if the rate of ejected gases is constant
D. constant for short range rocket.

Which of the following is not an example of projectile motion ?

A. a gas filled ballon
B. bullet fired from gun
C. a football kicked
D. a base ball shot

The acceleration in the rocket at any instant is proportional to the nth power of the velocity of the expelled gases. Where the value of n must be ?

A. -1
B. 1
C. 2
D. -2

When collision between the bodies in a system is inelastic in nature then for system _____?

A. momentum changes but K.E remain conserve
B. K.E changes but momentum remain conserve
C. both momentum and K.E changes
D. both momentum and K.E remain conserve

A body is falling freely under gravity. How much distance it falls during an interval of time between 1st and 2nd seconds of its motion, taking g=10 ?

A. 14 m
B. 20 m
C. 5 m
D. 25 m

During long jump, athlete runs before taking the jump. By doing so he_____?

A. provide him a larger inertia
B. decreases his inertia

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C. decreases his momentum
D. increases his momentum

Motorcycle safety helmet extends the time of collision hence decreasing the_____?

A. chance of collision
B. force acting
C. velocity
D. impulse

When a body moves in a straight line then its displacement coincides with_____?

A. distance
B. force
C. acceleration is zero
D. both A and B

Momentum depends upon_____?

A. force acts on the body
B. mass of the body
C. velocity of the body
D. both mass and velocity of the body

2nd law of motion gives the definition of_____?

A. force
B. acceleration
C. velocity
D. both force and acceleration

Newtons laws do not hold good for particles_____?

A. at rest
B. moving slowly
C. move with high velocity
D. move with velocity comparable to velocity of light

Which law of motion is also called law of inertia?

A. 1st law
B. 2nd law
C. 3rd law
D. all 1st, 2nd and 3rd laws

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Slope of velocity time graph is_____?

A. acceleration
B. distance
C. force
D. momentum

When velocity time graph is a straight line parallel to time axis then_____?

A. acceleration is const
B. acceleration is variable
C. acceleration is zero
D. velocity is zero

A body is moving with uniform velocity. Its_____?

A. speed changes
B. acceleration changes
C. direction of motion changes
D. displacement from origin changes

Why Ballistic missile fails in some circumstances of precision ?

A. due to their shape
B. due to air resistance
C. due to angle of projection
D. all of these

Time rate of change of momentum is equal to_____?

A. force
B. impulse
C. velocity
D. both A and C

At which angle the range of the projectile is maximum_____?

A. 45
B. 60
C. 30
D. none

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Flight of a rocket in the space is an example of_____?

A. second law of motion
B. third law of motion
C. first law of motion
D. law of gravitation

Distance covered by a freely falling body in 2 seconds will be_____?

A. 4.9 m
B. 19.6 m
C. 39.2 m
D. 44.1 m

What is the angle of projection for which the range and maximum height become equal ?

A. tan-1 ¼
B. tan-1 4
C. tan-1 ½
D. tan-1 2

Taking off rocket can be explained by _____?

A. 1st law of motion
B. 2nd law of motion
C. Law of conservation of momentum
D. law of conservation of energy

Which shows the correct relation between time of flight T and maximum height H ?

A. H=gT2/8
B. H=8T2/g
C. H=8g/T2
D. H=gT2

What is the shape of velocity, time graph for constant acceleration ?

A. straight inclined line.
B. parabola
C. inclined curve
D. declined curve

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When car takes turn around a curve road, the passengers feel a force acting on them in a direction away from the center of the curve. It is due to_____?

A. Centripetal force
B. Gravitational force
C. Their inertia
D. Centrifugal force

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