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UNIT 1 NATURE OF PHYSICAL WORLD AND MEASUREMENT

1.Define physical quantity.

Quantities that can be measured, and in terms of which, laws of physics are described are called physical quantities. Examples - length, mass, time, force, energy, etc

Physical quantities are classified into two types. They are fundamental and derived quantities.

2. Briefly explain the types of the physical quantities.

Fundamental quantity

Quantities which Cannot be expressed in terms of any other physical quantities are called Fundamental or base quantities. Examples - Length, mass, time, electric current

Derived quantity

Quantities that can be expressed in terms of fundamental quantities are called derived quantities. Examples - Area. volume. velocity ,acceleration, force

3. Define units. What are its types?

An arbitrarily chosen standard of measurement of a quantity, which is accepted internationally is called unit of the quantity.

Basically there are two types of units. They are fundamental units and derived units.

4. What are advantages of S.I system?

It is a rational system (i.e) only one unit for one physical quantity

• It is a coherent system (i.e) all derived units are easily obtained from basic and supplementary units. It is a metric system (i.e) multiples and submultiples can be expressed as powers of 10

5. Define one metre (S.I standard for length)

The S.I unit of length is metre (m)

• It is defined as length of the path travelled by light in vacuum in 1/ 29,97,92,458 of a second

6. Define one radian (S.I standard for plane angle)

The S.I unit of plane angle is radian (rad). It is the angle subtended at the centre of a circle by an arc equal in length to the radius of the circle.

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7. One Light Year.

It is the distance travelled by the light in vacuum in one year. 1 Light Year = **9.467×10^{15} m**

8. Define one astronomical unit (AU).

It is the mean distance of the Earth from the Sun. **1 A.U = 1.496×10^{11} m**

9. Define accuracy and precision

- Accuracy refers to how far we are from the true value
- Precision refers to how well we measure.

10. Write a note on absolute errors.

The difference between the true value and the measured value of a quantity is called absolute error.

11. Define mean absolute error.

The arithmetic mean of the magnitude of absolute errors in all the measurements is called the mean absolute error,

12. Define relative error.

The ratio of the mean absolute error to the mean value is called relative error (or) fractional error.

13. Detine percentage error.

The relative error expressed as a percentage is called percentage error.

14. Define dimensional variables.

Physical quantities which possess dimensions and have variable values are called dimensional variables. (e.g) length, velocity, acceleration etc..

15. Define dimensionless variables

Physical quantities which have no dimensions but have variable values are called dimensionless variables. (e.g) strain, specific gravity, refractive index etc

16. Define dimensional constants.

Physical quantities which possess dimensions and have constant values are called dimensional constants. (e.g) Gravitational constant, Plank's constant etc.

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17. Define dimensionless constants .

Physical quantities which have no dimensions but have constant values are called dimensionless constant. (e.g) numbers, e, etc..

18. Explain the principle of homogeneity of dimensions

It states that the dimensions of all the terms in a physical expression should be the same.

19. Give the applications of the method of dimensional analysis.

- To convert a physical quantity from one system of units to another.
- To check the dimensional correctness of a given physical equation.
- To establish the relation among various physical quantities.

20. Give the limitations of dimensional analysis.

- This method gives no information about the dimensional constants in the formula like numbers, π, e
- This method cannot decide, whether the given quantity is a vector or scalar
- This method is not suitable to derive relations involving trigonometric, exponential, logarithmic functions.

21.What is Gross Error ? How it can be minimized?

- The error caused due to the shear carelessness of an observer is called gross error.
- These errors can be minimized only when an observer is careful and mentally alert.

1. Define frame of reference.

The co ordinate system by which the position of an object is described relative to is called frame of reference,

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2. Define Cartesian co ordinate system.

At any instant, the frame of reference with respect to which the position of the object is described in terms of the position coordinates x, y, z is called Cartesian coordinate system.
In General we use the right-handed coordinate system

3. Define scalar and vector. Give examples.

SCALAR : The physical quantity which is described only by magnitude is called Scalar.
Examples: Mass, temperature, speed, work etc.,
VECTOR: The physical quantity which is described by both magnitude and direction is called Vector. **Examples:** Force, velocity, acceleration, momentum etc

4. Define scalar or dot product of two vectors.

Let $\vec{A}$ and $\vec{B}$ be inclined by an angle **θ**, then their scalar product is given by $\vec{A}.\vec{B} = AB\ cos\theta = C$ (scalar)

5. Define vector or cross product of two vectors.

Let $\vec{A}$ and $\vec{B}$ be inclined by an angle **θ**, then their vector product is given by
$\vec{A} \times \vec{B} = AB\ sin\theta\ \hat{n}$ = $\vec{C}$ (vector)

6. How will you prove that two vector are orthogonal?

If two vectors are orthogonal (perpendicular) to each other, then their scalar product is zero or vector product is maximum

7. Define distance and displacement.

Distance is the length of the path travelled by the particle in a given interval of time. It is positive scalar quantity.
Displacement is the shortest distance between the initial and final positions of the particle and its direction is from initial to final position. It is a vector quantity.

8. What is the relative velocity?

The velocity of one object with respect to another is called relative velocity.

9. Define acceleration.

The rate of change of velocity at any instant is called acceleration.
It is a vector quantity. Its unit is **m s^{-2}** and its dimensional formula is **[L T^{-2}]**

10. Define deceleration or retardation.

If the velocity decreases with time, then the acceleration becomes negative. The negative acceleration is called deceleration or retardation

11. Define projectile. Give examples.

When an object is thrown in air with some initial velocity and then allowed to move under the action of gravity alone, the object is known as a projectile. The path followed by the particle is called its trajectory.

Examples: (1) A bullet fired from the gun
(2) A ball thrown in any direction

12. Define angular displacement.

The angle described by the particle about the axis of rotation in a given time is called angular displacement. Its SI unit is radian (rad)

13. Define angular velocity.

The rate of change of angular displacement is called angular velocity. Its SI unit is **rad s^{-1}**

14. Define angular acceleration.

The rate of change of angular velocity is called angular acceleration. Its SI unit is **rad s^{-2}**

15. Define uniform circular motion.

When an object moving in a circular path covers equal distances on the circumference in equal interval of time. then the object is said to be in uniform circular motion.

In uniform circular motion, the velocity of the object (direction) always changes, but its speed (magnitude) remains the same.

16. Define Velocity and Speed.

Velocity: The rate of change of position vector with respect to time is called velocity. It is a vector quantity.

Speed : The magnitude of velocity is called speed. It is a Scalar quantity.

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UNIT 3 LAWS OF MOTION

1. State Newton's first law of motion.

Newton's first law states that, Every object continues to be in the state of rest or of uniform motion unless there is external force acting on it.

2. Define inertia. Explain its types.

The inability of objects to move on its own or change its state of motion is called inertia. Inertia means resistance to change its state.

There are three types of inertia, (1) Inertia at rest (2) Inertia at motion (3) Inertial at direction

3. State Newton's second law of motion.

Newton's second law states that, the force acting on an object is equal to the rate of change of its momentum.

4. Define one newton (1N).

One Newton is defined as the force which acts on 1 kg of mass to give an acceleration **1 m s^{-2}** in the direction of the force.

5. Distinguish between inertial frame and non-inertial frames.

Inertial frames

(i) The frame in which object moves with constant velocity or remains at rest is called inertial frame

(ii) It obeys Newton's laws of motion

(iii) It is also called as non - accelerated frame

Non-inertial frames

(i) The frame in which object get accelerated is called non inertial - frame.

(ii) It obeys only Newton's third law of motion

(iii) It is also called as accelerated frame

6. State Newton's third law of motion.

Newton's third law states that for every action there is an equal and opposite reaction. Here, action and reaction pair of forces do not act on the same body but on two different bodies.

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7. What are the steps followed in developing the free body diagram.

(i) Identify the forces acting on the object

(ii) Represent the forces acting as a point

(iii) Draw the vectors representing the forces action on the object

8. What is concurrent forces and coplanar forces?

* The lines of forces acting at a common point are called concurrent forces.
* The lines of forces they are in the same plane are called coplanar forces.

9. State Lami's theorem.

Lami's theorem states that, if a system of three concurrent and coplanar forces is in equilibrium, then each force is directly proportional to sine of angle between the other two forces

10. State the law of conservation of total linear momentum.

If there are no external forces acting on the system, then the total linear momentum of the system is always a constant vector.

11. Define impulse or impulsive force.

If a very large force acts on an object for a very short duration, then the force is called impulsive force or impulse.

12. What is meant by frictional force?

The force which always opposes the relative motion between an object and the surface where it is placed is called frictional force

13. What is meant by static friction?

Static friction is the force which opposes the initiation of motion of an object on the surface.

14. What is meant by kinetic friction?

When an objects slides, the surface exerts a frictional force called kinetic friction.

15. Give the applications of angle of repose.

(i) Antlions make sand traps in such a way that when an insect enters the edge of the trap, it starts to slide towards the bottom where the antlion hide itself. The angle of inclination of sand trap is made to be equal to angle of repose.

(ii) Children are fond of playing on sliding board. Sliding will be easier when the angle of inclination of the board is greater than the angle of repose. At the same time if inclination angle is much larger than the angle of repose, the slider will reach the bottom at greater speed and get hurt.

16. What are the types of friction?

Depending upon the magnitude of applied force, (a) Static friction (b) Limiting friction
Depending upon the motion, (a) Kinetic friction (b) Rolling friction

17. Give the methods to reduce friction.

(i) Applying Lubricants between the moving parts of a machine.
(ii) By using ball bearings

18. Define centripetal force.

If a particle is in uniform circular motion, there must be centripetal acceleration towards the centre of the circle.

According to Newton's second law, due to this acceleration, there must be some force acting on it with respect to an inertial frame. This force is called centripetal force.

19. Define centrifugal force.

To use newton's first and second law in the rotational frame of reference we need to introduce a pseudo force which appears to act on the particle radially outward . This force is called centrifugal force.

20. What is called pseudo force?

When we analyse circular motion of a particle from rotating frame of reference (non-inertial frame) in addition to centripetal force we must consider a force which must be equal and opposite to centripetal force. This outward force is called centrifugal force. But with respect to inertial frame, there exist centripetal force only. For this reason centrifugal force is called as a pseudo force.

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UNIT 4 WORK, ENERGY AND POWER

1. Explain how the definition of work in physics different from general perception.

In general, any activity refers work. It may be physical or mental work. But in physics, work is done by the force when the force applied on a body displaces it.

2. Can work done on an object becomes zero? Explain with example.

Work done is zero in the following three cases.

i) When the force is zero **(F = 0)**

(e.g.) particle sliding on a smooth frictionless horizontal surface will continue to move.

ii) When the displacement is zero **(dr = 0)**

(e.g.) when force is applied on a rigid wall it does not produce any displacement, so work is zero.

iii) When the force and displacement are perpendicular **(θ = 90°)**

(e.g.) when a body moves on a horizontal direction, the gravitational force does no work on the body, since it acts at right angles to the displacement.

3. Define Energy.

Energy is defined as capacity to do work. In other word work done is the manifestation of energy. Its SI unit is **J or Nm** and its dimension is **$M L^2 T^{-2}$**

4. Define kinetic energy .

It is the energy possessed by a body by virtue of its motion.

(e.g.) All moving bodies have kinetic energy

5. Define potential energy (U).

It is the energy possessed by an object by virtue of its position.

(e.g.) raised hammer, stretched string, etc.,

6. State law of conservation of energy.

It states that energy neither be created nor destroyed. It may transformed from one form to another but the total energy of an isolated system remains constant.

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7. Define work - energy theorem.

According to work - energy theorem, the work done by the force on the body changes the kinetic energy of the body. **(i.e) workdone = change in kinetic energy**

8. Write the various types of potential energy.

i) Gravitational potential energy:

Gravitational potential energy (U) at some height is equal to the amount of work required to take the object from the ground to that height h.

Its equation is **U=mgh**

ii) Elastic potential energy:

e potential energy possessed by a spring due to a deforming force which stretches or compresses the spring is termed as elastic potential energy.

Its is given by, $\mathbf{U = \frac{1}{2} kx^2}$

iii) Electrostatic potential energy :

The energy due to electrostatic forces on charges gives rise to electrostatic potential energy.

9. Compare the conservative force and Nonconservative forces.

Conservative forces:

(i) Work done is independent of the path
(ii) Work done in round trip is zero
(iii) Total energy remains constant
(iv) Work done is completely recoverable

Non-Conservative force

(i) Work done depends upon the path
(ii) Work done in round trip is not zero
(iii) Energy is dissipated as heat energy
(iv) Work done is not completely recoverable

10. Define power. Give its unit.

Power is defined as the rate of work done or energy delivered. P=W/t Unit : watt

11. What is called collision?, Give its types.

If one object influences the motion of other object, then they said to be in collision. Collisions are two types. They are, 1) Elastic collision 2) Inelastic collision

12. Define elastic collision.

In a collision, the total initial kinetic energy of the bodies is equal to the total final kinetic energy of the bodies, then it is called as elastic collision;

Total kinetic energy before collision = Total kinetic energy after collision

13. What is inelastic collision?

In a collision, the total initial kinetic energy of the bodies is not equal to the total final kinetic energy of the bodies, then it is called as inelastic collision;

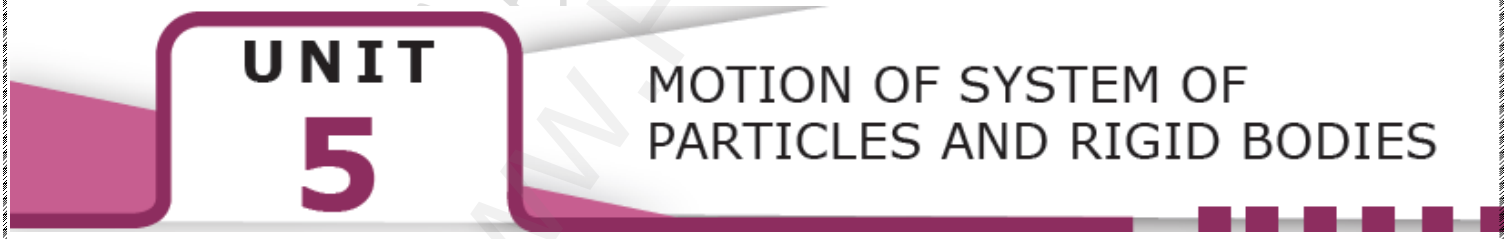
14. Define perfectly inelastic collision.

If the two colliding bodies stick together permenantly after collision such that they are move with common velocity are known as completely inelastic collision or perfectly inelastic collision.

For example, clay putty is thrown on a moving vehicle, the clay putty sticks to the moving vehicle.

15. Define coefficient of restitution.

It is defined as the ratio of velocity of separation after collision to the velocity of approach before collision.



1. Define centre of mass.

The centre of mass of a body is defined as a point where the entire mass of the body appears to be concentrated.

2. Define moment of a force (or) torque. Give its unit.

Torque is defined as the moment of the external applied force about a point or axis of rotation. The S.I unit of torque is N m

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3. What are the conditions in which force can not produce torque?

The expression for torque is, $\vec{\tau} = \vec{r} \times \vec{F} = rF\,sin\theta\hat{n}$

(i) When r and Fare parallel, then **θ=0** and **sin θ = 0**. $\tau = 0$

(ii) When r and F are antiparallel, then **θ= 180°** and sin **θ** = 0. $\tau = 0$

(iii) if the force acts at the reference point, **r = 0,** $\tau = 0$

4. Define angular momentum.

The angular momentum (L) of a point mass is defined as the moment of its linear momentum.

$\vec{L} = \vec{r} \times \vec{P}$ (or) **L = rp sinθ**

5. State law of conservation of angular momentum.

In the absence of external torque, the angular momentum of the rigid body or system of particles is conserved.

$\tau = 0$ then $\frac{dL}{dt} = 0$

6. Define couple. Give examples.

A pair of forces which are equal in magnitude but opposite in direction and separated by a perpendicular distance so that their lines of action do not coincide that causes a turning effect is called a couple.

Examples: (1) steering wheel of a car
(2) Opening and closing of water tap
(3) Turning of a screw driver

7. Define moment of a couple or torque.

The magnitude of moment of couple is defined as the product of either of the forces of a couple by the perpendicular distance between them. Its unit is Nm

8. State Principle of moments.

For rotational equilibrium the total clockwise moment about a point equals the total anticlockwise moment. $F_1 d_1 = F_2 d_2$

9. Define centre of gravity.

The centre of gravity of a body is the point at which the entire weight of the body acts irrespective of the position and orientation of the body. The centre of gravity and centre of mass coincide when the gravitational field is uniform across the body.

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10. Define moment of inertia.

In rotational motion, moment of inertia is a measure of rotational inertia.

It is given by $I = \sum m r^2$

11. What are the significance of moment of inertia.

(i) In rotational motion moment of inertia measures the r/otational inertia.

(ii) Mass is a invariable quantity. But moment of inertia is a variable quantity.

12. Define radius of gyration.

The radius of gyration (K) of an object is the perpendicular distance from the axis of rotation to an equivalent point mass, which would have the same mass as well as the same moment of inertia of the object. It is found as, $I = MK^2$

13. What is equilibrium?

A rigid body is said to be in mechanical equilibrium when both its linear momentum and angular momentum remain constant.