UNIT 2
KINEMATICS

SHORT QUESTIONS

Q.1 Define Kinematics. **(GRW 2015)**

Ans: The study of motion of an object without discussing the cause of motion is called the kinematics.

Q.2 Define dynamics. **(GRW 2015)**

Ans: The branch of mechanics that deals with the study of motion of an object and the cause of its motion is called dynamics.

Q.3 How you will define the rest? **(LHR 2011, GRW 2015)**

Ans: If a body does not change its position with respect to its surroundings then it is said to be in a state of rest.

Surrounding are the places in its neighborhood where various objects are present.

Q.4 How you will define the motion?

Ans: If a body continuously changes its position with respect to its surroundings then it is said to be in a state of motion.

Q.5 How we can say that rest and motion are relative states?

Ans: The state of rest or motion of a body is relative. For example, a passenger sitting in a moving bus is at rest because he/she is not changing his/her position with respect to the other passengers sitting in the bus. But to an observer outside the bus, the passengers and objects inside the bus are in motion because they are changing their positions.

Q.6 Define Rotatory motion. **(LHR 2013)**

Ans: The spinning motion of a body around its axis is called rotatory motion.

Example

- Motion of Earth around its geographical axis
- Motion of wheel and steering wheel around its axis
- Motion of a ceiling electric fan

Axis of Rotation

A line around which a body rotates is called axis of rotation.

Q.7 Differentiate between circular motion and rotatory motion **(GRW 2015)**

Ans:

Circular motion	Rotatory motion
1. The motion of an object in a circular path is known as circular motion. 2. In circular motion the point about which a body goes around is outside the body. 3. **Examples**:	1. The spinning motion of a body about its axis is called rotatory motion. 2. In rotatory motion the line around which a body moves about is passing through the body itself. 3. **Examples:** • Motion of earth about its geographical

• Motion of earth around the sun. • Motion of moon around the earth.	axis. • Motion of a wheel about its axis.

Q.8 Define Vibratory motion. **(LHR 2011, GRW 2015)**

Ans: To and fro motion of a body about its mean position is known as vibratory motion.

Examples

- Motion of swing back and forth about its mean position
- Motion of pendulum of wall clock
- Motion of see – saw
- Motion of a body attached with a spring.

Q.9 What do you know about scalar and vector quantities **(LHR 2014, 2015)**

Ans: A physical quantity which can be completely described by its magnitude only is called a scalar. The magnitude of a quantity means its numerical value with an appropriate unit.

Examples

Mass, length, time speed, volume, area, energy etc.

Vector

A physical quantity which can be completely described by its magnitude along with its direction.

Example

Velocity, force, displacement, momentum, torque etc.

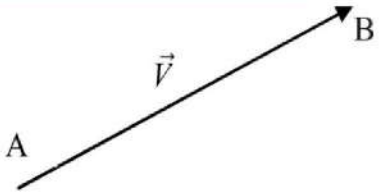
Q.10 How a vector is represented? **(LHR 2014)**

Ans: Symbolical Representation

A vector is represented symbolically by a letter (an alphabet) with an arrow drawn above or below the symbol as $\vec{A}$ or $\underset{\rightarrow}{A}$. A vector quantity can also be represented symbolically by using bold letters such as **A**.

Graphical Representation

Graphically, a vector can be represented by a line segment with an arrow head at its one end. The length of line, according to some selected scale, gives the magnitude of the vector and an arrow head at one end of the line gives the direction of the vector. The line AB drawn according to some selected scale with an arrow head represents the vector $\vec{V}$ graphically.



Q.11 What is Position? **(GRW 2015)**

Ans: The term position describes the location of place or a point with respect to some reference point called origin.

Example

Suppose you want to describe the position of your school from your home. Let the school be represented by S and home by H. The position of your school from your home will be represented by a straight line HS in the direction from H to S as shown in Fig.

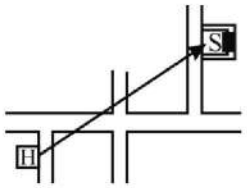


Figure 2.16: Position of the school S from the home H

Q.12 What is meant by distance?

Ans: Distance

The total length/separation of a path between two points is known as distance between those points.

Quantity

It is a scalar quantity

Unit

Its SI unit is meter (m).

Representation

It is represented by "S".

Q.13 What do you know about Displacement?

Ans: The shortest distance between two points is known as displacement which has magnitude and direction.

Representation

It is represented by "$\vec{d}$".

Quantity

It is a vector quantity and it is directed from initial to final point.

Unit

Its SI unit is meter (m).

Q.14 What do you know about speed?

Ans: The distance covered by an object in unit time is known as its speed.

Mathematical form

If a body covers distance 'S' in time 't' then its speed 'v' can be mathematically written as,

Speed = Distance covered/Total time

$$v = \frac{S}{t}$$

Distance = speed x time

$$S = v \times t$$

Quantity

It is a scalar quantity.

Unit

SI unit of speed is meter per second (ms^{-1}).

Q.15 How you will define the uniform speed? **(GRW 2013)**

Ans: If a body covers equal distances in equal intervals of time, however small the intervals may be, the speed of the body is said to be uniform.

Q.16 Define variable speed.

Ans: A body has variable speed if it covers unequal distances in equal intervals of time however short the interval may be.

Q.17 A body is moving with uniform speed. Will its velocity be uniform?

Ans: A body moving with uniform speed may have uniform or variable velocity.

If the direction of the body is not changing then its velocity will also be uniform.

Example 1

A car moving with uniform speed in the straight line will have uniform velocity.

If the direction of the body is changing then its velocity will be variable.

Example 2

A car moving with uniform speed in the circular path will have variable velocity because its direction changes at every point on the circle.

Q.18 What do you know about velocity?

Ans: The rate of displacement of a body is called velocity.

Mathematical form

$$\text{Velocity} = \frac{\text{displacement}}{\text{time taken}}$$

$$\vec{v} = \frac{\vec{d}}{t}$$

Here $\vec{d}$ is the displacement of the body moving with velocity $\vec{v}$ in time t.

Quantity

It is a vector quantity and its direction is same as the direction of displacement.

Unit

SI unit of velocity is same as that of speed that is meter per second (ms^{-1}).

Q.19 What do you know about uniform velocity? (GRW 2013, 2015)

Ans: A body has uniform velocity if it covers equal displacement in equal intervals of time however short the interval may be.

Q.20 Define variable velocity.

Ans: A body has variable velocity if it covers unequal displacement in equal intervals of time however short the interval may be.

Q.21 Does speedometer of a car measure its velocity?

Ans: The speedometer of a car measures only magnitude of velocity not the direction. Therefore, we can say that speedometer of the car does not measure its velocity. It measures only speed.

Q.22 Why a body moving along a circle with uniform speed has variable velocity?

Ans: A body moving along a circle with uniform speed has variable velocity because its direction is changing at every point on the circular path.

Q.23 What is meant by the acceleration? (LHR 2015)

Ans: The rate of change of velocity of a body is known as acceleration.

Mathematical form

If a body is moving with initial velocity '$\mathbf{v_i}$' and after some time 't' its velocity becomes '$\mathbf{v_f}$' then change in velocity will be $\mathbf{v_f - v_i}$ in time t.

$$\text{Acceleration} = \frac{\text{change in velocity}}{\text{time}}$$

$$\text{Acceleration} = \frac{\text{final velocity} - \text{initial velocity}}{\text{time}}$$

So $$\mathbf{a} = \frac{\mathbf{v_f - v_i}}{t}$$

Unit

SI unit of acceleration is meter per second per second (ms^{-2}).

Quantity

It is a vector quantity.

Q.24 What is meant by uniform acceleration?

Ans: If a body has equal changes in velocity in equal intervals of time, however small the intervals may be, then the acceleration of the body is said to be uniform.

Q.25 Define variable acceleration.

Ans: A body has variable acceleration if it has unequal changes in velocity in equal intervals of time however short the interval may be.

Q.26 What is meant by positive acceleration and negative acceleration? (GRW2012, 2015)

Ans: Positive acceleration

If the velocity of the body is increasing then acceleration will be positive. The direction of positive acceleration is the same in which the body is moving without change in its direction.

Example

If a car is moving in straight line and the driver presses the accelerator the velocity of the car starts to increase. So the acceleration of the body will be positive.

Negative acceleration or retardation

If the velocity of the body is decreasing then acceleration will be negative. The direction of negative acceleration is opposite to the direction in which the body is moving. Negative acceleration is also called retardation or deceleration.

Example

If the driver applies brake, the velocity will start to decrease. So acceleration of the body will be negative and direction of acceleration is opposite to the direction of velocity.

Q.27 A body moving with uniform velocity. What will be its acceleration?

(LHR 2011, 2012)

Ans: A body is moving with uniform velocity then its acceleration will be zero because acceleration is defined as the rate of change of velocity. When the body is moving with uniform velocity, the change in velocity will be zero and therefore the acceleration will also be zero.

Q.28 Can a body moving with certain velocity in the direction of east can have acceleration in the direction of west?

Ans: Yes, a body moving with certain velocity in the direction of east can have acceleration in the direction of west. It is the case when the velocity of the body decreases. When velocity decreases, acceleration is produced in opposite direction to the direction of motion.

Q.29 What do you know about graph?

Ans: Graph is a pictorial way of presenting the information about the relation between various quantities. The quantities used in plotting a graph are called the variables.

Independent variable quantity

The quantity which can be changed with our wish is called independent variable quantity.

Dependent variable quantity

The quantity, value of which varies with the change in independent variable quantity is called the dependent variable quantity.

Q.30 What do you know about gravitational acceleration? (LHR 2011)

Ans: If we neglect air resistance, then all the bodies either lighter or heavier will fall down with uniform acceleration. This uniform acceleration of freely falling bodies is known as gravitational acceleration. It is represented by 'g'. Its value is $9.8 ms^{-2}$, but for simplicity we shall use the value of g as $10 ms^{-2}$. For bodies falling vertically downward 'g' is positive and for bodies moving vertically upward 'g' is negative.

Q.31 How can we use equations of motion for bodies, which are falling freely under the gravity?

Ans: Equations of motion can be used for bodies moving under gravity. In such cases we replace 'a' by 'g' and S by h. so equations of motion for bodies falling freely can be written as,

$$v_f = v_i + gt$$

$$h = v_i t + \frac{1}{2} g t^2$$

$$2gh = v_f^2 - v_i^2$$

Q.32 What are the points kept in mind when bodies are moving freely under gravity?

Ans: When bodies are moving in downward direction:

- Initial velocity 'v_i' of the freely falling body will be zero
- Gravitational acceleration will be positive

When bodies are moving in upward direction:

- Final velocity 'v_f' of the body will be zero.
- Gravitational acceleration will be negative.

Q.33 When a body is thrown vertically upward, its velocity at the highest point is zero. Why?

Ans: When a body is thrown vertically upward, it moves against the force of attraction of the earth. It slows down gradually and on reaching the highest point it comes to rest. That is why the velocity of a body becomes zero at the highest point.