THE SMART STUDY NOTES

CLASS 9th New PHYSICS

Chapter 2: Kinematics

Additional Short Questions and Answers

(1) Write the second equation of motion and explain its terms.

Ans. Equation: $\mathbf{S = Vi\ t + \frac{1}{2}\ a\ t^2}$

S = displacement, Vi= initial velocity, a = acceleration and t = time

This equation tells us how far an object moves when it starts with some speed and speeds up or slows down.

(2) What does a distance-time graph show?

Ans. A distance-time graph shows how far an object moves over time.

A straight line means constant speed, and a curved line means changing speed.

(3) In which gun is the acceleration of the bullet larger? Explain your answer.

Ans. The gun with the shorter barrel gives more acceleration because the bullet reaches a high speed in a shorter distance and time.

(4) What is the formula for speed?

Ans. Speed = $\frac{Distance}{Time}$

(5) Why is speed a scalar quantity while velocity is a vector?

Ans. Speed has only magnitude (how fast), so it is scalar.

Velocity has magnitude and direction, so it is a vector quantity.

(6) Give an example of non-uniform acceleration.

Ans. A car that slows down or speeds up at different rates in traffic has non-uniform acceleration because the change in speed is not regular.

(7) What is the motion of a freely falling object called?

Ans. It is called free fall. In this motion, only gravity acts on the object, and it falls with constant acceleration.

(8) Is displacement always equal to the total distance covered? Why or why not?

Ans. No. Displacement is the shortest path between start and end points. Distance is the total path travelled, so they are only equal in straight-line motion.

(9) Is it possible that the velocity of an object is zero at an instant, but its acceleration is not zero?

Ans. Yes. When a ball is thrown upward, its velocity becomes zero at the highest point, but acceleration due to gravity is still acting on it.

(10) Can an object have zero acceleration while moving? Explain.

Ans. Yes. If an object moves at constant velocity, it has zero acceleration because its speed and direction are not changing.

(11) Is it possible for a body to have acceleration when moving with uniform speed?

Ans. Yes. In circular motion, speed remains the same but direction changes, so the body has acceleration due to the change in direction.

(12) Define speed and velocity.

Ans. Speed is the rate of change of distance with time. It has no direction.

Velocity is the rate of change of displacement with time. It has both magnitude and direction.

(13) A car is moving in a circular path at constant speed. Is its velocity uniform? Why or why not?

Ans. No, its velocity is not uniform. Even though speed is constant, direction keeps changing, so velocity changes.

(14) Define average speed and write its formula.

Ans. Average speed is total distance divided by total time.

Formula: $\textbf{Average Speed} = \frac{\textit{Total Distance}}{\textit{Total Time}}$

(15) Why can't an object with mass achieve the speed of light?

Ans. As speed increases, the mass of the object increases.

To reach the speed of light, it would need infinite energy, which is not possible.

(16) Distance and displacement may or may not be equal in magnitude. Explain this statement.

Ans. They are equal in a straight-line path.

If an object follows a curved or round path, distance becomes more than displacement.

(17) What does the area under a speed-time graph represent?

Ans. The area under a speed-time graph shows the distance travelled by the object during that time.

(18) What is the slope of a speed-time graph equal to?

Ans. The slope or gradient of a speed-time graph gives the acceleration of the object.

(19) What is acceleration? Write its formula.

Ans. Acceleration is the rate at which velocity changes with time.

Formula: $\boldsymbol{a = \frac{Vf - Vi}{t}}$

(20) Can displacement be zero while distance is not? Explain.

Ans. Yes. If an object returns to its starting point, the displacement is zero, but the distance covered is the total path travelled.

(21) The vector quantities are sometimes written in scalar notation (not bold face).

Ans. Yes, in some cases, vector quantities like velocity or force are written without bold letters for simplicity, but they still have direction and magnitude.

(22) Give an example of uniform acceleration.

Ans. An object falling freely under gravity has uniform acceleration.

Its velocity increases by **9.8 m/s** every second.

(23) What is the universal speed limit?

Ans. The universal speed limit is the speed of light in vacuum, which is $\boldsymbol{3 \times 10^8 m/s}$

(24) If an object moves at constant velocity, what is its acceleration?

Ans. If velocity is constant, it means there is no change in speed or direction, so acceleration is zero.

(25) Give an example of circular motion in daily life.

Ans. A ceiling fan blade or a child on a merry-go-round are common examples of circular motion.

(26) What is a graph in physics?

Ans. A graph is a visual way to show how two quantities are related.

For example, a distance-time graph shows how far something moves over time.

(27) What is the difference between a scalar and a vector?

Ans. Scalar: Has only magnitude (e.g., speed, time).

Vector: Has both magnitude and direction (e.g., velocity, force).

(28) Give two examples of scalar and vector quantities.

Ans. Scalar: Time, Temperature

Vector: Displacement, Acceleration

(29) A body is moving with uniform speed. Will its velocity be uniform? Give reason.

Ans. No. If direction changes (like in circular motion), then velocity changes, even if speed stays the same.

(30) What happens to the velocity of an object thrown vertically upward at its highest point?

Ans. At the highest point, the object's velocity becomes zero, but acceleration due to gravity is still acting downward.

(31) What are the Cartesian coordinates, and how do they help in vector representation?

Ans. Cartesian coordinates are horizontal (x) and vertical (y) values used to locate a point.

They help represent vectors by showing their direction and magnitude on a graph.

(32) What is rotatory motion? Give an example.

Ans. Rotatory motion is when an object spins around a fixed axis.

Example: The blades of a fan rotating around its center.

(33) Write the third equation of motion and explain its terms.

Ans. Equation: $2aS = Vf^2 - Vi^2$

a = acceleration, S = displacement, Vf = final velocity, and Vi = initial velocity

This equation connects velocity, acceleration, and displacement without using time.

(34) Why is displacement zero for a runner who completes a lap?

Ans. After one lap, the runner returns to the starting point.

Since start and end points are the same, displacement is zero.

(35) What is the SI unit of displacement?

Ans. The SI unit of displacement is the metre (m).

It shows the shortest distance between two points in a straight line.

(36) Two objects fall from the same height, but one is heavier. Which will hit the ground first in vacuum? Why?

Ans. In a vacuum, both objects fall with the same acceleration (gravity), so they hit the ground at the same time, regardless of mass.

(37) What are the three equations of motion?

Ans.

1. $Vf = Vi + at$
2. $S = Vit + \frac{1}{2}at^2$
3. $2aS = Vf^2 - Vi^2$

These relate displacement, velocity, acceleration, and time.

(38) What does a speed-time graph represent?

Ans. A speed-time graph shows how speed changes with time.

Its slope gives acceleration, and its area gives the distance covered.

(39) How is kinematics different from dynamics?

Ans. Kinematics studies motion without force.

Dynamics studies motion with the causes (like force or mass).

(40) Write the first equation of motion and explain its terms.

Ans. Equation: $\boldsymbol{Vf = Vi + at}$

$\boldsymbol{Vf}$ = final velocity, $\boldsymbol{Vi}$ = initial velocity, $\boldsymbol{a}$ = acceleration, and $\boldsymbol{t}$ = time

It shows how velocity changes with acceleration over time.

(41) How do we add two vectors using the head-to-tail rule?

Ans. In the head-to-tail rule, place the tail of the second vector at the head of the first.

The resultant vector is drawn from the tail of the first to the head of the second.

(42) What is instantaneous speed? How is it measured?

Ans. Instantaneous speed is the speed of an object at a specific moment.

It is measured using a speedometer or calculated by taking very short time intervals.

(43) What does the gradient (slope) of a distance-time graph show?

Ans. The slope of a distance-time graph gives the speed of the object.

A steeper slope means higher speed.

(44) Define scalar and vector quantities.

Ans. A scalar quantity has only magnitude (e.g., time, speed).

A vector quantity has both magnitude and direction (e.g., velocity, force).

(45) Why can't vectors be added like scalars?

Ans.

Vectors have direction, so they must be added using rules like the head-to-tail method.

Scalars don’t need direction, so they are added simply.

(46) If an object has a negative velocity and positive acceleration, what is happening to its motion?

Ans. The object is slowing down.

Positive acceleration is trying to reverse the direction of motion.

(47) Define translatory motion with an example.

Ans.

Translatory motion is when all parts of a body move in the same direction.

Example: A car moving on a straight road.

(48) What are the three types of motion?

Ans.

1. Translatory Motion

2. Rotatory Motion

3. Vibratory Motion

Each type depends on how the object moves.

(49) The figure shows a distance-time graph for a cyclist. Find velocities for segments a, b, and c.

Ans. Answer depends on the graph, but:

Find the slope of each segment using: Velocity = $\frac{Change\ in\ Distance}{Change\ in\ Time}$

(50) Define rest and motion in terms of surroundings.

Ans. An object is in rest if it does not change its position with respect to its surroundings.

It is in motion if its position changes with time.

(51) For a complete trip, average velocity was positive. Can instantaneous velocity be negative? Explain.

Ans. Yes, instantaneous velocity can be negative if the object is moving in the opposite direction at a certain moment, even if average velocity is positive overall.

(52) What is the reference line for geographical directions?

Ans. The reference line is the geographical north-south line, which helps in finding directions like east, west, north, and south.

(53) Falling objects near the Earth have the same constant acceleration. Does this mean heavier objects fall faster?

Ans. No, in the absence of air, all objects fall with the same acceleration due to gravity, no matter their mass.

(54) State head-to-tail rule for addition of vectors.

Ans. In the head-to-tail method, place the tail of one vector at the head of another.

The line from the start of the first to the end of the second gives the resultant vector.

(55) What is the difference between linear motion and random motion?

Ans. Linear motion is straight-line movement (e.g., car on a road).

Random motion is irregular and unpredictable (e.g., dust in air).

(56) What is vibratory motion? Give an example.

Ans. Vibratory motion is back-and-forth motion of an object around a fixed point.

Example: Motion of a guitar string when plucked.

(57) Differentiate between distance and displacement.

Ans. Distance: Total path covered (scalar).

Displacement: Straight-line change in position (vector).

(58) What is free fall?

Ans. Free fall is the motion of an object falling under gravity alone without air resistance.

It has a constant acceleration.

(59) What is the velocity of an object at its highest point when thrown upward?

Ans. At the highest point, the object's velocity becomes zero, but acceleration is still acting downward due to gravity.

(60) A train moving with uniform velocity suddenly stops. What type of acceleration does it experience?

Ans. The train experiences negative acceleration or deceleration, because its velocity decreases to zero suddenly.

(61) What is kinematics?

Ans. Kinematics is the branch of physics that deals with the motion of objects without discussing the causes (forces) behind that motion.

(62) What is the value of acceleration due to gravity (g)?

Ans. The standard value of acceleration due to gravity near the Earth's surface is:

$g = 9.8\ m/s^2 \approx 10\ m/s^2$

(63) What is Einstein's theory of relativity?

Ans. Einstein's theory explains how time, space, and motion are related, especially when objects move at very high speeds close to the speed of light.

(64) What are distance-time graph and speed-time graph?

Ans. A distance-time graph shows how distance changes with time.

A speed-time graph shows how speed changes over time and helps find acceleration and distance.

(65) Why is the state of rest or motion relative?

Ans. Rest or motion depends on the observer's position.

An object may appear to be at rest to one observer but moving for another.

(66) How is a vector quantity represented graphically?

Ans. A vector is represented by an arrow:

Its length shows magnitude

Its direction shows the direction of the vector

(67) When is acceleration positive and when is it negative?

Ans. Positive acceleration increases speed.

Negative acceleration (or deceleration) decreases speed.

(68) What is the SI unit of acceleration?

Ans. The SI unit of acceleration is: metre per second squared (m/s^2)

(69) A car is moving with a constant speed but changing direction. Is its velocity constant? Why?

Ans. No, its velocity is not constant because velocity depends on both speed and direction, and the direction is changing.

(70) What is meant by deceleration or retardation?

Ans. Deceleration (or retardation) is negative acceleration, meaning the object is slowing down.

(71) How can we represent a vector in symbolic notation?

Ans. A vector is written with an arrow above it or in bold:

Example: $\vec{v}$ or **v**

(72) Give an example where an object is at rest for one observer and in motion for another.

Ans. A passenger sitting in a moving bus is at rest for another passenger but in motion for a person standing outside.

(73) What does the direction of a vector represent?

Ans. The direction of a vector shows the way in which the quantity (like force or velocity) is acting.

(74) Give 5 examples each for scalar and vector quantities.

Ans. Scalar: Speed, Time, Distance, Mass, Temperature

Vector: Velocity, Displacement, Force, Acceleration, Momentum

(75) What assumptions are made when using the equations of motion?

Ans. 1. Acceleration is constant.

2. Motion is in a straight line.

3. Air resistance is ignored.

Exercise short answer questions

2.1 Define scalar and vector quantities.

Ans. A scalar quantity has only magnitude (size), no direction.

A vector quantity has both magnitude and direction.

2.2 Give 5 examples each for scalar and vector.

Ans. Scalars: Speed, Distance, Mass, Time, Temperature

Vectors: Velocity, Displacement, Force, Acceleration, Momentum

2.3 State head-to-tail rule for addition of vectors.

Ans. To add vectors using the head-to-tail rule:

Place the tail of one vector at the head of the other.

The resultant vector is drawn from the tail of the first to the head of the last.

2.4 What are distance-time graph and speed-time graph?

Ans. A distance-time graph shows how distance changes with time.

A speed-time graph shows how speed changes with time.

Both graphs help understand motion visually.

2.5 Falling objects near the Earth have the same constant acceleration. Does this imply that a heavier object will fall faster than a lighter object?

Ans. No, in the absence of air, both heavy and light objects fall with the same acceleration ($g = 9.8\ m/s^2$).

They hit the ground at the same time in a vacuum.

2.6 The vector quantities are sometimes written in scalar notation (not bold face). How is the direction indicated?

Ans. When vectors are written like scalars, their direction is shown by using a directional arrow or by mentioning direction in words (e.g., 5 m/s east).

2.7 A body is moving with uniform speed. Will its velocity be uniform? Give reason.

Ans. Not always.

If the direction changes, then the velocity is not uniform even if the speed is constant, because velocity depends on both speed and direction.

2.8 Is it possible for a body to have acceleration? When moving with:

Ans.

(i) Constant velocity: ✗ No, because acceleration means change in velocity.

(ii) Constant speed: ✓ Yes, if the direction is changing, like in circular motion.