CLASS 9 PHYSICS • CHAPTER 2

KINEMATICS

Comprehensive Multiple Choice Questions (MCQs)
With Detailed Explanations & Key Concepts

TOTAL QUESTIONS
65 Examination MCQs

COVERAGE
Sections A through J

FORMAT
Questions, Keys & Explanations

SUBJECT
Physics (Secondary Level)

SECTION A: SCALARS AND VECTORS

1. Which of the following is a scalar quantity?

A) Velocity
B) Displacement
C) Speed
D) Acceleration

Ans: C **Explanation:** A scalar quantity is completely described by its magnitude (number and unit) only. Speed tells how fast an object moves without direction, making it scalar.

2. A vector quantity is completely described by:

A) Magnitude only
B) Direction only
C) Magnitude and direction
D) Unit only

Ans: C **Explanation:** Vectors require both a numerical magnitude and a specific direction to be fully defined (e.g., 5 km North).

3. Which of the following is an example of a vector quantity?

A) Mass
B) Time
C) Energy
D) Weight

Ans: D **Explanation:** Weight is the gravitational force acting on a body, directed downward towards the Earth's center, making it a vector.

4. In text, a vector is represented by:

A) Italic letters (e.g., A)
B) Bold letters (e.g., **A**)
C) A small arrow over the letter (e.g., $\vec{A}$)
D) Both B and C

Ans: D **Explanation:** Textbooks distinguish vectors by using boldface text or putting a small arrow above the letter.

5. The magnitude of a vector is represented by:

A) Bold letters
B) Italic letters without an arrow head
C) A line with an arrowhead
D) A dot over the letter

Ans: B **Explanation:** Magnitude is a scalar quantity and is symbolized by standard italic letters without arrows (e.g., A or v).

6. To represent a vector graphically, we need:

A) Only a straight line
B) A straight line with an arrowhead
C) A circle
D) A curved line

Ans: B **Explanation:** Graphically, length represents magnitude and the arrowhead points in the vector's direction.

7. The direction of a vector is usually given by an angle θ with the:

A) y-axis
B) x-axis
C) Origin
D) North direction

Ans: B **Explanation:** In standard Cartesian coordinates, direction angle θ is measured counter-clockwise from the positive x-axis.

8. If a force vector F has a magnitude of 350 N at 60° to the x-axis, and scale is 100 N = 1 cm, what is the length of the vector line?

A) 3.0 cm
B) 3.5 cm
C) 4.0 cm
D) 6.0 cm

Ans: B **Explanation:** Scale length = 350 N / (100 N/cm) = 3.5 cm.

9. When adding two vectors by the head-to-tail rule, the resultant vector is drawn:

A) From tail of first to head of last
B) From head of first to tail of last
C) From origin to head of first
D) From tail of first to tail of last

Ans: A **Explanation:** The resultant vector joins the starting point (tail of 1st vector) directly to the end point (head of last vector).

SECTION B: REST AND MOTION

10. A body is said to be at rest if it:

A) Changes position with surroundings
B) Does not change position with surroundings
C) Moves in a circle
D) Moves with constant speed

Ans: B **Explanation:** Rest is defined relative to surrounding reference points over time.

11. The state of rest or motion of a body is always:

A) Absolute
B) Relative
C) Constant
D) Zero

Ans: B **Explanation:** Rest and motion depend entirely on the chosen observer's frame of reference.

12. When a motorcyclist drives on a road, a roadside observer sees the rider as:

A) At rest
B) In motion
C) Stationary
D) Moving backwards

Ans: B **Explanation:** The motorcyclist continually changes position with respect to stationary roadside objects.

SECTION C: TYPES OF MOTION

13. The motion of a train on a straight track is an example of:

A) Rotatory motion
B) Vibratory motion
C) Translatory motion
D) Circular motion

Ans: C **Explanation:** Translatory motion occurs when every particle of an object moves through the same distance in parallel paths.

14. The motion of a freely falling body is an example of:

A) Linear motion
B) Random motion
C) Circular motion
D) Rotatory motion

Ans: A **Explanation:** Linear motion is translatory motion along a straight vertical or horizontal line.

15. The motion of a bee flying around flowers is an example of:

A) Linear motion
B) Random motion
C) Circular motion
D) Vibratory motion

Ans: B **Explanation:** Irregular, disorderly, or unpredictable motion in any direction is random motion.

16. The motion of a body along a circular path is called:

A) Linear motion
B) Rotatory motion
C) Circular motion
D) Vibratory motion

Ans: C **Explanation:** Movement around a circular path centered at an external point is circular motion.

17. The motion of an electric fan is an example of:

A) Translatory motion
B) Rotatory motion
C) Vibratory motion
D) Linear motion

Ans: B **Explanation:** Spinning motion around an internal fixed axis passing through the body is rotatory motion.

18. The motion of a swing in a children's park is an example of:

A) Circular motion
B) Rotatory motion
C) Vibratory motion
D) Random motion

Ans: C **Explanation:** Back-and-forth oscillation about a mean central position is vibratory motion.

SECTION D: DISTANCE AND DISPLACEMENT

19. Distance is a:

A) Vector quantity
B) Scalar quantity
C) Base quantity
D) Derived quantity

Ans: B **Explanation:** Distance measures total length of path covered regardless of direction, making it scalar.

20. Displacement is a:

A) Scalar quantity
B) Vector quantity
C) Dimensionless quantity
D) Base quantity

Ans: B **Explanation:** Displacement is the straight-line distance from initial to final position with direction, making it a vector.

21. The SI unit of displacement is:

A) Metre (m)
B) Metre per second (m/s)
C) Metre per second squared (m/s^2)
D) Kilometre (km)

Ans: A **Explanation:** Since displacement measures length, its primary standard SI unit is the metre (m).

22. A person travels 320 km by road between two cities. The straight distance is 300 km. What is the displacement?

A) 320 km
B) 300 km
C) 20 km
D) 0 km

Ans: B **Explanation:** Displacement represents net positional shift along a straight line (300 km), not path distance (320 km).

23. Displacement can be:

A) Positive only
B) Negative only
C) Zero
D) Positive, negative, or zero

Ans: D **Explanation:** Depending on direction relative to origin, displacement vector values can be positive, negative, or zero (for round trips).

SECTION E: SPEED AND VELOCITY

24. Speed is defined as:

A) Distance covered per unit time
B) Displacement per unit time
C) Change in velocity per unit time
D) Change in distance per unit time

Ans: A **Explanation:** Speed measures the rate at which distance is covered: $v = S / t$.

25. The SI unit of speed is:

A) m
B) m/s
C) m/s²
D) km/h

Ans: B **Explanation:** Distance (metres) divided by time (seconds) yields metres per second (m/s or $m \cdot s^{-1}$).

26. Speedometer readings in a moving vehicle represent:

A) Average speed
B) Instantaneous speed
C) Uniform speed
D) Variable speed

Ans: B **Explanation:** Instantaneous speed is the exact rate of motion evaluated at a specific moment in time.

27. Average speed of a body is calculated as:

A) Total distance / Total time
B) Total displacement / Total time
C) Total distance × Total time
D) Total displacement × Total time

Ans: A **Explanation:** Average speed evaluates overall travel rate by dividing full path distance by full elapsed time.

28. An eagle dives 300 m in 5 s. What is its average speed?

A) 50 m/s
B) 60 m/s
C) 1500 m/s
D) 30 m/s

Ans: B **Explanation:** $v = 300\ m / 5\ s = 60\ m/s$.

29. Velocity is defined as:

A) Distance covered per unit time
B) Displacement per unit time
C) Rate of change of speed
D) Total distance × Total time

Ans: B **Explanation:** Velocity is directional rate of displacement: $v = d / t$.

30. Which of the following is a vector quantity?

A) Speed
B) Distance
C) Velocity
D) Time

Ans: C **Explanation:** Velocity incorporates both speed magnitude and explicit motion direction.

31. A car moving North at 70 km/h describes:

A) Speed
B) Velocity
C) Acceleration
D) Distance

Ans: B **Explanation:** Combining rate (70 km/h) with heading (North) fully describes a velocity vector.

32. Velocity is uniform if:

A) Only speed is constant
B) Only direction is constant
C) Speed & direction both remain constant
D) Speed changes along straight line

Ans: C **Explanation:** Changing either magnitude or heading alters velocity. Both must remain constant for uniform velocity.

33. A falling paratrooper reaching air resistance balance descends with:

A) Variable velocity
B) Uniform velocity
C) Zero velocity
D) Decreasing velocity

Ans: B **Explanation:** When upward drag equals downward gravity force, net force is zero and terminal uniform velocity is reached.

SECTION F: ACCELERATION

34. Acceleration is defined as:

A) Rate of change of distance
B) Rate of change of displacement
C) Rate of change of velocity
D) Rate of change of speed

Ans: C **Explanation:** Acceleration measures how rapidly velocity vectors change over time: $a = (v_f - v_i) / t$.

35. The SI unit of acceleration is:

A) m/s
B) m/s²
C) m²/s
D) N

Ans: B **Explanation:** Change in velocity (m/s) per unit time (s) produces m/s² ($m \cdot s^{-2}$).

36. Negative acceleration is also called:

A) Uniform acceleration
B) Variable acceleration
C) Deceleration or retardation
D) Positive acceleration

Ans: C **Explanation:** When velocity decreases, acceleration opposes direction of motion, termed deceleration.

37. If object velocity is increasing over time, acceleration is:

A) Zero
B) Negative
C) Positive
D) Constant

Ans: C **Explanation:** A positive velocity change $\Delta v > 0$ yields positive acceleration values.

38. A plane starts from rest and reaches 70 m/s in 20 s. Calculate average acceleration:

A) 3.5 m/s²
B) 5.0 m/s²
C) 2.5 m/s²
D) 7.0 m/s²

Ans: A **Explanation:** $a = (70\ m/s - 0\ m/s) / 20\ s = 3.5\ m/s^2$.

39. If velocity changes by equal increments in equal time intervals, acceleration is:

A) Variable
B) Uniform
C) Zero
D) Negative

Ans: B **Explanation:** Constant rate of velocity change defines uniform acceleration.

SECTION G: GRAPHICAL ANALYSIS OF MOTION

40. In a distance-time graph, the independent variable plotted on x-axis is:

A) Distance
B) Time
C) Speed
D) Acceleration

Ans: B **Explanation:** Time progresses independently and is conventionally assigned to the horizontal x-axis.

41. A straight sloping line on a distance-time graph represents motion with:

A) Uniform acceleration
B) Uniform speed
C) Variable speed
D) Zero speed

Ans: B **Explanation:** Equal distance coverage per unit time creates a constant graph slope (uniform speed).

42. A horizontal line parallel to time-axis on a distance-time graph means the body is:

A) Moving with uniform speed
B) Moving with uniform acceleration
C) At rest
D) Moving with variable speed

Ans: C **Explanation:** Distance remains fixed while time advances; zero slope indicates zero speed (at rest).

43. The gradient (slope) of a distance-time graph equals:

A) Speed
B) Acceleration
C) Total distance
D) Total time

Ans: A **Explanation:** Slope = Δy / Δx = Δdistance / Δtime = Speed.

44. On a speed-time graph, a straight line rising upward shows:

A) Constant speed
B) Uniform acceleration
C) Variable acceleration
D) Zero acceleration

Ans: B **Explanation:** Steady upward increase in speed over equal time steps corresponds to uniform acceleration.

45. The gradient of a speed-time graph represents:

A) Average speed
B) Acceleration
C) Distance covered
D) Displacement

Ans: B **Explanation:** Slope = Δspeed / Δtime = Acceleration.

46. The total area enclosed under a speed-time curve represents:

A) Acceleration
B) Distance covered
C) Final velocity
D) Time taken

Ans: B **Explanation:** Area = speed × time = total path distance traversed by the object.

SECTION H: EQUATIONS OF MOTION

47. Which equation represents the First Equation of Motion?

A) $S = v_i t + \frac{1}{2} a t^2$
B) $2aS = v_f^2 - v_i^2$
C) $v_f = v_i + at$
D) $v_f = v_i - at$

Ans: C **Explanation:** Standard 1st motion equation linking velocities, uniform acceleration, and time.

48. Which equation represents the Second Equation of Motion?

A) $v_f = v_i + at$ B) $S = v_i t + \frac{1}{2} a t^2$

C) $2aS = v_f^2 - v_i^2$ D) $S = v t$

Ans: B **Explanation:** 2nd equation calculates distance S using initial velocity, time, and acceleration.

49. Which equation represents the Third Equation of Motion?

A) $v_f = v_i + at$ B) $S = v_i t + \frac{1}{2} a t^2$

C) $2aS = v_f^2 - v_i^2$ D) $S = v t$

Ans: C **Explanation:** 3rd motion equation links distance, acceleration, and velocities independent of time.

50. Which basic assumptions apply to standard linear equations of motion?

A) Straight-line motion B) Uniform acceleration

C) Magnitudes of vectors used D) All of the above

Ans: D **Explanation:** Equations of motion strictly assume 1D linear trajectories with constant acceleration.

SECTION I: MOTION UNDER GRAVITY (FREE FALL)

51. Gravitational acceleration experienced by freely falling bodies is denoted by:

A) a B) v

C) g D) G

Ans: C **Explanation:** Standard symbol for local gravitational acceleration is lowercase g.

52. Standard numerical value used for Earth's surface gravitational acceleration 'g' is:

A) 9.8 m/s² B) 10 m/s²

C) Both A & B (context dependent) D) 8.9 m/s²

Ans: C **Explanation:** Exact baseline is 9.8 m/s², often rounded to 10 m/s² in school physics calculations.

53. Direction of acceleration due to gravity is always:

A) Upward B) Downward

C) Horizontal D) Variable

Ans: B **Explanation:** Earth's gravitational pull always acts vertically downward towards Earth's center.

54. A dropped bob hits ground in 4 s. Find tower height (g = 10 m/s²):

A) 40 m
B) 80 m
C) 20 m
D) 160 m

Ans: B **Explanation:** $S = \frac{1}{2} g t^2 = \frac{1}{2} \times 10 \times 4^2 = 5 \times 16 = 80\ m$.

55. In Q54, what is the striking velocity of the ball on reaching the ground?

A) 20 m/s
B) 40 m/s
C) 80 m/s
D) 10 m/s

Ans: B **Explanation:** $v_f = v_i + g\,t = 0 + 10 \times 4 = 40\ m/s$.

56. An arrow shot vertically upward at 30 m/s takes how long to reach peak height? (g = 10 m/s²)

A) 3 s
B) 4 s
C) 5 s
D) 2 s

Ans: A **Explanation:** At peak $v_f = 0$. $0 = 30 - 10t \rightarrow t = 3\ s$.

57. For the arrow in Q56, what maximum altitude is reached?

A) 30 m
B) 45 m
C) 60 m
D) 90 m

Ans: B **Explanation:** $2(-10)S = 0^2 - 30^2 \rightarrow -20S = -900 \rightarrow S = 45\ m$.

58. When a projectile object moves upward against Earth gravity, 'g' is taken as:

A) Positive
B) Negative
C) Zero
D) Variable

Ans: B **Explanation:** Gravity opposes upward velocity, causing retardation, so acceleration is negative (-g).

59. When an object drops freely under gravity, its initial velocity v_i is:

A) 10 m/s
B) 9.8 m/s
C) Zero
D) Negative

Ans: C **Explanation:** "Released/Dropped" signifies starting from complete rest ($v_i = 0$).

SECTION J: RELATIVITY & KEY POINTS

60. In special relativity (1905), Einstein posited which physical universal constant?

A) Speed of sound
B) Speed of light
C) Surface gravity g
D) Mass of Earth

Ans: B **Explanation:** Speed of light in vacuum ($c \approx 3\times10^{8}\,m/s$) is invariant across all reference frames.

61. According to relativity, the speed of light remains identical for:

A) Stationary observers only
B) Moving observers only
C) All observer states of motion
D) Earth-bound observers only

Ans: C **Explanation:** Light speed is independent of relative motion between source and observer.

62. Under universal speed limits, matter possessing rest mass cannot achieve speed:

A) Equal to speed of light
B) Greater than speed of light
C) Both A and B
D) Less than speed of light

Ans: C **Explanation:** Infinite relativistic energy would be required to accelerate mass to or beyond light speed.

63. Which of the following is NOT a scalar quantity?

A) Energy
B) Temperature
C) Weight
D) Length

Ans: C **Explanation:** Weight is gravitational force vector pointing downward; others are scalars.

64. The spinning motion of a top on a surface is an example of:

A) Translatory motion
B) Rotatory motion
C) Vibratory motion
D) Linear motion

Ans: B **Explanation:** Rotation about an internal central axis defines rotatory motion.

65. If an object moves along a curved path, displacement is defined as:

A) Length of curved path
B) Straight line distance start to end
C) Always zero
D) Greater than path distance

Ans: B **Explanation:** Displacement ignores path shape and measures strictly direct distance from start to end points.