Answer Key

Unit 2 — Kinematics

Paper	Questions
2025 (B)	6 questions (key no. 1–6)
2025 (D)	6 questions (key no. 7–12)
2025 (II)	5 questions (key no. 13–17)
2026 (B)	4 questions (key no. 18–21)
2026 (D)	5 questions (key no. 22–26)
2026 (M)	7 questions (key no. 27–33)
Model Paper 2026 (48 marks)	6 questions (key no. 34–39)
Model Paper 2026 (50% MCQs)	11 questions (key no. 40–50)

Papers do not print answers, so these are solved answers. Numericals use g = 9.8 m/s² unless the paper gives g = 10 m/s². Descriptive answers are short model answers for checking.

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2025 (B) Answer key

1. Q2 A bird accelerates at 0.3 ms^{-2} for 3 s. Δv is:

A) 0.9 ms^{-1} B) 1.5 ms^{-1} C) 1.95 ms^{-1} D) 2.4 ms^{-1}

Answer: A — $\Delta v = a\Delta t = 0.3 \times 3 = 0.9\ ms^{-1}$.

2. Q3 The given graph shows (speed-time graph: a straight line rising from the origin):

A) Uniform velocity B) Uniform acceleration C) Variable acceleration D) Negative acceleration

Answer: B — A straight sloping line means the speed increases by equal amounts every second.

3. Q2 (ii) (OR) A train travelled a distance of 30 kilometers in 7 minutes and 30 seconds. What is its speed? Convert the speed to km/h.

Answer:

- 7 min 30 s = 450 s and 30 km = 30 000 m.
- v = s/t = 30 000 ÷ 450 = 66.67 m/s.
- In km/h: 66.67 × 3600 ÷ 1000 = 240 km/h.

4. Q2 (iii) What kind of motion does a butterfly have? Briefly describe this kind.

Answer:

- Random motion. It is translatory motion of an object along an irregular path with no fixed pattern.
- Other examples: a kite flying in the sky, motion of clouds.

5. Q2 (x) (OR) Can direction of velocity and acceleration be in opposite direction? Explain briefly.

Answer:

- Yes. When an object slows down, its acceleration (deceleration) is opposite to its velocity.
- Example 1: a car moving east and braking has velocity towards east and acceleration towards west.
- Example 2: a ball thrown upward has velocity upward but acceleration g downward.

6. Q2 (xi) (OR) Is it possible to accelerate an object without speeding up or slowing it down? Justify.

Answer:

- Yes. Acceleration is the rate of change of velocity, and velocity changes when its direction changes, even if the speed stays constant.
- Example: a car moving at constant speed around a circular track, or a satellite orbiting the Earth.

2025 (D) Answer key

7. Q2 A car changes its velocity from 20 ms^{-1} to 56 ms^{-1} in 2 s. Its acceleration is:

A) 28 ms^{-2} B) 36 ms^{-2} C) 10 ms^{-2} D) 18 ms^{-2}

Answer: D — $a = (56 - 20) \div 2 = 18\ ms^{-2}$.

8. Q3 The given graph shows (speed-time graph: a horizontal line):

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

Answer: A — A horizontal line means the speed is constant, so the acceleration is zero.

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9. Q2 (ii) Differentiate between uniform acceleration and non-uniform acceleration.

Answer:

- Uniform acceleration: velocity changes by equal amounts in equal intervals of time (e.g. a freely falling body). Its speed-time graph is a straight sloping line.
- Non-uniform acceleration: velocity changes by unequal amounts in equal intervals of time (e.g. a car in city traffic). Its speed-time graph is a curve.

10. Q2 (iii) Compare Rotatory motion and Vibratory motion.

Answer:

- Rotatory motion: an object turns about its own axis and its particles move in circles (fan blades, helicopter rotor).
- Vibratory motion: an object moves to and fro about a mean position and repeats its motion (swing, string of a sitar or guitar).
- So rotatory motion is about an axis, while vibratory motion is back-and-forth about a mean position.

11. Q2 (v) (OR) Velocity v of a car increases uniformly from 15 m/s to 25 m/s in 5 s. Find v_avg and acceleration.

Answer:

- $v_{avg} = (v_i + v_f) \div 2 = (15 + 25) \div 2 = 20$ m/s.
- $a = (v_f - v_i) \div t = (25 - 15) \div 5 = 2$ m/s².

12. Q2 (vii) (OR) Can direction of velocity and acceleration be in opposite direction? Explain briefly.

Answer:

- Yes. When an object slows down, its acceleration (deceleration) is opposite to its velocity.
- Example: a car moving east and braking has velocity towards east and acceleration towards west.

2025 (II)

Answer key

13. Q3 In 5 s a car accelerates so that its velocity increases by 20 ms^{-1}. The acceleration is:

A) 0.25 ms^{-2} B) 4 ms^{-2} C) 25 ms^{-2} D) 100 ms^{-2}

Answer: B — $a = \Delta v \div t = 20 \div 5 = 4$ ms^{-2}.

14. Q5 The rate of change of velocity is called:

A) speed B) acceleration C) force D) motion

Answer: B — Acceleration is the time rate of change of velocity.

15. Q2 (i) (OR) Justify that displacement is a vector quantity. Also draw diagram.

Answer:

- Displacement is the shortest straight distance from the initial to the final position, and it has both magnitude and direction.
- Walking 5 m east and walking 5 m west have the same magnitude but end at different positions, so direction must be stated. A quantity that needs magnitude and direction is a vector.
- Diagram: draw an arrow from the initial position d_i to the final position d_f and label it $\Delta d = d_f - d_i$.

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16. Q2 (x) Draw distance-time graphs for a body: a. Decelerating, b. At rest, c. Moving with constant speed.

Answer:

- (a) Decelerating: a curve rising and bending downwards (its slope keeps decreasing).
- (b) At rest: a horizontal line parallel to the time axis (distance does not change).
- (c) Constant speed: a straight line sloping upward (constant slope).

17. Q4 A block of mass 3 kg falls from the top of a building. How much time will the block take to reach the ground if it strikes the ground with a speed of 80 m/s? (Ignore air resistance). Also calculate the height from which the block was dropped.

Answer:

- Using $g = 10\ ms^{-2}$ (given in the paper's formula list), with $v_i = 0$ and $v_f = 80$ m/s:
- $t = v_f \div g = 80 \div 10 = 8$ s.
- $h = v_f^2 \div 2g = 6400 \div 20 = 320$ m.
- (With $g = 9.8\ ms^{-2}$: $t \approx 8.16$ s and $h \approx 326.5$ m. The mass is not needed.)

2026 (B)

Answer key

18. Q2 A cyclist moves 2 km in 4 minutes. What is the speed in m/s?

A) 4 m/s B) 8.3 m/s C) 12 m/s D) 16.3 m/s

Answer: B — $v = 2000\ m \div 240\ s = 8.3$ m/s.

19. Q2 (ii) (OR) Sketch distance-time graph of an object when it is: a. At rest, b. Moving with constant speed, and c. Accelerating.

Answer:

- (a) At rest: a horizontal line.
- (b) Constant speed: a straight line sloping upward from the origin.
- (c) Accelerating: a curve bending upward (slope keeps increasing).

20. Q2 (iv) (OR) From given speed-time graph, calculate: a. Total distance covered, b. Acceleration in first 5 seconds. (graph is given in the paper)

Answer:

- The graph values are not readable from the scanned paper, so only the method is given:
- (a) Total distance = total area under the speed-time graph (split into triangles and rectangles).
- (b) Acceleration in first 5 s = slope = $(v_f - v_i) \div 5$ s, read from the graph.
- Send a clear image of this graph if you want the numerical answer.

21. Q2 (vi) (OR) A cyclist applies brakes and slows down from $12\ ms^{-1}$ to $4\ ms^{-1}$ in 3 seconds. Calculate the acceleration.

Answer:

- $a = (v_f - v_i) \div t = (4 - 12) \div 3 = -2.67\ m/s^2$.
- The negative sign shows deceleration of 2.67 m/s^2.

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2026 (D)

Answer key

22. Q3 A car starts from rest, moves with constant speed, then accelerates, and finally comes to rest. a. Draw distance-time graph showing all four stages. b. How the gradient of each section represents the car's speed?

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

Answer: C — A pendulum moves to and fro about its mean position.

23. Q2 (i) (OR) A car travels different distances in different time intervals as shown (0 m, 6 m, 14 m, 24 m with $t_1 = 2$ s, $t_2 = 4$ s, $t_3 = 2$ s). Determine: a. Total distance, b. Total time, c. Average speed. (figure is given in the paper)

Answer:

- (a) Total distance = 24 m.
- (b) Total time = 2 + 4 + 2 = 8 s.
- (c) Average speed = total distance ÷ total time = 24 ÷ 8 = 3 m/s.
- (Read from the figure as given in the paper.)

24. Q2 (iv) (OR) What is meant by velocity? Justify that speed is a scalar quantity while velocity is a vector quantity.

Answer:

- Velocity is the rate of change of displacement: $v = \Delta d \div \Delta t$.
- Speed = distance ÷ time. Distance has only magnitude, so speed is a scalar.
- Velocity = displacement ÷ time. Displacement has magnitude and direction, so velocity is a vector.
- Example: after one full lap of a circular track, speed is not zero but the average velocity is zero.

25. Q3 A car starts from rest, moves with constant speed, then accelerates, and finally comes to rest. a. Draw distance-time graph showing all four stages. b. How the gradient of each section represents the car's speed?

Answer:

- (a) Graph (distance on y-axis, time on x-axis), four parts: (1) at rest: horizontal line; (2) constant speed: straight line sloping upward; (3) accelerating: curve bending upward (getting steeper); (4) at rest again: horizontal line at the final distance.
- (b) Gradient = $\Delta s \div \Delta t$ = speed. Horizontal line: gradient zero, so speed is zero. Straight sloping line: constant gradient, so constant speed. Curve getting steeper: gradient increasing, so speed increasing.

26. Q3 (OR) (part a) A player kicks a football of mass 450 g vertically upward at a speed of 22 ms^{-1}. Neglecting air resistance, how high would it reach? (part b of the paper question is about energy and is not included)

Answer:

- At the highest point $v_f = 0$. Using $2aS = v_f^2 - v_i^2$ with $a = -g = -10\ ms^{-2}$:
- $h = v_i^2 \div 2g = 22^2 \div 20 = 484 \div 20 = 24.2$ m.
- (With $g = 9.8\ ms^{-2}$: $h \approx 24.7$ m. The mass is not needed.)

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2026 (M)

Answer key

27. Q4 A car travels 150 m in 10 seconds. What is its speed?

A) 5 m/s B) 10 m/s C) 15 m/s D) 20 m/s

Answer: C — v = s ÷ t = 150 ÷ 10 = 15 m/s.

28. Q6 Which statement best explains why displacement is a vector quantity?

A) It has only magnitude B) It depends on path length C) It has magnitude and direction D) It is measured in meters

Answer: C — A quantity with both magnitude and direction is a vector.

29. Q11 Ball dropped freely from a tower reaches ground in 4 s, the speed of impact of ball is:

A) 0 m/s B) 2.45 m/s C) 19.6 m/s D) 39.2 m/s

Answer: D — v = gt = 9.8 × 4 = 39.2 m/s.

30. Q12 A mosquito flying in different directions shows:

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

Answer: B — An irregular path with no fixed pattern is random motion.

31. Q2 (vi) (OR) How different slopes represent three different types of motion in a speed-time graph? Make sketches.

Answer:

- Horizontal line (zero slope): constant speed, zero acceleration.
- Straight line sloping upward (positive slope): uniform acceleration (speed increases equally every second).
- Straight line sloping downward (negative slope): uniform deceleration.
- A steeper slope means a larger acceleration. Sketch all three lines on speed (y) and time (x) axes.

32. Q2 (vii) (OR) A ball is thrown straight upward with an initial speed of 19.6 m/s. Using g = 9.8 ms^{-2}: a. After how much time does it reach the highest point? b. What is its velocity at the highest point?

Answer:

- (a) At the highest point $v_f = 0$. From $v_f = v_i - gt$: $t = v_i \div g = 19.6 \div 9.8 = 2$ s.
- (b) Velocity at the highest point = 0 m/s (the acceleration is still 9.8 ms^{-2} downward).

33. Q5 A speed-time graph of a car shows the speed increasing from 0 to 15 m/s in 5 seconds, then staying constant for the next 5 seconds, and finally decreasing back to 0 m/s in 3 seconds. a. Identify the type of motion in each interval (0–5 s, 5–10 s, 10–13 s). b. Calculate the acceleration during the first 5 seconds. c. Calculate the deceleration during the last 3 seconds.

Answer:

- (a) 0–5 s: uniform acceleration. 5–10 s: constant speed (zero acceleration). 10–13 s: uniform deceleration.
- (b) a = (15 − 0) ÷ 5 = 3 m/s^2.
- (c) a = (0 − 15) ÷ 3 = −5 m/s^2, so the deceleration is 5 m/s^2.

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Model Paper 2026 (48 marks)

Answer key

34. Q1 When a body moves in a circular path, its velocity is:

A) Constant B) Variable C) Zero D) Increasing

Answer: B — The direction of velocity keeps changing, so the velocity is variable.

35. Q3 What are different types of motion? Give two examples of each.

A) 0.5 m/s² B) 2 m/s² C) 0.05 m/s² D) 0.2 m/s²

Answer: A — a = (0 − 20) ÷ 40 = −0.5 m/s², so the magnitude is 0.5 m/s².

36. Q4 If two objects, one heavy and one light, are dropped from the same height, neglecting air resistance, which object will hit the ground first?

A) The heavy object B) The light object C) Both objects will hit the ground at the same time D) It depends on the shape of the objects

Answer: C — Without air resistance all objects fall with the same g, independent of mass.

37. Q2 (ii) Draw the speed time graph for uniform acceleration. Use this graph to show that gradient of speed time graph gives acceleration.

Answer:

- Graph: speed (y-axis) against time (x-axis) is a straight line sloping upward.
- Take two points P_i(t_i, v_i) and P_f(t_f, v_f). Gradient = Δv ÷ Δt = (v_f − v_i) ÷ (t_f − t_i).
- By definition a = Δv ÷ Δt, so the gradient of the speed-time graph is the acceleration.

38. Q2 (viii) (OR) What is average speed of a car if it completes a circle of radius 200 m in 5 minutes?

Answer:

- Distance = circumference = 2πr = 2 × 3.14 × 200 = 1256 m. Time = 5 × 60 = 300 s.
- v_avg = s ÷ t = 1256 ÷ 300 = 4.19 m/s.

39. Q3 What are different types of motion? Give two examples of each.

Answer:

- 1. Translatory motion: the whole body changes position. It is of three kinds: rectilinear (train on a track, falling apple), curvilinear/circular (car on a turn, roller coaster), random (butterfly, kite).
- 2. Rotatory motion: an object rotates about its own axis (fan blades, helicopter rotor).
- 3. Vibratory motion: to-and-fro motion about a mean position (swing, guitar string).

Model Paper 2026 (50% MCQs)

Answer key

40. Q2 The rate of change of displacement is called:

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

Answer: B — Velocity is displacement divided by time.

41. Q8 Which statement best describes translational motion of a body?

A) all its parts move in one direction B) rotates about a fixed axis C) moves about a fixed point D) Changes its shape

Answer: A — In translational motion all points of the body move together in the same direction.

42. Q9 The value of ‘g’ at the surface of the moon is approximately:

A) 9.8 m/s² B) 1.6 m/s² C) Infinite D) 0 m/s²

Answer: B — The moon's gravity is about one-sixth of the Earth's, 1.6 m/s².

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43. Q20 The slope of a distance-time graph gives:

A) Acceleration B) Force C) Speed D) Work

Answer: C — Gradient = Δs ÷ Δt, which is speed.

44. Q31 In which of the following situations are the distance traveled and the magnitude of the displacement equal?

A) A child moving on a swing B) An object is moving along a circular path. C) A car moving on a curved road D) Linear motion in one direction.

Answer: D — Only in straight-line motion in one direction does the path length equal the displacement.

45. Q33 The distance-time graph for a cyclist moving along a straight road is shown (parts A, B, C). Which motion is displayed by the cyclist in portion A of the graph? (graph is given in the paper)

A) At rest B) Uniform speed C) Non-uniform speed D) Variable speed

Answer: B — Portion A is a straight sloping line, so equal distances are covered in equal times.

46. Q41 Scenario for MCQs # 41 to 44: Atif is playing with his remote-controlled car on a flat carpet. When he gently pushes the throttle forward, the car starts moving and gradually speeds up on straight line. Curious, he increases the force applied by the motor to observe how the motion changes. What type of motion does the toy car exhibit?

A) constant velocity B) constant acceleration C) decreasing velocity D) decreasing momentum

Answer: B — A steady force on a car of fixed mass gives constant acceleration.

47. Q42 Scenario for MCQs # 41 to 44: Atif is playing with his remote-controlled car on a flat carpet. When he gently pushes the throttle forward, the car starts moving and gradually speeds up on straight line. Curious, he increases the force applied by the motor to observe how the motion changes. How would the toy car's speed-time graph look like?

A) Straight line with negative slope B) Straight line with positive slope C) curved graph D) Horizontal line

Answer: B — Constant acceleration gives a straight line with a positive slope.

48. Section B Q2 A car starts from rest and reaches a velocity of 20 m/s in 5 seconds. Calculate its average velocity and total distance covered by it.

Answer:

- v_avg = (0 + 20) ÷ 2 = 10 m/s.
- Distance s = v_avg × t = 10 × 5 = 50 m.

49. Section B Q4 Can a body have zero velocity but non-zero acceleration? Explain with a physical example.

Answer:

- Yes. When a ball is thrown straight up, at the highest point its velocity is zero for an instant, but its acceleration is still g = 9.8 m/s² downward.
- So velocity can be zero while the velocity is still changing.

50. Section C Q8 Define acceleration. What does it tell us about the motion of an object? If the slope of a speed-time graph for a moving object is steeper, what can you explain about the motion of the object?

Answer:

- Acceleration is the time rate of change of velocity: a = Δv ÷ Δt. Its SI unit is m/s².
- It tells how quickly the velocity of an object is changing (speeding up, slowing down or changing direction).
- A steeper slope on a speed-time graph means a larger acceleration: the speed is changing faster.

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