UNIQUE STUDY POINT (USP)

by Sumeet Sahu

PRACTICE TEST 01 (2026-27)

CHAPTER 04 DESCRIBING MOTION AROUND US

Subject : Science (Physics)	Max. Marks : 40	Session : 2026-27
Class : IX	Duration : 1½ hrs	

General Instructions :

(i) All questions are compulsory.

(ii) This question paper contains 20 questions divided into five Sections A, B, C, D and E.

(iii) Section A comprises of 10 MCQs of 1 mark each. Section B comprises of 4 questions of 2 marks each. Section C comprises of 3 questions of 3 marks each. Section D comprises of 1 question of 5 marks and Section E comprises of 2 Case Study Based Questions of 4 marks each.

(iv) There is no overall choice. However, an internal choice has been provided in Section C.

(v) Use of Calculators is not permitted.

SECTION – A

Questions 1 to 10 carry 1 mark each.

1. A car travels 60 m towards the east and then 80 m towards the north. The magnitude of its displacement is:

(a) 60 m (b) 80 m (c) 100 m (d) 140 m

2. The slope of a position–time graph gives:

(a) Acceleration (b) Distance (c) Average velocity (d) Force

3. A body starts from rest and has a uniform acceleration of 4 m s^{-2}. Its velocity after 5 s will be:

(a) 10 m s^{-1} (b) 20 m s^{-1} (c) 25 m s^{-1} (d) 40 m s^{-1}

4. An object moving in a straight line covers equal distances in equal intervals of time. This type of motion is called:

(a) Non-uniform motion (b) Uniform acceleration (c) Uniform motion (d) Variable motion

5. The area enclosed between a velocity–time graph and the time axis gives:

(a) Acceleration (b) Speed (c) Displacement (d) Force

6. An object completes one full revolution along a circular path of radius R. The magnitude of its displacement is:

(a) $2\pi R$ (b) πR (c) 2R (d) Zero

7. The SI unit of average acceleration is:

(a) m s^{-1} (b) m s^{-2} (c) m s (d) km h^{-1}

8. A straight line velocity–time graph parallel to the time axis indicates:

(a) Uniform acceleration (b) Uniform deceleration (c) Uniform velocity (d) Non-uniform motion

In questions 9 and 10, a statement of Assertion (A) is followed by a statement of Reason (R). Mark the correct choice as:

(a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true but R is NOT the correct explanation of A.
(c) A is true but R is false.
(d) A is false but R is true.

9. Assertion (A): The displacement of an object can be zero even if the total distance travelled by it is not zero.

Reason (R): When an object returns to its starting point, the net change in position is zero; however, it has covered a non-zero total path length.

(a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true but R is NOT the correct explanation of A.
(c) A is true but R is false.
(d) A is false but R is true.

10. Assertion (A): A car moving on a circular road at constant speed has zero acceleration.

Reason (R): In uniform circular motion, the direction of velocity changes continuously at every instant; hence the object undergoes continuous acceleration even though the magnitude of velocity (speed) remains constant.

(a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true but R is NOT the correct explanation of A.
(c) A is true but R is false.
(d) A is false but R is true.

SECTION – B

Questions 11 to 14 carry 2 marks each.

11. A cyclist travels 400 m towards the south and then 300 m towards the east. Find: (i) the total distance travelled, and (ii) the magnitude of displacement.

12. The velocity of a train increases from 72 km h^{-1} to 90 km h^{-1} in 5 seconds. Calculate the average acceleration of the train in m s^{-2}.

13. Distinguish between *uniform motion* and *non-uniform motion*. Give one example of each.

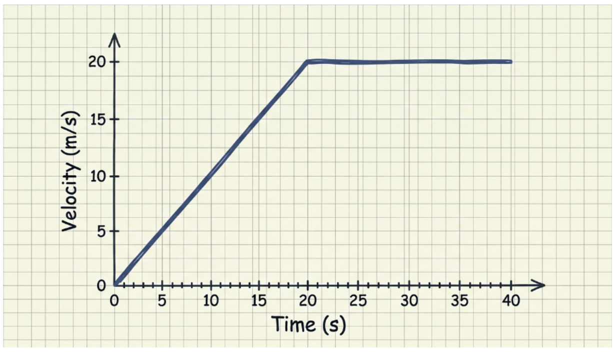
14. An athlete runs along a circular track of radius 70 m and completes one revolution in 44 seconds. Find: (i) the average speed, and (ii) the average velocity for one complete revolution. (*Take* $\pi = 22/7$)

SECTION – C

Questions 15 to 17 carry 3 marks each.

15. A bus is travelling at 36 km h^{-1} when the driver sees a road sign 30 m ahead and applies the brakes immediately. The driver's reaction time is 0.5 s and after the brakes are applied, the bus decelerates uniformly at 2.5 m s^{-2}. Will the bus stop before reaching the sign? Show complete step-by-step working.

16. The velocity–time graph of an object is shown alongside. Using the graph, find:
(i) the nature of motion in each time interval,
(ii) the acceleration during 0–20 s and 20–40 s,
(iii) the total displacement in the first 40 s.



17. A car starts from rest and accelerates uniformly to 20 m s^{-1} in 5 s. It then travels at constant velocity for 10 s. Finally it decelerates uniformly to rest in 6 s. Using kinematic equations find: (i) acceleration in phase 1, (ii) distance covered in each phase, (iii) total distance travelled.

– OR –

A vehicle starts from the origin. Positions at different times are:

Time (s)	:	0	2	4	6	8	10
Position (m)	:	0	1	4	9	16	25

(i) Is the motion uniform or non-uniform? Justify using the data. (ii) What is the nature of velocity — increasing, decreasing or constant? Explain from the data. (iii) Calculate average velocity between t = 4 s and t = 10 s.

SECTION – D

Question 18 carries 5 marks.

18. A ball is thrown vertically upward from the ground with an initial velocity of 49 m s^{-1}. (Take g = 9.8 m s^{-2})

(i) Using v = u − gt, find the time taken to reach maximum height. [1]

(ii) Using s = ut − ½gt², find the maximum height reached. [1]

(iii) Find the velocity when the ball returns to the ground. What does this say about symmetry of motion? [1]

(iv) Find the total time of flight. [1]

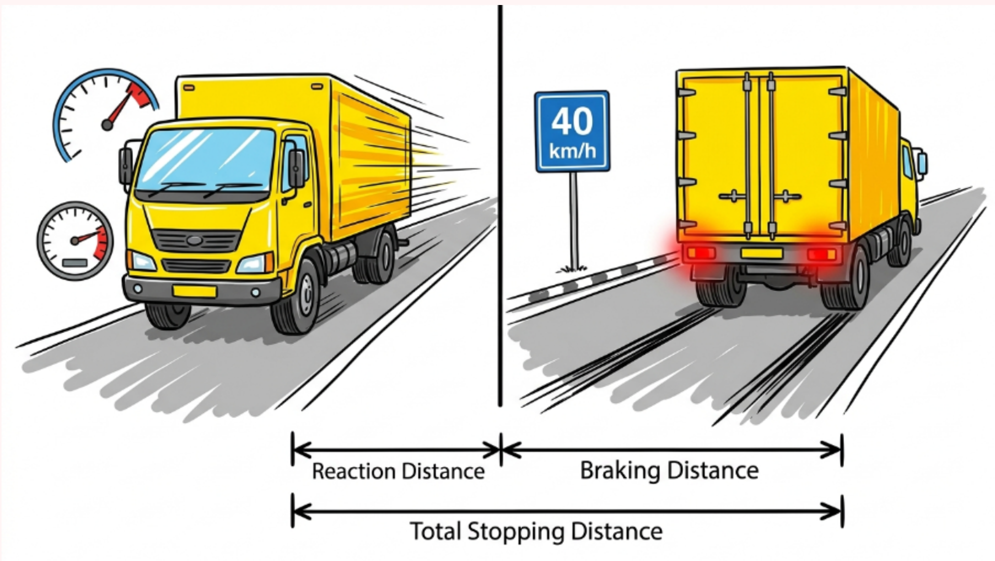
(v) What is the net displacement for the entire journey? Explain why it differs from total distance. [1]

SECTION – E (Case Study Based Questions)

Questions 19 and 20 carry 4 marks each.

Case Study 1 – Road Safety and Braking Distance

When brakes are applied to a moving vehicle, it does not stop instantly. The vehicle travels some distance before coming to rest — this is called the braking distance. The total stopping distance = reaction distance + braking distance. Engineers use $v^2 = u^2 + 2as$ to calculate it. In a road-safety study, a truck was travelling at 54 km h^{-1}. The driver's reaction time was 0.5 s and after brakes were applied, the truck decelerated at 4 m s^{-2}.



By using the above, answer the following questions :

19(a) Convert 54 km h^{-1} to m s^{-1}. Using this speed and the reaction time of 0.5 s, calculate the reaction distance covered by the truck before the brakes are applied. *[1 mark]*

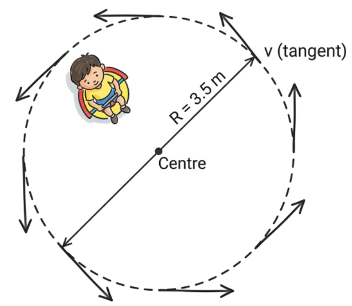
19(b) Using $v^2 = u^2 + 2as$ with v = 0, calculate the braking distance after the brakes are applied. *[1 mark]*

19(c) Calculate the total stopping distance. If another vehicle is parked only 25 m ahead when the driver first spots the obstacle, will the truck stop in time? Justify your answer with calculations. *[1½ marks]*

19(d) Name one factor other than initial speed and braking force that affects stopping distance. Briefly explain how V2V (Vehicle-to-Vehicle) communication technology helps prevent collisions. *[½ mark]*

Case Study 2 – Uniform Circular Motion

Priya sits on a merry-go-round that completes one full revolution every 8 seconds. The radius of the circular path is 3.5 m. Her friend Akash observes from outside and tells her: "*Even though your speed appears constant, your velocity is continuously changing because its direction keeps changing at every point on the circle — so you are always accelerating.*" This is known as Uniform Circular Motion.



By using the above, answer the following questions :

20(a) Calculate the total distance covered by Priya in one complete revolution. (Take π = 22/7) *[1 mark]*

20(b) Using the distance from part (a) and the time for one revolution, calculate the average speed of Priya. *[1 mark]*

20(c) What is the displacement of Priya after exactly one complete revolution? Using this displacement and the time period, calculate her average velocity. Explain why average velocity differs from average speed here. *[1 mark]*

20(d) Is Akash correct in saying Priya is accelerating even though her speed is constant? Give a scientific reason. Also state the direction of velocity at any instant during uniform circular motion. *[1 mark]*

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ANSWER KEY -- PRACTICE TEST 01 (2026-27)

SECTION - A | MCQ Answer Key

Q	Correct Answer	Key Reason / Concept
1	**(c) 100 m**	Displacement = √(60² + 80²) = √(10000) = 100 m [Pythagoras]
2	**(c) Average velocity**	Slope of s–t graph = Δs / Δt = velocity
3	**(b) 20 m/s**	v = u + at = 0 + (4 × 5) = 20 m/s
4	**(c) Uniform motion**	Equal distances in equal time intervals constant speed, a = 0
5	**(c) Displacement**	Area under v–t graph = displacement
6	**(d) Zero**	After one full revolution, returns to start net displacement = 0
7	**(b) m s^{-2}**	SI unit of acceleration = m s^{-2}
8	**(c) Uniform velocity**	Parallel to time axis velocity constant a = 0
9	**(a) Both A and R true; R explains A**	Returns to start => displacement = 0 but total path is not zero
10	**(d) A false, R true**	UCM: speed constant but direction changes => IS accelerating (A is false)

SECTION - B | Short Answer (2 marks each)

Q11. Cyclist: 400 m south, then 300 m east.

Total distance = 400 + 300 = **700 m**

The two paths are perpendicular, so use Pythagoras theorem:

$$\text{Displacement} = \sqrt{400^2 + 300^2} = \sqrt{160000 + 90000} = \sqrt{250000} = \mathbf{500\ m}$$

Direction: south-east

Answer: Distance = 700 m ; Displacement = 500 m (south-east)

Q12. Train: 72 km/h to 90 km/h in 5 s.

Convert speeds:

$$u = \frac{72 \times 1000}{3600} = 20\ \text{m/s}, \quad v = \frac{90 \times 1000}{3600} = 25\ \text{m/s}$$

$$a = \frac{v - u}{t} = \frac{25 - 20}{5} = \frac{5}{5} = \mathbf{1}\ \text{m s}^{-2}$$

Answer: Average acceleration = 1 m s^{-2} (in direction of motion)

Q13. Distinguish uniform and non-uniform motion.

Uniform Motion: Equal distances in equal time intervals. Speed constant; a = 0.

Example: Car at steady 60 km/h on straight highway.

Non-Uniform Motion: Unequal distances in equal time intervals. Speed varies.

Example: Bus accelerating away from a bus stop.

Answer: Uniform: constant speed. Non-uniform: variable speed.

Q14. Circular track R = 70 m, T = 44 s. (pi = 22/7)

Distance in one revolution:

$$d = 2\pi R = 2 \times \frac{22}{7} \times 70 = \mathbf{440\ m}$$

$$\text{Average speed} = \frac{440}{44} = \mathbf{10}\ \text{m/s}$$

After one full revolution, displacement = 0 (returns to start).

$$\text{Average velocity} = \frac{0}{44} = \mathbf{0}\ \text{m/s}$$

Answer: Average speed = 10 m/s ; Average velocity = 0 m/s

SECTION - C | 3 marks each

Q15. Bus at 36 km/h, sign 30 m ahead, reaction 0.5 s, decel. 2.5 m s^{-2}.

Step 1 - Convert speed:

$$u = \frac{36 \times 1000}{3600} = \mathbf{10} \text{ m/s}$$

Step 2 - Reaction distance:

$$d_r = u \times t = 10 \times 0.5 = \mathbf{5} \text{ m}$$

Step 3 - Braking distance (v = 0, a = -2.5 m s^{-2}):

$$v^2 = u^2 + 2as \Rightarrow 0 = 100 + 2 \times (-2.5) \times s \Rightarrow s = \frac{100}{5} = \mathbf{20} \text{ m}$$

Step 4 - Total stopping distance:

$$d_{total} = 5 + 20 = \mathbf{25} \text{ m}$$

Step 5 - Compare: 25 m < 30 m => Bus WILL stop before the sign.

Answer: YES -- bus stops in 25 m < 30 m. Safe stop.

Q16. v-t graph: (0,0) to (20,20) then horizontal to (40,20).

(i) Nature of motion:

0 to 20 s: velocity increases uniformly => Uniformly Accelerated Motion

20 to 40 s: velocity constant at 20 m/s => Uniform Motion (a = 0)

(ii) Acceleration:

$$a_1 \text{ (0-20s)} = \frac{20-0}{20} = \mathbf{1} \text{ m s}^{-2}, \qquad a_2 \text{ (20-40s)} = \mathbf{0}$$

(iii) Total Displacement = area under v-t graph:

$$\text{Triangle (0-20s)} = \frac{1}{2} \times 20 \times 20 = 200 \text{ m}$$
$$\text{Rectangle (20-40s)} = 20 \times 20 = 400 \text{ m}$$
$$\text{Total displacement} = 200 + 400 = \mathbf{600} \text{ m}$$

Answer: Acc: 1 m s^{-2} (0-20s), 0 (20-40s) ; Total displacement = 600 m

Q17. Car: rest -> 20 m/s in 5 s, constant 10 s, stops in 6 s.

Phase 1 (0-5 s) -- Acceleration:

$$a = \frac{v-u}{t} = \frac{20-0}{5} = \mathbf{4} \text{ m s}^{-2}$$
$$s_1 = \frac{1}{2}at^2 = \frac{1}{2} \times 4 \times 25 = \mathbf{50} \text{ m}$$

Phase 2 (5-15 s) -- Constant velocity:

$$s_2 = v \times t = 20 \times 10 = \mathbf{200} \text{ m}$$

Phase 3 (15-21 s) -- Deceleration:

$$a = \frac{0-20}{6} = -3.33 \text{ m s}^{-2}$$
$$s_3 = ut + \frac{1}{2}at^2 = 20 \times 6 + \frac{1}{2} \times (-3.33) \times 36 = 120 - 60 = \mathbf{60} \text{ m}$$

Answer: Phase distances: 50 + 200 + 60 = Total 310 m

-- OR --

Q17 (OR). Position data: 0,1,4,9,16,25 m at t = 0,2,4,6,8,10 s.

(i) Distances in successive 2s intervals: 1, 3, 5, 7, 9 m (unequal) => **Non-uniform motion**

(ii) Distances keep increasing => velocity is **continuously increasing**

(iii) Average velocity from t = 4s to t = 10s:

$$v_{av} = \frac{\Delta s}{\Delta t} = \frac{25-4}{10-4} = \frac{21}{6} = \mathbf{3.5} \text{ m/s}$$

Answer: Non-uniform; increasing velocity; average velocity = 3.5 m/s

SECTION - D | 5 marks

Q18. Ball thrown vertically up: u = 49 m/s, g = 9.8 m s^{-2}.

(i) Time to reach maximum height (v = 0 at top):

$$v = u - gt \Rightarrow 0 = 49 - 9.8t \Rightarrow t = \frac{49}{9.8} = \mathbf{5}\ \text{s}$$

(ii) Maximum height:

$$s = ut - \frac{1}{2}gt^2 = 49 \times 5 - \frac{1}{2} \times 9.8 \times 25 = 245 - 122.5 = \mathbf{122.5}\ \text{m}$$

(iii) Speed on return to ground:

$$v^2 = u^2 + 2as = 0 + 2 \times 9.8 \times 122.5 = 2401 \Rightarrow v = \mathbf{49}\ \text{m/s (downward)}$$

Speed equals initial speed -- motion is symmetric.

(iv) Total time of flight:

$$T = t_{up} + t_{down} = 5 + 5 = \mathbf{10}\ \text{s}$$

(v) Net displacement:

Ball starts and ends at ground level => Displacement = **0 m**

Total distance = 122.5 + 122.5 = 245 m

Displacement is not equal to distance because the ball reverses direction.

Answer: t = 5s ; H = 122.5m ; return v = 49 m/s ; T = 10s ; displacement = 0 m

SECTION - E | Case Study (4 marks each)

Case Study 1 -- Road Safety and Braking Distance

19(a). Convert 54 km/h ; find reaction distance (t = 0.5 s).

$$u = \frac{54 \times 1000}{3600} = \mathbf{15}\ \text{m/s}$$
$$d_r = u \times t = 15 \times 0.5 = \mathbf{7.5}\ \text{m}$$

Answer: Speed = 15 m/s ; Reaction distance = 7.5 m

19(b). Braking distance (v=0, u=15 m/s, a=-4 m s^{-2}).

Using v^2 = u^2 + 2as:

$$0 = 15^2 + 2 \times (-4) \times s$$
$$0 = 225 - 8s \Rightarrow s = \frac{225}{8} = 28.125 \approx \mathbf{28.1}\ \text{m}$$

Answer: Braking distance = 28.1 m

19(c). Total stopping distance vs 25 m available.

$$d_{total} = 7.5 + 28.1 = \mathbf{35.6}\ \text{m}$$

Available distance = 25 m

Since 35.6 m > 25 m => Truck **CANNOT stop in time**. Collision will occur.

Answer: Total = 35.6 m > 25 m -- Collision unavoidable.

19(d). Other factor + V2V technology.

Factor: Road surface condition (wet/oily road reduces friction, increases stopping distance).

V2V Technology: Vehicles exchange real-time speed, position and braking signals.

This gives advance warning, reducing reaction time and preventing collisions.

Answer: Road surface condition ; V2V gives early collision warnings.

Case Study 2 -- Uniform Circular Motion

20(a). Distance in one revolution. R = 3.5 m, pi = 22/7.

$$d = 2\pi R = 2 \times \frac{22}{7} \times 3.5 = 2 \times 22 \times 0.5 = \mathbf{22}\ \text{m}$$

Answer: Distance = 22 m

20(b). Average speed. T = 8 s.

$$\text{Average speed} = \frac{d}{T} = \frac{22}{8} = \mathbf{2.75}\ \text{m/s}$$

Answer: Average speed = 2.75 m/s

20(c). Displacement and average velocity after one complete revolution.

After one full revolution, Priya returns to starting point.

Displacement = **0 m**

$$\text{Average velocity} = \frac{0}{8} = \mathbf{0}\ \text{m/s}$$

Why they differ: Speed uses path length (22m); velocity uses displacement (0m).

Answer: Displacement = 0 m ; Average velocity = 0 m/s

20(d). Is Akash correct? Direction of velocity in UCM.

Yes, Akash is correct.

In UCM, speed is constant but **direction of velocity changes continuously** at every point.

Change in direction = change in velocity (vector) = acceleration.

Direction of velocity: Along the **tangent** to the circular path at that point.

Answer: Yes ; acceleration due to direction change ; velocity is tangent to circle.

*** All the Best! *** **Unique Study Point (USP) | uniquestudyonline.com | Prepared by: Sumeet Sahu**