Physics Questions and Answer Key

Set 1: Displacement and Vector Motion (10 Questions)

1. A car travels 12 m north, 5 m east, and then 9 m vertically upwards. What is the magnitude of its resultant displacement from the starting point?

   (a) 15 m

   (b) 16 m

   (c) 17 m

   (d) 18 m

2. A hiker walks 15 m east, then 20 m north, and finally 25 m west. What is the magnitude of the hiker's displacement from the origin?

   (a) 10 m

   (b) 15 m

   (c) 20 m

   (d) 25 m

3. A particle moves 40 m north, 30 m east, and then 50 m in a direction 53° south of west ($\sin 53° = 0.8$, $\cos 53° = 0.6$). The magnitude of the displacement from the starting point is closest to:

   (a) 20 m

   (b) 30 m

   (c) 40 m

   (d) 50 m

4. A boat sails 8 km south, 6 km east, and then 10 km north. What is the magnitude of its net displacement from the initial position?

   (a) 2 km

   (b) 6 km

   (c) 10 km

   (d) 12 km

5. A cyclist travels around a circular track of radius 50 m and completes 3.5 revolutions in 2 minutes. What is the magnitude of the displacement from the starting point?

   (a) 0 m

   (b) 50 m

   (c) 100 m

   (d) 150 m

6. A wheel of radius 2 m rolls forward along a straight path for 1.5 revolutions. What is the magnitude of the displacement of a point on the rim that was initially at the bottom?

   (a) 2π m

   (b) 4π m

   (c) $\sqrt{4\pi^2 + 16}$ m

   (d) $\sqrt{\pi^2 + 4}$ m

7. A person walks 5 m north, 12 m east, and then moves 13 m southwest (at 45° to the south and west axes). The displacement of the person from the origin is:

   (a) 5 m west

   (b) 5 m east

   (c) 10 m south

   (d) 0 m

8. A drone flies 600 m north, 800 m south, and then 1000 m vertically upwards. What is the magnitude of its resultant displacement?

   (a) 800 m

   (b) 1000 m

   (c) 1040 m

   (d) 1200 m

9. A ball rolls 3 m east, then 4 m north, and finally 5 m in a direction 37° west of south ($\sin 37° = 0.6$, $\cos 37° = 0.8$). The magnitude of the ball's displacement from its starting point is:

(a) 2 m

(b) 4 m

(c) 5 m

(d) 6 m

10. A ship travels 10 km north, 24 km east, and then 26 km in a direction 60° south of west ($\sin 60° = \sqrt{3}/2$, $\cos 60° = 1/2$). What is the magnitude of its displacement from the starting point?

    (a) 10 km

    (b) 14 km

    (c) 18 km

    (d) 20 km

Answer Key for Set 1

1. (c) 17 m
2. (c) 20 m
3. (c) 40 m
4. (b) 6 km
5. (c) 100 m
6. (c) $\sqrt{4\pi^2 + 16}$ m
7. (d) 0 m
8. (c) 1040 m
9. (c) 5 m
10. (b) 14 km

Set 2: Average Velocity and Speed (10 Questions)

1. A person travels half the distance along a straight path at a speed of v_1 and the other half at a speed of v_2. The average speed for the entire journey is:

    (a) $\frac{v_1+v_2}{2}$

    (b) $\frac{2v_1v_2}{v_1+v_2}$

    (c) $\frac{v_1v_2}{v_1+v_2}$

    (d) $\sqrt{v_1v_2}$

2. The displacement-time graph of two particles P and Q are straight lines making angles of 45° and 30° with the time axis, respectively. The ratio of the velocities $v_P : v_Q$ is:

    (a) $\sqrt{3} : 1$

    (b) $1 : \sqrt{3}$

    (c) $1 : 1$

    (d) $2 : 1$

3. A truck travels from point X to Y at 40 km/h and returns from Y to X at 60 km/h. What is the average speed for the round trip?

    (a) 48 km/h

    (b) 50 km/h

    (c) 52 km/h

    (d) 45 km/h

4. A girl cycles 8 km to school at a speed of 16 km/h and returns home at a speed of 12 km/h. What is her average speed for the entire journey in km/h?

    (a) 13.5

    (b) 14

    (c) 13.71

    (d) 14.4

5. A bus covers the first third of a journey at 25 km/h, the second third at 50 km/h, and the final third at 75 km/h. What is the average speed of the bus for the whole journey?

    (a) 45 km/h

    (b) 50 km/h

    (c) 43.48 km/h

    (d) 47.37 km/h

6. A cyclist travels for the first half of the time at 10 km/h and the second half of the time at 20 km/h. If the total distance covered is 30 km, what is the average speed?

    (a) 12 km/h

    (b) 15 km/h

    (c) 13.33 km/h

    (d) 16 km/h

7. A car travels the first 60 km of a trip at 30 km/h and the next 40 km at 60 km/h. What is the average speed for the entire journey in km/h?

    (a) 36

    (b) 40

    (c) 45

(d) 48

8. A train moves at 80 km/h for 2 hours and then at 50 km/h for 1 hour. What is the average speed of the train for the entire trip in km/h?

   (a) 66.67

   (b) 70

   (c) 65

   (d) 60

9. Which of the following represents one-dimensional motion?

   (a) A kite flying in a circular path

   (b) A pendulum swinging back and forth

   (c) A car moving in a circular track

   (d) A bird flying in a spiral pattern

10. A 200 m long train travels at a uniform speed of 54 km/h. How long will it take to cross a platform that is 300 m long?

    (a) 20 sec

    (b) 25 sec

    (c) 30 sec

    (d) 33.33 sec

Answer Key for Set 2

1. (b) $\frac{2v_1v_2}{v_1+v_2}$
2. (b) $1 : \sqrt{3}$
3. (a) 48 km/h
4. (c) 13.71
5. (c) 43.48 km/h
6. (b) 15 km/h
7. (b) 40 km/h
8. (a) 66.67 km/h
9. (b) A pendulum swinging back and forth
10. (c) 30 sec

Set 3: Acceleration (10 Questions)

1. The acceleration of a particle is zero when:

   (a) Its speed is constant but direction changes

   (b) Its velocity is constant in both magnitude and direction

   (c) Its speed increases but direction remains the same

   (d) Its velocity changes but speed remains constant

2. If a particle moves with uniform acceleration, which of the following quantities must change?

   (a) Speed only

   (b) Velocity only

   (c) Either speed or direction of velocity (or both)

   (d) Neither speed nor velocity

3. A body moving with uniform acceleration covers 10 m in 2 s, with an average velocity of 5 m/s. If its initial velocity was 2 m/s, what is its acceleration?

   (a) 1.5 m/s^2

   (b) 2 m/s^2

   (c) 2.5 m/s^2

   (d) 3 m/s^2

4. A truck moving at 72 km/h comes to rest in 8 s. What is the magnitude of its retardation?

   (a) 2 m/s^2

   (b) 2.5 m/s^2

   (c) 3 m/s^2

   (d) 3.5 m/s^2

5. A particle's velocity changes from 10 m/s to 16 m/s in 4 s while moving in a straight line. What is its uniform acceleration?

   (a) 1 m/s^2

   (b) 1.5 m/s^2

   (c) 2 m/s^2

   (d) 2.5 m/s^2

6. When a body moves in a circular path at constant speed, its acceleration:

   (a) Is zero

   (b) Changes in magnitude only

   (c) Changes in direction only

   (d) Changes in both magnitude and direction

7. A car accelerates uniformly from rest and covers 48 m in 4 s. What is its acceleration?

   (a) 3 m/s^2

   (b) 4 m/s^2

   (c) 5 m/s^2

   (d) 6 m/s^2

8. A ball is dropped from a height, and its velocity increases by 9.8 m/s every second. If it hits the ground after 3 s, what was its velocity just before impact?

   (a) 19.6 m/s

   (b) 24.5 m/s

   (c) 29.4 m/s

   (d) 34.3 m/s

9. A particle moving with uniform acceleration has an initial velocity of 5 m/s and a final velocity of 15 m/s after traveling 20 m. What is its acceleration?

   (a) 2 m/s^2

   (b) 2.5 m/s^2

   (c) 3 m/s^2

   (d) 3.5 m/s^2

10. A cyclist slows down from 20 m/s to 8 m/s in 6 s while moving in a straight line. The retardation of the cyclist is:

    (a) 1 m/s^2

    (b) 2 m/s^2

    (c) 2.5 m/s^2

    (d) 3 m/s^2

Answer Key for Set 3

1. (b) Its velocity is constant in both magnitude and direction
2. (c) Either speed or direction of velocity (or both)
3. (c) 2.5 m/s^2
4. (b) 2.5 m/s^2
5. (b) 1.5 m/s^2
6. (c) Changes in direction only
7. (d) 6 m/s^2
8. (c) 29.4 m/s
9. (b) 2.5 m/s^2
10. (b) 2 m/s^2

Set 4: Uniformly Accelerated Motion (10 Questions)

1. A body moving with uniform retardation reduces its velocity to $\frac{1}{3}$ of its initial velocity in time t_0. The total time taken for the velocity to become zero is:

   (a) $\frac{3}{2}t_0$

   (b) $2t_0$

   (c) $\frac{4}{3}t_0$

   (d) $3t_0$

2. A particle starts from rest with an acceleration of $25\,cm/s^2$. The displacement of the particle in 6 seconds is:

   (a) 450 cm

   (b) 225 cm

   (c) 4.5 m

   (d) 900 cm

3. The velocity of a particle is given by $v = bt$, where b is a constant. The distance traveled by the particle in the first 5 seconds is:

   (a) $12.5b$

   (b) $10b$

   (c) $15b$

   (d) $25b$

4. A car starts with a velocity of $5\,\text{m/s}$ and moves with a uniform retardation of $0.5\,\text{m/s}^2$. The time at which it is 20 m from the starting point for the first time is:

   (a) 4 s
   (b) 6 s
   (c) 8 s
   (d) 10 s

5. A particle starts from rest, accelerates at $3\,\text{m/s}^2$ for 5 s, moves with constant speed of $15\,\text{m/s}$ for 20 s, and then decelerates at $5\,\text{m/s}^2$ until it stops. The total distance traveled is:

   (a) 337.5 m
   (b) 375 m
   (c) 350 m
   (d) 400 m

6. A body moves with a uniform velocity of $10\,\text{m/s}$. At the moment it passes another body at rest, the second body starts moving with a uniform acceleration of $2\,\text{m/s}^2$. The time after which they meet is:

   (a) 5 s
   (b) 10 s
   (c) 15 s
   (d) 20 s

7. Two particles P and Q start from rest at the same point with a uniform acceleration of $4\,\text{m/s}^2$. If Q starts 2 seconds after P, the distance between them at the end of 3 seconds from Q's start is:

   (a) 8 m
   (b) 12 m
   (c) 16 m
   (d) 20 m

8. A train starts from rest, accelerates uniformly to a speed of $30\,\text{m/s}$ in 15 s, travels at this speed for 10 s, and then comes to rest with uniform retardation in 20 s. The average velocity during the entire journey is:

   (a) 15 m/s
   (b) 18 m/s
   (c) 20 m/s
   (d) 22.5 m/s

9. A particle starts from rest, covers a distance d with uniform acceleration, then moves a further distance $3d$ with constant speed, and finally stops after covering $2d$ with uniform retardation. The ratio of its average speed to its maximum speed is:

   (a) $\frac{2}{5}$
   (b) $\frac{3}{5}$
   (c) $\frac{4}{5}$
   (d) $\frac{1}{2}$

10. A body moving with uniform acceleration passes points X and Y with velocities of $15\,\text{m/s}$ and $25\,\text{m/s}$, respectively. The speed of the body at the midpoint of X and Y is:

    (a) 20 m/s
    (b) 22.5 m/s
    (c) $\sqrt{500}\,\text{m/s}$
    (d) 18 m/s

Answer Key for Set 4

1. (b) $2t_0$
2. (a) 450 cm
3. (a) $12.5b$
4. (c) 8 s
5. (b) 375 m
6. (b) 10 s
7. (c) 16 m
8. (b) 18 m/s
9. (c) $\frac{4}{5}$
10. (a) 20 m/s

Set 5: Motion Under Gravity (20 Questions)

1. A ball is thrown upward with an initial velocity of 19.6 m/s. How long does it take to return to the point of release? (Take $g = 9.8\,\text{m/s}^2$)

   (a) 2 s

   (b) 3 s

   (c) 4 s

   (d) 5 s

2. A stone is thrown vertically upward with speed v. The distance covered in the last t seconds of its upward motion is:

   (a) $\frac{1}{2}gt^2$

   (b) $vt - \frac{1}{2}gt^2$

   (c) vt

   (d) $\frac{1}{2}vt$

3. A person throws balls upward every 2 seconds. The next ball is thrown when the previous one reaches its maximum height. How high does each ball rise? (Take $g = 10\,\text{m/s}^2$)

   (a) 5 m

   (b) 10 m

   (c) 15 m

   (d) 20 m

4. A particle is thrown vertically upward, and its velocity at one-third of its maximum height is 12 m/s. What is the maximum height attained? (Take $g = 10\,\text{m/s}^2$)

   (a) 18 m

   (b) 24 m

   (c) 28.8 m

   (d) 36 m

5. A ball is thrown vertically upward with velocity v_0 to reach a height h. To increase the maximum height to $4h$, the initial velocity should be:

   (a) $2v_0$

   (b) $\sqrt{2}v_0$

   (c) $4v_0$

   (d) $3v_0$

6. A stone is thrown upward from a cliff with speed u and hits the ground below with speed $4u$. The height of the cliff is:

   (a) $\frac{3u^2}{g}$

   (b) $\frac{7u^2}{2g}$

   (c) $\frac{15u^2}{2g}$

   (d) $\frac{8u^2}{g}$

7. A body is thrown vertically upward and passes a height of 19.6 m twice, with a time interval of 4 s between the two passages. What is its initial velocity? (Take $g = 9.8\,\text{m/s}^2$)

   (a) 25.4 m/s

   (b) 29.4 m/s

   (c) 19.6 m/s

   (d) 39.2 m/s

8. A particle is projected upward with velocity u and passes a point at height h after t_1 seconds. The time after which it passes the same point on its descent is:

   (a) $\frac{u}{g} - t_1$

   (b) $\frac{2u}{g} - t_1$

   (c) t_1

   (d) $\frac{u}{g} - 2t_1$

9. A ball is thrown vertically upward from the top of a tower and reaches the ground in t_1 seconds. When thrown downward with the same speed, it reaches the ground in t_2 seconds. The time to reach the ground if dropped from rest is:

   (a) $\frac{t_1+t_2}{2}$

   (b) $t_1 t_2$

   (c) $\sqrt{t_1 t_2}$

   (d) $\frac{t_1-t_2}{2}$

10. A balloon rises vertically with an acceleration of $4.9\,\text{m/s}^2$. A ball is released 3 s after takeoff. What is the maximum height above the ground reached by the ball? (Take $g = 9.8\,\text{m/s}^2$)

    (a) 44.1 m

    (b) 66.15 m

    (c) 88.2 m

    (d) 110.25 m

11. A stone falls freely from rest, and the distance it covers in the last second equals the distance covered in the first 2 seconds. How long was it in the air? (Take $g = 10\,\text{m/s}^2$)

    (a) 3 s

    (b) 4 s

    (c) 5 s

    (d) 6 s

12. A body falls freely from a height of 245 m. The ratio of distances traveled in the 1st, 2nd, and 3rd seconds is: (Take $g = 9.8\,\text{m/s}^2$)

    (a) 1 : 3 : 5

    (b) 1 : 2 : 3

    (c) 1 : 4 : 9

    (d) 1 : 5 : 9

13. Two balls are dropped from heights h and $3h$. The ratio of their times to reach the ground is:

    (a) $1 : \sqrt{3}$

    (b) $\sqrt{3} : 1$

    (c) 1 : 3

    (d) 3 : 1

14. A particle falls from a height h and covers $\frac{16}{25}h$ in the last second of its fall. The height h is: (Take $g = 10\,\text{m/s}^2$)

    (a) 62.5 m

    (b) 100 m

    (c) 125 m

    (d) 156.25 m

15. A stone dropped from a tower covers a distance $5x$ in the last second, where x is the distance covered in the first second. The total time of fall is: (Take $g = 10\,\text{m/s}^2$)

    (a) 3 s

    (b) 4 s

    (c) 5 s

    (d) 6 s

16. The displacement of a particle along the x-axis is given by $x = 10t - 2t^2$. The average acceleration between $t = 1\,\text{s}$ and $t = 3\,\text{s}$ is:

    (a) $-4\,\text{m/s}^2$

    (b) $-2\,\text{m/s}^2$

    (c) $-6\,\text{m/s}^2$

    (d) $-8\,\text{m/s}^2$

17. The displacement of a particle is given by $s = 4t^2 - 16t + 12$. The distance traveled by the particle in the first 4 seconds is:

    (a) 16 m

    (b) 24 m

    (c) 32 m

    (d) 40 m

18. The displacement of a particle is $x = 2t^3 + 3t^2 + 4t + 5$. The ratio of its initial acceleration to its initial velocity is:

    (a) 3/2

    (b) 2/3

    (c) 3/4

    (d) 4/3

19. A particle starts from rest with an acceleration given by $a = 2+3t$. The distance traveled in the first 2 seconds is:

    (a) 8 m

    (b) 10 m

    (c) 12 m

    (d) 14 m

20. A particle's acceleration is $a = 4t + 1\,\text{m/s}^2$, and it starts with a velocity of $3\,\text{m/s}$ at $t = 0$. The velocity at $t = 3\,\text{s}$ is:

    (a) 18 m/s

    (b) 21 m/s

    (c) 24 m/s

    (d) 27 m/s

Answer Key for Set 5

1. (c) 4 s
2. (b) $vt - \frac{1}{2}gt^2$
3. (b) 10 m
4. (c) 28.8 m
5. (a) $2v_0$
6. (c) $\frac{15u^2}{2g}$
7. (b) 29.4 m/s
8. (b) $\frac{2u}{g} - t_1$
9. (c) $\sqrt{t_1 t_2}$
10. (d) 110.25 m
11. (c) 5 s
12. (a) 1 : 3 : 5
13. (a) 1 : $\sqrt{3}$
14. (c) 125 m
15. (c) 5 s
16. (a) $-4\,\text{m/s}^2$
17. (c) 32 m
18. (c) 3/4
19. (c) 12 m
20. (c) 24 m/s