



Chapter 4: MOTION IN 2D AND 3D

1. If the x component of vector \vec{r} is 2.6 m and the y component is -2.3 m then \vec{r} in unit-vector notation is:

- (A) $2.6 \hat{i} - 2.3 \hat{j}$ (B) $-2.3 \hat{i} + 2.6 \hat{j}$ (C) $6.2 \hat{i} + 3.2 \hat{j}$ (D) $3.2 \hat{i} - 6.2 \hat{j}$

2. The displacement of a particle moving from $\vec{r}_1 = 5\hat{i} - 6\hat{j} + 2\hat{k}$ to

$$\vec{r}_2 = -2\hat{i} + 6\hat{j} + 2\hat{k}$$

- (A) $-7\hat{i} + 12\hat{j}$ (B) $3\hat{i} + 4\hat{k}$ (C) $7\hat{i} - 12\hat{j}$ (D) $-3\hat{i} - 4\hat{k}$

3. A particle goes from $(x_1=-2\text{m}, y_1=3\text{m}, z_1=1\text{m})$ to $(x_2=3\text{m}, y_2=-1\text{m}, z_2=4\text{m})$. Its displacement is:

- (a) $\hat{i} + 2\hat{j} + 5\hat{k}$ (b) $5\hat{i} - 4\hat{j} + 3\hat{k}$ (c) $-5\hat{i} + 4\hat{j} - 3\hat{k}$ (d) $-\hat{i} - 2\hat{j} - 5\hat{k}$

4. The coordinates of a car's position as function of time is given by: $x = 5t^2 + 16$, and $y = -t^3 + 5$, the magnitude of position vector \vec{r} at $t=2\text{s}$ is:

- (a) 5 m (b) 1 m (c) 2.6 m (d) 4 m

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5. The components of a car's velocity as a function of time are given by :

$V_x = 2t + 3$, and $V_y = 4t - 1$, its velocity \vec{V} at $(t=1\text{ s})$ is:

- (A) $\vec{V} = 9\hat{i} + 11\hat{j}$ (B) $\vec{V} = 5\hat{i} + 3\hat{j}$ (C) $\vec{V} = 7\hat{i} + 7\hat{j}$ (D) $\vec{V} = 11\hat{i} + 15\hat{j}$

6. Velocity is defined as:

- (a) rate of change of position with time (b) position divided by time (c) a speeding up or slowing down (d) change of position

7. The position of a particle moving on an x axis is given by: $X = t^2 + 2$, its average velocity in the time interval from $t=1\text{s}$ to $t=2\text{s}$ is:

- (a) 4 m/s (b) 2 m/s (c) 3 m/s (d) 1 m/s

8. A car travels east at 200 m/s and then travels west at 200 m/s, the change in its velocity is:

- (a) zero (b) 400 m/s east (c) 400 m/s west (d) 200 m/s west

9. The position vector for a moving particle is: $\vec{r} = \hat{i} + 4t^2\hat{j} + t\hat{k}$, its velocity and acceleration as a function of time are:

- (a) $\vec{v} = 8t\hat{j} + \hat{k}$
 $\vec{a} = 8\hat{j}$ (b) $\vec{v} = \hat{i} + 8t\hat{j} + \hat{k}$
 $\vec{a} = 8\hat{j} + \hat{k}$ (c) $\vec{v} = 8t\hat{j}$
 $\vec{a} = \hat{i} + 8\hat{j}$ (d) $\vec{v} = 8t^2\hat{j} + t\hat{k}$
 $\vec{a} = 8\hat{j}$

10. A particle moves in the xy plane. In which situation of the following V_x and V_y are both constant

Situation	X(m)	Y(m)
A	$2t^2$	$4t + 3$
B	$4t^3 - 2$	$+3$
C	$5t$	$2t + 1$
D	$-3t$	$t^2 - 1$

- (a) A (b) B (c) C (d) D

11. The components of a car's velocity as a function of time are given by $v_x = 6t^2 - 5$, $v_y = -3t^3$. The acceleration components are:

- (A) $a_x = 10t$
 $a_y = -12t^2$ (B) $a_x = 4t$
 $a_y = -6t^2$ (C) $a_x = 6t$
 $a_y = -15t^2$ (D) $a_x = 12t$
 $a_y = -9t^2$

12. A particle moving with initial velocity $\vec{v}_0 = -2\hat{i} + 4\hat{j}$ m/s, and acceleration $\vec{a} = -5\hat{i} + 8\hat{j}$ m/s², the x-component v_x of the final velocity at (t=1 s) is ?

- (A) -7 m/s (B) -17 m/s (C) -27 m/s (D) -37 m/s

13. Acceleration is defined as:

- (a) rate of change of position with time (b) speed divided by time (c) rate of change of velocity with time (d) change of velocity

14. A particle had a speed of 18 m/s in the +x direction and after 2.4 s its speed was 30 m/s in the -x direction. Its average acceleration during this time is:

- (a) $a = \frac{-30-18}{2.4}$ (b) $a = \frac{30-18}{2.4}$ (c) $a = \frac{18+30}{2.4}$ (d) $a = \frac{18-30}{2.4}$

15. A particle moving with $\vec{v}_0 = 2\hat{i} + 5\hat{j}$ and acceleration $\vec{a} = 5\hat{j}$. Its velocity after 2s is:

- (a) 15 m/s (b) 12 m/s (c) $\sqrt{29}$ m/s (d) $\sqrt{43.2}$ m/s

16. A particle leaves the origin with initial velocity $\vec{v}_0 = 8\hat{i} + 12\hat{j}$ m/s and a constant acceleration $\vec{a} = 4\hat{i} - 2\hat{j}$ m/s². The particle's velocity at t = 6 s is:

- (a) $\vec{v} = 24\hat{j}$ $\vec{v} = 32\hat{i} + 24\hat{j}$ (c) $\vec{v} = 32\hat{i}$ (d) $\vec{v} = 32\hat{i} - 12\hat{j}$

17. Acceleration is equal to

- (a) $\frac{d\vec{v}}{dt}$ (b) $\frac{d\vec{r}}{dt}$ (c) $\frac{d\vec{v}}{dr}$ (d) $\frac{\Delta\vec{r}}{\Delta t}$

18. The range of a ball is thrown at an angle of 30° above the horizontal with an initial speed 50 m/s is:

- (A) 318.1 m (B) 267.3 m (C) 373.4 m (D) 220.9 m
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19. The maximum range of a projectile is at launch angle

- (A) $\theta = 25^\circ$ (B) $\theta = 35^\circ$ (C) $\theta = 45^\circ$ (D) $\theta = 55^\circ$
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20. In the projectile motion the acceleration in the horizontal direction is:

- (A) 19.6 m/s^2 (B) zero (C) 9.8 m/s^2 (D) 4.9 m/s^2
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21. The range of a ball is thrown at an angle of 30° above the horizontal with an initial speed 50 m/s is:

- (A) 318.1 m (B) 267.3 m (C) 373.4 m (D) 220.9 m
-

22. A large cannon fired a ball at an angle of 30° above the horizontal with initial speed 980m the projectile will travel what horizontal distance before striking the ground?

- (a) 4.3 km (b) 8.5 km (c) 43 km (d) 85 km
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23. A stone thrown from the top of a tall building follows a path that is:

- (a) circular (b) parabolic (c) hyperbolic (d) a straight line
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24. Two projectiles are in flight at the same time. The acceleration of one relative to the other:

- (a) is always 9.8 m/s^2 (b) can be as large as 19.8 m/s^2 (c) can be horizontal (d) is zero
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25. A ball is thrown at V_0 and angle θ_0 above horizontal and returned to its initial height. The path of the ball is called:

- (a) Range (b) Trajectory (c) Horizontal path (d) Vertical path
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26. In question 25, the horizontal component of the ball's velocity V_{x0} is:

- (a) $V_{x0} = \text{unchanged}$ (b) $V_{x0} = \text{zero}$ (c) $V_{x0} = V_0$ (d) V_{x0} is changed
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27. In question 25, at the maximum height, the vertical component of the ball's velocity V_y is:

- (a) $V_y = V_x$ (b) $V_y = V_0$ (c) $V_y = \text{zero}$ (d) $V_y = V_{0y}$
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28. A ball is thrown with initial velocity $v_0=120 \text{ m/s}$ at an angle $\theta_0=60^\circ$ above the horizontal, the velocity v_0 in unit vector notation is:

- (a) $\vec{v}_0 = 104\hat{i} + 60\hat{j}$ (b) $\vec{v}_0 = 60\hat{i} + 104\hat{j}$ (c) $\vec{v}_0 = 60\hat{i}$ (d) $\vec{v}_0 = 104\hat{j}$
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29. In question 28, the acceleration in the horizontal direction when $t=5 \text{ s}$ is:

- (a) 24 m/s^2 (b) -9.8 m/s^2 (c) zero (d) 600 m/s^2
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30. In question 28, the maximum range of the ball is:

- (a) 1469.4 m (b) 1272.5 m (c) 1649.4 m (d) 1722.5 m

31. The horizontal range is the horizontal distance the projectile has traveled when it returns to

- (a) the origin (b) its max. height (c) its final height (d) its initial height

32. You are to launch a rocket, from just above the ground, with one of the following initial velocity vectors: (1) $\vec{v}_0 = 20\hat{i} + 70\hat{j}$, (2) $\vec{v}_0 = -20\hat{i} + 70\hat{j}$, (3) $\vec{v}_0 = 20\hat{i} - 70\hat{j}$, (4) $\vec{v}_0 = -20\hat{i} - 70\hat{j}$. Rank the vector according to the launch speed greatest first.

- (a) $4 > 3 > 2 > 1$ (b) $4 > 2 > 3 > 1$ (c) $1 > 2 > 3 > 4$ (d) all the same

33. In the projectile motion, the vertical velocity component v_y

- (a) changes continuously (b) remains constant (c) equals zero (d) v_y equals v_x

34. The maximum range of a projectile is at launch angle

- (a) $\theta = 25^\circ$ (b) $\theta = 35^\circ$ (c) $\theta = 45^\circ$ (d) $\theta = 55^\circ$

35. In the projectile motion the horizontal velocity component v_x remains constant because the acceleration in the horizontal direction is:

- (a) $a_x > 0$ (b) $a_x = g$ (c) $a_x > g$ (d) $a_x = 0$

36. The range of a ball is thrown at an angle of 30° above the horizontal with an initial speed 50 m/s is:

- (a) 318.1 m (b) 267.3 m (c) 373.4 m (d) 220.9 m

37. A ball is thrown at an angle of 30° above the horizontal with an initial speed 980 m/s. The ball's range is:

- (a) 4.3 km (b) 8.5 km (c) 43 km (d) 85 km

38. In the projectile motion the horizontal velocity component v_x remains constant because the acceleration in the horizontal direction is:

- (a) $a_x = 0$ (b) $a_x > 0$ (c) $a_x = g$ (d) $a_x > g$

39. A ball is thrown at V_0 and angle θ_0 above horizontal and returned to its initial height. The path of the ball is called:

- (a) Range (b) Trajectory (c) Horizontal path (d) Vertical path

40. In question 39, the horizontal component of the ball's velocity V_{x0} is:

- (a) V_{x0} unchanged = (b) $V_{x0} = \text{zero}$ (c) $V_{x0} = V_0$ (d) V_{x0} is changed

41. In question 39, at the maximum height, the vertical component of the ball's velocity V_y is:

- (a) $V_y = V_x$ (b) $V_y = V_0$ (c) $V_y = \text{zero}$ (d) $V_y = V_{0y}$

42. The period of an objects moving at a constant speed of 4 m/s on a circular path of radius 2 m is:

- (A) $\frac{\pi}{2}$ s (B) 2π s (C) 4π s (D) 8π s

43. The period of an objects moving at a constant speed of 4 m/s on a circular path of radius 2 m is:

- (A) $\frac{\pi}{2}$ s (B) 2π s (C) 4π s (D) 8π s

44. A particle moves at constant speed in a circular path. The instantaneous velocity and instantaneous acceleration vectors are:

- (a) both tangent to the circular path (b) both perpendicular to the circular path (c) perpendicular to each other (d) opposite to each other

45. For a biological sample in a 1:0-m radius centrifuge to have a centripetal acceleration of 25g, its speed must be:

- (a) 11 m/s (b) 16 m/s (c) 50 m/s (d) 122 m/s

46. A stone is tied to a 0.50-m string and whirled at a constant speed of 4m/s in a vertical circle. Its acceleration at the top of the circle is:

- (a) 9.8 m/s^2 , up (b) 9.8 m/s^2 , down (c) 32 m/s^2 , up (d) 32 m/s^2 , down

47. A stone is tied to a 0.50-m string and whirled at a constant speed of 40m/s in a vertical circle. Its acceleration at the bottom of the circle is:

- (a) 9.8 m/s^2 , up (b) 9.8 m/s^2 , down (c) 32 m/s^2 , up (d) 32 m/s^2 , down

48. A car rounds a 20-m radius curve at 10m/s. The magnitude of its acceleration is:

- (a) zero (b) 0.2 m/s^2 (c) 5 m/s^2 (d) 40 m/s^2

49. The speed of a car moving in a circular path of radius 20 m with a centripetal acceleration of 5 m/s^2 is:

- (a) 10 m/s (b) 100 m/s (c) 4 m/s (d) 2000 m/s

50. The period of a plane that enters a horizontal circular turn with $\vec{v}_i = 200\hat{i} + 600\hat{j} \text{ m/s}$ and 32 s later leaves the turn with $\vec{v}_f = 200\hat{i} + 600\hat{j}$ is:

- (a) 12 (b) 16 (c) 32 (d) 64

