Chapter 4: MOTIN 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) $3.2\ \hat{i} - 6.2\ \hat{j}$

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2. The displacement of a particle moving from $\vec{r}_1 = 5\hat{i} - 6\hat{j} + 2\hat{k}$ to $\vec{r}_2 = -2\hat{i} + 6\hat{j} + 2\hat{k}$ is

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

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3. A particle goes from (x_1=-2m, y_1=3m, z_1=1m) to (x_2=3m, y_2=-1m, z_2=4m). 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) $-\hat{i} - 2\hat{j} - 5\hat{k}$

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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=2s 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= 2 t + 3, and V_y= 4 t – 1, its velocity $\vec{V}$ at (t= 1 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) $\vec{V} = 11\hat{i} + 15\hat{j}$

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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

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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=1s to t=2s is:

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

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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

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

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

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	$2\,t^2$	$4\,t + 3$
B	$4\,t^3 - 2$	+3
C	5 t	2 t + 1
D	- 3 t	$t^2 - 1$

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

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

(A) $a_x = 10\,t$, $a_y = -12\,t^2$ (B) $a_x = 4\,t$, $a_y = -6\,t^2$ (C) $a_x = 6\,t$, $a_y = -15\,t^2$ <u>(D) $a_x = 12\,t$, $a_y = -9\,t^2$</u>

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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/s^2 , the x-component v_x of the final velocity at (t=1 s) is ?

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

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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

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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) $a = \frac{18-30}{2.4}$

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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

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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/s^2. 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) $\vec{v} = 32\hat{i} - 12\hat{j}$

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17. Acceleration is equal to

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

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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

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

(A) $\theta = 25°$ (B) $\theta = 35°$ (C) $\theta = 45°$ (D) $\theta = 55°$

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

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 30^0 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

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

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

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

26. In question 25, the horizontal component of the ball's velocity V_{x0} is:

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

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 = zero (d) $V_y = V_{0y}$

28. A ball is thrown with initial velocity v_0=120 m/s at an angle θ_0=60° above the horizontal, the velocity v_0 in unit vector notation is:

(a) $\bar{v}_0 = 104\hat{i} + 60\hat{j}$ (b) $\bar{v}_0 = 60\hat{i} + 104\hat{j}$ (c) $\bar{v}_0 = 60\hat{i}$ (d) $\bar{v}_0 = 104\hat{j}$

29. In question 28, the acceleration in the horizontal direction when t=5 s is:

(a) 24 m/s^2 (b) – 9.8 m/s^2 (c) zero (d) 600 m/s^2

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) $\bar{v}_0 = 20\hat{i} + 70\hat{j}$, (2) $\bar{v}_0 = -20\hat{i} + 70\hat{j}$, (3) $\bar{v}_0 = 20\hat{i} - 70\hat{j}$, (4) $\bar{v}_0 = -20\hat{i} - 70\hat{j}$. 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) $\theta = 25°$ (b) $\theta = 35°$ (c) $\theta = 45°$ (d) $\theta = 55°$

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 intial 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} = (b) V_{x0} = zero (c) $V_{x0} = V_0$ (d) V_{x0} is changed unchanged

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 = 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) π 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) π 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 $\bar{v}_i = 200\hat{i} + 600\hat{j}$ m/s and 32 s later leaves the turn with $\bar{v}_f = 200\hat{i} + 600\hat{j}$ is:

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

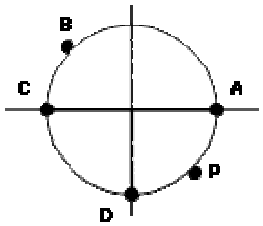
51. The period of an objects moving at a constant speed of 4 m/s on a circular path of radius 2 m is:

(a) π s (b) 2π s (c) 4π s (d) 8π s

52. Referring to question 51, the acceleration of the object is:

(a) 1 m/s^2 (b) 2 m/s^2 (c) 4 m/s^2 (d) 8 m/s^2

53. A particle is moving in circular path, at point P the particles velocity is: $\vec{v} = 3\hat{i} + 4\hat{j}$ at which point the velocity is $\vec{v} = -3\hat{i} - 4\hat{j}$



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

1. A
2. A
3. b
4. 36.12 m
5. B
6. a
7. c
8. c
9. a
10. c
11. D
12. A
13. c
14. a
15. a
16. c
17. a
18. D
19. C
20. B
21. D
22. d
23. b
24. d
25. b
26. a
27. c
28. b
29. c
30. a
31. d
32. d
33. a
34. c
35. d
36. d
37. d
38. a
39. b
40. a
41. c
42. A
43. A
44. c
45. b (taking the radius to be 1 m)
46. d
47. c
48. c
49. a
50. c
51. a
52. d
53. b