

PACE-IIT & MEDICAL

MUMBAI / AKOLA / DELHI / KOLKATA / GHAZIABAD / NASHIK / GOA / BOKARO / PUNE

IIT – JEE: 2024

TW TEST (ADV)

DATE: 18/09/22

TOPIC: KINEMATICS - I

ANSWER KEY

- | | | | | |
|---------|---------|---------|---------|---------|
| 1. (C) | 2. (D) | 3. (A) | 4. (B) | 5. (B) |
| 6. (D) | 7. (B) | 8. (B) | 9. (A) | 10. (D) |
| 11. (B) | 12. (C) | 13. (A) | 14. (A) | 15. (B) |
| 16. (B) | 17. (B) | 18. (B) | 19. (B) | 20. (C) |
| 21. (C) | 22. (C) | 23. (D) | 24. (A) | 25. (D) |

SOLUTIONS

1. (C)

$$\text{Speed of maximum height} = u \cos \theta = \frac{u}{2} \Rightarrow \theta = 60^\circ$$

$$R = \frac{u^2 \sin 120^\circ}{g} = \frac{\sqrt{3}u^2}{2g}$$

2. (D)

$$\frac{u^2 \sin 30^\circ}{g} = 100\sqrt{3}$$

$$\text{So, } \frac{u^2 \sin 60^\circ}{g} = 300\text{m}$$

3. (A)

$$S_{p/b} = x; u_{p/b} = u; a_{p/b} = -a$$

$$x = ut - \frac{1}{2}at^2.$$

Also, this equation should have real root.

$$\text{So, } u^2 - 2ax \geq 0 \Rightarrow u \geq \sqrt{2ax}$$

4. (B)

$$S_{1st} = \frac{1}{2} \times 10 \times 1^2 = 5\text{m}.$$

$$S_{nth} = \frac{1}{2} \times 10 \times (2n-1) = 5 \times 7 = 35\text{m}$$

$$\Rightarrow n = 4\text{sec}.$$

5. (B)

Time to fall from height H is $\sqrt{\frac{2H}{g}}$

6. (D)

$$u_y^2 = 2^2 + 2 \times 10 \times 0.4 \Rightarrow u_y = 2\sqrt{3} \text{ m/s}$$

$$u_x = 6 \text{ m/s}$$

$$\text{So, } \tan \theta = \frac{u_y}{u_x} = \frac{1}{\sqrt{3}} \Rightarrow \theta = 30^\circ$$

7. (B)

8. (B)

$$\vec{r}_f = \vec{r}_i + \vec{u}t + \frac{1}{2}\vec{a}t^2 = 20\hat{i} + 20\hat{j}$$

9. (A)

$$-1500 = -100t - 5t^2 \Rightarrow t = 10 \text{ s}$$

$$\text{Now, } S_x = \frac{400}{3} \times 10 = \frac{4000}{3} \text{ m}$$

10. (D)

11. (B)

12. (C)

$$a = \frac{v}{n}$$

$$S_{n\text{th}} = \frac{1}{2}a(2n-1)$$

13. (A)

$$\text{Time to drop 5 m, } \Delta t = \sqrt{\frac{2 \times 5}{10}} = 1 \text{ sec}$$

$$\text{Now, } H = \frac{1}{2} \times 10 \times t^2; \quad H - 25 = \frac{1}{2} \times 10 \times (t-1)^2$$

Solving, $t = 3 \text{ sec.}$

So, $H = 45 \text{ m}$

14. (A)

15. (B)

$$(3u)^2 = u^2 + 2gH \Rightarrow H = \frac{4u^2}{g}$$

16. (B)

$$v_{avg} = \frac{20 \times 3 + 30 \times 3 + 25 \times 2}{8} = 25 \text{ km/h}$$

17. (B)

18. (B)

$$S = 8 \times 5 + \frac{1}{2}(-4)5^2 = -10 \text{ m}$$

But it stops after displacement of S'

$$0 = 8^2 - 2 \times 4 \times S' \Rightarrow S' = 8 \text{ m}$$

$$\text{Total distance} = 8 + 8 + 10 = 26 \text{ m}$$



19. (B)

$$v_y = 40 - 10 \times 1 = 30 \text{ m/s}; v_x = 40 \text{ m/s}$$

20. (C)

21. (C)

$$t_1 + t_2 = \text{time of flight} = \frac{2u}{g}$$

22. (C)

$$\frac{1}{2}gt^2 = 20 \quad \dots(1)$$

$$\frac{1}{2}g(t + \Delta t)^2 = 22.05 \quad \dots(2)$$

$$\Delta t = 0.1 \text{ sec}$$

23. (D)

$$2 = \frac{2u \sin \theta}{g} \Rightarrow u \sin \theta = g \quad \dots(1)$$

$$-H = u \sin \theta \times 3 - \frac{1}{2}g \times 3^2 = -15 \text{ m}$$

24. (A)

$$R = 4H \cot \theta = 25 \times \frac{3}{4} \times 4 = 75 \text{ m}$$

25. (D)

$$\left(\frac{u}{2}\right)^2 + \left(\frac{u\sqrt{3}}{2} - 10t\right)^2 = \frac{1}{4}u^2$$

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TOPIC: PERIODIC TABLE

ANSWER KEY

26. (D)	27. (C)	28. (C)	29. (D)	30. (D)
31. (D)	32. (B)	33. (C)	34. (A)	35. (B)
36. (B)	37. (D)	38. (D)	39. (D)	40. (B)
41. (D)	42. (C)	43. (A)	44. (D)	45. (C)
46. (C)	47. (C)	48. (B)	49. (C)	50. (C)

SOLUTIONS

26. (D)
Hg, Br

27. (C)

28. (C)

29. (D)

30. (D)

31. (D)

32. (B)

33. (C)

34. (A)

35. (B)

36. (B)

37. (D)

38. (D)

39. (D)

40. (B)
41. (D)
42. (C)
43. (A)
44. (D)
45. (C)
IE₁ : B < Be < C
46. (C)
47. (C)
48. (B)
49. (C)
50. (C)

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TOPIC: TRIGONOMETRIC EQUATIONS

ANSWER KEY

51. (C)	52. (D)	53. (C)	54. (A)	55. (C)
56. (B)	57. (A)	58. (C)	59. (C)	60. (B)
61. (B)	62. (B)	63. (C)	64. (D)	65. (C)
66. (C)	67. (B)	68. (C)	69. (D)	70. (A)
71. (B)	72. (A)	73. (B)	74. (A)	75. (C)

SOLUTIONS

51. (C)

$$\Rightarrow 1 + \tan^2 \theta - 2 \tan^2 \theta = 0$$

$$\Rightarrow \tan^2 \theta = 1 \Rightarrow \tan \theta = \pm 1$$

$$\Rightarrow \theta = n\pi \pm \frac{\pi}{4} \Rightarrow \text{(C) option.}$$

52. (D)

$$\Rightarrow 1 - \cos 2\theta = 3 + 3 \cos 2\theta$$

$$\Rightarrow 4 \cos 2\theta = -2 \Rightarrow \cos 2\theta = -\frac{1}{2}$$

$$\Rightarrow 2\theta = 2n\pi \pm \frac{2\pi}{3}$$

Alternative:

$$\frac{1 - \cos 2\theta}{1 + \cos 2\theta} = \tan^2 \theta = (\sqrt{3})^2 = \tan^2 \left(\frac{\pi}{3} \right)$$

$$\therefore \theta = n\pi \pm \frac{\pi}{3}$$

53. (C)

$$\sin^2 \theta + \sin \theta - 2 = 0$$

$$\Rightarrow \sin \theta = -2, 1$$

$$\Rightarrow \theta = 2n\pi + \frac{\pi}{2}, n \in I.$$

\Rightarrow (C) options.

54. (A)

$$\sin^4 x + \cos^4 x = \sin x \cos x$$

$$\Rightarrow (\sin^2 x + \cos^2 x)^2 - 2\sin^2 x \cos^2 x = \sin x \cos x$$

$$\Rightarrow 1 - \frac{\sin^2 2x}{2} = \frac{\sin 2x}{2}$$

$$\Rightarrow \sin^2 2x + \sin 2x - 2 = 0$$

$$\Rightarrow (\sin 2x + 2)(\sin 2x - 1) = 0$$

$$\Rightarrow 2x = (4n+1)\frac{\pi}{2}$$

$$\Rightarrow x = (4n+1)\frac{\pi}{4}, n \in Z$$

$$\Rightarrow x = \frac{\pi}{4}, \frac{5\pi}{4} (\because x \in [0, 2\pi])$$

55. (C)

$$\Rightarrow \cos \theta = -\frac{5}{4}, \cos \theta = -\frac{1}{2}$$

No solutions,

$$\Rightarrow \theta = \frac{2\pi}{3}, \frac{4\pi}{3}$$

\Rightarrow (C) option.

56. (B)

$$4\cos^2 x + 6\sin^2 x = 5$$

$$\Rightarrow 4 + 2\sin^2 x = 5 \Rightarrow \sin^2 x = \frac{1}{2}$$

$$\Rightarrow \sin x = \pm \frac{1}{\sqrt{2}}$$

$$\Rightarrow x = n\pi \pm \frac{\pi}{4}, n \in I$$

\Rightarrow (B) option.

57. (A)

$$\tan \theta = 1, \sqrt{3}$$

$$\Rightarrow \theta = n\pi + \frac{\pi}{4}, n\pi + \frac{\pi}{3}$$

\Rightarrow (A) option.

58. (C)

$$\tan^2 \alpha + 2\sqrt{3} \tan \alpha - 1 = 0$$

$$\Rightarrow \tan \alpha = \frac{-2\sqrt{3} \pm \sqrt{12+4}}{2} = -\sqrt{3} \pm 2$$

$$\Rightarrow \tan \alpha = 2 - \sqrt{3} \text{ and } -(2 + \sqrt{3})$$

$$\Rightarrow \alpha = (6n+1)\frac{\pi}{12}, n \in I \Rightarrow \text{(C) option.}$$

59. (C)

$$\begin{aligned}\sin 2x - 2\cos x + 4\sin x - 4 &= 0 \\ \Rightarrow 2\sin x \cdot \cos x - 2\cos x + 4(\sin x - 1) &= 0 \\ \Rightarrow 2\cos x(\sin x - 1) + 4(\sin x - 1) &= 0 \\ \Rightarrow (2\cos x + 4)(\sin x - 1) &= 0 \\ \Rightarrow \sin x = 1, \cos x = -2\end{aligned}$$

No solutions.

$$\Rightarrow x = \frac{\pi}{2}, \frac{5\pi}{2}, \frac{9\pi}{2}$$

\Rightarrow (C) option.

60. (B)

$$\begin{aligned}\cos \theta &= \frac{2\sqrt{2} \pm \sqrt{8 + 4 \times 4}}{8} \\ \cos \theta &= \frac{2\sqrt{2} + 2\sqrt{6}}{8} = \frac{\sqrt{3} + 1}{2\sqrt{2}} \text{ or } \frac{-\sqrt{3} + 1}{2\sqrt{2}} \\ \Rightarrow \theta &= \frac{\pi}{12}, \frac{7\pi}{12}, \frac{17\pi}{12}, \frac{23\pi}{12}\end{aligned}$$

61. (B)

$$\begin{aligned}\sin 3x + (\sin 5x + \sin x) &= 0 \\ \Rightarrow \sin 3x + (2\sin 3x \cos 2x) &= 0 \\ \Rightarrow \sin 3x = 0 \text{ or } \cos 2x = -\frac{1}{2} &= \cos \frac{2\pi}{3} \\ \Rightarrow x = n\pi/3 \text{ or } x = n\pi \pm \frac{\pi}{3}, n \in \mathbb{Z}\end{aligned}$$

Then $x = 0, \pi/3, \text{ and } 2\pi/3, \text{ and } \pi$.

Hence there are four solutions.

62. (B)

$$\begin{aligned}\Rightarrow \tan(3\theta) = 0 &\Rightarrow 3\theta = n\pi, n \in \mathbb{I} \\ \Rightarrow \theta = \frac{n\pi}{3} &\Rightarrow \text{(B) option}\end{aligned}$$

(using $\tan(A+B)$ formula)

63. (C)

$$\begin{aligned}1 + 4\cos^3 x - 3\cos x - 2(2\cos^2 x - 1) &= 0 \\ 4\cos^3 x - 4\cos^3 x - 3\cos x + 3 &= 0 \\ 4\cos^2 x(\cos x - 1) - 3(\cos x - 1) &= 0 \\ (4\cos^2 x - 3)(\cos x - 1) &= 0 \\ \cos x = \frac{\sqrt{3}}{2}, \cos x = -\frac{\sqrt{3}}{2}; \cos x = 1\end{aligned}$$

So the smallest positive solution is $x = 30^\circ$.

64. (D)

$$\sin \theta - \sqrt{2} = \sqrt{3} \cos \theta$$

$$\sin \theta - \sqrt{3} \cos \theta = \sqrt{2}$$

$$\frac{1}{2} \sin \theta - \frac{\sqrt{3}}{2} \cos \theta = \frac{1}{\sqrt{2}}$$

$$\sin \left(\theta - \frac{\pi}{3} \right) = \sin \frac{\pi}{4}$$

$$\theta - \frac{\pi}{3} = n\pi + (-1)^n \frac{\pi}{4}$$

$$\theta = n\pi + (-1)^n \frac{\pi}{4} + \frac{\pi}{3}$$

65. (C)

$$\Rightarrow 4 \cdot 16^{\sin^2 x} = 2^{6 \sin x}$$

$$\Rightarrow 2^2 \cdot 2^{4 \sin^2 x} = 2^{6 \sin x}$$

$$\Rightarrow 2 + 4 \sin^2 x = 6 \sin x$$

$$\Rightarrow 2 \sin^2 x - 3 \sin x + 1 = 0$$

$$\Rightarrow 2 \sin^2 x - 2 \sin x - \sin x + 1 = 0$$

$$\Rightarrow 2 \sin x (\sin x - 1) - 1 (\sin x - 1) = 0$$

$$\sin x = \frac{1}{2}, 1$$

$$\Rightarrow x = \frac{\pi}{6}, \frac{5\pi}{6}, \frac{\pi}{2}$$

\Rightarrow (C) option

66. (C)

Minimum $(a, b) \Rightarrow$ means which even is minimum out of 'a' & 'b'.

Maximum $(a, b) \Rightarrow$ means which even is maximum out of 'a' & 'b'.

$$a^2 - 4a + 6 = (a - 2)^2 + 2$$

$$\therefore \min. (a^2 - 4a + 6) = 2$$

$$\min. \{1, \underbrace{a^2 - 4a + 6}_{\geq 2}\} = 1$$

$$a^2 - 4a + 6 = (a - 2)^2 + 2$$

So, $\sin x + \cos x = 1$

$$\Rightarrow \frac{1}{\sqrt{2}} \sin x + \frac{1}{\sqrt{2}} \cos x = \frac{1}{\sqrt{2}}$$

$$\Rightarrow \sin \left(x + \frac{\pi}{4} \right) = \sin \frac{\pi}{4}$$

$$\Rightarrow x + \frac{\pi}{4} = n\pi + (-1)^n \frac{\pi}{4}$$

$$\Rightarrow x = n\pi + (-1)^n \frac{\pi}{4} - \frac{\pi}{4}$$

⇒ (C) option.

67. (B)

$$3 \frac{\sin^2 \theta}{\cos^2 \theta} - 2 \sin \theta = 0, \cos \theta \neq 0$$

$$\Rightarrow 3 \sin^2 \theta - 2 \sin \theta (1 - \sin^2 \theta) = 0$$

$$\Rightarrow 3 \sin^2 \theta - 2 \sin \theta (1 - \sin^2 \theta) = 0$$

$$\Rightarrow \sin \theta (2 \sin^2 \theta + 3 \sin \theta - 2) = 0$$

$$\Rightarrow \sin \theta (2 \sin \theta - 1)(\sin \theta + 2) = 0$$

$$\Rightarrow \sin \theta = 0, \frac{1}{2}, -2 \text{ (rejected)}$$

$$\Rightarrow \theta = n\pi, n\pi + (-1)^n \frac{\pi}{6}, n \in \mathbb{Z}$$

68. (C)

$$3 \sin^2 x - 7 \sin x + 2 = 0$$

$$(3 \sin x - 1)(\sin x - 2) = 0$$

$$\sin x = \frac{1}{3} \text{ or } (\sin x = 2) \text{ not possible}$$

$$x = n\pi + (-1)^n \sin^{-1} \left(\frac{1}{3} \right)$$

$$\sin^{-1} \left(\frac{1}{3} \right), \pi - \sin^{-1} \left(\frac{1}{3} \right), 2\pi + \sin^{-1} \left(\frac{1}{3} \right), 3\pi - \sin^{-1} \left(\frac{1}{3} \right), 4\pi + \sin^{-1} \left(\frac{1}{3} \right), 5\pi - \sin^{-1} \left(\frac{1}{3} \right)$$

Total 6

69. (D)

$$-1 \leq \sin x \leq 1 \text{ and } -1 \leq \cos x \leq 1$$

So, $\sin x \cdot \cos x = 2$ not possible

⇒ (D) options.

70. (A)

$$\sec^2 x - \sec^{10} x = 0$$

$$\Rightarrow \sec^2 x (1 - \sec^8 x) = 0$$

$$\Rightarrow \sec x = 0, \sec x = 1, -1$$

No solution ⇒ $x = 2n\pi, 2n\pi + \pi$

$$\Rightarrow x = \pi, 2\pi, 3\pi$$

So, option (A)

71. (B)

$$1 - \frac{3}{4} \sin^2 2x = \lambda \quad \sin^2 2x \in [0, 1] \quad \lambda \in [1/4, 1]$$

72. (A)

73. (B)

74. (A)

$$3^x + 3^{-x} \geq 2 \text{ But } 2 \cos \frac{x}{2} \leq 2$$

So, solutions exist only where $x = 0 \Rightarrow$ (A) option.

75. (C)

$$\text{For } x \in \left(0, \frac{\pi}{2}\right]$$

$$0 < 2 \cos^2 \frac{x}{2} \cdot \sin^2 x < 2$$

$$\text{Where as } x^2 + \frac{1}{x^2} \geq 2$$

So, no solution.