

# PACE-IIT & MEDICAL

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

IIT - JEE: 2025

TW TEST

DATE: 22/07/23

TOPIC: UNITS & DIMENSIONS  
ERRORS & MEASUREMENTS

## SOLUTIONS

1. (B)

$$\therefore E = \frac{1}{2}mv^2$$

$\therefore$  % Error in *K.E.*

= % error in mass +  $2 \times$  % error in velocity

$$= 2 + 2 \times 3 = 8 \%$$

2. (B)

Number of significant figures are 3, because  $10^3$  is decimal multiplier.

3. (B)

$$\therefore V = \frac{4}{3}\pi r^3$$

$\therefore$  % error in volume =  $3 \times$  % error in radius

$$= 3 \times 1 = 3\%$$

4. (C)

$$L + B = 2.331 + 2.1$$

$$= 4.431$$

= 4.4 (Since least decimal place is 1)

5. (C)

Since *C* has maximum power among *A*, *B*, *C* & *D*

6. (A)

7. (D)

$$\begin{aligned} & \left[ \frac{0.003}{0.3} + \frac{2 \times 0.005}{0.5} + \frac{0.06}{6} \right] \times 100 \\ & = [10^{-2} + 2 \times 10^{-2} + 10^{-2}] \times 100 = [4 \times 10^{-2}] \times 100 = 4 \end{aligned}$$

8. (B)

$$F = \frac{Gm_1m_2}{d^2} \Rightarrow G = \frac{Fd^2}{m_1m_2}$$

$$\therefore [G] = \frac{[MLT^{-2}][L^2]}{[M^2]} = [M^{-1}L^3T^{-2}]$$

9. (C)

Let  $v^2 = k\rho^x g^y \lambda^z$ .

Now by substituting the dimensions of each quantities and equating the powers of  $M$ ,  $L$  and  $T$  we get  
 $x = 0, y = 1, z = 1$ .

10. (A)

By substituting the dimension of each quantity we get  $T = [ML^{-1}T^{-2}]^a[L^{-3}M]^b[MT^{-2}]^c$

By solving we get  $a = -\frac{3}{2}$ ,  $b = \frac{1}{2}$  and  $c = 1$

11. (A)

$$\text{Acceleration} = \frac{\text{distance}}{\text{time}^2} \Rightarrow A = LT^{-2} \Rightarrow L = AT^2$$

12. (D)

$$\begin{aligned}\because \text{Density, } \rho &= \frac{M}{V} = \frac{M}{\pi r^2 L} \Rightarrow \frac{\Delta\rho}{\rho} = \frac{\Delta M}{M} + 2 \frac{\Delta r}{r} + \frac{\Delta L}{L} \\ &= \frac{0.003}{0.3} + 2 \times \frac{0.005}{0.5} + \frac{0.06}{6} \\ &= 0.01 + 0.02 + 0.01 = 0.04 \\ \therefore \text{Percentage error} &= \frac{\Delta\rho}{\rho} \times 100 = 0.04 \times 100 = 4\%\end{aligned}$$

13. (A)

The result should have 3 significant figures.

14. (D)

$ct^2$  must have dimensions of  $L$

15. (A)

1 C.G.S unit of density = 1000 M.K.S. unit of density

$$\Rightarrow 0.5 \text{ gm/cc} = 500 \text{ kg/m}^3$$

16. (B)

$$mv = \text{kg} \left( \frac{\text{m}}{\text{sec}} \right)$$

17. (A)

Quantities having different dimensions can only be divided or multiplied but they cannot be added or subtracted.

18. (C)

19. (D)

20. (C)

Let  $m \propto c^x G^y h^z$  or  $m = K c^x G^y h^z$

Substituting the dimension of each quantity in both sides

$$[M^1 L^0 T^0] = [LT^{-1}]^x [M^{-1} L^3 T^{-2}]^y [ML^2 T^{-1}]^z = [M^{-y+z} L^{x+3y+2z} T^{-x-2y-z}]$$

Equating the power of  $M$ ,  $L$  and  $T$  in both sides :  $-y+z=1$ ,  $x+3y+2z=0$ ,  $-x-2y-z=0$

Solving above three equations  $x = \frac{1}{2}$ ,  $y = -\frac{1}{2}$  and  $z = \frac{1}{2}$

$$\therefore m \propto c^{1/2} G^{-1/2} h^{1/2}$$

## SOLUTIONS

21. (C)

Newland, Lother Meyer and Mendeleev's all are based on Atomic weight.

22. (D)

They show variable oxidation states

23. (A)

Shielding effect order:

S > P > d > f

24. (A)

All the species are isoelectronic species and for such species radius  $\propto \frac{1}{\text{number of nuclear charge}}$

25. (B)

Electron gain enthalpy is less negative down a group. But Cl has maximum negative value due to compact electronic configuration of F.

26. (D)

Electronegativity depends upon : charge on atom, Hybridisation and Effective Nuclear charge.

27. (D)

Li and Mg have diagonal relationship.

28. (B)

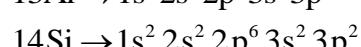
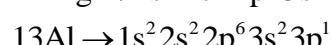
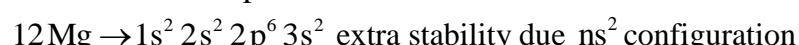
% ionic character

$$= 16(x_A - x_B) + 3.5(x_A - x_B)^2$$

$$= 16 \times 0.5 + 3.5(0.5)^2$$

$$= 8.9$$

29. (B)

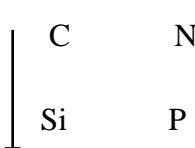


They are third period elements. Theoretical ionisation energy should be as follows

Na < Mg < Al < Si

But due to extra stability in its configuration ionisation energy of Al is less than the Mg.

30. (C)  $\xrightarrow{\hspace{2cm}}$  increasing order



decreasing order

31. (C)

Electronic configuration of species after the removal of one electron i.e.,

$$_6\text{C}^{+1} = 1s^2 2s^2 2p^1$$

$$_7\text{N}^{1+} = 1s^2 2s^2 2p^2$$

$$_8\text{O}^{1+} = 1s^2 2s^2 2p^3 \text{ (most stable configuration due to half filled subshell)}$$

$$_9\text{F}^{1+} = 1s^2 2s^2 2p^4$$

Thus O > F > N > C ionisation energy increases from left to right in a period.

32. (C)

Nitrogen has higher IE than oxygen due to the presence of half filled electronic configuration.

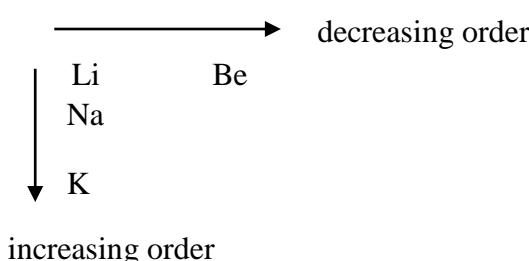
33. (C)

$$\text{size} \propto \frac{1}{\text{Nuclear charge}}$$

34. (C)

$1s^1$  and  $1s^2 2s^2 2p^6 3s^1$  are first group elements. IE of first group is minimum. In first group IE decreases from top to bottom.

35. (A)



increasing order

36. (C)

$$E \cdot N = \frac{I \cdot E + E \cdot A}{5 \cdot 6}$$

Where I·E and E·A are in eV/atom.

$$E \cdot N = \frac{I \cdot E + E \cdot A}{544}$$

Where I·E and E·A are in kJ/mole.

37. (C)

Second electron affinity is endothermic due to repulsion between anion and electron.

38. (D)

Size:  $P^{+3} > P^{+5}$

39. (C)

Size order:  $\text{N}^{-3} > \text{O}^{-2} > \text{F}^{-}$

40. (B)

The elements with atomic number 9, 17, 35, 53 & 85 belong to halogens.



# PACE-IIT & MEDICAL

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

IIT - JEE: 2025

TW TEST

DATE: 22/07/23

TOPIC: TRIGONOMETRIC EQUATION

## SOLUTIONS

41. (D)

$$\begin{aligned} \frac{\sqrt{3}}{2} \cos \theta + \frac{1}{2} \sin \theta &= \frac{\sqrt{2}}{2} \text{ dividing by } \sqrt{(\sqrt{3})^2 + 1^2} = 2 \\ \Rightarrow \sin\left(\theta + \frac{\pi}{3}\right) &= \frac{1}{\sqrt{2}} = \sin\left(\frac{\pi}{4}\right) \\ \Rightarrow \theta &= n\pi + (-1)^n \frac{\pi}{4} - \frac{\pi}{3} \end{aligned}$$

42. (C)

$$2 \tan^2 \theta = \sec^2 \theta \Rightarrow 2 \tan^2 \theta = \tan^2 \theta + 1 \Rightarrow \tan^2 \theta = 1 = \tan^2\left(\frac{\pi}{4}\right) \Rightarrow \theta = n\pi \pm \frac{\pi}{4}$$

43. (B)

$$\begin{aligned} \sqrt{3} \tan 2\theta + \sqrt{3} \tan 3\theta + \tan 2\theta \tan 3\theta &= 1 \Rightarrow \frac{\tan 2\theta + \tan 3\theta}{1 - \tan 2\theta \tan 3\theta} = \frac{1}{\sqrt{3}} \Rightarrow \tan 5\theta = \tan \frac{\pi}{6} \\ \Rightarrow 5\theta &= n\pi + \frac{\pi}{6} \Rightarrow \theta = \left(n + \frac{1}{6}\right) \frac{\pi}{5} \end{aligned}$$

44. (C)

$$\begin{aligned} \sin 4\theta = \cos \theta - \cos 7\theta &\Rightarrow \sin 4\theta = 2 \sin(4\theta) \sin(3\theta) \Rightarrow \sin 4\theta = 0 \Rightarrow 4\theta = n\pi \\ \text{or } \sin 3\theta &= \frac{1}{2} = \sin\left(\frac{\pi}{6}\right) \Rightarrow 3\theta = n\pi + (-1)^n \frac{\pi}{6} \Rightarrow \theta = \frac{n\pi}{4}, \frac{n\pi}{3} + (-1)^n \frac{\pi}{18} \end{aligned}$$

45. (A)

It is obvious.

46. (A)

$$3(\sin \theta - \cos \theta) = 4 \sin \theta \cos \theta \Rightarrow 3(\sin \theta - \cos \theta) = 2 \sin 2\theta$$

Squaring both sides, we get  $9(1 - S) = 4S^2$ ,

Where  $S = 2 \sin 2\theta$  or  $4S^2 + 9S - 9 = 0$

$$\therefore (S+3)(4S-3) = 0 \text{ or } S = \frac{3}{4} \text{ as } S \neq -3 \text{ or } \sin 2\theta = \frac{3}{4} = \sin \alpha$$

$$\therefore 2\theta = n\pi + (-1)^n \alpha \text{ or } \theta = \frac{1}{2} \left[ n\pi + (-1)^n \sin^{-1}\left(\frac{3}{4}\right) \right]$$

47. (A)

$$\begin{aligned} \text{We have } \cos 3x + \sin\left(2x - \frac{7\pi}{6}\right) &= -2 \Rightarrow 1 + \cos 3x + 1 + \sin\left(2x - \frac{7\pi}{6}\right) = 0 \\ \Rightarrow (1 + \cos 3x) + 1 - \cos\left(2x - \frac{2\pi}{3}\right) &= 0 \\ \Rightarrow 2\cos^2 \frac{3x}{2} + 2\sin^2\left(x - \frac{\pi}{3}\right) &= 0 \\ \Rightarrow \cos \frac{3x}{2} &= 0 \text{ and } \sin\left(x - \frac{\pi}{3}\right) = 0 \text{ is } x = 2k\pi + \frac{\pi}{3} = \frac{\pi}{3}(6k+1) \text{ where } k \in \mathbb{Z} \end{aligned}$$

48. (A)

$$\begin{aligned} \tan(\pi \cos \theta) &= \tan\left(\frac{\pi}{2} - \pi \sin \theta\right) \\ \therefore \sin \theta + \cos \theta &= \frac{1}{2} \Rightarrow \cos\left(\theta - \frac{\pi}{4}\right) = \frac{1}{2\sqrt{2}} \end{aligned}$$

49. (B)

$$(1 + \tan \theta)(1 + \tan \varphi) = 2 \Rightarrow \frac{\tan \theta + \tan \varphi}{1 - \tan \theta \tan \varphi} = 1 \Rightarrow \tan(\theta + \varphi) = 1 \Rightarrow \theta + \varphi = \frac{\pi}{4} = 45^\circ$$

50. (C)

$$\begin{aligned} \tan \theta &= -1 = \tan\left(2\pi - \frac{\pi}{4}\right) \\ \cos \theta &= \frac{1}{\sqrt{2}} = \cos\left(2\pi - \frac{\pi}{4}\right) \\ \text{Hence general value is } 2n\pi + \left(2\pi - \frac{\pi}{4}\right) &= 2n\pi + \frac{7\pi}{4} \end{aligned}$$

51. (D)

We have,

$$\begin{aligned} \cos^2 \theta + \sin \theta + 1 &= 0 \Rightarrow 1 - \sin^2 \theta + \sin \theta + 1 = 0 \Rightarrow \sin^2 \theta - \sin \theta - 2 = 0 \Rightarrow (\sin \theta + 1)(\sin \theta - 2) = 0 \\ \sin \theta &= 2 \text{ which is not possible and } \sin \theta = -1. \end{aligned}$$

Therefore, solution of given equation lies in the interval  $\left(\frac{5\pi}{4}, \frac{7\pi}{4}\right)$ .

52. (C)

$$\text{The expression is } \frac{(1 + \tan x + \tan^2 x)(1 + \tan^2 x - \tan x)}{\tan^2 x} = \frac{(1 + \tan^2 x)^2 - \tan^2 x}{\tan^2 x}$$

Obviously,  $1 + \tan^2 x \geq \tan^2 x, \forall x$

Hence, it is positive for all value of  $x$ .

53. (D)

$$\operatorname{cosec} \theta + 2 = 0 \Rightarrow \sin \theta = -\frac{1}{2} \Rightarrow \theta = 210^\circ \text{ or } 330^\circ$$

54. (A)

Given  $\sin x + \sin y + \sin z = -3$  is satisfied only when  $x = y = z = \frac{3\pi}{2}$ , for  $x, y, z \in [0, 2\pi]$ .

55. (D)

$$3\cos x + 4\sin x = 6 \Rightarrow \frac{3}{5}\cos x + \frac{4}{5}\sin x = \frac{6}{5} \Rightarrow \cos(x - \theta) = \frac{6}{5} \quad [\text{where } \theta = \cos^{-1}\left(\frac{3}{5}\right)]$$

So, that equation has no solution.

56. (C)

$$\begin{aligned} 3\sin^2 x - 7\sin x + 2 = 0 &\Rightarrow 3\sin^2 x - 6\sin x - \sin x + 2 = 0 \Rightarrow 3\sin(\sin x - 2) - (\sin x - 2) = 0 \\ &\Rightarrow (3\sin x - 1)(\sin x - 2) = 0 \Rightarrow \sin x = \frac{1}{3} \text{ or } 2 \end{aligned}$$

$$\Rightarrow \sin x = \frac{1}{3} \quad (\because \sin x \neq 2)$$

Let  $\sin^{-1} \frac{1}{3} = \alpha$ ,  $0 < \alpha < \frac{\pi}{2}$  are the solutions in  $[0, 5\pi]$ .

Then  $\alpha, \pi - \alpha, 2\pi + \alpha, 3\pi - \alpha, 4\pi + \alpha, 5\pi - \alpha$  are the solutions in  $[0, 5\pi]$ .

$\therefore$  Required number of solutions = 6.

57. (A)

$$f(x) = \cos x - x + \frac{1}{2}$$

$$f(0) = \frac{3}{2} > 0$$

$$f\left(\frac{\pi}{2}\right) = 0 - \frac{\pi}{2} + \frac{1}{2} = \frac{1-\pi}{2} < 0 \quad \left(\because \pi = \frac{22}{7} \text{ nearly}\right)$$

$\therefore$  One root lies in the interval  $\left[0, \frac{\pi}{2}\right]$ .

58. (C)

$$\sec \theta + \tan \theta = \sqrt{3} \quad \dots(i)$$

Also we have

$$\sec^2 \theta - \tan^2 \theta = 1 \quad \dots(ii)$$

$$\Rightarrow \sec \theta - \tan \theta = \frac{1}{\sqrt{3}} \quad \dots(iii)$$

Now (i) and (iii) gives,

$$\tan \theta = \frac{1}{2} \left( \sqrt{3} - \frac{1}{\sqrt{3}} \right) = \frac{1}{\sqrt{3}} = \tan\left(\frac{\pi}{6}\right) \Rightarrow \theta = n\pi + \frac{\pi}{6}$$

$\therefore$  Solutions for  $0 \leq \theta \leq 2\pi$  are  $\frac{\pi}{6}$  and  $\frac{7\pi}{6}$ .

Hence there are two solutions.

59. (D)

$\sin x \cos x = 2$  or  $\sin 2x = 4$  which is impossible.

60. (A)

$$\tan(3x - 2x) = \tan x = 1 \Rightarrow x = n\pi + \frac{\pi}{4}$$

But this value does not satisfy the given equation.

Hence, option (A) is the correct answer.