FIITJEE

ALL INDIA TEST SERIES

FULL TEST – VII

JEE (Main)-2025

TEST DATE: 16-03-2025

ANSWERS, HINTS & SOLUTIONS

Physics

PART – A

SECTION – A

1. D

Sol. The fringe–width β is given by

$$\beta = \frac{\lambda D}{2d} \text{ and } \beta' = \frac{\lambda D'}{2d}$$

Where λ is the wavelength of light used, D is the distance of the screen from the two slits and 2 d is the separation between two slits.

Now $$\beta - \beta' = \frac{\lambda(D - D')}{2d}$$

$$\Rightarrow \quad \lambda = \frac{(\beta - \beta')2d}{D - D'}$$

$$\lambda = \frac{(3\times10^{-5})(10^{-3})}{5\times10^{-2}}$$

$= 0.6 \times 10^{-6}$ m = 6000 Å

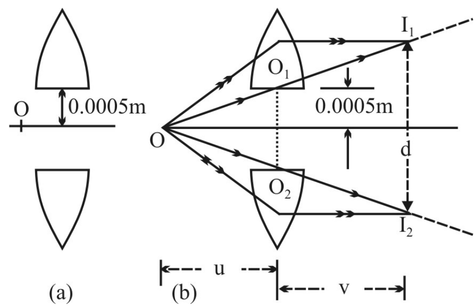
2. B

3. D

4. B

5. A

Sol. The image formation is shown in fig.



The rays through optical centres O_1 and O_2 pass undeflected. The image of O are formed at I_1 and I_2 due to upper and lower lenses respectively.

The number of images formed = two

For a convex lens, $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$

Here u = – 0.3 m and f = 0.2 m

$\therefore \quad \frac{1}{v} = \frac{1}{u} + \frac{1}{f} = -\frac{1}{0.3} + \frac{1}{0.2} = \frac{1}{0.6}$

u = **0.6 m**

Let d be the distance between the two images I_1 and I_2. From ΔOO_1O_2 and ΔII_1I_2, we have

$$\frac{d}{O_1O_2} = \frac{u+v}{u}$$

or $$\frac{d}{0.0005+0.0005} = \frac{0.3+0.6}{0.3}$$

Solving we get d = 0.003 m

6. A

7. B

8. A

9. A

Sol. According to given data, ionization energy of Li^{++} ion is 122.4 eV

$\therefore$ Excitation energy of this ion

$= 122.4\left[\frac{1}{1^2} - \frac{1}{2^2}\right]$

$= 122.4\left[1 - \frac{1}{4}\right]$

$= 122.4 \times \frac{3}{4}$ eV

$\therefore$ E_{ex} = 91.8 eV

Hence, the value of the first excitation potential

= 91.8 V

10. B

11. B

Sol. In one half-life the number of active nuclei reduces to half the original number. Thus, in two half-lives the number is reduced to $\left(\frac{1}{2}\right)\left(\frac{1}{2}\right)$ of the original number. The number of remaining active nuclei is, therefore, $6.0 \times 10^{18} \times \left(\frac{1}{2}\right) \times \left(\frac{1}{2}\right) = 1.5 \times 10^{18}$

12. C

13. D

Sol. Moseley's equation is

$$\sqrt{\nu} = a(Z - b).$$

Thus $\sqrt{\frac{c}{\lambda_1}} = a(Z_1 - b)$ ...(i)

and $\sqrt{\frac{c}{\lambda_2}} = a(Z_2 - b)$ ...(ii)

Using equations (i) and (ii), we get

$$\sqrt{c}\left(\frac{1}{\sqrt{\lambda_1}} - \frac{1}{\sqrt{\lambda_2}}\right) = a(Z_1 - Z_2)$$

$$\Rightarrow a = \frac{\sqrt{c}}{(Z_1 - Z_2)}\left(\frac{1}{\sqrt{\lambda_1}} - \frac{1}{\sqrt{\lambda_2}}\right)$$

Putting given values

$a = 5.06 \times 10^7$ Hz

Dividing equation (i) by (ii), we get

$$\sqrt{\frac{\lambda_2}{\lambda_1}} = \frac{Z_1 - b}{Z_2 - b}$$

$$\Rightarrow \sqrt{\frac{178.5}{71}} = \frac{42 - b}{27 - b}$$

$$\Rightarrow b = 1.37$$

14. A

Sol. Let the frequency of the fork be n. In the first case, the length of the wire is 70 cm (0.70 m). Therefore,

$$n = \frac{1}{2 \times 0.70}\sqrt{\frac{T}{m}} \quad ...(1)$$

On decreasing the length of the wire, its frequency will increase. Hence in the second case when the length is 69 cm = 0.69 m, then

$$n + 4 = \frac{1}{2 \times 0.69}\sqrt{\frac{T}{m}} \quad ...(2)$$

dividing equation (1) by (2), we get

$$\Rightarrow \frac{n}{n+4} = \frac{0.69}{0.70}$$

$$\Rightarrow n \times 0.70 = (n + 4) \times 0.69$$

$$\Rightarrow n = \frac{4 \times 0.69}{0.01} = 276 \text{ sec}^{-1}$$

15. A

Sol. $\tan 60^o = \frac{\omega L}{R}$, $\tan 60^o = \frac{1/\omega C}{R}$.

$\therefore \omega L = \frac{1}{\omega C}$.

$\therefore$ impedance of the circuit,

$$Z = \left[R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2\right]^{\frac{1}{2}} = R.$$

Current in the circuit,

$i_0 = \frac{V_0}{Z} = \frac{V_0}{R} = \frac{200}{100} = 2$ ampere.

Average power, $\overline{P} = \frac{1}{2} V_0\, i_0 \cos\phi$.

But $\tan\phi = \frac{\omega L - 1/\omega C}{R} = 0$, $\quad \therefore \cos\phi = 1$.

$\therefore \overline{P} = \frac{1}{2} \times 200 \times 2 \times 1 = 200$

16. C

Sol. From the law of length of stretched string, we have $n_1\ell_1 = n_2\ell_2 = n_3\ell_3$

Here $n_1 : n_2 : n_3 = 1 : 3 : 15$

$\therefore \frac{\ell_1}{\ell_2} = \frac{n_1}{n_2} = \frac{3}{1}$ and $\frac{\ell_1}{\ell_3} = \frac{n_3}{n_1} = 15/1$

$\ell_2 = \frac{\ell_1}{3}$ and $\ell_3 = \frac{\ell_1}{15}$

The total length of the wire is 105 cm.

Therefore $\ell_1 + \ell_2 + \ell_3 = 105$

or $\ell_1 + \frac{\ell_1}{3} + \frac{\ell_1}{15} = 105$ or $\frac{21\ell_1}{15} = 105$

$\ell_1 = \frac{105 \times 15}{21} = 75$ cm.

$\therefore \ell_2 = \frac{\ell_1}{3} = \frac{75}{3} = 25$ cm

$\ell_3 = \frac{\ell_1}{15} = \frac{75}{15} = 5$ cm

Hence the bridge should be placed at 75 cm and (75 + 25) = 100 cm from one end.

17. B

Sol. We know that

$i = \frac{\varepsilon}{R}(1 - e^{t/\tau})$

$i = \eta \frac{\varepsilon}{R}$ (given)

$n\frac{\varepsilon}{R} = \frac{\varepsilon}{R}(1 - e^{-t/\tau})$

or $e^{-t/\tau} = 1 - \eta$

or $t = \tau \ \ln \left|\frac{1}{1-\eta}\right|$

18. A

19. A

20. C

SECTION – B

21. 9
Sol. Field inside the shell is zero, so potential is uniform

$$V = \frac{kq}{2R} = 9\,\text{kilo volts}$$

22. 0

23. 9

24. 0

25. 4

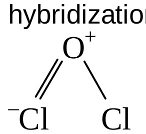
Chemistry

PART – B

SECTION – A

26. C

Sol. Due to back bonding between lone pair of oxygen atom and vacant d-orbital of Cl atom, hybridization of oxygen atom changes from sp^3 to sp^2, so the bond angle increases.



27. B

Sol. Be atom has it's configuration $1s^2.2s^2$ so, B^- has it's configuration $1s^2$, $2s^2$, $2p^1$ and therefore it will be most destabilized.

28. B

29. B

Sol. Stability order is I > II > III > IV, because I is neutral, while in II all atoms with complete octet system while III is more stable than IV because in case of IV oxygen is positive with incomplete octet system.

30. B

Sol. In (III) carbocation cannot be formed because of the bridge head.

31. A

32. B

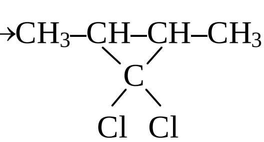
Sol. $CH_3–\underset{CH_3}{\underset{|}{C}}H–\underset{CH_3}{\underset{|}{C}}H–CH_3$ It can be prepared by the hydrogenation of only two alkenes.

$H_2C=\underset{CH_3}{\underset{|}{C}}–\underset{CH_3}{\underset{|}{C}}H–CH_3$ and $H_3C–\underset{CH_3}{\underset{|}{C}}=\underset{CH_3}{\underset{|}{C}}–CH_3$

33. B

Sol. $CHCl_3 + t–BuO^-k^+ \rightarrow t–BuOH + CCl_3^-$

$CCl_3^- \rightarrow :CCl_2 + Cl^-$

$CH_3–CH=CH–CH_3 + :CCl_2 \rightarrow$ 

34. D

Sol. $\Delta T_f = k_f \times \text{Molality}$

$$\therefore \quad \frac{\Delta T_f}{k_f} = \text{molality} = \frac{\text{number of moles of glucose}}{\text{mass of water (in kg)}} = \frac{1}{1000} = \frac{\text{weight of glucose (in g)}}{180 \times 1}$$

$\therefore$ weight of glucose (in g) = 0.18 g

35. B

Sol. Steric hinderence of two $–CH_3$ groups makes $-N\!<\!\begin{matrix}CH_3\\ CH_3\end{matrix}$ group out of plane of benzene ring. So, lone pair on nitrogen atom is not involved in resonance, therefore, this amine is most basic.

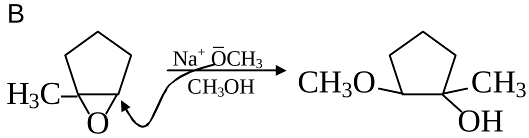
36. B

37. B

38. D

39. B

Sol.



40. D

41. B

42. B

43. C

44. A

Sol. $(CH_3–COO)_2Ca + (H–COO)_2Ca \xrightarrow{\Delta} 2CH_3–CHO + 2CaCO_3$

45. A

SECTION – B

46. 73

Sol. Let the volume of the tank be *V* litres.

As the number of moles of N_2 before and after connecting it to the tank will be same,

$$\frac{21.4\times 55}{RT} = \frac{1.5\times(55+V)}{RT} \quad \left[n = \frac{PV}{RT}\right]$$

(moles of N_2 before connection) (moles of N_2 after connection)

$\therefore$ V = 726 litres.

47. 48

Sol. 18mL water $\equiv$ 18g water = 1 mole water

= N_A water molecules

$\because$ One water molecule contains 8 neutrons

$\therefore$ total number of neutrons in the given sample = $8N_A$.

48. 5

Sol. At equilibrium, $E_{cell} = 0$, Cell reaction is $\frac{1}{2}D_2(g) + H^+ \rightarrow D^+ + \frac{1}{2}H_2(g)$

$$\therefore \quad E^o_{cell} = 0.0591 \log \frac{[D^+]}{[H^+]} = 0.003$$

$$\therefore \quad \log\frac{[D^+]}{[H^+]} = \frac{E^o_{cell}}{0.0591} = \frac{0.003}{0.0591} \cong 0.05$$

49. 4

Sol. k_{sp} of AgI = $[Ag^+]$ $[4g^+]$ × $[I^-]$
$1.0 \times 10^{-16} = [Ag^+] \times 10^{-4}$
$\therefore \quad [Ag^+] = 1.0 \times 10^{-12}$
So, solubility of AgI = $[Ag^+] = 1 \times 10^{-12}$ mol/L

50. 2

Sol. Total number of equivalents of $Na_2CO_3.xH_2O$ = $\frac{\text{weight (in g)}}{\text{Equivalent weight}} = \frac{0.7}{53+9x}$

(n factor of $Na_2CO_3.xH_2O$ = 2)
Total number of equivalents of HCl required for complete neutralization

$$= \left(\frac{0.1\times19.8}{1000}\right)\times 5$$

so, $\frac{0.7}{53+9x} = \frac{0.1\times19.8\times5}{1000}$

$\Rightarrow \quad x = 2$

Mathematics

PART – C

SECTION – A

51. C

Sol. Function is many one so inverse does not exist.

52. B

Sol. Let $x-\pi/3=t,\ x\to\pi/3\Rightarrow t\to 0$

$$\lim_{t\to 0}\frac{\sin(-t)}{2\cos(t+\pi/3)-1}$$

53. C

Sol. $f(x)$ is decreasing, so $\Rightarrow f'(x)<0$

54. C

Sol. $=\int\frac{\frac{1}{x^3}-\frac{1}{x^5}}{\sqrt{2-\frac{2}{x^2}+\frac{1}{x^4}}}dx$, let $t=2-\frac{2}{x^2}+\frac{1}{x^4}$

55. D

56. D

57. C

Sol. $\mathrm{y}=\frac{\mathrm{x}^2+2\mathrm{x}+\mathrm{c}}{\mathrm{x}^2+4\mathrm{x}+3\mathrm{c}}$, apply nature of roots

58. C

Sol. Let terms a, ar, ar^2, ar^3, ar^4 given that $ar^2=2$, product of five terms

$=a.ar.\ ar^2.\ ar^3.\ ar^4=\left(ar^2\right)^5=2^5$

59. C

60. A

61. D

62. D

63. C

64. A

65. B

Sol. Put $x=1, x=\omega\ \&\ x=\omega^2$

66. A

67. C

68. C

Sol. $x+\frac{1}{x}>2$

$\left.\begin{matrix} a^2-3a+3>1 \\ a^2-3a+3>0 \end{matrix}\right\}\cap$

69. B

70. D

Sol. $\left[\vec{a}\,\vec{b}\,\vec{c}\right]=\vec{a}.\left(\vec{b}\times\vec{c}\right)$

SECTION – B

71. 2

Sol. $\ln\cos^{-1}x>0$

$-1\le x\le 1$

72. 3

73. 4

74. 0

Sol. $k<0,\ \& D<0$

75. 2

Sol. $\sum_{r=1}^{\infty}\frac{2.\left\{\left(2r^2+2r+1\right)-\left(2r^2+1-2r\right)\right\}}{\left(2r^2+2r+1\right).\left(2r^2+1-2r\right)}$