FIITJEE

ALL INDIA TEST SERIES

FULL TEST – IX

JEE (Main)-2025

TEST DATE: 26-03-2025

ANSWERS, HINTS & SOLUTIONS

Physics

PART – A

SECTION – A

1. A

Sol. x-axis along the inclined plane
y-axis perpendicular to the inclined plane.

$$v_{0x} = v_0 \cos 30° = v_0 \frac{\sqrt{3}}{2}, \quad a_x = -g\sin 30° = -\frac{g}{2}$$

$$v_{0y} = v_0 \sin 30° = -\frac{v_0}{2}, \quad a_y = -g\cos 30° = -g\frac{\sqrt{3}}{2}$$

$$x_0 = 0, \quad y_0 = H\sin 30° = H\frac{\sqrt{3}}{2}$$

When particle reaches the inclined plane, y = 0

$$\Rightarrow 0 = \frac{H\sqrt{3}}{2} - \frac{v_0}{2}t - \frac{1}{2}\frac{g\sqrt{3}}{2}t^2 \qquad \ldots(i)$$

If particle hits the inclined plane at 90°. It will retrace the path for this $v_x = 0$

$$\Rightarrow 0 = \frac{v_0\sqrt{3}}{2} - \frac{g}{2}t$$

$$\Rightarrow t = \frac{v_0\sqrt{3}}{g} \qquad \ldots(ii)$$

$$0 = \frac{H\sqrt{3}}{2} - \frac{v_0}{2} \times \frac{v_0\sqrt{3}}{g} - \frac{1}{2} \times \frac{g\sqrt{3}}{2} \times \frac{v_0^2 \times 3}{g^2}$$

$$\Rightarrow \quad v_0 = \sqrt{\frac{2gH}{5}}$$

2. A

Sol. Modulation index = $\frac{A_m}{A_C} = \frac{20}{50} = 0.4$

Side frequency band is $f_C - f_m$ and $f_C + f_m$

3. D

Sol. For the ball along perpendicular to the inclined plane

$\int N dt = mv_0(e+1)$ …(i) (v_0 = 10 m/s)

For the block along the surface of the inclined plane

$-\int \mu N dt = m(v_f - v_i)$ …(ii)

$\Rightarrow -\mu \times mv_0(e+1) = m\Delta v$

$\Rightarrow \Delta v = -0.2 \times v_0 \times 1.5 = -3$ m/s

4. B

Sol. $\because$ $f = n\frac{v}{2\ell}$

$\Rightarrow$ $1100 = n \times \frac{330}{2 \times 30 x 10^{-2}}$

This shows that air column vibrates in 2nd harmonic. This implies that wavelength $\lambda = \ell$ = 30 cm.

$\because$ $\Delta P = 0.1 P_0 \sin kx \cos wt.$

x is measured from open end.

At x =5 cm, i.e., at $x = \frac{\lambda}{6}$

$\Delta P = 0.1 P_0 \sin\left(\frac{2\pi}{\lambda} \cdot \frac{\lambda}{6}\right) \cos wt$

$\Rightarrow P_{max} - P_{min} = 2 \times 0.1 P_0 \cdot \frac{\sqrt{3}}{2}$

$= \sqrt{3} \times 10^4 \text{ N/m}^2$

5. D

Sol. $f_T = m\alpha r$

$f_R = m\omega^2 r = m\alpha^2 t^2 r$

Since $\sqrt{f_T^2 + f_R^2} = \mu mg$

$\Rightarrow m\alpha r\sqrt{1+\alpha^2 t^4} = \mu mg$

$\Rightarrow t = \frac{1}{\sqrt{\alpha}}\left[\left(\frac{\mu g}{\alpha r}\right)^2 - 1\right]^{1/4} = \frac{\left[\left(\frac{0.255 \times 10}{1 \times 0.5}\right)^2 - 1\right]^{1/4}}{\sqrt{\alpha}} = \sqrt{5}$ s

6. B

Sol. $V = \frac{kQ}{\frac{R}{2}} + \frac{kQ}{R} = \frac{Q}{2\pi\varepsilon_0 R} + \frac{Q}{4\pi\varepsilon_0 R}$

7. C

Sol. $1A \times 0.081\ \Omega = 9A \times R$

$\Rightarrow R = 0.09\ \Omega$

8. A

Sol. $\Delta Q_{AB} = \Delta W_{AB} + \Delta U_{AB}$

$= 10 \times + nC_V \dfrac{10}{nR} = 10 + \dfrac{10C_V}{R}$

$\Delta Q_{BC} = \Delta W_{BC} + \Delta U_{BC} = 0 + \left(\dfrac{2P_C - 20}{R}\right)C_V$

$\Delta Q_{CA} = \Delta W_{CA} + \Delta U_{CA} = \Delta W_{CA} + \left(\dfrac{10 - 2P_C}{R}\right)C_V$

$\Delta Q = \Delta Q_{AB} + \Delta Q_{BC} + \Delta Q_{CA} = 5J$

$\Rightarrow 10 + \dfrac{10C_V}{R} + \left(\dfrac{2P_C - 20}{R}\right)C_V + \Delta W_{CA} + \left(\dfrac{10 - 2P_C}{R}\right)C_V = 5\ J$

$\Rightarrow \Delta W_{CA} = -5J$

9. A

Sol. $mvR = mv'r$ …(i)

and $\dfrac{1}{2}mv^2 = -\dfrac{GMm}{r} + \dfrac{1}{2}mv'^2$

$\Rightarrow v'^2 = v^2 + \dfrac{2GM}{r}$

$\Rightarrow \dfrac{v^2R^2}{r^2} = v^2 + \dfrac{2GM}{r}$

$R = \dfrac{r}{v}\left[v^2 + \dfrac{2GM}{r}\right]^{1/2}$

10. D

Sol. $q_{max} = \dfrac{2EC}{3}$

In the beginning current through the cell

$I_0 = \dfrac{3E}{5R}$

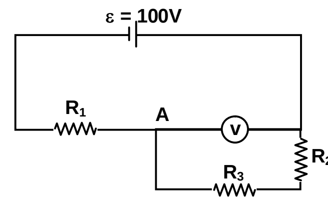
Therefore, $\dfrac{dq}{dt} = \dfrac{2}{3}I_0 = \dfrac{2E}{5R}$

Since, $\left(\dfrac{2E}{5R}\right) \times t = \dfrac{2EC}{3}$

$\Rightarrow t\ \dfrac{5RC}{3}$

11. B

Sol. In the steady state current in the branch having capacitor is zero. The effective circuit is shown in the figure.



Current through the cell

$I = \frac{3}{7}A$

Therefore current through the voltmeter is $I' = \frac{2}{3}I = \frac{2}{7}A$

Therefore, voltmeter reading is $= I'R_V = \frac{400}{7}V$

12. B

Sol. From snell's law

$\mu\sin\theta = 16\mu \sin x$

$\Rightarrow \sin x = \frac{5}{8}\sin\theta$

13. A

Sol. $Q = A_{He}.BE_{He}$ (per nucleon) – $2A_H(BE_H$ per nuclear)

= 28 MeV – 4.4 MeV = 23.6 MeV

14. B

Sol. $V_R = V\left(1 - e^{-\frac{tR}{L}}\right)$, at $t = \tau\ \ell n2$

$V_R = \frac{3V}{4}$

15. A

Sol. Initially, $P = \frac{V_{rms}^2}{R} \Rightarrow V_{rms} = \sqrt{PR}$

Finally, $P' = I_{rms}^2 R = \frac{V_{rms}^2}{z^2}R = \frac{PR}{z^2} \times R = P\left(\frac{R}{z}\right)^2$

16. B

Sol. The gas expands isobarically, therefore, $\Delta Q = nC_p\Delta T$

At STP. 1 mole of a gas occupies the volume 22.4 liter. This implies that in the vessel 2 mole helium is present

$\Rightarrow \Delta Q = 2 \times \frac{5R}{2} \times 20J = 100R$.

17. A

Sol. $\frac{\lambda_2}{\lambda_1} = \frac{(z_1 - 1)^2}{(z_2 - 1)^2} = 4$

$\Rightarrow 2z_2 - z_1 = 1$

18. A

Sol. The effective decay constant

$\lambda = \lambda_1 + \lambda_2$

Therefore effective half life

$$T_{1/2} = \frac{\ell n2}{\lambda} = \frac{0.693}{\lambda_1 + \lambda_2}$$

19. D

Sol. Collective energy of both photons is 11.6 eV more than the ionization energy of a hydrogen atom.

20. B

Sol. $\because \quad y(x, t) = 0.5\text{cm}\sin\left\{100\pi\left(t - \frac{x}{v}\right)\right\}$

Here, $v = \sqrt{\frac{T}{\mu}} = \sqrt{\frac{1600}{40\times10^{-3}}} = 200\text{m}/\text{s}$

and $t = \frac{5}{200}\text{s}$

$x = \frac{5}{2}\text{m}$

$$y\left(x = \frac{5}{2}, t = \frac{5}{200}\text{s}\right) = 0.5\text{cm}\sin\left\{100\pi\left(\frac{5}{200} - \frac{5}{400}\right)\right\}$$

$$= -\frac{0.5}{\sqrt{2}}\text{cm}$$

SECTION – B

21. 5

Sol. Let the resistance be R,

Therefore, $I_{rms} = \frac{110}{R}\text{A}$

With L, $I_{rms} = \frac{220}{\sqrt{R^2 + \omega^2 L^2}} = \frac{110}{R}$

$\Rightarrow R^2 = \frac{4}{3}\times10^5\,\Omega^2$

With C, $I_{rms} = \frac{220}{\sqrt{R^2 + \left(\frac{1}{\omega C}\right)^2}} = \frac{110}{R}$

$\Rightarrow$ C = 5μF

22. 7

Sol. $\because \quad A = A_0 e^{\frac{-bt}{2m}}$

Where, A_0 = initial amplitude
b = damping constant
M = mass of the block

$\Rightarrow \frac{A_0}{2} = A_0 e^{\frac{-bt}{2m}}$

$\Rightarrow \quad t = \frac{\ell n2}{b/2m}$

$= \frac{0.693}{40\,g/s}\times2\times200\,g = 7$ s

23. 3

Sol. $R_{cm} = \dfrac{u^2 \sin 2\theta}{g} = 5\sqrt{3}$ m

Let M be the mass of each fragment

$\Rightarrow \dfrac{M\sqrt{3} + (n-1)M \times 7\sqrt{3}}{nM} = 5\sqrt{3}$

$\Rightarrow$ n = 3

24. 11

Sol. The point P acts like a virtual object for the lens.

Since, $\dfrac{1}{f} = \dfrac{1}{v} - \dfrac{1}{u}$

$\Rightarrow \dfrac{1}{25} = \dfrac{1}{v} - \dfrac{1}{20}$

$\Rightarrow \dfrac{1}{v} = \dfrac{1}{25} + \dfrac{1}{20} = \dfrac{9}{100}$

$\Rightarrow$ v = 11.11 cm $\approx$ 11 cm

25. 38

Sol. Energy of the incident photon

$E = E_0 z^2 \times \dfrac{3}{4} = 40.8$ eV

Stopping potential, $v_0 = \dfrac{E - \phi}{e} = 38\,V$

Chemistry

PART – B

SECTION – A

26. B

Sol. Decreasing pressure usually decreases the sublimation temperature of the substance and thus preventing it from decomposition.

27. A

Sol. $\frac{Y_A}{Y_B} = \frac{X_A}{X_B}\frac{p_A^o}{p_B^o}$

$\frac{Y_A}{Y_B} = \left(\frac{m_A}{m_B}\right) \times \frac{M_B}{M_A}$; M_A = molar mass of A

M_B = molar mass of B

$\frac{m_A}{m_B}$ = ratio of their masses in vapour phase.

Similarly, $\frac{X_A}{X_B} = \left(\frac{m'_A}{m'_B}\right) \times \frac{M_B}{M_A}$

$\frac{m'_A}{m'_B}$ = (Ratio of their masses in liquid phase)

28. D

Sol. Defect usually increases the conductivity, while heating metallic conductor decreases its conductivity due to increase in the vibration of metal ions which consequently increases the resistance.

29. B

Sol. In aqueous medium,
Size of ion is in the order of
$Li^+ > Na^+ > K^+ > Rb^+$

30. B

Sol. In a particular group, lower member have high basic character of their oxide. For same element with different oxides (having different oxidation states), the oxides having high oxidation state of element have high acidic characer.

31. C

Sol. (Structure of H_2O_2, NCERT)

32. C

Sol. Z-components of angular momentum of an electron in an atomic orbital is governed by magnetic quantum number. For, d sub-shell, there are 5 Z-components possible.

33. A

Sol. Root mean square speed of any gas $= \left(\frac{3RT}{M}\right)^{\frac{1}{2}}$

Mean square speed $= \left(\frac{3RT}{M}\right)$

Both the gases are in same compartment, the temperature is same for both the gases.

Required ratio $= \frac{3RT}{28} \times \frac{32}{3RT} = \frac{32}{28} = \frac{8}{7}$

34. A

Sol. $T_1V_1^{\gamma-1} = T_2V_2^{\gamma-1}$ (for adiabatical change)

$$\left(\frac{T_2}{T_1}\right) = \left(\frac{V_1}{V_2}\right)^{\gamma-1} = 3^{\gamma-1}$$

As γ is more for monoatomic gas He. Hence, temperature will also be more for it.

35. C

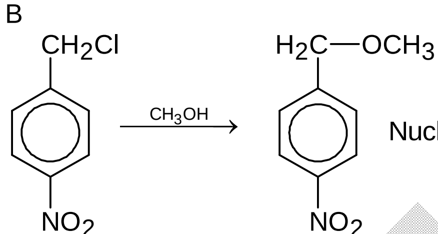
Sol. $C\overset{3}{—}C$ bond has lowest electronegativity difference. For homolytic bond cleavage a bond should have low electronegative difference.

36. C

Sol. With HBr along with peroxide, the product can both have syn as well as anti addition.

37. B

Sol.



Nucleophilic substitution at benzylic carbon.

38. B

Sol. Value of van't Hoff factor is more than unity during dissociation. Solid CO_2 first liquefies upon heating at high pressure. Blood cells present in hypotonic solution will swell.

39. D

Sol. $CH_3COOCH_3(aq) + H_2O(\ell) \xrightarrow{NaOH} CH_3COO^-(aq) + CH_3OH(aq)$

40. B

Sol. $AB_2(s) \rightleftharpoons A^{2+}(aq) + 2B^-(aq)$

$K_{SP} = \left[A^{2+}(aq)\right]\left[B^-(aq)\right]^2$

i.e. $\left[A^{2+}(aq)\right]\left[B^-(aq)\right]^2 = \text{Constant}(C)$

$C = K_{SP}$

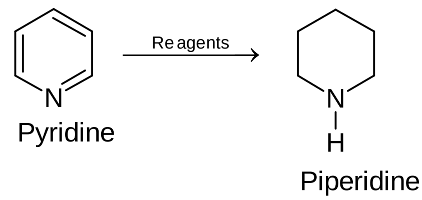
$\log\left[A^{2+}\right] + 2\log\left[B^-\right] = \log C$

$\log\left[A^{2+}\right] = \log C - 2\log\left[B^-\right]$

$y = C - mx \qquad (m = 2)$

41. B

Sol.



42. A

Sol. $\xrightarrow[\text{Strong ligands}]{Cl^{-} < H_2O < NH_3 < CN^{-}}$

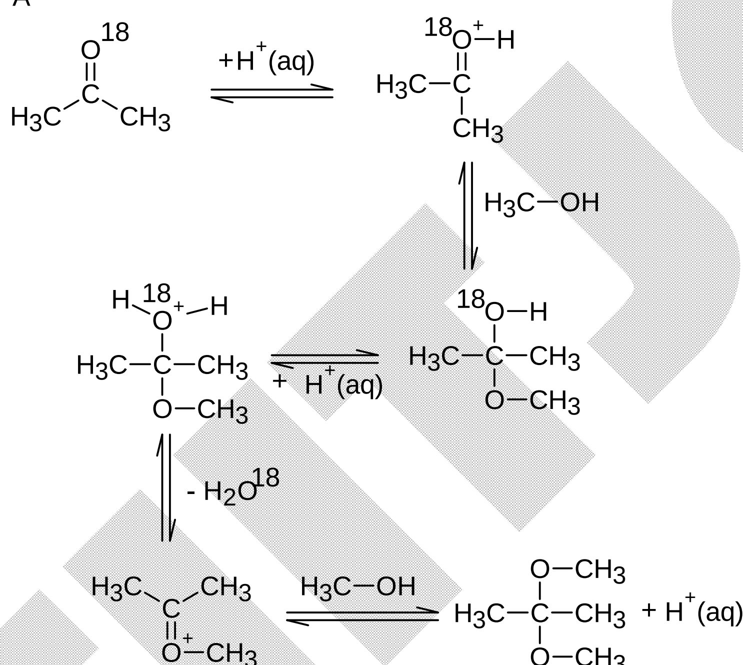
Stronger the ligand, greater will be the splitting and hence the compound will absorbs light of high frequency (or low wavelength).

43. B

Sol. Octahedral ionic radii of these elements in M^{2+} state is related with its stabilization due to CFSE.

44. A

Sol.



45. B

Sol. $\underset{(A)}{KClO_3} \xrightarrow{\Delta} \underset{(B)}{KCl} + \underset{(C)}{O_2(g)}$

$\underset{(B)}{KCl(aq)} + AgNO_3 \longrightarrow AgCl\downarrow$

$KOH + \underset{(D)}{Cl_2(g)} \longrightarrow KCl + KClO_3 + H_2O$

SECTION – B

46. 17

Sol. Hybridisation is involved in sigma bond. Hybridisation and number of corresponding bonds, respectively are given as

$CH_4\left(sp^3\right) \to 4$

$ClF_3\left(sp^3d\right) \to 3$

$C_2H_4\left(sp^2\right) \to 5$

$C_2H_2\left(sp\right) \to 3$

$NO_2^+\left(sp\right) \to 2$

47. 83

Sol. 20 mL of '10 volume' H_2O_2 solution produces 200 ml of O_2 at STP (or $\frac{200}{22400}$ mole of O_2)

$C_2H_4 + 3O_2 \longrightarrow 2CO_2 + 2H_2O$

$\frac{200}{22400}$ mole of O_2 will burn $\left(\frac{1}{3} \times \frac{200}{22400} \times 28\right)$ g of C_2H_4

Required answer = 83 mg.

48. 404

Sol. $Li_2CO_3\,(s) \xrightarrow{\Delta} Li_2O(s) + CO_2 \uparrow$

1 mole

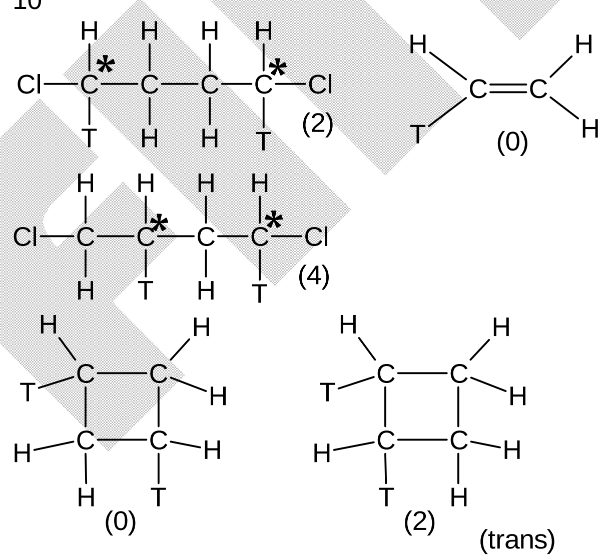
$Na_2CO_3.10H_2O(s) \xrightarrow{\Delta} Na_2CO_3\,(s) + 10H_2O \uparrow$

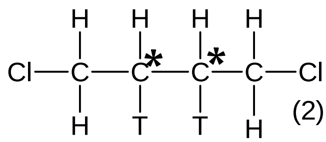
2 moles

Required answer = 44 + 180 × 2
= 44 + 360
= 404 g.

49. 10

Sol.




(2)

50. 120

Sol.
$$4Fe(s) + 3O_2(g) \longrightarrow 2Fe_2O_3(s)$$
40 moles 20 moles

So, 40 moles of Fe will give up 120 moles of electrons to form 20 moles of Fe_2O_3.

Mathematics

PART – C

SECTION – A

51. C
Sol. 55 + 65 + 80 = 200

52. D
Sol. $p \to T$, $q \to F$, $r \to F$, $s \to T$

53. D
Sol. $\frac{1}{2}\int_0^{\pi} f(x) + f(\pi - x)\,dx = 0$

54. D
Sol. R is symmetric but neither reflexive nor transitive. Domain and range of R has 19 and 10 elements respectively.

55. D
Sol. $\sin 32° \sin 88° \sin 28° = \frac{1}{4}\sin 84° = \frac{\cos 6°}{4}$

56. C
Sol. $-p = (\alpha + \beta)^2 - 2\alpha\beta + \frac{\alpha+\beta}{\alpha\beta} = 9 - \frac{11}{\sqrt{7}}$

$q = \alpha^2\beta^2 + \alpha + \beta + \frac{1}{\alpha\beta} = 10 - \frac{1}{\sqrt{7}}$

57. A
Sol. $A + B = 2024({}^{2023}C_0 + {}^{2023}C_1 + \ldots\ldots + {}^{2023}C_{2023}) = 2024.2^{2023}$

58. C
Sol. $\frac{b^2}{a} \le a + ae \Rightarrow e^2 - 1 \le 1 + e$

$\Rightarrow e \in (1, 2]$

59. A
Sol. $\cos\theta + \sin\theta = 1 \Rightarrow \theta = 0, \frac{\pi}{2}$

60. B
Sol. $ae = AE$, $\frac{b^2}{a} = \frac{B^2}{A} \Rightarrow eE = 1 \Rightarrow e = \frac{1}{\sqrt{2}}$

61. D
Sol. Limit equals 0 for $n \ge 1$ and does not exist for $n < 1$

62. D
Sol. $A_1 + A_3 + \ldots.. + A_{2023}$ is skew symmetric matrix of order 3 so its determinant equals 0.

63. B

Sol. Check RHD and LHD at x = 0

64. B

Sol. $\frac{dv}{dt} = -\pi r^2 \cot\theta \frac{dr}{dt}, \frac{ds}{dt} = -2\pi r \frac{dr}{dt} \operatorname{cosec}\theta$

$\Rightarrow \frac{ds}{dt} = \frac{\sqrt{41}}{12}\pi$

65. D

Sol. f(x) = (x + 2) (x + 1) (x – 1) $(x^7 + x + 1)$

There are 3 stationary points in (–2, 1)

66. B

Sol. Let $I_n = \int_0^1 x^6\left(x^3-1\right)^n dx$

$= \left|\frac{x^7}{7}\left(x^3-1\right)^n\right|_0^1 - \frac{3n}{7}\int_0^1 x^9\left(x^3-1\right)^{n-1} dx$

$= -\frac{3n}{7}\left(I_n + I_{n-1}\right) \quad \Rightarrow I_n = -\frac{3n}{3n+7} I_{n-1}$

$I_{n-1} = -\frac{3(n-1)}{3n+4} I_{n-2}$

…

…

…

$I_2 = -\frac{3.2}{13} I_1$ where $I_1 = -\frac{3}{70}$

67. A

Sol. $\pi(a^2 - ab) = \pi(a^2 + b^2 - a^2) \Rightarrow \frac{b}{a} = \frac{\sqrt{5}-1}{2}$

$\Rightarrow e = \sqrt{\frac{2\sqrt{5}-2}{4}} = \sqrt{2\sin 18^\circ}$

68. D

Sol. Let amount of salt in bloodstream a time t = x

$\Rightarrow \frac{dx}{dt} = -kx \Rightarrow x = ce^{-kt}$

where c = 100 and $k = \frac{\ln 2}{5}$

$\Rightarrow x = 100e^{-\frac{\ln 2}{5}t}$ (for first 12 hours)

At $t = 12^+$ hrs, initial amount is $100\left(1 + e^{-\frac{12}{5}\ln 2}\right)$

At t = 15 hrs, $x = 100\left(1 + e^{-\frac{12}{5}\ln 2}\right)e^{-\frac{3\ln 2}{5}}$

69. A

Sol. Plane contains (1, 2, 3) and (–1, –3, 1) and parallel to $2\hat{i}+3\hat{j}+4\hat{k}$

70. D

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

$= \left[\vec{a}\,\vec{b}\,\vec{c}\right]\left(\left(\vec{b}\cdot\vec{a}\right)c-\left(\vec{b}\cdot\vec{c}\right)\vec{a}\right)\cdot\vec{b}=0$

SECTION – B

71. 4

Sol. $b=\frac{\pi}{2}, a=\frac{\pi}{4}$

72. 3

Sol. $(4^{\sin x} + 4^{-\sin x})(16^{\sin y} + 16^{-\sin y}) = 4$

$\Rightarrow \sin x = \sin y = 0$ (by A.M - G.M)

$3^{|\cos x|} + 3^{\cos y} = \frac{10}{3} \Rightarrow 3^{\cos y} = \frac{1}{3} \Rightarrow \cos y = -1$

$y = \pi$, $x = 0, \pi, 2\pi$

73. 2

Sol. $p = \frac{2}{35}$

74. 60

Sol. $x_1x_2x_3x_4x_5 = 9 \times 8 \times 7 \times 5 \times 5$

$\Rightarrow$ total numbers = $\frac{5!}{2} = 60$

75. 3

Sol. Using Binomial expansion remainder comes out to be 3.