All India Aakash Test Series for JEE (Main)-2020

TEST - 1 - Code-A

Test Date : 09/06/2019

ANSWERS

PHYSICS		CHEMISTRY		MATHEMATICS	
1.	(3)	31.	(4)	61.	(4)
2.	(4)	32.	(3)	62.	(3)
3.	(3)	33.	(3)	63.	(4)
4.	(1)	34.	(2)	64.	(4)
5.	(3)	35.	(4)	65.	(3)
6.	(4)	36.	(2)	66.	(4)
7.	(1)	37.	(2)	67.	(1)
8.	(1)	38.	(4)	68.	(3)
9.	(1)	39.	(3)	69.	(4)
10.	(2)	40.	(1)	70.	(3)
11.	(4)	41.	(4)	71.	(1)
12.	(3)	42.	(3)	72.	(2)
13.	(4)	43.	(4)	73.	(2)
14.	(3)	44.	(2)	74.	(1)
15.	(3)	45.	(1)	75.	(4)
16.	(4)	46.	(2)	76.	(2)
17.	(2)	47.	(4)	77.	(1)
18.	(2)	48.	(1)	78.	(1)
19.	(2)	49.	(2)	79.	(3)
20.	(4)	50.	(2)	80.	(4)
21.	(2)	51.	(3)	81.	(3)
22.	(4)	52.	(2)	82.	(3)
23.	(1)	53.	(4)	83.	(3)
24.	(2)	54.	(3)	84.	(2)
25.	(4)	55.	(2)	85.	(2)
26.	(4)	56.	(4)	86.	(2)
27.	(3)	57.	(2)	87.	(2)
28.	(2)	58.	(1)	88.	(3)
29.	(1)	59.	(1)	89.	(4)
30.	(1)	60.	(2)	90.	(3)

PART - A (PHYSICS)

1. Answer (3)

Hint : $E_A = \frac{KQ}{r^2}$ due to shell at outside point

Sol. : $E_A = \frac{K(3Q)}{r_A^2}$

r_A is distance of A from O

$\Rightarrow E_A$ = constant

2. Answer (4)

Hint : $V_P = V_1 + V_2$

Sol. : $V_P = \frac{\left(\frac{\sigma}{2}\right)2R}{\pi\varepsilon_0} + \frac{(2\sigma)\frac{R}{2}}{\pi\varepsilon_0}$

$= \left(\frac{2\sigma R}{\pi\varepsilon_0}\right)$

3. Answer (3)

Hint : Parallel arrangement

Sol. : $C_{eq} = C + \frac{C}{2} + \frac{C}{4} + \frac{C}{8} + \ldots \infty$

$= C \times \frac{1}{\left(1 - \frac{1}{2}\right)} = 2C$

4. Answer (1)

Hint : $\sum Q = 0$

Sol. : $\sum Q = 0$

$\Rightarrow Q + 2Q - Q + Q_1 = 0$

$\Rightarrow Q_1 = -2Q$

5. Answer (3)

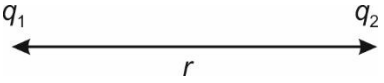
Hint : $U = \left(\frac{Q^2}{2C}\right)$

Sol. : $U = \frac{(2Q)^2}{(2)\{4\pi\varepsilon_0 2a\}}$

$U = \frac{4Q^2}{16\pi\varepsilon_0 a} = \frac{Q^2}{4\pi\varepsilon_0 a}$

6. Answer (4)

Hint : $U = \frac{kq_1q_2}{r}$



Sol. : $U = 2 \times \left[-\frac{kq^2}{a} + \frac{kq^2}{2a} - \frac{kq^2}{3a} + \ldots\infty\right]$

$= -\frac{kq^2 \times 2}{a}\left(1 - \frac{1}{2} + \frac{1}{3} - \ldots\infty\right)$

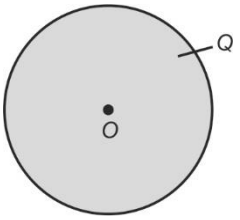
Note: $\boxed{\ln(1+x) = x - \frac{x^2}{2} + \frac{x^3}{3} - \frac{x^4}{4} + \ldots}$

$\therefore \; U = -\frac{kq^2 \times 2}{a} \times \ln(2)$

$\Rightarrow \; \boxed{U = -\frac{q^2}{2\pi\varepsilon_0 a} \cdot \ln(2)}$

7. Answer (1)

Hint : $V_0 = \frac{kQ}{R}$



Sol. : V at center is $\frac{Q}{4\pi\varepsilon_0 R} \cdot \frac{3}{2} = \frac{3}{2}V_0$

$\Delta V = \frac{3}{2}V_0 - V_0 = \frac{V_0}{2} = \frac{1}{2} \cdot \frac{1}{4\pi\varepsilon_0 R} \cdot \frac{4}{3}\pi R^3 \rho$

$\Rightarrow \Delta V = \frac{\rho R^2}{6\varepsilon_0}$

8. Answer (1)

Hint : $V_{inside} = V_{surface}$

Sol. : Potential at inside point will be same as potential at the surface of inside sphere.

9. Answer (1)

Hint : $U_{Q_0} = V_0 Q_0$

Sol. : $V_0 = \frac{(\lambda L)\ln 2}{4\pi\varepsilon_0 L} = \left(\frac{\lambda \ln 2}{4\pi\varepsilon_0}\right)$

$U = \frac{\lambda Q_0 \ln 2}{4\pi\varepsilon_0}$

10. Answer (2)

Hint : $\phi = \frac{q_{in}}{\varepsilon_0}$

Sol. : $\phi_1 = \left(\frac{q_1}{\varepsilon_0}\right)$

$\phi_2 = \left(-\frac{q_2}{\varepsilon_0}\right)$

$\phi_3 = 0$

11. Answer (4)

Hint : $U = \frac{1}{2}CV^2$

Sol. : $\frac{Q_1}{C_1} = \frac{Q_2}{C_2}$

$U = \left(\frac{1}{2}\right)(2)\left(\frac{48}{3}\right)^2$

= 256 μJ

12. Answer (3)

Hint : Electric field near a point charge will dominated by nearer charge.

Sol. : Electric field at x = ± ∞ will tend to zero.

13. Answer (4)

Hint : Use symmetry

Sol. : Field due to each spherical shell will be along –*y* direction.

14. Answer (3)

Hint : Use super position principle

Sol. : $\vec{E}_P = \vec{E}_{\text{sheet}} - \vec{E}_{\text{hole}}$

$\vec{E}_P = \frac{\sigma}{2\sqrt{2}\varepsilon_0}$

15. Answer (3)

Hint : Work done in closed loop is zero due to conservative field.

Sol. : Electric field lines cannot form a closed loop.

16. Answer (4)

Hint : Use Gauss' law

Sol. : Use concept of solid angle

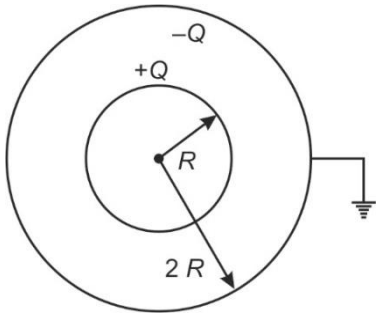
Total flux = $\left(\frac{2Q}{10\varepsilon_0}\right)$

$\Rightarrow \phi = \left(\frac{Q}{5\varepsilon_0}\right)$

17. Answer (2)

Hint : V_B = 0 after switch *S* is closed

Sol. :



$V_B = 0$

$V_A = \frac{kQ}{R} - \frac{kQ}{2R} = \frac{kQ}{2R}$

18. Answer (2)

Hint : Use combination of capacitor

Sol. : $C_{PQ} = \frac{2C}{3} + 2C = \frac{8}{3}C$

$\therefore \quad V_{AB} = V \times \frac{1}{\left(\frac{8}{3}+1\right)} \times \left(\frac{1}{3}\right)$

$= 110 \times \left(\frac{1}{11}\right) = 10 \text{ V}$

$V_{AB} = 10 \text{ V}$

19. Answer (2)

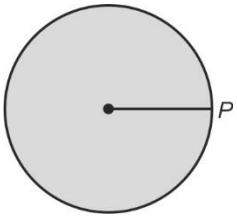
Hint : $\oint \vec{E} \cdot \overrightarrow{ds} = \frac{Q}{\varepsilon_0}$

Sol. : $4\phi = \frac{Q}{\varepsilon_0}$

$\Rightarrow \phi = \left(\frac{1}{4}\right)\frac{Q}{\varepsilon_0}$

20. Answer (4)

Hint : $V_P = \frac{\sigma R}{\pi\varepsilon_0}$



Sol. : $V_P = \left(\frac{\sigma R}{\pi\varepsilon_0}\right)$

$\sigma = \frac{2Q}{(\pi R^2)}$

$V_P = \left(\frac{R}{\pi\varepsilon_0}\right)\left(\frac{2Q}{\pi R^2}\right)$

$= \left(\frac{2Q}{\pi^2 R\varepsilon_0}\right)$

21. Answer (2)

Hint : $C_{eq}^{AB} = 2C$

Sol. : $Q = C_{eq}^{AB} V$

= (2*C*) *V*

= 2 × 1 × 12

= 24 μC

22. Answer (4)

Hint : Potential increases opposite to the direction of electric field

Sol. : $E_A > E_B$

Since field lines are more dense at *A* and $V_A > V_B$

23. Answer (1)

Hint : Use symmetry

Sol. : $\frac{1}{C} = \frac{1}{1} + \frac{1}{3} + \frac{1}{9} + \ldots\infty$

$= \frac{1}{\left(1 - \frac{1}{3}\right)} = \frac{3}{2}$

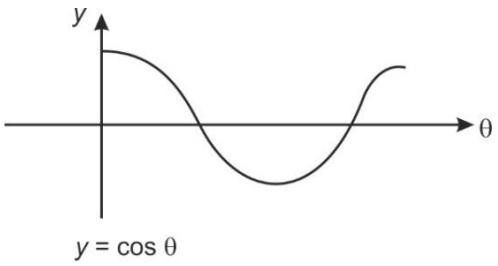
$\therefore\ C = \frac{2}{3}\mu F$

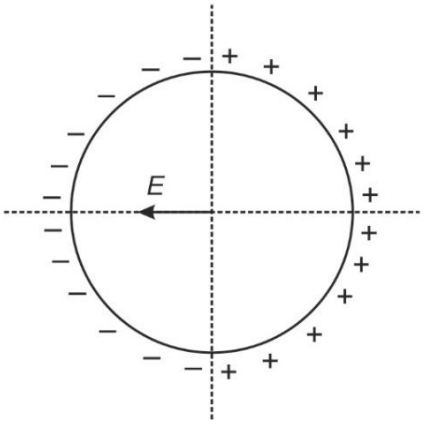
$\therefore\ C_{AB} = 2C = \frac{4}{3}\mu F$

24. Answer (2)

Hint : Show charge distribution on ring

Sol. :





25. Answer (4)

Hint : $\oint \vec{E} \cdot \overrightarrow{ds} = \frac{q_{in}}{\varepsilon_0}$

Sol. : $\phi_{Total} = \frac{(2Q)}{\varepsilon_0}$

$\phi = \left(\frac{1}{3}\right)\left[\frac{2Q}{\varepsilon_0} - \frac{Q}{4\varepsilon_0}\right] = \left(\frac{7Q}{12\varepsilon_0}\right)$

26. Answer (4)

Hint : Potential become same

Sol. : $V_1 = V_2$

$\Rightarrow$ Field will be zero in between them

27. Answer (3)

Hint : For maximum field

$$\frac{dE}{dz} = 0$$

Sol. : Calculate electric field at z

Then $\frac{d}{dz}E = 0 \Rightarrow z = \frac{R}{\sqrt{2}}$

28. Answer (2)

Hint : $V = \left(\frac{KQ}{R}\right)$

Sol. : $V_B = \frac{KQ}{2a} + \frac{K2Q}{2a} - \frac{KQ}{3a}$

$$= \frac{KQ}{a}\left[\frac{1}{2} + 1 - \frac{1}{3}\right]$$

$$= \left(\frac{KQ}{a}\right)\left[\frac{3+6-2}{6}\right]$$

$$= \frac{7}{6}\frac{KQ}{a}$$

29. Answer (1)

Hint : $|\vec{P}| = Q\ell$

Sol. : $P_r = (\sqrt{3})Q\ell$

30. Answer (1)

Hint : $E = \frac{\rho r}{3\in_0}$

Sol. : $E = \frac{\rho r}{3\in_0}$

$\therefore \quad |E| = \frac{\rho R}{6\in_0}$

PART - B (CHEMISTRY)

31. Answer (4)

Hint : Body diagonal plane contains 2 Zn^{2+} ions.

Sol. : Body diagonal plane will consist of four S^{2-} ions at the corners $\left(4\times\frac{1}{8}\right)$ and two S^{2-} ions at the face centre $\left(2\times\frac{1}{2}\right)$.

32. Answer (3)

Hint : Mole of H_2 = 2 mole of e^-

Sol. : $n_{H_2} = \frac{1.93\times5\times60}{2\times96500} = 3\times10^{-3}$

33. Answer (3)

Hint : LHE is anode.

RHE is cathode.

Sol. : A : $\underset{M_1}{2Cl^-} \longrightarrow \underset{P_1}{Cl_2} + 2e^-$

C : $\underset{P_2}{Cl_2} + 2e^- \longrightarrow \underset{M_2}{2Cl^-}$

$$\underset{M_1}{2Cl^-} + \underset{P_2}{Cl_2} \longrightarrow \underset{P_1}{Cl_2} + \underset{M_2}{2Cl^-}$$

34. Answer (2)

Hint : In the titration, AD is precipitated so A^+ are replaced by C^+.

Sol. : Since, conductance does not change so mobility of C^+ is comparable to A^+.

35. Answer (4)

Hint : The liquids may be immiscible or showing positive deviation from Raoults law.

Sol. : For solution with positive deviation, the more volatile component may have very low mole fraction in the liquid phase.

36. Answer (2)

Hint : $d = \frac{z(M_0)}{6\times10^{23}\times a^3}$

$M_0 = 58$

$d = 2.48\ gcm^{-3}$

Sol. : $a^3 = \frac{4\times 58}{6\times 10^{23}\times 2.48} = 1.56\times 10^{-22}$

$\Rightarrow a = 5.38 \times 10^{-8}$ cm = 538 pm

$\therefore \frac{a}{2} = 269$ pm

37. Answer (2)

Hint : Mole fraction of solute will be equal in both the beakers after a long time.

Sol. : Initially

Beaker A : n moles solute
4 moles of water

Beaker B : 2 moles of solute
3 moles of water

Finally

There is shifting of $\frac{1}{2}$ mole of water to beaker B.

$\therefore \frac{n}{n+4-\frac{1}{2}} = \frac{2}{2+3+\frac{1}{2}}$

$\Rightarrow n = 2$

$\therefore$ 28 g of X contains 2 moles

$\therefore$ M = 14 g/mol

38. Answer (4)

Hint : $E^o_{cell} = E^o_{cathode} - E^o_{Anode}$

Sol. : For (4), $E^o = 2.126$ V.

39. Answer (3)

Hint : Electrolyte is paste of KOH and ZnO

Sol. : It does not involve any ion whose conc. can change during its life time

40. Answer (1)

Hint : For positive deviation, $P_{actual} > P_{Raoult}$

Sol. : $\Delta H > 0$ and $\Delta V > 0$

41. Answer (4)

Hint : van't Hoff factor = number of ions furnished by 1 mole.

Sol. : $Ca_3(PO_4)_2$, i = 5

$Na_4[Fe(CN)_6]$, i = 5

42. Answer (3)

Hint : $MnO_4^- + 8H^+ + 5e^- \longrightarrow Mn^{2+} + 4H_2O$

Sol. : $E = E° - \frac{0.06}{5}\log\frac{1}{[H^+]^8}$

$= E° - 0.096$ pH

$= 1.51 - 0.096$ (pH)

43. Answer (4)

Hint : meq of NaOH = meq of H_2SO_4

Sol. : Neutralisation

$\frac{1.2}{40}\times 1000 = M\times 20\times 2$

$\Rightarrow M = 0.75$

Now, wt. of H_2SO_4 in 1 lit solution = $0.75 \times 98 = 73.5$ and wt. of 1 lit solution = 1024.5

$\therefore$ wt. of solvent = 951

$\therefore$ Mass percent of solute

$= \frac{73.5}{1024.5}\times 1000$

= 7.17%

$\therefore m = \frac{0.75\times 1000}{951} = 0.79$

And mole fraction

$= \frac{0.75}{\frac{951}{18}+0.75} = 0.014$

44. Answer (2)

Hint : $P = K_H \cdot X$

Sol. : $K_H = \frac{500}{0.01} = 5 \times 10^{+4}$

= 50 k torr

As temperature increases, Henry's constant increases. As solvent solute interactions become stronger, value of Henry's constant decreases.

45. Answer (1)

Hint : When the last trace of liquid disappears, the vapor contains 6 moles of A and 4 moles of B.

Sol. : $P_A^o = 30$, $P_B^o = 50$

$x_A = ?, x_B = ?$

$y_A = \frac{3}{5}$, $y_B = \frac{2}{5}$

Now $y_A = \frac{P_A}{P_T} = \frac{P_A^o x_A}{P_A^o x_A + P_B^o x_B}$

$y_A = \frac{P_A^o x_A}{\left(P_A^o - P_B^o\right)x_A + P_B^o}$

$\frac{3}{5} = \frac{30\,x_A}{50 - 20\,x_A}$

$10 - 4x_A = 10x_A$

$x_A = \frac{10}{14}$

$\therefore P_T = 30 \times \frac{10}{14} + 50 \times \frac{4}{14} = \frac{500}{14}$

46. Answer (2)

Hint : meq of acid = meq of base

$\frac{1.5}{M} \times 1 \times 1000 = 25 \times 0.2$

$\Rightarrow$ M = 300

Sol. : Molality = $\frac{2.5 \times 1000}{300 \times 250} = \frac{1}{30}$

$\therefore \Delta T_f = iK_f m$

$0.1 = i(1.86)\frac{1}{30}$

$\Rightarrow i = 1.61$

$\therefore 1 + \alpha = 1.61$

$\Rightarrow \alpha = 0.61$

47. Answer (4)

Hint : T_b (solution) = T_b (solvent) + $K_b \cdot m$.

Sol. : Solution with the least boiling point will be decided by the value of 'm'.

48. Answer (1)

Hint : Entropy of solid is lesser than liquid.

Sol. : As $S_{solvent} < S_{solution}$

So $\left|\left(\Delta S_{fusion}\right)_{solvent}\right| < \left|\left(\Delta S_{fusion}\right)_{solution}\right|$

49. Answer (2)

Hint : Reactions take place in basic medium.

Sol. : **Cathode:** $O_2(g) + H_2O(l) + 4e^- \longrightarrow 4OH^-(aq)$

Anode: $2H_2(g) + 4OH^-(aq) \longrightarrow 4H_2O(l) + 4e^-$

50. Answer (2)

Hint : Charge in faradays passed = g eq of species produced

Sol. : Charge passed $= \frac{1.93 \times 2500 \times 40}{100}$

= 1930 C

$\therefore$ Number of m moles of e^- = 20

Now, A : $H_2O \longrightarrow \frac{1}{2}O_2 + 2H^+ + 2e^-$

C : $Cu^{2+} + 2e^- \longrightarrow Cu$

$\therefore$ m moles of Cu deposited = 10

m moles of H^+ produced = 20

$\therefore [H^+] = \frac{20 \times 10^{-3}}{3} = \frac{2}{3} \times 10^{-2}$

$\therefore$ pH = 2 + log3 – log2 = 2.18

51. Answer (3)

Hint : At Cathode, reduction takes place

Sol. : At Anode, oxidation takes place

52. Answer (2)

Hint : In conductivity cell, AC is used.

Sol. : DC changes the composition of solution and KCl cannot be used as Cl^- react with Ag^+ to form AgCl.

53. Answer (4)

Hint : $E_{cell} = E_{cell}^o - \frac{0.06}{2}\log Q$

Sol. : C : $B^{3+} + e^- \longrightarrow B^{2+}$

A : $A \longrightarrow A^{2+} + 2e^-$

$A + 2B^{3+} \longrightarrow A^{2+} + 2B^{2+}$

$Q = \frac{[B^{2+}]^2 \cdot [A^{2+}]}{[B^{3+}]^2} = \frac{x^2}{0.1}$

$\therefore E = E^o - \frac{0.06}{2}\log\left(\frac{x^2}{0.1}\right)$

$2.03 = 2 - 0.03\log\left(\frac{x^2}{0.1}\right)$

$\Rightarrow \log\left(\frac{x^2}{0.1}\right) = -1$

$\Rightarrow x = 0.1$

54. Answer (3)

Hint : $\lambda_m = \frac{K \times 1000}{C}$

Sol. : $100 = \frac{K \times 1000}{\left(\frac{0.1}{2}\right) \times 0.8}$

$\Rightarrow K = 4 \times 10^{-3}$

55. Answer (2)

Hint : Tetragonal system has all angles equal to 90°.

Sol. : Trigonal system has all angles not equal to 90°.

56. Answer (4)

Hint : Electrical neutrality must be maintained in ionic solids.

Sol. : Presence of F-centres impart colour.

57. Answer (2)

Hint : If edge length is a, then $\sqrt{3}a = 4R$.

Sol. : $a = \frac{4R}{\sqrt{3}}$

Now $2R + 2x = a$

$\Rightarrow x = \frac{a - 2R}{2}$

$= \frac{\frac{4R}{\sqrt{3}} - 2R}{2}$

$= \left(\frac{2-\sqrt{3}}{\sqrt{3}}\right)R$

58. Answer (1)

Hint : In AB type structure, the cation A^+ can occupy either all octahedral voids or half the tetrahedral voids.

Sol. : In AB_2 type structure, co-ordination number ratio of $A^{2+} : B^-$ is 2 : 1.

59. Answer (1)

Hint : In HCP, there are 6 atoms per unit cell.

Sol. : 8 tetrahedral voids are completely inside. There are tetrahedral voids on the vertical edges which are shared.

60. Answer (2)

Hint : Paramagnetic substances get magnetised in a magnetic field and lose their magnetism when the field is removed.

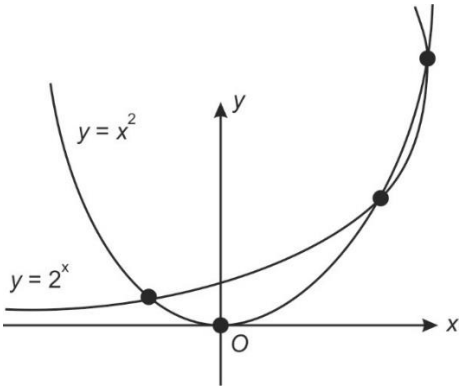
Sol. : Ferrimagnetic substances have domains oriented oppositely in unequal numbers.

PART - C (MATHEMATICS)

61. Answer (4)

Hint : Draw graph

Sol. :



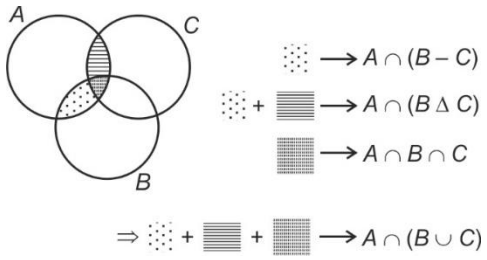
$n(A \cap B) = 3$

$\Rightarrow n(P(A \cap B)) = 2^3 = 8$

62. Answer (3)

Hint : Venn diagram

Sol. :



63. Answer (4)

Hint : $y = x$

Sol. : $\because \sin^{-1}x + \cos^{-1}y = \frac{\pi}{2}$ …(1)

$(x, y) \in R$

$\because \sin^{-1}x + \cos^{-1}x = \frac{\pi}{2} \Rightarrow (x, x) \in R$

$\Rightarrow R$ is reflexive

Let $\sin^{-1}y + \cos^{-1}x = k$ …(2)

From (1) + (2)

$\Rightarrow k = \frac{\pi}{2} \Rightarrow \sin^{-1}y + \cos^{-1}x = \frac{\pi}{2}$

$\Rightarrow (y, x) \in R \Rightarrow R$ is symmetric

Let $(y, z) \in R \Rightarrow \sin^{-1}y + \cos^{-1}z = \frac{\pi}{2}$ …(3)

From (1) + (3),

$\sin^{-1}x + \cos^{-1}z = \frac{\pi}{2} \Rightarrow (x, z) \in R$

$\Rightarrow R$ is transitive

$\Rightarrow R$ is equivalence relation

64. Answer (4)

Hint : $\cos^{-1}x = \frac{\pi}{2} - \sin^{-1}x$

Sol. :

$$\sin^{-1}x\left(\frac{\pi}{2} - \sin^{-1}x\right) + \frac{\pi}{4}\left(\frac{\pi}{2} - \sin^{-1}x - \sin^{-1}x\right) - \frac{\pi^2}{16} > 0$$

$$\frac{\pi}{2}\sin^{-1}x - (\sin^{-1}x)^2 + \frac{\pi^2}{8} - \frac{\pi}{2}\sin^{-1}x - \frac{\pi^2}{16} > 0$$

$$(\sin^{-1}x)^2 - \frac{\pi^2}{16} < 0$$

$$-\frac{\pi}{4} < \sin^{-1}x < \frac{\pi}{4}$$

$$-\frac{1}{\sqrt{2}} < x < \frac{1}{\sqrt{2}}$$

65. Answer (3)

Hint : $t + \frac{1}{t} \geq 2$, when $t > 0$

Sol. :

$$|x| + \frac{1}{|x|} \geq 2,\ |y| + \frac{1}{|y|} \geq 2,$$

$$|x| \cdot |y| + \frac{1}{|x||y|} \geq 2$$

$$\Rightarrow |x| + |y| + |x||y| + \frac{1}{|x|} + \frac{1}{|y|} + \frac{1}{|x||y|} \geq 6$$

$$\Rightarrow |x| + |y| + |x||y| + \frac{1}{|x|} + \frac{1}{|y|} + \frac{1}{|x||y|} = 6$$

$$\Rightarrow |x| = |y| = \frac{1}{|x|} = \frac{1}{|y|} = |x||y| = \frac{1}{|x||y|} = 1$$

$\Rightarrow |x| = |y| = 1 \Rightarrow x = \pm 1, y = \pm 1$

Ordered pairs are (1, 1), (–1, 1), (1, –1), (–1, –1)

66. Answer (4)

Hint : Put $9^x = t$

Sol. : $3^{4x} + 9^{|x-1|} - 10 \leq 0$

$81^x + 9^{|x-1|} - 10 \leq 0$

Put $9^x = t$

If $x - 1 \leq 0$	If $x - 1 \geq 0$
$t^2 + \frac{9}{t} - 10 \leq 0$	$t^2 + \frac{t}{9} - 10 \leq 0$
$t^3 - 10t + 9 \leq 0$	$\because x \geq 1 \Rightarrow 9^x \geq 9$
$(t-1)(t^2 + t - 9) \leq 0$	$\Rightarrow t \geq 9$
$(t-1)\left[\left(t + \frac{1}{2}\right)^2 - 9 - \frac{1}{4}\right] \leq 0$	$\Rightarrow t^2 + \frac{t}{9} \geq 82$
$(t-1)\left(t + \frac{1}{2} + \frac{\sqrt{37}}{2}\right)$ $\left(t + \frac{1}{2} - \frac{\sqrt{37}}{2}\right) \leq 0$	$\Rightarrow t^2 + \frac{t}{9} - 10 \leq 0$ Has no solution.
$\Rightarrow (t-1)\left(t - \frac{\sqrt{37} - 1}{2}\right) \leq 0$	
$1 \leq t \leq \frac{\sqrt{37} - 1}{2}$	

$$1 \le 9^x \le \frac{\sqrt{37}-1}{2}$$

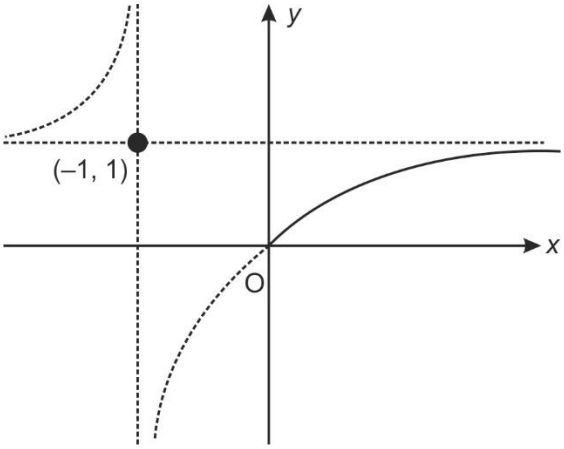
$$0 \le x \le \log_9\left(\frac{\sqrt{37}-1}{2}\right)$$

67. Answer (1)

Hint : Draw graph

Sol. : $y = \frac{x}{1+x} = 1 - \frac{1}{1+x}$

$(y-1)(x+1) = -1$



$y \in [0, 1)$

$\Rightarrow f(x)$ is one-one and into function

68. Answer (3)

Hint : $\sin x \in [-1, 1]$

Sol. : $2^{\sin x} + 2^y = 1$

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

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

$$\Rightarrow \frac{1}{2} \ge 1 - 2^{\sin x} \ge -1 \Rightarrow -1 \le 2^y \le 2^{-1}$$

$\Rightarrow y \in (-\infty, -1]$

69. Answer (4)

Hint : $\ln(1 + x)$ is an integer

Sol. : $x + 1 > 0 \quad x > -1$

$\ln(1 + x) + [(1+ x)^2] - 3$ is an integer

$\Rightarrow \ln(1 + x)$ is an integer

$\Rightarrow [\ln(1 + x)] = \ln(1 + x)$

$\Rightarrow [(1 + x)^2] = 3$

$3 \le (1 + x)^2 < 4$

$\sqrt{3} \le |1+x| < 2$

$\ln\sqrt{3} \le \ln(1+x) < \ln 2$

$\ln(1 + x)$ is integer for no value of x

70. Answer (3)

Hint : Break G.I.F

Sol. : $f(x) = \begin{cases} -3, & x \in [-1, -\sin 1) \\ -2, & x \in [-\sin 1, 0) \\ 0, & x \in [0, \sin 1) \\ 1, & x \in [\sin 1, 1] \end{cases}$

71. Answer (1)

Hint : $|\sin x| + |\cos x| \in [1, \sqrt{2}]$

Sol. : $\because |\sin x| + |\cos x| \in [1, \sqrt{2}]$

$\Rightarrow [|\sin x| + |\cos x|] = 1$

$\Longrightarrow$ domain of $f(x)$ is ϕ (empty set)

72. Answer (2)

Hint : $0 \le \{x\} < 1$

Sol. : $\because \operatorname{sgn}(\sin^{-1}x) = \{-1, 0, 1\}$ and $\{2x\} \in [0, 1)$

$\Longrightarrow \operatorname{sgn}(\sin^{-1}x) = \{2x\} = 0 \Longrightarrow x = 0$

73. Answer (2)

Hint : $2\tan^{-1}x = \tan^{-1}\frac{2x}{1-x^2}$

Sol. : $4\tan^{-1}\left(\frac{1}{5}\right) = 2\left(2\tan^{-1}\frac{1}{5}\right)$

$$= 2 \cdot \tan^{-1}\left(\frac{2 \times \frac{1}{5}}{1 - \frac{1}{25}}\right) = 2\tan^{-1}\left(\frac{5}{12}\right)$$

$$= \tan^{-1}\left(\frac{2\times\frac{5}{12}}{1-\frac{25}{144}}\right) = \tan^{-1}\left(\frac{120}{119}\right)$$

$$\Rightarrow 4\tan^{-1}\left(\frac{1}{5}\right) - \cot^{-1}(239)$$

$$= \tan^{-1}\left(\frac{120}{119}\right) - \tan^{-1}\left(\frac{1}{239}\right)$$

$$= \tan^{-1}\left(\frac{\frac{120}{119}-\frac{1}{239}}{1+\frac{120}{119}\cdot\frac{1}{239}}\right) = \tan^{-1}(1) = \frac{\pi}{4}$$

74. Answer (1)

Hint : Find domain

Sol. : $-1 \le 2x \le 1 \Rightarrow -\frac{1}{2} \le x \le \frac{1}{2}$

Let $f(x) = \sin^{-1}(2x) - \cos^{-1}x + \tan^{-1}(2x)$

$\sin^{-1}2x$ is increasing

$\cos^{-1}x$ is decreasing

and $\tan^{-1}(2x)$ is increasing function

$$\Rightarrow f(x)_{\min} = f\left(-\frac{1}{2}\right) = -\frac{\pi}{2} - \frac{2\pi}{3} - \frac{\pi}{4} = \frac{-17\pi}{12}$$

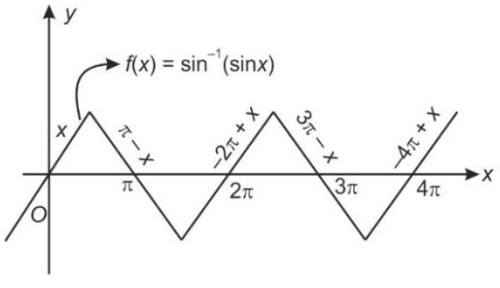
$$f(x)_{\max.} = f\left(\frac{1}{2}\right) = \frac{\pi}{2} - \frac{\pi}{3} + \frac{\pi}{4} = \frac{5\pi}{12}$$

$\Rightarrow f(x) = \frac{\pi}{2}$ does not have any solution

75. Answer (4)

Hint : Draw graph of $\sin^{-1}(\sin x)$

Sol. :



$\Rightarrow f(2) = \pi - 2,\ f(3) = \pi - 3,\ f(7) = 7 - 2\pi,\ f(9) = 3\pi - 9,$

76. Answer (2)

Hint : $\tan^{-1}x \pm \tan^{-1}y = \tan^{-1}\left(\frac{x \pm y}{1 \mp xy}\right)$

Sol. : $\tan x \cdot \cot x = 1 > -1$

$$\Rightarrow \tan^{-1}(\tan x) - \tan^{-1}(\cot x) = \tan^{-1}\left(\frac{\tan x - \cot x}{1 + \tan x\ \cot x}\right)$$

$$= \tan^{-1}\left(\frac{\tan^2 x - 1}{2\tan x}\right) = \tan^{-1}(-\cot 2x)$$

$$= -\tan^{-1}(\cot 2x) = -\tan^{-1}\tan\left(\frac{\pi}{2} - 2x\right)$$

$$= \tan^{-1}\tan\left(2x - \frac{\pi}{2}\right)$$

$$\Rightarrow T = \frac{\pi}{2}$$

77. Answer (1)

Hint : $-\frac{\pi}{2} \le \sin^{-1}x \le \frac{\pi}{2}$

Sol. : $-\frac{\pi}{2} \le 2\tan^{-1}a \le \frac{\pi}{2}$

$$\Rightarrow -\frac{\pi}{4} \le \tan^{-1}a \le \frac{\pi}{4} \Rightarrow -1 \le a \le 1$$

78. Answer (1)

Hint : $T_n = \tan^{-1}\frac{n(r+1)}{n+1} - \tan^{-1}\frac{nr}{n+1}$

Sol. : $T_n = \tan^{-1}\frac{n(n+1)}{(n+1)^2 + n^2 r(r+1)}$

$$= \tan^{-1}\left(\frac{\frac{n}{n+1}}{1+\frac{n(r+1)}{n+1}\cdot\frac{nr}{n+1}}\right)$$

$$= \tan^{-1}\left(\frac{\frac{n(r+1)}{n+1}-\frac{nr}{n+1}}{1+\frac{n(r+1)}{n+1}\cdot\frac{nr}{n+1}}\right)$$

$$= \tan^{-1}\frac{n(r+1)}{n+1} - \tan^{-1}\frac{nr}{n+1}$$

$$S = \tan^{-1}(n) - \tan^{-1}\left(\frac{n}{n+1}\right)$$

$$\Rightarrow \lim_{n\to\infty} S = \frac{\pi}{2} - \frac{\pi}{4} = \frac{\pi}{4}$$

79. Answer (3)

Hint : Break the function at –1, 0, 1, 2, 3

Sol. : $[x] \neq 0 \Rightarrow x \notin [0,1)$

$$f(x) = \begin{cases} -1, & -\infty < x < -1 \\ -2, & -1 \le x < 0 \\ 2, & 1 \le x < 2 \\ 1, & 2 \le x < 3 \\ 0, & 3 \le x < \infty \end{cases}$$

80. Answer (4)

Hint : $\sin^{-1}x + \cos^{-1}x = \frac{\pi}{2}$

Sol. : $(\sin^{-1}x)^2 + (\cos^{-1}x)^2$

$$= (\sin^{-1}x + \cos^{-1}x)^2 - 2\sin^{-1}x\left(\frac{\pi}{2} - \sin^{-1}x\right)$$

$$= \frac{\pi^2}{4} + 2(\sin^{-1}x)^2 - \pi\sin^{-1}x$$

$$= \frac{\pi^2}{4} + 2\left[(\sin^{-1}x)^2 - \frac{\pi}{2}\sin^{-1}x + \frac{\pi^2}{16}\right] - \frac{\pi^2}{8}$$

$$= \frac{\pi^2}{8} + 2\left[\left(\sin^{-1}x - \frac{\pi}{4}\right)^2\right]$$

$$-\frac{\pi}{2} \le \sin^{-1}x \le \frac{\pi}{2} \Rightarrow -\frac{3\pi}{4} \le \sin^{-1}x - \frac{\pi}{4} \le \frac{\pi}{4}$$

$$\Rightarrow 0 \le \left(\sin^{-1}x - \frac{\pi}{4}\right)^2 \le \frac{9\pi^2}{16}$$

$$\Rightarrow \frac{\pi^2}{8} \le (\sin^{-1}x)^2 + (\cos^{-1}x)^2 \le \frac{10\pi^2}{8}$$

81. Answer (3)

Hint : $\tan^{-1}x - \tan^{-1}y = \tan^{-1}\frac{x-y}{1+xy}$

Sol. : $\tan^{-1}x + \tan^{-1}\left(\frac{1}{y}\right) = \tan^{-1}(3)$

$$\tan^{-1}\left(\frac{1}{y}\right) = \tan^{-1}3 - \tan^{-1}x = \tan^{-1}\left(\frac{3-x}{1+3x}\right)$$

$$y = \frac{1+3x}{3-x} = -3 + \frac{10}{3-x}$$

For positive integer y, $x = 1, 2$

$\Rightarrow$ Solutions are (1, 2)(2, 7)

82. Answer (3)

Hint : $1 - \sin 2 = (\cos 1 - \sin 1)^2$

Sol. : $\tan^{-1}\left(\frac{\sin 2 - 1}{\cos 2}\right) = \tan^{-1}\left(-\frac{1-\tan 1}{1+\tan 1}\right)$

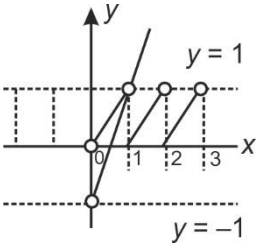
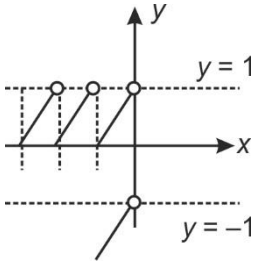
$$= \tan^{-1}\left\{-\tan\left(\frac{\pi}{4} - 1\right)\right\}$$

$$= 1 - \frac{\pi}{4}$$

83. Answer (3)

Hint : Solve graphically

Sol. : $-1 \le \frac{[x]-1}{x} \le 1, x \neq 0$

If $x > 0$	If $x < 0$
$-x \le [x] - 1 \le x$	$-x \ge [x] - 1 \ge x$
$1 - x \le [x] \le x + 1$	$1 - x \ge [x] \ge 1 + x$
$1 - x \le x - \{x\} \le x + 1$	$1 - x \ge x - \{x\} \ge 1 + x$
$x - 1 \ge \{x\} - x \ge -x - 1$	$x - 1 \le \{x\} - x \le -1 - x$
$2x - 1 \ge \{x\} \ge -1$	$2x - 1 \le \{x\} \le -1$
	
$\Rightarrow x \ge 1$	$\Rightarrow x = \phi$

$\Rightarrow x \in [1, \infty)$

84. Answer (2)

Hint : $f(x + T) = f(x)$

Sol. : $f\left(x+\frac{\pi}{2}\right)=f(x)$

85. Answer (2)

Hint : Find domain

Sol. : $-1 \le x \le 1, \quad -1 \le x+2 \le 1$

$\Rightarrow x = -1$

$f(-1)=-\frac{\pi}{2}-0+0=-\frac{\pi}{2}$

86. Answer (2)

Hint : Onto function = 0

Sol. : Number of onto functions = 0

Number of functions = 4^3

$\Rightarrow$ Number of functions which are not onto = 64

87. Answer (2)

Hint : Reflexive relations = 2^{n^2-n}

Sol. : Number of relations = $2^{n^2}=2^{25}$

Number of reflexive relations

$= 2^{n^2-n}=2^{25-5}=2^{20}$

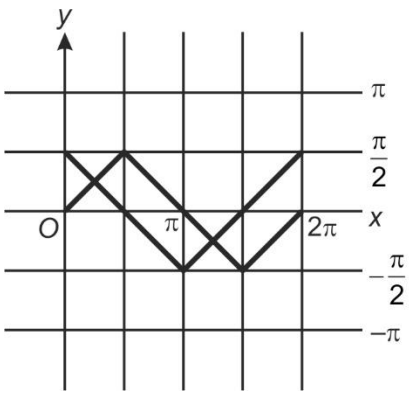
88. Answer (3)

Hint : Draw graph

Sol. :

• $y = \sin^{-1}(\sin x)$

• $y = \sin^{-1}(\cos x) = \frac{\pi}{2}-\cos^{-1}(\cos x)$



89. Answer (4)

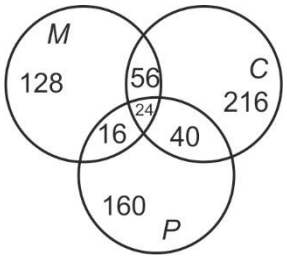
Hint : R^{-1} is also an equivalence relation

Sol. : The inverse of an equivalence relation is also an equivalence relation.

90. Answer (3)

Hint : Venn diagram

Sol. :



$n(P \cup C \cup M) = 640$

$\Rightarrow n$(who did not opt)

$= 800 - 640 = 160$

❐ ❐ ❐

All India Aakash Test Series for JEE (Main)-2020

TEST - 1 - Code-B

Test Date : 09/06/2019

ANSWERS

PHYSICS		CHEMISTRY		MATHEMATICS	
1.	(1)	31.	(2)	61.	(3)
2.	(1)	32.	(1)	62.	(4)
3.	(2)	33.	(1)	63.	(3)
4.	(3)	34.	(2)	64.	(2)
5.	(4)	35.	(4)	65.	(2)
6.	(4)	36.	(2)	66.	(2)
7.	(2)	37.	(3)	67.	(2)
8.	(1)	38.	(4)	68.	(3)
9.	(4)	39.	(2)	69.	(3)
10.	(2)	40.	(3)	70.	(3)
11.	(4)	41.	(2)	71.	(4)
12.	(2)	42.	(2)	72.	(3)
13.	(2)	43.	(1)	73.	(1)
14.	(2)	44.	(4)	74.	(1)
15.	(4)	45.	(2)	75.	(2)
16.	(3)	46.	(1)	76.	(4)
17.	(3)	47.	(2)	77.	(1)
18.	(4)	48.	(4)	78.	(2)
19.	(3)	49.	(3)	79.	(2)
20.	(4)	50.	(4)	80.	(1)
21.	(2)	51.	(1)	81.	(3)
22.	(1)	52.	(3)	82.	(4)
23.	(1)	53.	(4)	83.	(3)
24.	(1)	54.	(2)	84.	(1)
25.	(4)	55.	(2)	85.	(4)
26.	(3)	56.	(4)	86.	(3)
27.	(1)	57.	(2)	87.	(4)
28.	(3)	58.	(3)	88.	(4)
29.	(4)	59.	(3)	89.	(3)
30.	(3)	60.	(4)	90.	(4)

PART - A (PHYSICS)

1. Answer (1)

Hint : $E = \frac{\rho r}{3 \in_0}$

Sol. : $E = \frac{\rho r}{3\in_0}$

$\therefore \quad |E| = \frac{\rho R}{6\in_0}$

2. Answer (1)

Hint : $|\vec{P}| = Q\ell$

Sol. : $P_r = (\sqrt{3})Q\ell$

3. Answer (2)

Hint : $V = \left(\frac{KQ}{R}\right)$

Sol. : $V_B = \frac{KQ}{2a} + \frac{K2Q}{2a} - \frac{KQ}{3a}$

$= \frac{KQ}{a}\left[\frac{1}{2} + 1 - \frac{1}{3}\right]$

$= \left(\frac{KQ}{a}\right)\left[\frac{3+6-2}{6}\right]$

$= \frac{7}{6}\frac{KQ}{a}$

4. Answer (3)

Hint : For maximum field

$\frac{dE}{dz} = 0$

Sol. : Calculate electric field at z

Then $\frac{d}{dz}E = 0 \Rightarrow z = \frac{R}{\sqrt{2}}$

5. Answer (4)

Hint : Potential become same

Sol. : $V_1 = V_2$

$\Longrightarrow$ Field will be zero in between them

6. Answer (4)

Hint : $\oint \vec{E} \cdot \overrightarrow{ds} = \frac{q_{in}}{\varepsilon_0}$

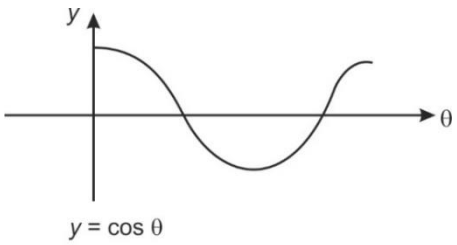
Sol. : $\phi_{Total} = \frac{(2Q)}{\varepsilon_0}$

$\phi = \left(\frac{1}{3}\right)\left[\frac{2Q}{\varepsilon_0} - \frac{Q}{4\varepsilon_0}\right] = \left(\frac{7Q}{12\varepsilon_0}\right)$

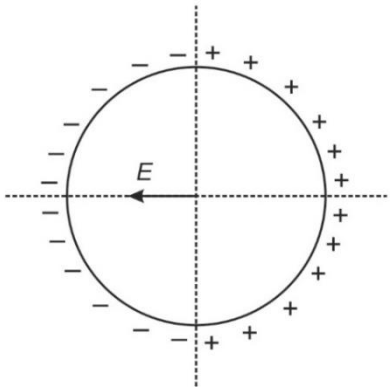
7. Answer (2)

Hint : Show charge distribution on ring

Sol. :



$y = \cos\theta$



8. Answer (1)

Hint : Use symmetry

Sol. : $\frac{1}{C} = \frac{1}{1} + \frac{1}{3} + \frac{1}{9} + \ldots\infty$

$= \frac{1}{\left(1 - \frac{1}{3}\right)} = \frac{3}{2}$

$\therefore \quad C = \frac{2}{3}\mu F$

$\therefore \quad C_{AB} = 2C = \frac{4}{3}\mu F$

9. Answer (4)

Hint : Potential increases opposite to the direction of electric field

Sol. : $E_A > E_B$

Since field lines are more dense at A and $V_A > V_B$

10. Answer (2)

Hint : $C_{eq}^{AB} = 2C$

Sol. : $Q = C_{eq}^{AB} V$

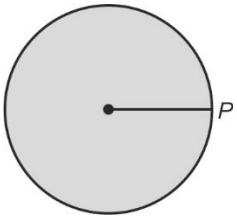
$= (2C)\, V$

$= 2 \times 1 \times 12$

$= 24\ \mu C$

11. Answer (4)

Hint : $V_P = \dfrac{\sigma R}{\pi \varepsilon_0}$



Sol. : $V_P = \left(\dfrac{\sigma R}{\pi \varepsilon_0}\right)$

$\sigma = \dfrac{2Q}{(\pi R^2)}$

$V_P = \left(\dfrac{R}{\pi \varepsilon_0}\right)\left(\dfrac{2Q}{\pi R^2}\right)$

$= \left(\dfrac{2Q}{\pi^2 R \varepsilon_0}\right)$

12. Answer (2)

Hint : $\oint \vec{E} \cdot \overrightarrow{ds} = \dfrac{Q}{\varepsilon_0}$

Sol. : $4\phi = \dfrac{Q}{\varepsilon_0}$

$\Rightarrow \phi = \left(\dfrac{1}{4}\right)\dfrac{Q}{\varepsilon_0}$

13. Answer (2)

Hint : Use combination of capacitor

Sol. : $C_{PQ} = \dfrac{2C}{3} + 2C = \dfrac{8}{3}C$

$\therefore\ V_{AB} = V \times \dfrac{1}{\left(\dfrac{8}{3}+1\right)} \times \left(\dfrac{1}{3}\right)$

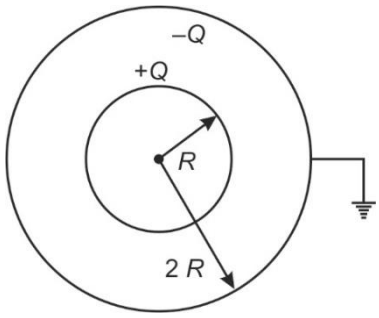
$= 110 \times \left(\dfrac{1}{11}\right) = 10\ \text{V}$

$V_{AB} = 10\ \text{V}$

14. Answer (2)

Hint : $V_B = 0$ after switch S is closed

Sol. :



$V_B = 0$

$V_A = \dfrac{kQ}{R} - \dfrac{kQ}{2R} = \dfrac{kQ}{2R}$

15. Answer (4)

Hint : Use Gauss' law

Sol. : Use concept of solid angle

Total flux = $\left(\dfrac{2Q}{10\varepsilon_0}\right)$

$\Rightarrow \phi = \left(\dfrac{Q}{5\varepsilon_0}\right)$

16. Answer (3)

Hint : Work done in closed loop is zero due to conservative field.

Sol. : Electric field lines cannot form a closed loop.

17. Answer (3)

Hint : Use super position principle

Sol. : $\vec{E}_P = \vec{E}_{\text{sheet}} - \vec{E}_{\text{hole}}$

$$\vec{E}_P = \frac{\sigma}{2\sqrt{2}\varepsilon_0}$$

18. Answer (4)

Hint : Use symmetry

Sol. : Field due to each spherical shell will be along –*y* direction.

19. Answer (3)

Hint : Electric field near a point charge will dominated by nearer charge.

Sol. : Electric field at x = $\pm\infty$ will tend to zero.

20. Answer (4)

Hint : $U = \frac{1}{2}CV^2$

Sol. : $\frac{Q_1}{C_1} = \frac{Q_2}{C_2}$

$$U = \left(\frac{1}{2}\right)(2)\left(\frac{48}{3}\right)^2$$

= 256 μJ

21. Answer (2)

Hint : $\phi = \frac{q_{in}}{\varepsilon_0}$

Sol. : $\phi_1 = \left(\frac{q_1}{\varepsilon_0}\right)$

$$\phi_2 = \left(-\frac{q_2}{\varepsilon_0}\right)$$

$$\phi_3 = 0$$

22. Answer (1)

Hint : $U_{Q_0} = V_0 Q_0$

Sol. : $V_0 = \frac{(\lambda L)\ln 2}{4\pi\varepsilon_0 L} = \left(\frac{\lambda \ln 2}{4\pi\varepsilon_0}\right)$

$$U = \frac{\lambda Q_0 \ln 2}{4\pi\varepsilon_0}$$

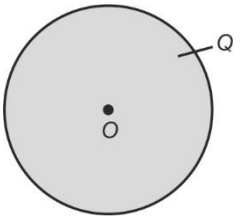
23. Answer (1)

Hint : $V_{\text{inside}} = V_{\text{surface}}$

Sol. : Potential at inside point will be same as potential at the surface of inside sphere.

24. Answer (1)

Hint : $V_0 = \frac{kQ}{R}$



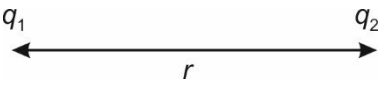
Sol. : V at center is $\frac{Q}{4\pi\varepsilon_0 R}\cdot\frac{3}{2} = \frac{3}{2}V_0$

$$\Delta V = \frac{3}{2}V_0 - V_0 = \frac{V_0}{2} = \frac{1}{2}\cdot\frac{1}{4\pi\varepsilon_0 R}\cdot\frac{4}{3}\pi R^3\rho$$

$$\Rightarrow \Delta V = \frac{\rho R^2}{6\varepsilon_0}$$

25. Answer (4)

Hint : $U = \frac{kq_1q_2}{r}$



Sol. : $U = 2\times\left[-\frac{kq^2}{a} + \frac{kq^2}{2a} - \frac{kq^2}{3a} + \ldots\infty\right]$

$$= -\frac{kq^2\times 2}{a}\left(1 - \frac{1}{2} + \frac{1}{3} - \ldots\infty\right)$$

Note: $\boxed{\ln(1+x) = x - \frac{x^2}{2} + \frac{x^3}{3} - \frac{x^4}{4} + \ldots}$

$$\therefore\ U = -\frac{kq^2\times 2}{a}\times\ln(2)$$

$$\Rightarrow \boxed{U = -\frac{q^2}{2\pi\varepsilon_0 a}\cdot\ln(2)}$$

26. Answer (3)

Hint : $U = \left(\frac{Q^2}{2C}\right)$

Sol. : $U = \frac{(2Q)^2}{(2)\{4\pi\varepsilon_0 2a\}}$

$$U = \frac{4Q^2}{16\pi\varepsilon_0 a} = \frac{Q^2}{4\pi\varepsilon_0 a}$$

27. Answer (1)

Hint : $\sum Q = 0$

Sol. : $\sum Q = 0$

$\Rightarrow Q + 2Q - Q + Q_1 = 0$

$\Rightarrow Q_1 = -2Q$

28. Answer (3)

Hint : Parallel arrangement

Sol. : $C_{eq} = C + \frac{C}{2} + \frac{C}{4} + \frac{C}{8} + \ldots\infty$

$$= C \times \frac{1}{\left(1 - \frac{1}{2}\right)} = 2C$$

29. Answer (4)

Hint : $V_P = V_1 + V_2$

Sol. : $V_P = \frac{\left(\frac{\sigma}{2}\right)2R}{\pi\varepsilon_0} + \frac{(2\sigma)\frac{R}{2}}{\pi\varepsilon_0}$

$$= \left(\frac{2\sigma R}{\pi\varepsilon_0}\right)$$

30. Answer (3)

Hint : $E_A = \frac{KQ}{r^2}$ due to shell at outside point

Sol. : $E_A = \frac{K(3Q)}{r_A^2}$

r_A is distance of A from O

$\Rightarrow E_A$ = constant

PART - B (CHEMISTRY)

31. Answer (2)

Hint : Paramagnetic substances get magnetised in a magnetic field and lose their magnetism when the field is removed.

Sol. : Ferrimagnetic substances have domains oriented oppositely in unequal numbers.

32. Answer (1)

Hint : In HCP, there are 6 atoms per unit cell.

Sol. : 8 tetrahedral voids are completely inside. There are tetrahedral voids on the vertical edges which are shared.

33. Answer (1)

Hint : In AB type structure, the cation A^+ can occupy either all octahedral voids or half the tetrahedral voids.

Sol. : In AB_2 type structure, co-ordination number ratio of $A^{2+} : B^-$ is 2 : 1.

34. Answer (2)

Hint : If edge length is a, then $\sqrt{3}\,a = 4R$.

Sol. : $a = \frac{4R}{\sqrt{3}}$

Now $2R + 2x = a$

$\Rightarrow x = \frac{a - 2R}{2}$

$$= \frac{\frac{4R}{\sqrt{3}} - 2R}{2}$$

$$= \left(\frac{2 - \sqrt{3}}{\sqrt{3}}\right)R$$

35. Answer (4)

Hint : Electrical neutrality must be maintained in ionic solids.

Sol. : Presence of F-centres impart colour.

36. Answer (2)

Hint : Tetragonal system has all angles equal to 90°.

Sol. : Trigonal system has all angles not equal to 90°.

37. Answer (3)

Hint : $\lambda_m = \frac{K \times 1000}{C}$

Sol. : $100 = \frac{K \times 1000}{\left(\frac{0.1}{2}\right) \times 0.8}$

$\Rightarrow K = 4 \times 10^{-3}$

38. Answer (4)

Hint : $E_{cell} = E^o_{cell} - \frac{0.06}{2} \log Q$

Sol. : $C: \ B^{3+} + e^- \longrightarrow B^{2+}$

$A: \ A \longrightarrow A^{2+} + 2e^-$

$A + 2B^{3+} \longrightarrow A^{2+} + 2B^{2+}$

$Q = \frac{[B^{2+}]^2 \cdot [A^{2+}]}{[B^{3+}]^2} = \frac{x^2}{0.1}$

$\therefore \ E = E^o - \frac{0.06}{2} \log\left(\frac{x^2}{0.1}\right)$

$2.03 = 2 - 0.03 \log\left(\frac{x^2}{0.1}\right)$

$\Rightarrow \log\left(\frac{x^2}{0.1}\right) = -1$

$\Rightarrow x = 0.1$

39. Answer (2)

Hint : In conductivity cell, AC is used.

Sol. : DC changes the composition of solution and KCl cannot be used as Cl^- react with Ag^+ to form AgCl.

40. Answer (3)

Hint : At Cathode, reduction takes place

Sol. : At Anode, oxidation takes place

41. Answer (2)

Hint : Charge in faradays passed = g eq of species produced

Sol. : Charge passed $= \frac{1.93 \times 2500 \times 40}{100}$

$= 1930$ C

$\therefore$ Number of m moles of e^- = 20

Now, A : $H_2O \longrightarrow \frac{1}{2} O_2 + 2H^+ + 2e^-$

C : $Cu^{2+} + 2e^- \longrightarrow Cu$

$\therefore$ m moles of Cu deposited = 10

m moles of H^+ produced = 20

$\therefore \ [H^+] = \frac{20 \times 10^{-3}}{3} = \frac{2}{3} \times 10^{-2}$

$\therefore$ pH = 2 + log3 – log2 = 2.18

42. Answer (2)

Hint : Reactions take place in basic medium.

Sol. : **Cathode:** $O_2(g) + H_2O(l) + 4e^- \longrightarrow 4OH^-(aq)$

Anode: $2H_2(g) + 4OH^-(aq) \longrightarrow 4H_2O(l) + 4e^-$

43. Answer (1)

Hint : Entropy of solid is lesser than liquid.

Sol. : As $S_{solvent} < S_{solution}$

So $\left|(\Delta S_{fusion})_{solvent}\right| < \left|(\Delta S_{fusion})_{solution}\right|$

44. Answer (4)

Hint : T_b (solution) = T_b (solvent) + $K_b \cdot m$.

Sol. : Solution with the least boiling point will be decided by the value of 'm'.

45. Answer (2)

Hint : meq of acid = meq of base

$\frac{1.5}{M} \times 1 \times 1000 = 25 \times 0.2$

$\Rightarrow M = 300$

Sol. : Molality = $\frac{2.5 \times 1000}{300 \times 250} = \frac{1}{30}$

$\therefore \ \Delta T_f = iK_f m$

$0.1 = i(1.86)\frac{1}{30}$

$\Rightarrow i = 1.61$

$\therefore \ 1 + \alpha = 1.61$

$\Rightarrow \alpha = 0.61$

46. Answer (1)

Hint : When the last trace of liquid disappears, the vapor contains 6 moles of A and 4 moles of B.

Sol. : $P^o_A = 30$, $P^o_B = 50$

x_A = ?, x_B = ?

$y_A = \frac{3}{5}$, $y_B = \frac{2}{5}$

Now $y_A = \frac{P_A}{P_T} = \frac{P_A^o x_A}{P_A^o x_A + P_B^o x_B}$

$y_A = \frac{P_A^o x_A}{\left(P_A^o - P_B^o\right)x_A + P_B^o}$

$\frac{3}{5} = \frac{30\,x_A}{50 - 20\,x_A}$

$10 - 4x_A = 10x_A$

$x_A = \frac{10}{14}$

$\therefore P_T = 30 \times \frac{10}{14} + 50 \times \frac{4}{14} = \frac{500}{14}$

47. Answer (2)

Hint : $P = K_H \cdot X$

Sol. : $K_H = \frac{500}{0.01} = 5 \times 10^{+4}$

= 50 k torr

As temperature increases, Henry's constant increases. As solvent solute interactions become stronger, value of Henry's constant decreases.

48. Answer (4)

Hint : meq of NaOH = meq of H_2SO_4

Sol. : Neutralisation

$\frac{1.2}{40} \times 1000 = M \times 20 \times 2$

$\Rightarrow$ M = 0.75

Now, wt. of H_2SO_4 in 1 lit solution = 0.75 × 98 = 73.5 and wt. of 1 lit solution = 1024.5

$\therefore$ wt. of solvent = 951

$\therefore$ Mass percent of solute

$= \frac{73.5}{1024.5} \times 1000$

= 7.17%

$\therefore\ m = \frac{0.75 \times 1000}{951} = 0.79$

And mole fraction

$= \frac{0.75}{\frac{951}{18} + 0.75} = 0.014$

49. Answer (3)

Hint : $MnO_4^- + 8H^+ + 5e^- \longrightarrow Mn^{2+} + 4H_2O$

Sol. : $E = E° - \frac{0.06}{5}\log\frac{1}{[H^+]^8}$

= E° – 0.096 pH

= 1.51 – 0.096 (pH)

50. Answer (4)

Hint : van't Hoff factor = number of ions furnished by 1 mole.

Sol. : $Ca_3(PO_4)_2$, i = 5

$Na_4[Fe(CN)_6]$, i = 5

51. Answer (1)

Hint : For positive deviation, $P_{actual} > P_{Raoult}$

Sol. : $\Delta H > 0$ and $\Delta V > 0$

52. Answer (3)

Hint : Electrolyte is paste of KOH and ZnO

Sol. : It does not involve any ion whose conc. can change during its life time

53. Answer (4)

Hint : $E^o_{cell} = E^o_{cathode} - E^o_{Anode}$

Sol. : For (4), E^o = 2.126 V.

54. Answer (2)

Hint : Mole fraction of solute will be equal in both the beakers after a long time.

Sol. : Initially

Beaker A : n moles solute
4 moles of water

Beaker B : 2 moles of solute
3 moles of water

Finally

There is shifting of $\frac{1}{2}$ mole of water to beaker B.

$\therefore\ \frac{n}{n + 4 - \frac{1}{2}} = \frac{2}{2 + 3 + \frac{1}{2}}$

$\Rightarrow n = 2$

$\therefore$ 28 g of X contains 2 moles

$\therefore$ M = 14 g/mol

55. Answer (2)

Hint : $d = \dfrac{z(M_0)}{6\times10^{23}\times a^3}$

$M_0 = 58$

$d = 2.48\ gcm^{-3}$

Sol. : $a^3 = \dfrac{4\times58}{6\times10^{23}\times2.48} = 1.56\times10^{-22}$

$\Rightarrow a = 5.38\times10^{-8}\ cm = 538\ pm$

$\therefore \dfrac{a}{2} = 269\ pm$

56. Answer (4)

Hint : The liquids may be immiscible or showing positive deviation from Raoults law.

Sol. : For solution with positive deviation, the more volatile component may have very low mole fraction in the liquid phase.

57. Answer (2)

Hint : In the titration, AD is precipitated so A^+ are replaced by C^+.

Sol. : Since, conductance does not change so mobility of C^+ is comparable to A^+.

58. Answer (3)

Hint : LHE is anode.

RHE is cathode.

Sol. : A : $\underset{M_1}{2Cl^-} \longrightarrow \underset{P_1}{Cl_2} + 2e^-$

C : $\underset{P_2}{Cl_2} + 2e^- \longrightarrow \underset{M_2}{2Cl^-}$

$$\underset{M_1}{2Cl^-} + \underset{P_2}{Cl_2} \longrightarrow \underset{P_1}{Cl_2} + \underset{M_2}{2Cl^-}$$

59. Answer (3)

Hint : Mole of H_2 = 2 mole of e^-

Sol. : $n_{H_2} = \dfrac{1.93\times5\times60}{2\times96500} = 3\times10^{-3}$

60. Answer (4)

Hint : Body diagonal plane contains 2 Zn^{2+} ions.

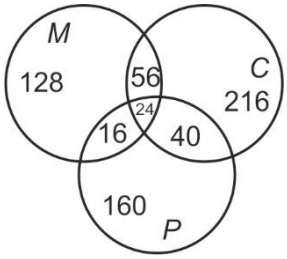
Sol. : Body diagonal plane will consist of four S^{2-} ions at the corners $\left(4\times\dfrac{1}{8}\right)$ and two S^{2-} ions at the face centre $\left(2\times\dfrac{1}{2}\right)$.

PART - C (MATHEMATICS)

61. Answer (3)

Hint : Venn diagram

Sol. :



$n(P \cup C \cup M) = 640$

$\Rightarrow n$(who did not opt)

= 800 – 640 = 160

62. Answer (4)

Hint : R^{-1} is also an equivalence relation

Sol. : The inverse of an equivalence relation is also an equivalence relation.

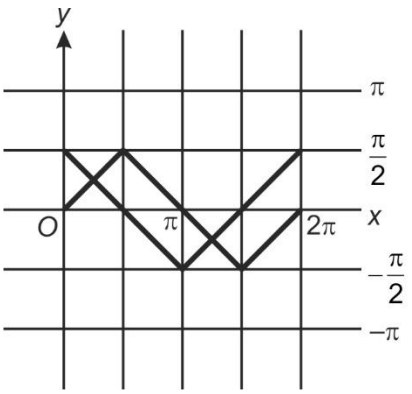
63. Answer (3)

Hint : Draw graph

Sol. :

- $y = \sin^{-1}(\sin x)$
- $y = \sin^{-1}(\cos x)$

$= \dfrac{\pi}{2} - \cos^{-1}(\cos x)$



64. Answer (2)

Hint : Reflexive relations = 2^{n^2-n}

Sol. : Number of relations = $2^{n^2} = 2^{25}$

Number of reflexive relations

$= 2^{n^2-n} = 2^{25-5} = 2^{20}$

65. Answer (2)

Hint : Onto function = 0

Sol. : Number of onto functions = 0

Number of functions = 4^3

$\Rightarrow$ Number of functions which are not onto = 64

66. Answer (2)

Hint : Find domain

Sol. : $-1 \le x \le 1$, $-1 \le x+2 \le 1$

$\Rightarrow x = -1$

$f(-1) = -\frac{\pi}{2} - 0 + 0 = -\frac{\pi}{2}$

67. Answer (2)

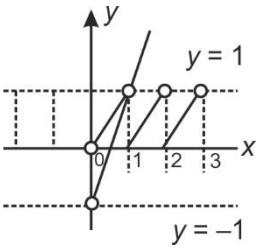
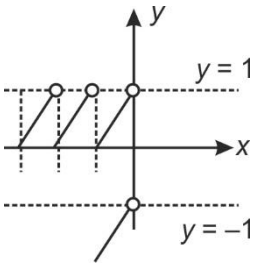
Hint : $f(x + T) = f(x)$

Sol. : $f\left(x+\frac{\pi}{2}\right) = f(x)$

68. Answer (3)

Hint : Solve graphically

Sol. : $-1 \le \frac{[x]-1}{x} \le 1, x \ne 0$

If $x > 0$	If $x < 0$
$-x \le [x] - 1 \le x$	$-x \ge [x] - 1 \ge x$
$1 - x \le [x] \le x + 1$	$1 - x \ge [x] \ge 1 + x$
$1 - x \le x - \{x\} \le x + 1$	$1 - x \ge x - \{x\} \ge 1 + x$
$x - 1 \ge \{x\} - x \ge -x - 1$	$x - 1 \le \{x\} - x \le -1 - x$
$2x - 1 \ge \{x\} \ge -1$	$2x - 1 \le \{x\} \le -1$
	
$\Rightarrow x \ge 1$	$\Rightarrow x = \phi$

$\Rightarrow x \in [1, \infty)$

69. Answer (3)

Hint : $1 - \sin 2 = (\cos 1 - \sin 1)^2$

Sol. : $\tan^{-1}\left(\frac{\sin 2 - 1}{\cos 2}\right) = \tan^{-1}\left(-\frac{1-\tan 1}{1+\tan 1}\right)$

$= \tan^{-1}\left\{-\tan\left(\frac{\pi}{4} - 1\right)\right\}$

$= 1 - \frac{\pi}{4}$

70. Answer (3)

Hint : $\tan^{-1}x - \tan^{-1}y = \tan^{-1}\frac{x-y}{1+xy}$

Sol. : $\tan^{-1}x + \tan^{-1}\left(\frac{1}{y}\right) = \tan^{-1}(3)$

$\tan^{-1}\left(\frac{1}{y}\right) = \tan^{-1}3 - \tan^{-1}x = \tan^{-1}\left(\frac{3-x}{1+3x}\right)$

$y = \frac{1+3x}{3-x} = -3 + \frac{10}{3-x}$

For positive integer y, $x = 1, 2$

$\Rightarrow$ Solutions are (1, 2)(2, 7)

71. Answer (4)

Hint : $\sin^{-1}x + \cos^{-1}x = \frac{\pi}{2}$

Sol. : $(\sin^{-1}x)^2 + (\cos^{-1}x)^2$

$= (\sin^{-1}x + \cos^{-1}x)^2 - 2\sin^{-1}x\left(\frac{\pi}{2} - \sin^{-1}x\right)$

$= \frac{\pi^2}{4} + 2(\sin^{-1}x)^2 - \pi\sin^{-1}x$

$= \frac{\pi^2}{4} + 2\left[(\sin^{-1}x)^2 - \frac{\pi}{2}\sin^{-1}x + \frac{\pi^2}{16}\right] - \frac{\pi^2}{8}$

$= \frac{\pi^2}{8} + 2\left[\left(\sin^{-1}x - \frac{\pi}{4}\right)^2\right]$

$-\frac{\pi}{2} \le \sin^{-1}x \le \frac{\pi}{2} \Rightarrow -\frac{3\pi}{4} \le \sin^{-1}x - \frac{\pi}{4} \le \frac{\pi}{4}$

$\Rightarrow 0 \le \left(\sin^{-1}x - \frac{\pi}{4}\right)^2 \le \frac{9\pi^2}{16}$

$\Rightarrow \frac{\pi^2}{8} \le (\sin^{-1}x)^2 + (\cos^{-1}x)^2 \le \frac{10\pi^2}{8}$

72. Answer (3)

Hint : Break the function at –1, 0, 1, 2, 3

Sol. : $[x] \ne 0 \Rightarrow x \notin [0, 1)$

$$f(x) = \begin{cases} -1, & -\infty < x < -1 \\ -2, & -1 \le x < 0 \\ 2, & 1 \le x < 2 \\ 1, & 2 \le x < 3 \\ 0, & 3 \le x < \infty \end{cases}$$

73. Answer (1)

Hint : $T_n = \tan^{-1}\frac{n(r+1)}{n+1} - \tan^{-1}\frac{nr}{n+1}$

Sol. : $T_n = \tan^{-1}\frac{n(n+1)}{(n+1)^2 + n^2r(r+1)}$

$= \tan^{-1}\left(\frac{\frac{n}{n+1}}{1 + \frac{n(r+1)}{n+1}\cdot\frac{nr}{n+1}}\right)$

$= \tan^{-1}\left(\frac{\frac{n(r+1)}{n+1} - \frac{nr}{n+1}}{1 + \frac{n(r+1)}{n+1}\cdot\frac{nr}{n+1}}\right)$

$= \tan^{-1}\frac{n(r+1)}{n+1} - \tan^{-1}\frac{nr}{n+1}$

$S = \tan^{-1}(n) - \tan^{-1}\left(\frac{n}{n+1}\right)$

$\Rightarrow \lim_{n\to\infty} S = \frac{\pi}{2} - \frac{\pi}{4} = \frac{\pi}{4}$

74. Answer (1)

Hint : $-\frac{\pi}{2} \le \sin^{-1}x \le \frac{\pi}{2}$

Sol. : $-\frac{\pi}{2} \le 2\tan^{-1}a \le \frac{\pi}{2}$

$\Rightarrow -\frac{\pi}{4} \le \tan^{-1}a \le \frac{\pi}{4} \Rightarrow -1 \le a \le 1$

75. Answer (2)

Hint : $\tan^{-1}x \pm \tan^{-1}y = \tan^{-1}\left(\frac{x \pm y}{1 \mp xy}\right)$

Sol. : $\tan x \cdot \cot x = 1 > -1$

$\Rightarrow \tan^{-1}(\tan x) - \tan^{-1}(\cot x) = \tan^{-1}\left(\frac{\tan x - \cot x}{1 + \tan x\cot x}\right)$

$= \tan^{-1}\left(\frac{\tan^2 x - 1}{2\tan x}\right) = \tan^{-1}(-\cot 2x)$

$= -\tan^{-1}(\cot 2x) = -\tan^{-1}\tan\left(\frac{\pi}{2} - 2x\right)$

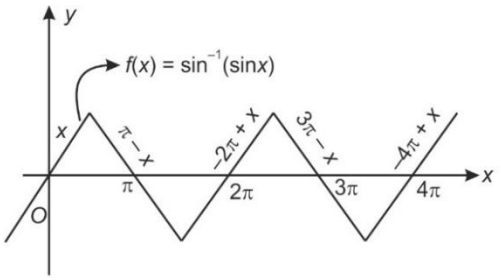
$= \tan^{-1}\tan\left(2x - \frac{\pi}{2}\right)$

$\Rightarrow T = \frac{\pi}{2}$

76. Answer (4)

Hint : Draw graph of $\sin^{-1}(\sin x)$

Sol. :



$\Rightarrow f(2) = \pi - 2,\ f(3) = \pi - 3,\ f(7) = 7 - 2\pi,\ f(9) = 3\pi - 9,$

77. Answer (1)

Hint : Find domain

Sol. : $-1 \le 2x \le 1 \Rightarrow -\frac{1}{2} \le x \le \frac{1}{2}$

Let $f(x) = \sin^{-1}(2x) - \cos^{-1}x + \tan^{-1}(2x)$

$\sin^{-1}2x$ is increasing

$\cos^{-1}x$ is decreasing

and $\tan^{-1}(2x)$ is increasing function

$$\Rightarrow f(x)_{\min} = f\left(-\frac{1}{2}\right) = -\frac{\pi}{2} - \frac{2\pi}{3} - \frac{\pi}{4} = \frac{-17\pi}{12}$$

$$f(x)_{\max.} = f\left(\frac{1}{2}\right) = \frac{\pi}{2} - \frac{\pi}{3} + \frac{\pi}{4} = \frac{5\pi}{12}$$

$\Rightarrow f(x) = \frac{\pi}{2}$ does not have any solution

78. Answer (2)

Hint : $2\tan^{-1}x = \tan^{-1}\frac{2x}{1-x^2}$

Sol. : $4\tan^{-1}\left(\frac{1}{5}\right) = 2\left(2\tan^{-1}\frac{1}{5}\right)$

$$= 2\cdot\tan^{-1}\left(\frac{2\times\frac{1}{5}}{1-\frac{1}{25}}\right) = 2\tan^{-1}\left(\frac{5}{12}\right)$$

$$= \tan^{-1}\left(\frac{2\times\frac{5}{12}}{1-\frac{25}{144}}\right) = \tan^{-1}\left(\frac{120}{119}\right)$$

$$\Rightarrow 4\tan^{-1}\left(\frac{1}{5}\right) - \cot^{-1}(239)$$

$$= \tan^{-1}\left(\frac{120}{119}\right) - \tan^{-1}\left(\frac{1}{239}\right)$$

$$= \tan^{-1}\left(\frac{\frac{120}{119} - \frac{1}{239}}{1 + \frac{120}{119}\cdot\frac{1}{239}}\right) = \tan^{-1}(1) = \frac{\pi}{4}$$

79. Answer (2)

Hint : $0 \le \{x\} < 1$

Sol. : $\because$ $\text{sgn}(\sin^{-1}x) = \{-1, 0, 1\}$ and $\{2x\} \in [0, 1)$

$\Rightarrow \text{sgn}(\sin^{-1}x) = \{2x\} = 0 \Rightarrow x = 0$

80. Answer (1)

Hint : $|\sin x| + |\cos x| \in [1, \sqrt{2}]$

Sol. : $\because$ $|\sin x| + |\cos x| \in [1, \sqrt{2}]$

$\Rightarrow [|\sin x| + |\cos x|] = 1$

$\Rightarrow$ domain of $f(x)$ is ϕ (empty set)

81. Answer (3)

Hint : Break G.I.F

Sol. : $f(x) = \begin{cases} -3, & x \in [-1, -\sin 1) \\ -2, & x \in [-\sin 1, 0) \\ 0, & x \in [0, \sin 1) \\ 1, & x \in [\sin 1, 1] \end{cases}$

82. Answer (4)

Hint : $\ln(1 + x)$ is an integer

Sol. : $x + 1 > 0 \quad x > -1$

$\ln(1 + x) + [(1+ x)^2] - 3$ is an integer

$\Rightarrow \ln(1 + x)$ is an integer

$\Rightarrow [\ln(1 + x)] = \ln(1 + x)$

$\Rightarrow [(1 + x)^2] = 3$

$3 \le (1 + x)^2 < 4$

$\sqrt{3} \le |1 + x| < 2$

$\ln\sqrt{3} \le \ln(1 + x) < \ln 2$

$\ln(1 + x)$ is integer for no value of x

83. Answer (3)

Hint : $\sin x \in [-1, 1]$

Sol. : $2^{\sin x} + 2^y = 1$

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

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

$$\Rightarrow \frac{1}{2} \ge 1 - 2^{\sin x} \ge -1 \Rightarrow -1 \le 2^y \le 2^{-1}$$

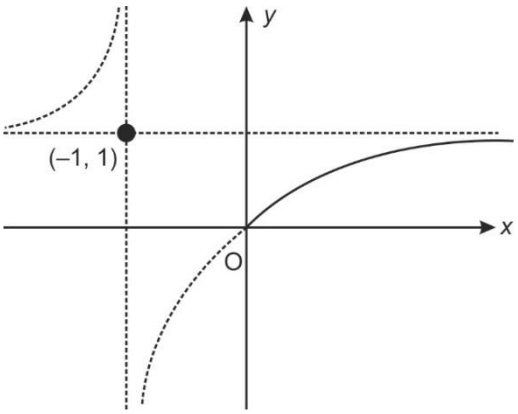
$$\Rightarrow y \in (-\infty, -1]$$

84. Answer (1)

Hint : Draw graph

Sol. : $y = \frac{x}{1+x} = 1 - \frac{1}{1+x}$

$(y - 1)(x + 1) = -1$



$y \in [0, 1)$

$\Rightarrow f(x)$ is one-one and into function

85. Answer (4)

Hint : Put $9^x = t$

Sol. : $3^{4x} + 9^{|x-1|} - 10 \le 0$

$81^x + 9^{|x-1|} - 10 \le 0$

Put $9^x = t$

If $x - 1 \le 0$	If $x - 1 \ge 0$
$t^2 + \frac{9}{t} - 10 \le 0$	$t^2 + \frac{t}{9} - 10 \le 0$
$t^3 - 10t + 9 \le 0$	$\because x \ge 1 \Rightarrow 9^x \ge 9$
$(t-1)(t^2 + t - 9) \le 0$	$\Rightarrow t \ge 9$
$(t-1)\left[\left(t + \frac{1}{2}\right)^2 - 9 - \frac{1}{4}\right] \le 0$	$\Rightarrow t^2 + \frac{t}{9} \ge 82$
$(t-1)\left(t + \frac{1}{2} + \frac{\sqrt{37}}{2}\right)$	$\Rightarrow t^2 + \frac{t}{9} - 10 \le 0$
$\left(t + \frac{1}{2} - \frac{\sqrt{37}}{2}\right) \le 0$	Has no solution.
$\Rightarrow (t-1)\left(t - \frac{\sqrt{37}-1}{2}\right) \le 0$	
$1 \le t \le \frac{\sqrt{37}-1}{2}$	
$1 \le 9^x \le \frac{\sqrt{37}-1}{2}$	
$0 \le x \le \log_9\left(\frac{\sqrt{37}-1}{2}\right)$	

86. Answer (3)

Hint : $t + \frac{1}{t} \ge 2$, when $t > 0$

Sol. :

$$|x| + \frac{1}{|x|} \ge 2, \ |y| + \frac{1}{|y|} \ge 2,$$

$$|x| \cdot |y| + \frac{1}{|x||y|} \ge 2$$

$$\Rightarrow |x| + |y| + |x||y| + \frac{1}{|x|} + \frac{1}{|y|} + \frac{1}{|x||y|} \ge 6$$

$$\Rightarrow |x| + |y| + |x||y| + \frac{1}{|x|} + \frac{1}{|y|} + \frac{1}{|x||y|} = 6$$

$$\Rightarrow |x| = |y| = \frac{1}{|x|} = \frac{1}{|y|} = |x||y| = \frac{1}{|x||y|} = 1$$

$\Rightarrow |x| = |y| = 1 \Rightarrow x = \pm 1, y = \pm 1$

Ordered pairs are (1, 1), (–1, 1), (1, –1), (–1, –1)

87. Answer (4)

Hint : $\cos^{-1}x = \frac{\pi}{2} - \sin^{-1}x$

Sol. :

$$\sin^{-1}x\left(\frac{\pi}{2} - \sin^{-1}x\right) + \frac{\pi}{4}\left(\frac{\pi}{2} - \sin^{-1}x - \sin^{-1}x\right) - \frac{\pi^2}{16} > 0$$

$$\frac{\pi}{2}\sin^{-1}x - (\sin^{-1}x)^2 + \frac{\pi^2}{8} - \frac{\pi}{2}\sin^{-1}x - \frac{\pi^2}{16} > 0$$

$$(\sin^{-1}x)^2 - \frac{\pi^2}{16} < 0$$

$$-\frac{\pi}{4} < \sin^{-1}x < \frac{\pi}{4}$$

$$-\frac{1}{\sqrt{2}} < x < \frac{1}{\sqrt{2}}$$

88. Answer (4)

Hint : $y = x$

Sol. : $\because \sin^{-1}x + \cos^{-1}y = \frac{\pi}{2}$ …(1)

$(x, y) \in R$

$\because \sin^{-1}x + \cos^{-1}x = \frac{\pi}{2} \Rightarrow (x, x) \in R$

$\Rightarrow R$ is reflexive

Let $\sin^{-1}y + \cos^{-1}x = k$ …(2)

From (1) + (2)

$\Rightarrow k = \frac{\pi}{2} \Rightarrow \sin^{-1}y + \cos^{-1}x = \frac{\pi}{2}$

$\Rightarrow (y, x) \in R \Rightarrow R$ is symmetric

Let $(y, z) \in R \Rightarrow \sin^{-1}y + \cos^{-1}z = \frac{\pi}{2}$ …(3)

From (1) + (3),

$\sin^{-1}x + \cos^{-1}z = \frac{\pi}{2} \Rightarrow (x, z) \in R$

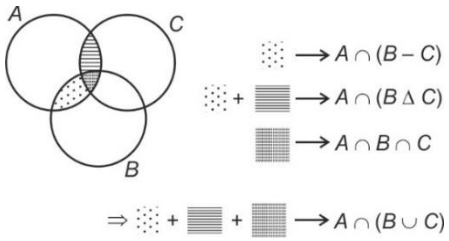
$\Rightarrow R$ is transitive

$\Rightarrow R$ is equivalence relation

89. Answer (3)

Hint : Venn diagram

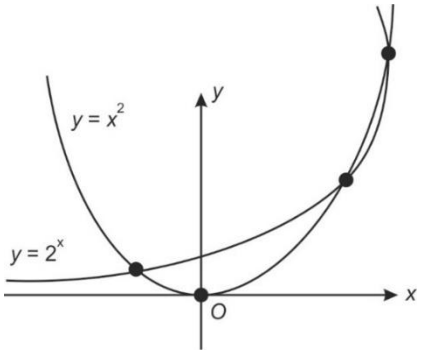
Sol. :



90. Answer (4)

Hint : Draw graph

Sol. :



$n(A \cap B) = 3$

$\Rightarrow n(P(A \cap B)) = 2^3 = 8$

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