Sri Chaitanya IIT Academy.,India.

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A right Choice for the Real Aspirant

ICON Central Office - Madhapur - Hyderabad

Sec: Sr.Super60_STERLING BT | **JEE-ADV-2023_P1** | **Date: 15-06-2025**

Time: 09.00Am to 12.00Pm | **WTA-34** | **Max. Marks: 180**

KEY SHEET

MATHEMATICS

1	**CD**	2	**BD**	3	**ABC**	4	**A**	5	**D**	6	**B**
7	**C**	8	**3**	9	**3**	10	**4**	11	**3600**	12	**4**
13	**35**	14	**C**	15	**C**	16	**C**	17	**A**		

PHYSICS

18	**ACD**	19	**ABD**	20	**ABCD**	21	**B**	22	**B**	23	**A**
24	**A**	25	**3**	26	**5**	27	**4**	28	**5**	29	**3**
30	**4**	31	**A**	32	**C**	33	**B**	34	**C**		

CHEMISTRY

35	**ABD**	36	**ABCD**	37	**ABD**	38	**C**	39	**A**	40	**C**
41	**B**	42	**3**	43	**9**	44	**6**	45	**4**	46	**1**
47	**3**	48	**A**	49	**B**	50	**B**	51	**A**		

SOLUTIONS
MATHEMATICS

1. CD

If α is real root then $\alpha = 2, m = \pm 2,$ non real root $= 1 + i$ ACD

2. BCD

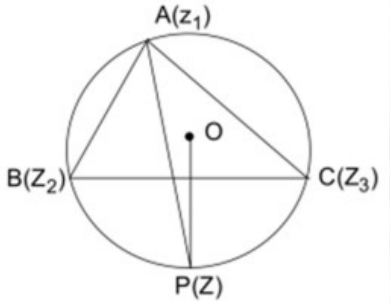
3. $$\sum_{1\le i<j\le 7}\left|a_i + a_j\right|^2 = \sum_{1<i<j<7}\left(\left|a_i\right|^2 + \left|a_j\right|^2 + a_i\bar{a}_j + \bar{a}_i a_j\right)$$

$$= 2R^{2.7}C_2 + \sum_{i\neq j} a_i\bar{a}_j = 42R^2 + \sum_{i=1}^{7}\sum_{j=1}^{7} a_i\bar{a}_i$$

$$= 35R^2 + \left(\sum_{i=1}^{7} a_i\right)\left(\sum_{i=1}^{7}\bar{a}_i\right) - 7R^2$$

$$= 35R^2 + \left|\sum_{i=1}^{7} a_i\right| \ge 35R^2$$

4. Since $OP \perp BC$



$$\Rightarrow \arg\left(\frac{z}{z_3 - z_2}\right) = -\frac{\pi}{2}$$

5. $$z_1, z_2, z_3, \ldots\ldots z_k = \cos\left(\sum_{n=1}^{n=k}\frac{1}{n(n+1)(n+2)}\right) + i\sin\left(\sum_{n=1}^{n=k}\frac{1}{n(n+1)(n+2)}\right)$$

$$= \cos\frac{\pi}{4} + i\sin\frac{\pi}{4} = \frac{1}{\sqrt{2}} + i\frac{1}{\sqrt{2}}$$

6. B

$$\frac{z+\bar{z}}{2} = |z-1| \Rightarrow x^2 = (x-1)^2 + y^2 \; or \; y^2 = 2x - 1$$

Let $z_1\left(\frac{t_1^2+1}{2}, t_1\right)$ & $z_2\left(\frac{t_2^2+1}{2}, t_2\right)$

$$\because \arg(z_1 - z_2) = \frac{\pi}{3} \Rightarrow \frac{t_2 - t_1}{\frac{t_2^2 - t_1^2}{2}} = \sqrt{3}$$

$\Rightarrow Im(z_1+z_2)=\frac{2}{\sqrt{3}}$

7. C

The image of z in the line $x=y$ is $i\bar{z}$.

$\therefore$ The image of the given curve is $\arg\left(\frac{i\bar{z}+i}{i\bar{z}-i}\right)=\frac{\pi}{4}\Rightarrow \arg\left(\frac{z-i}{z+1}\right)=\frac{\pi}{4}$

8. Assume $\alpha_1<\frac{\pi}{6}$

$2(\sin\alpha_1+\sin\alpha_2+\sin\alpha_3)=3\sin(\alpha_1+\alpha_2+\alpha_3)$

Also, $\frac{\sin\alpha_1+\sin\alpha_2+\sin\alpha_3}{3}\le\sin\left(\frac{\alpha_1+\alpha_2+\alpha_3}{3}\right)\left[\alpha_1\in\left(0,\frac{\pi}{2}\right)\right]$

$\Rightarrow\frac{\sin(\alpha_1+\alpha_2+\alpha_3)}{2}\le\sin\left(\frac{\alpha_1+\alpha_2+\alpha_3}{3}\right)\Rightarrow\sin 3t\le\sin t\Rightarrow 4\sin^3 t-\sin t\ge 0$

$\Rightarrow\sin^2 t\ge\frac{1}{4}$, which contradicts assumption

9. 3

$\therefore z_1=z\Rightarrow z_2^2=z^2\omega^2, z_3=z_2^2\omega^2$

$\therefore\frac{z_2}{z_1}=+\omega\ or\ -\omega$

$\frac{z_3}{z_1}=+\omega^2\ \ or\ -\omega^2$

10. 4

Multiple the given equation $z^3-1=0$

Yield $z^9-1=0$

$z_n=\cos n,40^0+i\sin n40^0\ n=0,1,2.....,8$ of these only z_3 and z_4 are in the second quadrant. However, since the solution of $z^9-1=0$ are distinct and since z_3 is a solution of $z^3=1$ it cannot be solution of the original equation. It follows that desired root in z_4 with of agree measure 160^0

11. 03600.00

As $z_1+z_2+z_3=0\Rightarrow z_1,z_2,z_3$ are vertices of an equilateral and z_4,z_5 are end points of diameter

So, $|z_i-z_j|^2=3r^2$

If $i,j\in\{1,2,3\};|z_i-z_j|^2=4r^2$ if $i\in\{1,2,3\}$ & $z\in\{4,5\}$ & $|z_4-z_5|^2=4r^2$

$\Rightarrow\sum_{1\le i\le j\le 5}\sum|z_i-z_j|=25r^2=3600$

12. Let $z_1 = r_1 e^{i\theta_1}$ and $z_2 = r_2 e^{i\theta_2}$

$$\Rightarrow \frac{z_1\bar{z}_2 + \bar{z}_1 z_2 + z_1 z_2 + \bar{z}_1\bar{z}_2}{|z_1 z_2|} = 2\cos(\theta_1 - \theta_2) + 2\cos(\theta_1 + \theta_2)$$

13. From the figure it is clear that for $\arg z \geq \frac{\pi}{2}$ circle should either lie in second quadrant of touch the positive imaginary axis $\Rightarrow f(\alpha) \leq 1$

$\alpha^2 - 7\alpha + 13 \leq 1$

$\alpha^2 - 7\alpha + 12 \leq 0$

$3 \leq \alpha \leq 4$

14. $\because \left|\frac{z_1 - 2z_2}{2 - z_1 z_2}\right| = 1$

$\Rightarrow |z_1 - 2z_2|^2 = |2 - z_1\bar{z}_2|^2 \Rightarrow (z_1 - 2x_2)\left(\overline{z_1 - 2z_2}\right) = \left(2 - z_1\overline{z_2}\right)\left(\overline{2 - z_1\bar{z}_2}\right)$

$\Rightarrow (z_1 - 2z_2)\left(\bar{z}_1 - 2\bar{z}_2\right) = \left(2 - z_1\bar{z}_2\right)\left(2 - \bar{z}_1 z_2\right)$

$\Rightarrow z_1\bar{z}_1 - 2z_1\bar{z}_2 + 4z_2\bar{z}_2 = 4 - 2\bar{z}_1 z_2 - 2z_1\bar{z}_2 + z_1\bar{z}_1 z_2\bar{z}_2 \Rightarrow \left(|z_1|^2 - 4\right)\left(1 - |z_2|^2\right) = 0$

$\because |z_2| \neq 1$

$\therefore |z_1|^2 = 4$ *or* $|z_1| = 2 \Rightarrow$ Point z_1 lies on circle of radius 2

15. B

P-2, Q-1, R-3, S-5

$|z|^3 + 2z^2 + 4\bar{z} - 8 = 0$

Let $z = x + iy, y \neq 0$

Put $|x + iy|^3 + 2(x + iy)^2 + 4(x - iy) - 8 = 0 \Rightarrow x = 1, y^2 = 3$

$(P)\left|z^2\right| = x^2 + y^2 = 1 + 3 = 4$

$(Q)\left|z - \bar{z}\right|^2 = |x + iy - x + iy|^2 = 4y^2 = 12$

$(R)|z|^2 + \left|z + \bar{z}\right|^2 = x^2y^2 + |x + iy + x - iy|^2 = x^2 + y^2 + 4x^2 = 5x^2 + y^2 = 5 + 3 = 8$

$(S)|z + 1|^2 = |x + iy + 1|^2 = \left|1 + i\sqrt{3} + 1\right|^2 = (4 + 3) = 7$

16. $(P)Z = \frac{(1+i)^5\left(1+\sqrt{3i}\right)^2}{-2i\left(-\sqrt{3}+i\right)} = \frac{\left(\sqrt{2}^5\right)\left(\frac{1}{\sqrt{2}} + \frac{1}{\sqrt{2}}\right)^5 2^2\left(\frac{1}{2} + \frac{\sqrt{3}}{2}i\right)^2}{2i2\left(\frac{\sqrt{3}}{2} - \frac{i}{2}\right)}$

$\Rightarrow Argument = \frac{5\pi}{4} + \frac{2\pi}{3} - \frac{\pi}{2} + \frac{\pi}{6} = \frac{19\pi}{12}$

Therefore, the principle argument is $-5\pi/12$

$(Q) = \sin\frac{6\pi}{5} + i\left(1+\cos\frac{6\pi}{5}\right)$

Lies in 2nd quadrant and $\left|\frac{1+\cos\frac{6\pi}{5}}{\sin\frac{6\pi}{5}}\right| = \left|\cot\left(\frac{3\pi}{5}\right)\right| = \left|\cot\left(\frac{\pi}{2}+\frac{\pi}{10}\right)\right| = \tan\frac{\pi}{10}$

2nd quadrant $\Rightarrow \pi - \frac{\pi}{10}$

$(R)\, z = 1+\cos\frac{11\pi}{9} + i\sin\frac{11\pi}{9} = \left(-2\cos\frac{11\pi}{18}\right)\left[\cos\frac{11\pi}{18} + i\sin\frac{11\pi}{18}\right](-1)$

$|z| = -2\cos\frac{11\pi}{18} = 2\cos\frac{7\pi}{18}$

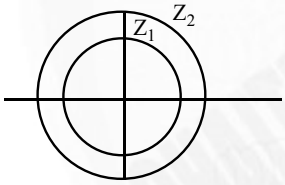
$\arg|z| = \frac{11\pi}{18} - \pi = \frac{-7\pi}{18}$

$(S)\, Z = \sin x \sin\left(x-60^0\right)\sin\left(x+60^0\right)$

Now, $Z = -\frac{1}{4}\sin 3x$ $\qquad 3x \in (0,\pi)$

Z is a negative real number hence principal arguments is π

17.



$(P)|z_1+z_2| \le |z_1|+|z_2| \le 2+1 \le 3 \quad (P)\to 1$

$(Q)\to 2|z_1-z_2| \Rightarrow$ minimum distance between z_1 & $z_2 = 1 \quad (Q)\to 2$

$(R)\to 3|2z_1+3z_2|$ minimum is $= 6-2 = 4 \qquad (R)\to 3$

$(S)|z_1-2z_2| \le |z_1|+|-2z_2|$

$1+4 \le 5$

$(S)\to 5$

PHYSICS

18) Conceptual

19. Conceptual

20. $\chi\alpha\frac{1}{T};\chi=\frac{I}{H}$

21. $E_0=c\,B_0=3\times10^8\times1.6\times10^{-6}\quad=4.8\times10^2$

$\vec{E}\perp^r\vec{B}\Rightarrow\vec{E}.\vec{B}=0$

22. Susceptibility χ for a paramagnetic substance varies with absolute temperature as

$\chi=\frac{C}{T}$

$\therefore\frac{\chi_2}{\chi_1}=\frac{T_1}{T_2}$

$\therefore\chi_2=\frac{300}{350}\times2.5\times10^{-5}=2.14\times10^{-5}$

$\therefore$ Magnetisation at $350\,K$ is

$I=\chi H=2.14\times10^{-5}\times2000\ Am^{-1}=4.28\times10^{-2}\ Am^{-1}$

23. $T=2\pi\sqrt{\frac{I}{MB_H}}$

'M' remains same

$T\alpha\sqrt{I}$

$\frac{T_1}{T_2}=\sqrt{\frac{I_1}{I_2}}$

$I_1=I$

$I_2=I/4$

$\frac{T}{T_2}=\sqrt{\frac{I}{I/4}}=2\Rightarrow T_2=T/2$

24. $W=mB\left[\cos\theta_1-\cos\theta_2\right]=-\frac{mB}{2}$

$T=mB\sin\theta_2=\left|mB\sin60^0\right|$

$\left|\vec{T}\right|=\left|\frac{mB\sqrt{3}}{2}\right|=\sqrt{3}\,W$

25. $\vec{E}_y=0.5\cos\left[w\left(t-\frac{x}{c}\right)\right]$

$\therefore w=2\pi\times10^8=2\pi\nu$

$\nu=10^8=\frac{C}{\lambda}$

$\lambda=\frac{3\times10^8}{10^8}=3\ m$

26. $A = 4\pi r^2 = 4\pi\left(\frac{10}{\sqrt{\pi}}\right)^2 = 400\,m^2$

Intensity $I = \varepsilon_0 C E_{rms}^{\ 2}$

and also $I - \frac{P}{4\pi r^2}\eta$

$\varepsilon_0 C E_{rms}^{\ 2} = \frac{P\eta}{4\pi r^2}$

$E_{rms} = \sqrt{\frac{60 \times 8.85}{100 \times 8.85 \times 10^{-12} \times 3 \times 10^8 \times 400}}$

$E_{rms} = \sqrt{5}\,v/m = 2.23 \text{ to } 2.24\,v/m$

27. $E = 10\ v/m \qquad \Rightarrow E_{rms=} \frac{E}{\sqrt{2}} = \frac{10}{\sqrt{2}}$

$\nu = 5 \times 10^{14}\,v_2$

$< E.D > = \frac{1}{2}\varepsilon_0 \quad E_{rms}^2 = \frac{1}{2} \times 8.854 \times 10^{-12} \times \frac{100}{2} = \frac{8.854}{4} \times 10^{-10} = 2.21 \times 10^{-10}\ \ J/m^3$

$< JED >= U_E + U_B = 2.21 \times 10^{-10} + 2.21 \times 10^{-10} = 4.42 \times 10^{10}\ J/m^3 = 4$

28. $B_a = \frac{\mu_0}{4\pi}.\frac{2M}{X^3}.....(1)$

$B_{eq} = \frac{\mu_0}{4\pi}.\frac{M}{X^3}.....(2)$

$B_a = 2\,B_{eq} = 2\,B_{eq}$

$200 = 2B_{eq}$

$B_{eq} = 100\ G$

29. $T_1 = -73 + 273 = 200k$

$T_2 = -173 + 273 = 100k$

$\chi\alpha\frac{1}{T} \qquad \frac{x_1}{x_2} = \frac{T_2}{T_1}$

$\frac{0.0075}{x_2} = \frac{1}{2}$

$x_2 = 0.015 = 15 \times 10^{-3}$

$\frac{x}{2} \times 10^{-2} = 15 \times 10^{-3}$

$x = 30 \times 10^{-3} \times 10^2$

$= 2x \times 10^{-2} = 15 \times 10^{-3}$

$\frac{x}{2} \times 10^{-2} = 15 \times 10^{-3}$

$x = 30 \times 10^{-3} \times 10^2$

$= 3$

30. $I\alpha\frac{B}{T} \quad \rightarrow (1)$

$I_1 = 8 \ A/m$

$B_1 = 0.6T \qquad T_1 = 4k$

$I_2 = ?$

$B_2 = 1.2T$

$T_2 = 16K$

$\frac{I_2}{I_1} = \frac{B_2}{B_1} \times \frac{T_1}{T_2}$

$I_2 = 8 \times \frac{1.2}{0.6} \times \frac{4}{16} = 4$

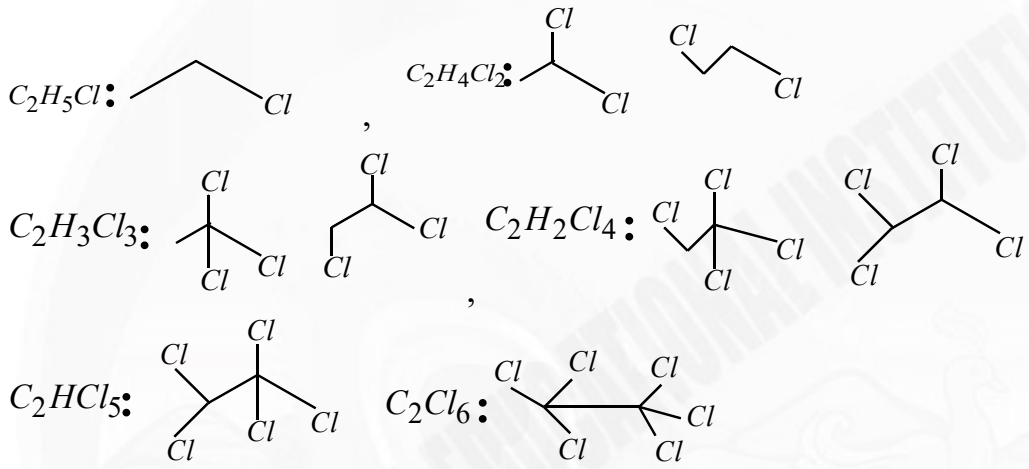
31. Conceptual

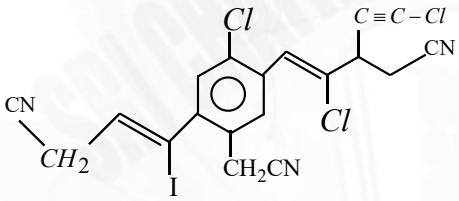
32. Conceptual

33. Conceptual

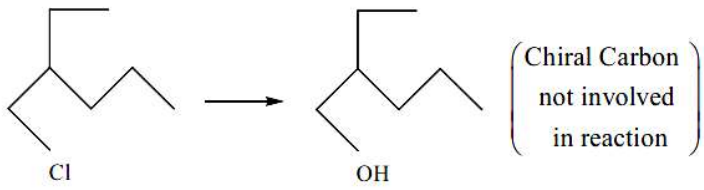
34. Conceptual

CHEMISTRY

35) ABD
36) ABCD
37) ABCD
38) 4
39) from sp^2 to sp
40) Conceptual
41) A will be faster both in S_N1 and S_N2 reaction
42) 6
43) 

Total
44) 6 (ALL ARE CORRECT)
45) 5 (ALL ARE CORRECT)
46) 1
47) 

$M.P = C_{19}H_{11}N_3Cl_3I = 228+11+42+106.5+127 = 514.5$

48) a-qr, b-ps, c-qr d-ps
49) a-s, b-r, c-p, d-q
50) 

51) a-q, b-p, c-s, d-r