Sri Chaitanya IIT Academy.,India.

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A right Choice for the Real Aspirant

ICON Central Office - Madhapur - Hyderabad

SEC: Sr.S60_Elite, Target & LIIT-BTs **JEE-MAIN** **Date: 12-01-2025**
Time: 09.00Am to 12.00Pm **GTM-17/12** **Max. Marks: 300**

KEY SHEET

MATHEMATICS

1	**4**	2	**3**	3	**1**	4	**4**	5	**3**
6	**2**	7	**2**	8	**1**	9	**2**	10	**3**
11	**1**	12	**1**	13	**3**	14	**2**	15	**2**
16	**2**	17	**3**	18	**4**	19	**3**	20	**4**
21	**4**	22	**1**	23	**3**	24	**12**	25	**6**

PHYSICS

26)	**3**	27)	**1**	28)	**3**	29)	**1**	30)	**4**
31)	**4**	32)	**3**	33)	**1**	34)	**2**	35)	**2**
36)	**1**	37)	**4**	38)	**2**	39)	**3**	40)	**2**
41)	**1**	42)	**3**	43)	**3**	44)	**1**	45)	**4**
46)	**4**	47)	**4**	48)	**2**	49)	**640**	50)	**425**

CHEMISTRY

51	**3**	52	**1**	53	**1**	54	**2**	55	**4**
56	**2**	57	**3**	58	**4**	59	**1**	60	**1**
61	**1**	62	**3**	63	**2**	64	**1**	65	**1**
66	**1**	67	**1**	68	**4**	69	**1**	70	**4**
71	**6**	72	**5**	73	**1**	74	**1**	75	**1**

SOLUTIONS
MATHEMATICS

01. $\int \frac{dx}{\cos^3 x\sqrt{4\sin x}\cos x} = \int \frac{dx}{2\cos^2 x\sqrt{\tan x}}$

let $\tan x = t^2 \Rightarrow \sec^2 x = 1+t^4 \Rightarrow \sec^2 x dx = 2tdt$

$= \int \frac{\sec^4 x}{2\sqrt{\tan x}} = \int \frac{\sec^2 x\left(\sec^2 x dx\right)}{2\sqrt{\tan x}} = \int \frac{\left(1+t^4\right)2tdt}{2t}$

$= \int \left(1+t^4\right)dt = t + \frac{t^5}{5} + k = \sqrt{\tan x} + \frac{1}{5}\tan^{5/2} + k \qquad \therefore A = 1/2, B = 5/2, C = 1/5$

02. $\frac{x-2}{2} = \frac{y-3}{2} = \frac{z-0}{1}, \frac{x+4}{-1} = \frac{y-7}{8} = \frac{z-5}{4}$

$a_1 = 2i+3j \; a_2 = -4i+7j+5k$

$b_1 = 2i+2j+k, b_2 = -i+8j+4k \; |b_1 \times b_2| = \begin{vmatrix} i & j & k \\ 2 & 2 & 1 \\ -1 & 8 & 4 \end{vmatrix} = -9i+18k$

$S.D = \left|\frac{(a_2-a_1)(b_1\times b_2)}{|b_1\times b_2|}\right| = \left|\frac{-36+90}{9\sqrt{5}}\right| = \frac{6}{\sqrt{5}} \therefore \frac{6}{\sqrt{5}} \in (2,3]$

3. Apply $\tan^{-1}x + \tan^{-1}y = \tan^{-1}\left(\frac{x+y}{1-xy}\right)$, Where $0<x<1$ *and* $0<y<1$

04. $(\sin x + \sin 4x) + (\sin 2x + \sin 3x) = 0 \Rightarrow 2\sin\frac{5x}{2}\left\{\cos\frac{3x}{2} + \cos\frac{x}{2}\right\} = 0$

$\Rightarrow 2\sin\frac{5x}{2}\left\{2\cos x\cos\frac{x}{2}\right\} = 0$

$2\sin\frac{5x}{2} = 0 \Rightarrow \frac{5x}{2} = 0, \pi, 2\pi, 3\pi, 4\pi, 5\pi$

$\Rightarrow x = 0, \frac{2\pi}{5}, \frac{4\pi}{5}, \frac{6\pi}{5}, \frac{8\pi}{5}, 2\pi \qquad \cos\frac{x}{2} = 0 \Rightarrow \frac{x}{2} = \frac{\pi}{2} \Rightarrow x = \pi$

$\cos x = 0 \Rightarrow x = \frac{\pi}{2}, \frac{3\pi}{2}$ So, sum = $6\pi + \pi + 2\pi = 9\pi$

05. Equation of real plane

$2x-5y+z-3+\lambda(x+y+4z-5) = 0$

$x(2+\lambda) + y(\lambda-5) + z(4\lambda+1) - 3 - 5\lambda = 0$

$\Rightarrow \frac{\lambda+2}{1} = \frac{\lambda-5}{3} = \frac{4\lambda+1}{6}$

$3\lambda+6 = \lambda-5 \qquad 2\lambda = -11 \qquad \lambda = \frac{-11}{2}$

$\Rightarrow$ Equation of plane $\frac{-7x}{2}-\frac{21y}{2}-21z+\frac{49}{2}=0\Rightarrow 7x+21y+42z-49=0$

$\Rightarrow x+3y+6z-7=0$

06. $fof(x)=f\left[\left(a-x^n\right)^{\frac{1}{n}}\right]=x$

07. Midpoint of line segment PQ be $\left(\frac{K+1}{2},\frac{7}{2}\right)$

Slope of perpendicular line P.T $(0,-4)$ & $\left(\frac{K+1}{2},\frac{7}{2}\right)\Rightarrow\frac{\frac{7}{2}+4}{\frac{K+1}{2}-0}=\frac{15}{K+1}$

Slope of PQ $=\frac{4-3}{1-K}=\frac{1}{1-K}$

$\frac{15}{1+K}\times\frac{1}{1-K}=-1\Rightarrow 1-K^2=-15$

$K^2=16\Rightarrow K=\pm 4\Rightarrow K=-4$

08. Equation of ellipse $\frac{x^2}{25}+\frac{y^2}{b^2}=1\Rightarrow e_1=\sqrt{1-\frac{b^2}{25}}$

Equation of hyp $\frac{x^2}{16}-\frac{y^2}{b^2}=1\Rightarrow e_2=\sqrt{1+\frac{b^2}{16}}$

$e_1e_2=1\Rightarrow\left(e_1e_2\right)^2=1\Rightarrow\left(1-\frac{b^2}{25}\right)\left(1+\frac{b^2}{16}\right)=1$

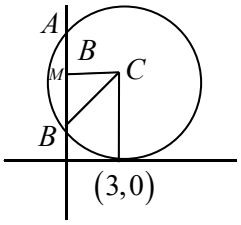
$\Rightarrow\frac{9b^2}{16.25}-\frac{b^4}{25.16}=0\Rightarrow b^2=9\Rightarrow e_1=4/5$ & $e_2=5/4$

$\alpha=2ae_1=8,\ \beta=2ae_2=10\Rightarrow|\alpha-\beta|=2$

09. $f'(x)=0\Rightarrow x=e$ stationary point $\left(e,f(e)\right)$

10. Let centre of circle is C and circle cuts the y-axis at B & A. Let midpoint of chord BA is M. $CB=\sqrt{MC^2+MB^2}=\sqrt{3^2+4^2}=5=radius\ of\ circle$

Equation of circle is $(x-3)^2+(y-5)^2=5^2$, $(3,10)$ satisfies this equation.



11. $A\to S;B\to r;C\to q;D\to p$

(A) Put $x=\frac{1}{y}\Rightarrow \underset{y\to 0}{Lim}\left(\frac{1}{1+y}\right)^{1/y}=e^{\underset{y\to 0}{Lim}\frac{1-y-1}{y(1+y)}}=e^{-1}$

(B) $\underset{y\to 0}{Lim}\left(\sin y+\cos y\right)^{1/y}=e^{\lim\limits_{y\to 0}\frac{\sin y+\cos y-1}{y}}=e$

(C) $e^{\lim\limits_{x\to 0}\frac{\cos x-1}{\frac{\tan^2 x}{x^2}x^2}}=e^{-1/2}$

$e^{\underset{x\to 0}{Lim}\left(\frac{\tan(45+x)+\tan 45}{x}\right)}=e^{\underset{x\to 0}{Lim}\frac{\tan x(1+\tan(45+x))}{x}}=e^2$

12. Both are true and Statement II is not correct explanation of the statement I
Statement I is true as period of $\sin x$ is 2π

13. $\int\frac{e^x}{1-e^x}dx+\int\frac{\sec^2 y}{\tan y}dy=0$

$-\log\left(1-e^x\right)+\log\left(\tan y\right)=\log c$

$\log\left(\frac{\tan y}{1-e^x}\right)=\log c$

$\tan y=\left(1-e^x\right)c$

14. Let $f(x)=5x^3+Mx+N$

Also $x^2+x+1=(x-\omega)\left(x-\omega^2\right)$

It is given that $f(x)$ is divisible by x^2+x+1.

$\therefore f(\omega)=5+M\omega+N=0 \qquad \therefore f\left(\omega^2\right)=5+M\omega^2+N=0$

So $M=0$ and $N=-5 \qquad \therefore M+N=-5$

15. $T_4={}^nC_3a^{n-3}b^3$

${}^nC_3=56$

$\frac{n!}{(n-3)!3!}=56\Rightarrow n(n-1)(n-2)=56\times 6$

$n(n-1)(n-2)=8\times 7\times 6\Rightarrow n=8$

16. Let two observations x_1,x_2

$\bar{x}=\frac{2+4+10+12+14+x_1+x_2}{7}=8\Rightarrow x_1+x_2=14\ldots.(1)$

$$\sigma^2 = \frac{\sum x_i^2}{N} - \left(\frac{\sum x_i}{N}\right)^2 = 16$$

$$\frac{4+16+100+144+196+x_1^2+x_2^2}{7} - 64 = 16 \Rightarrow x_1^2 + x_2^2 = 100 \quad \ldots.(2)$$

$$(x+y)^2 = x^2 + y^2 - 2xy \Rightarrow xy = 48$$

$$(x-y)^2 = (x+y)^2 - 4xy \Rightarrow |x-y| = 2$$

17. $f(t) = t^2 - 3t + 7 \Rightarrow t = A$

$$f(A) = A^2 - 3A + 7 \Rightarrow f(A) = \begin{bmatrix} -3 & -6 \\ 12 & 9 \end{bmatrix}$$

18. $y^2 = 8x \;\; 4a = 8 \Rightarrow a = 2$

Equation total of parbola $y = mx + \frac{2}{m}$ and $xy = +1$

$$x\left(mx + \frac{2}{m}\right) = +1 \Rightarrow mx^2 + \frac{2x}{m} - 1 = 0$$

$$\Delta = 0 \Rightarrow b^2 - 4ac = 0 \; \frac{4}{m^2} + 4m(1) = 0$$

$$\frac{4}{m^2} = -4m \Rightarrow \frac{1}{m^2} = -m \Rightarrow -m^3 = 1 \Rightarrow$$

$$1 + m^3 = 0 \Rightarrow (m+1)\left(m^2 - m + 1\right) = 0 \; m + 1 = 0 \Rightarrow m = -1$$

19. $f(x)\begin{cases} x^3 - 4x^2 + 3x & if \;\; x \geq 0 \\ -x^3 - 4x^2 - 3x & if \;\; x < 0 \end{cases}$

Case (i)

$$x^3 - 4x^2 + 3x \geq 0$$

$$x\left(x^2 - 4x + 3\right) = 0$$

$$x(x-1)(x-3) = 0$$

$$x = 0, 1, 3$$

Case (ii)

$$x < 0$$

$$-x^3 - 4x^2 - 3x = 0$$

$$-x\left(x^2 + 4x + 3\right) = 0$$

$$x(x+1)(x+3) = 0$$

$$x = 0, -1, -3$$

$$sum \; of \; all \; solution = 0 \,||$$

20. $\frac{t_4}{t_6} = \frac{1}{4} \qquad \frac{ar^3}{ar^5} = \frac{1}{4} \Rightarrow r^2 = 4 \Rightarrow r = 2 \qquad t_2 + t_5 = 216 \qquad ar + ar^4 = 216$

$$2a + 16a = 216 \Rightarrow 18a = 216 \Rightarrow a = 12$$

21. $Area = 2\int_0^2 xdx$ (or) $A = \frac{1}{2}(4)(2) = 4$

22. $\frac{dy}{dx} = \frac{x+1}{x+1} + \frac{y}{x+1}$

$\frac{dy}{dx} - \frac{1}{x+1}y = 1$

$If = e^{-\int \frac{1}{x+1}} = e^{-\log(x+1)} = \frac{1}{x+1}$

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

23. $I = \int_0^{\frac{\pi}{2}} \frac{dx}{3 + 2\sin x + \cos x} = \int_0^{\frac{\pi}{2}} \frac{\sec^2 \frac{x}{2}.dx}{2\tan^2 \frac{x}{2} + 4\tan \frac{x}{2} + 4}$

Put $\tan \frac{x}{2} = t$, so $I = \int_0^1 \frac{dt}{(t+1)^2 + 1} = \tan^{-1}(x+1)\Big|_0^1 = \tan^{-1} 2 - \frac{\pi}{4}$

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

24. $[i - \lambda j + k, i + j + \mu k, i - j + k] = 0 \quad = \lambda + \mu - 4\lambda\mu = 1 \ldots (1)$

$\lambda - \mu = 2 \ldots (2)$ From (1) & (2) $\mu = \pm 1, \lambda = 3, 1$

25. $P\left(\frac{A}{B}\right) = \frac{P(A \cap B)}{P(B)} = \frac{P(A)}{P(B)} \quad P = \frac{0.6}{0.8} = \frac{6}{8}$

$8P = 6$

PHYSICS

26. $\beta = \frac{\lambda D}{d}$

$D = 1m$, $d = 2mm$

$\lambda = 1000\,nm$

27. Buoyant force reduces after coin falls inside

28. Dimensional formula

29. Due to latent heat of fusion

30. 3rd over tone in closed pipe $= \frac{7V}{4l} = n$

$l = \frac{7V}{4n}$

31. $\Delta Q = mS\Delta T + mL$

$\frac{V^2}{R} \times t = mS\Delta T + mL$

$\frac{200^2}{20} \times t = 1 \times 4200 \times 80 + 1 \times 2260 \times 10^3$

$t = 1298 \text{ sec} \Rightarrow t = 22 \text{ min}$

32. $E_x = -\frac{\partial v}{\partial x} = 0 \qquad E_y = -\frac{\partial v}{\partial y} = 0$

$E_z = -\frac{\partial v}{\partial z} = (-10z)_{z=5} = -50\,\hat{k}v/m$

33. $E_0 = B_0 C \quad = 200 \times 10^{-8} \times 3 \times 10^8 = 6 \times 10^2$

34. $\frac{kq^2}{L^2} = \mu mg$

$L = \sqrt{\frac{kq^2}{\mu mg}} = \sqrt{\frac{k}{\mu mg}} \cdot q$

35. Mass of water per second $= AV\rho$

$\frac{Momentum\ change}{second} = AV\rho V \quad = AV^2\rho$

Force $= AV^2\rho \qquad = \pi\left[\frac{5}{100}\right]^2 \times (20)^2 \times 1000 = 3143\,N$

36. Keplers laws

37. Conceptual

38. Conceptual

39. Conceptual

40. $\mu = \frac{C}{V} = \frac{c}{d/t_1} = \frac{ct_1}{d}, \frac{\mu_1}{t_1} = \frac{c}{d} \qquad \frac{\mu_2}{t_2} = \frac{c}{d}$

41. $I = \frac{q}{T} = \frac{q\omega}{2\pi} \quad B = \frac{\mu_0 i}{2r} = \frac{\mu_0}{4\pi}\left(\frac{q\omega}{r}\right)$

42. As the battery and inductor are in parallel, at any instant emf of battery and self emf in inductor are equal

$$|e| = \frac{L\,di}{dt} \text{ or } \frac{di}{dt} = \frac{|e|}{L} = \frac{800}{0.4} = 2000\,As^{-1}$$

43. From graph $\vartheta_0 = 8\times10^{14}\,Hz$

$$W = h\vartheta_0 = 6.6\times10^{-34}\times8\times10^{14} = 52.8\times10^{-20}\,J \qquad = \frac{52.8\times10^{-20}}{1.6\times10^{-19}} = 3.3\,eV$$

44. $h = \frac{u^2\sin^2\theta}{2g} \qquad T = \frac{u\sin\theta}{g}$

45. Conceptual

46. Conservation of angular momentum $I_1\omega_1 = I_2\omega_2$

$$I\times30 = I_2\times120 \Rightarrow I_2 = \frac{I}{4}$$

$$Change = I - \frac{I}{4} = \frac{3I}{4}$$

47. $\text{Energy} = \frac{y}{2}\times(strain)^2\cdot\frac{m}{d}$

48. $V_s = 24V \qquad P_s = 12w$

$$I_s = \frac{P_s}{V_s} = \frac{12}{24} = 0.5\,A$$

$$I_m = \sqrt{2}I_s = \sqrt{2}\times0.5 = \frac{1}{\sqrt{2}}A$$

49. $V = \sqrt{\frac{3RT}{M}}$

50. $r_n = r_0\frac{n^2}{z}$

$$= 0.51\times\frac{25}{3}$$

CHEMISTRY

51. Trihalides of nitrogen family except BiF_3 are predominantly covalent in nature.

52. Down the group atomic radius increases

53. The oxidation state of mercury in HgO is $+2$.

54. H_2O Bent

$BeC\ell_2$ – Linear

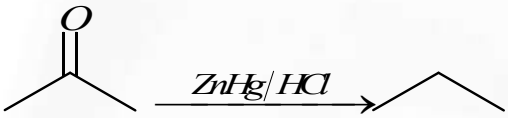
SF_4 – See-saw

BF_3 – Trigonal planar

55. Boron has $3e^-$ in the outer shell

$BC\ell_3$ is an electron deficient molecule

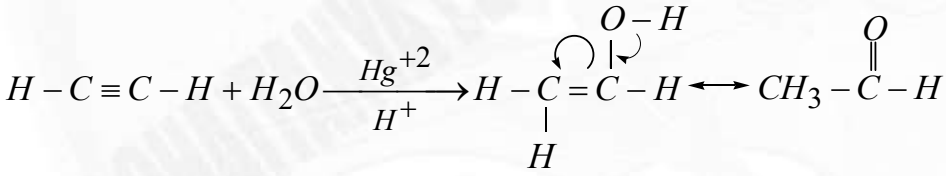
56.



Clemmensen reduction

57. $MnO_2 + 2NaC\ell + 2H_2SO_4 \rightarrow MnSO_4 + Na_2SO_4 + 2H_2O + C\ell_2$

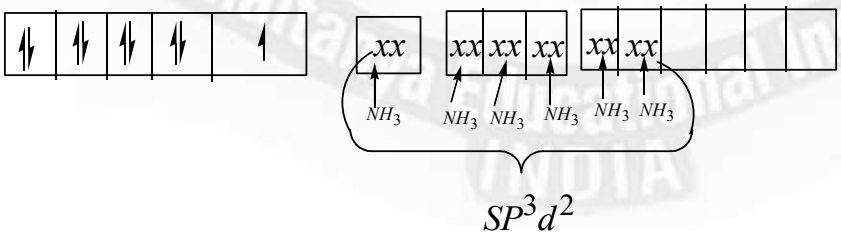
58.



59. $k_{sp} = 4s^3 \Rightarrow 4\left(5\times10^{-5}\right)^3 = 5\times10^{-13}\ mol^3dm^{-3}$

60.

$\left[Cu(NH_3)_6\right]^{+2}$ $3d^9\ 4S^o\ 4p^o\ 4d^0$



SP^3d^2

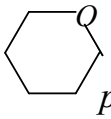
paramagnetic Octahedral

61. $E = hc\bar{\vartheta},\ \bar{\vartheta} = R\times Z^2\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$

62. $\left[Cr(NH_3)_4Cl_2\right]Cl \rightarrow Cl^- + \left[Cr(NH_3)_4Cl_2\right]^+$

63. $\therefore$ M$=\dfrac{\text{no.of moles of glucose}}{\text{vol.in lits}}$

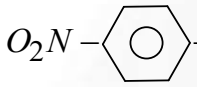
64.



pyranose

65. Isothermal means temperature isconstant

66.



67. $\Delta T_f = F.pt$ of solvent F.pt of solution

$\Delta T_f = k_f \times molality$

68. $CH_3 - \overset{\overset{O}{\|}}{C}$, group gives positive 2,4-DNP test

69. $S > Se > Te > Po > 0$

70. Mn atom exhibits upto +7 oxidation. Due to $4s^2 3d^5$ configuration.

71. Temperature coefficient $= \dfrac{k_{t+10^0C}}{k_{t^0C}} = 2$

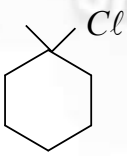
72. All the five compounds are carbon ring structures.

73. $k_p = k_c(RT)^{\Delta n}$

$\Delta n = -1$

$\therefore k_p \times RT = k_c$

74.



(3^0)

75. $NaOH + HC\ell \rightarrow NaC\ell + H_2O$