

**SEC: Sr.Super60(Incoming)_STERLING BT****JEE-MAIN****Date: 12-04-2025****Time: 09:00AM to 12:00PM****WTM-28****Max. Marks: 300****KEY SHEET****MATHEMATICS**

1	2	2	3	3	2	4	4	5	1
6	3	7	4	8	2	9	2	10	3
11	1	12	1	13	3	14	3	15	2
16	1	17	3	18	2	19	2	20	1
21	2026	22	1	23	2	24	1	25	182

PHYSICS

26	1	27	4	28	2	29	3	30	3
31	2	32	1	33	3	34	3	35	1
36	3	37	2	38	4	39	2	40	4
41	3	42	3	43	1	44	2	45	3
49	5000	47	20	48	0	49	25	50	1

CHEMISTRY

51	1	52	3	53	3	54	4	55	3
56	4	57	2	58	3	59	4	60	1
61	4	62	4	63	2	64	4	65	1
66	1	67	3	68	2	69	1	70	3
71	5	72	20	73	3	74	4	75	75

SOLUTION

MATHEMATICS

1. $|SP - S^1P| = 2b, SS^1 = 2be$
2. $S_1 = S_{11}$
3. $a = 109, b = 2, \frac{x^2}{109} - \frac{y^2}{2} = 1$
4. $P(CP \cos \theta, CP \sin \theta), Q(CQ \cos(90^\circ + \theta), CQ \sin(90^\circ + \theta)) = (-CQ \sin \theta, CQ \cos \theta)$
P, Q lie on Hyperbola
5. $e_H = \sqrt{1 + \sin^2 \theta}, e_E = \sqrt{1 - \sin^2 \theta}$ & use $e_H = \sqrt{7} \cdot e_E \Rightarrow \theta = \frac{\pi}{3}$
6. $a = 2, b^2 = 9, \frac{x^2}{4} - \frac{y^2}{9} = 1, e = \frac{\sqrt{13}}{2}, (h, k) = (4, 3\sqrt{3})$
 $m = |(a + ex_1)(a - ex_1)| = 48$
7. $e_H = 2, b^2 = 3a^2, a = \frac{5}{2}, b^2 = \frac{75}{4}, G.E = 150 - 75 = 75$
8. $y = mx \pm \sqrt{a^2m^2 - b^2}$, intercepts $\frac{8}{9}, \frac{4}{3}$
9. $e = \sqrt{\frac{2n+4}{n+1}}$ e is rational for $n = 48$ (smallest even)
($2n+4, n+1$ are perfect squares for n (even))
10. centre = (1,2) transverse axis is parallel to y axis, $b = \sqrt{3}, a^2 = 6 \frac{(y-2)^2}{3} - \frac{(x-1)^2}{6} = 1$
 $\Rightarrow x^2 - 2y^2 - 2x + 8y - 1 = 0$
11. Slope of tangent at $P(x_0, y_0) = \frac{-3}{2} \Rightarrow x_0 = -2y_0$,
Solve $3x_0^2 - 4y_0^2 = 36$ and $x_0 = -2y_0$ we get
 $P(x_0, y_0) = \left(3\sqrt{2}, \frac{-3}{\sqrt{2}}\right) (or) \left(-3\sqrt{2}, \frac{3}{\sqrt{2}}\right)$
But at $P\left(3\sqrt{2}, \frac{-3}{\sqrt{2}}\right)$ min distance occurs
12. Given incident ray passes through $S(5,0)$. So reflected ray passes through focus $S^1(-5,0)$ & Point of intersection of given hyperbola & given incident line be $D(4\sqrt{2}, 3)$



13. Equation of angle bisector containing the point (2,3)
14. Normal is $\frac{x}{\sec \theta} + \frac{y}{\tan \theta} = 2a \dots (1)$
 Chord having (x_1, y_1) as mid point is $xx_1 - yy_1 = x_1^2 - y_1^2 \dots (2)$
 Compare 1&2 eliminate ' θ '
15. Solve normals at $P(\theta), Q(\phi)$ where $\theta + \phi = \frac{\pi}{2}$, we get $k = \frac{-3}{\sqrt{2}} \Rightarrow (2k)^2 = 18$
16. $H + H^1 = 2A, 2\sqrt{2}C, x^2 - y^2 = 2C^2$ for $xy = C^2$
17. Solve circle $x^2 + y^2 - 2x - 4y - 20 = 0$ & $xy = C^2$
 4th degree in 'x' (eliminate y), 4 roots for x, similarly for 4 roots for 'y'
 (by eliminating x)
18. $\frac{2b^2}{a} = 15\sqrt{2}, a = 5\sqrt{2}, b = 5\sqrt{3}, \frac{2A^2}{B} = 12\sqrt{5}, 2a.2B = 100\sqrt{10}$
 $A = 5\sqrt{6}, e_2^2 = 1 + \frac{30}{25} = 1 + \frac{6}{5} = \frac{11}{5}$
19. $e = \frac{1}{\sqrt{2}}$ for given ellipse, $\alpha = 5\sqrt{2}, \beta = 5, e_1^2 = 51$
20. Use $\tan \theta = \frac{2ab\sqrt{-S_{11}}}{x^2 + y^2 - a^2 + b^2}$ Here $\theta = 30^\circ$ & squareing on both sides
21. $\frac{ah}{\sec \theta} + \frac{bk}{\tan \theta} = a^2 + b^2 \Rightarrow \left(\frac{bk}{\tan \theta}\right)^2 = \left(a^2 + b^2 - \frac{ah}{\sec \theta}\right)^2$
 Simplify get a 4th degree equation in $\sec \theta$ (by eliminating $\tan \theta$)
 $G.E = a.S_1 \cdot \frac{1}{a} \cdot \frac{S_3}{S_4} = \frac{2ah}{a^2 + b^2} \cdot \frac{-2ah}{a^2 + b^2} \times \frac{(a^2 + b^2)^2}{-a^2 h^2} = 4$
22. Slope of $\overline{PQ} \times$ slope of $\overline{RS} = -1 \Rightarrow t_1 t_2 t_3 t_4 = -1$,
 $G.E = \frac{1}{t_1^2} \cdot \frac{1}{t_2^2} \cdot \frac{1}{t_3^2} \cdot \frac{1}{t_4^2} = \frac{1}{1} = 1$
23. $ab = 2.1 = 2$
24. Normal at $P(t_1) \Rightarrow y - \frac{c}{t_1} = t_1^2(x - ct_1)$, now $Q(t_2)$ lies on this normal $\Rightarrow t_1^3 t_2 = -1$
25. $b^4 = 3b^2 + 27 \Rightarrow b^2 = \frac{3 + \sqrt{117}}{2} = \frac{3 + 3\sqrt{13}}{2} = \frac{3}{2}(1 + \sqrt{13})$
 $\ell = 3, m = 2, n = 13$
 $G.E = 9 + 4 + 169 = 182$

PHYSICS

26. m rows each of n identical cells

For maximum current $R = \frac{nr}{m}$

$$12 = \frac{n \times 2}{m} \Rightarrow n = 6m$$

$$24 = n \times m \quad \therefore n = 12 \quad m = 12$$

27. Applying KVL

$$28I_1 = -6 - 8 \Rightarrow I_1 = -\frac{1}{2}A$$

$$54I_2 = -6 - 12 \Rightarrow I_2 = -\frac{1}{3}A$$

$$I_3 = I_1 + I_2 = -\frac{5}{6}A$$

28. $V = E - Ir = E = r_1 \left[\frac{2E}{r_1 + r_2 + R} \right]$

But $V = 0$

$$E - \frac{2Er_1}{r_1 + r_2 + R} = 0$$

$$r_1 + r_2 + R = 2r_1$$

$$R = r_1 - r_2$$

29. Net emf $E = E_1 - E_2 = 6V$

Net resistance $= R + r_1 + r_2 = 4\Omega$

$$i = \frac{E}{R_{net}} = \frac{6}{4} = 1.5A$$

$$V_1 = E_1 - ir_1 = 10 - 1.5 \times 1 = 8.5V$$

$$V_2 = E_2 + ir_2 = 4 + 1.5 \times 1 = 5.5V$$

30. $E_{eq} = \frac{\frac{E_1}{r_1} - \frac{E_2}{r_2}}{\frac{1}{r_1} + \frac{1}{r_2}} = 3V$

This is in series with third one

$$6 - 3 = 3V$$

Net internal resistance $= 1\Omega$

In series with with 1Ω

Total resistance $= 2\Omega$



$$31. \quad S = \left(\frac{i_g}{i - i_g} \right) G$$

32. Conceptual

33. Conceptual

$$34. \quad i^2 \propto r^3$$

$$35. \quad V_{10\Omega} = V_{20\Omega} = \text{const}$$

$$P = \frac{V^2}{R}$$

$$P \propto \frac{1}{R}$$

$$36. \quad P = i^2 R$$

$$P_i = i_1^2 R$$

$$P_f = (0.6i_2)^2 R = 0.36i_1^2 R$$

$$\frac{P_i - P_f}{P_i} = (1 - 0.36) \times 100 = 64\%$$

37. Conceptual

38. Conceptual

$$39. \quad \frac{i}{i_g} = \frac{G}{S} + 1 = \frac{45}{5} + 1 = 10 \quad = \quad \frac{i_g}{i} = \frac{1}{10} \times 100 = 10\%$$

40. Conceptual

$$41. \quad 6\Omega \text{ and } 3\Omega \text{ in parallel } R_{eq} = 2\Omega$$

$$i = \frac{E_T}{r_T} = \frac{20}{3 + 2 + 5} = 2A$$

$$V = iR = 2 \times 2 = 4V$$

$$V_0 \text{ across } 6\Omega \text{ and } 3\Omega \text{ are } 4V$$

$$H_{3\Omega} = i^2 R t = 2^2 \times 3 \times 2 = 24J$$

$$H_{6\Omega} = \frac{V^2}{R} t = \frac{(4)^2}{6} \times (2) = \frac{16}{3} J$$

$$H_{3\Omega} = \frac{V^2}{R} t = \frac{(4)^2}{3} \times (2) = \frac{32}{3} J$$

$$H_{5\Omega} = i^2 R t = (2)^2 \times 5 \times 2 = 40J$$



$$42. \quad P = \frac{V^2}{R}, P \propto \frac{1}{R}, R \propto \frac{\ell}{A}, R \propto \frac{\ell^2}{m}$$

$$R \propto \ell^2$$

$$P \propto \frac{1}{\ell^2}$$

$$43. \quad R = \frac{V^2}{P} = \frac{600 \times 600}{240} = 96 \Omega$$

$$44. \quad \frac{P}{Q} = \frac{\ell}{100 - \ell}$$

$$45. \quad E \propto \ell$$

$$E_0 \propto \ell$$

$$(n - 2m)E_0 \propto \frac{\ell}{3}$$

$$46. \quad H = i^2 R t$$

$$47. \quad P_T = V_T I_T$$

$$I = \frac{\text{Total power}(P)}{\text{Total Voltage}(V)}$$

$$48. \quad C.S = \frac{NBA}{K} \Rightarrow V.S = \frac{NBA}{KR}$$

As C.S increases by 50%

No. of turns increases by 50%

As no of turn increases by 50%

Resistance increases by 50%

\therefore Vs remains constant.

$$49. \quad R = \frac{V^2}{P} = \frac{(220)^2}{100} = 484 \Omega$$

$$P^1 = \frac{(V^1)^2}{R} = \frac{(110)^2}{484} = 2510$$

$$50. \quad \% \text{ error} = \frac{\Delta E}{E} 100 = \frac{ir}{E} \times 100$$

$$= \frac{\left(\frac{E}{R+r}\right)r}{E} \times 100 = \left(\frac{r}{R+r}\right) \times 100 = \left(\frac{4}{500+4}\right) \times 100 = 0.8\%$$

CHEMISTRY

$$51. \quad P_1^0 X_1 = P_T Y_1 \dots [1]$$

$$P_T = P_1^0 X_1 + P_2^0 X_2$$

$$P_1^0 X_1 + P_2^0 [1 - X_1]$$

$$P_r = P_2^0 + X_1 [P_1^0 - P_2^0] \dots [2]$$

From [1] & [2]

$$\frac{P_2^0 + X_1 [P_1^0 - P_2^0]}{X_1} = \frac{P_1^0}{y_1}$$

$$\frac{1}{X_1} = \left(\frac{P_1^0}{P_2^0} \right) \frac{1}{Y} + \frac{P_2^0 - P_1^0}{P_2^0}$$

$$\text{Slop} = \frac{P_1^0}{P_2^0} \quad \text{Y-intercept} = \frac{P_2^0 - P_1^0}{P_2^0}$$

$$52. \quad M = \frac{\left(\frac{w}{w} \right) \% \times d \times 10}{GMW_{(B)}} = \frac{9 \times 1.11 \times 10}{36.5} = 2.73 \text{ M}$$

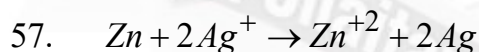
53. For an ideal solution $\Delta H_{mix} = 0$ $\Delta V_{mix} = 0$ and $A-A$ and $B-B$ intermolecular forces are nearly equal to $A-B$.

$$54. \quad \Delta T_b = i k_b m$$

$$m = \frac{\Delta T_b}{i k_b} \text{ (i-unit less)}$$

55. Solubility of a gas depends on k_H value and k_H value vary with temperature, Gas having highest k_H value is least soluble.

56. Strongest reducing agent reduction potential should be lowest and for strongest oxidising agent reduction potential should be highest.



$$E = E^0 - \frac{RT}{2F} \ln \frac{[Zn^{+2}]}{[Ag^+]^2}$$

$$E = E^0 + \frac{RT}{2F} \ln \frac{[Ag^+]^2}{[Zn^{+2}]}$$

58. Standard reduction potential order: $Co^{+3} / Co^{+2} > Cl_2 / Cl^- > Ag^+ / Ag > Na^+ / Na$



59. Cathode having highest reduction potential will give maximum value of E_{cell}^0 for a given anode.
60. Pressure does not have any significant effect on solubility of solids in liquids. Solids and liquids are highly incompressible and practically remain unaffected by change in pressure.
61. In case of galvanic cell, chemical energy of a spontaneous process converts in to electrical energy.
62. A potential difference develops between the electrode and the electrolyte which is called electrode potential. According to IUPAC convention, standard reduction potentials are now called standard electrode potentials.
63. M.Wt of ethylene glycol = 62
Let $A = H_2O$ $B =$ ethyleneglycol
$$n_{(B)} = \frac{20}{62} = 0.322 \text{ mol} \quad , \quad n_{(A)} = \frac{80}{18} = 4.444 \text{ mol}$$
$$X_{(B)} = \frac{0.322}{0.322 + 4.444} = 0.068$$
64. 11.7% Helium (x)
56.2% Nitrogen (y)
32.1% Oxygen (z)
65. Fluorine gas has the maximum tendency to get reduced to fluoride ion and there fluorine gas is the strongest oxidizing agent and fluoride ion is the weakest reducing agent.
66. 100 g solution – 75g HNO_3 & 25g H_2O $d = 1.25 \text{ g / ml}$;
32 ml solution - $32 \times 1.25 = 40 \text{ gram}$ solution.
100g solution $\rightarrow 25 \text{ g } H_2O$
40gr solution $\rightarrow 10 \text{ gr } H_2O$
67. $\Delta T_b = i k_b M$
 $\Delta T_b \propto i m$
 $i = 1$ (urea, glucose)
 $i = 2$ ($NaCl$)
68.
$$m = \frac{1000M}{1000d - MM_w}$$
69. Normality (N) involves volume of solution which is temperature dependent.
70. 1) Osmotic pressure – used to determine molar masses of proteins
2) No Osmosis occurs between isotonic solutions.
3) Pig's bladder – Naturally occurring 3PM.
4) Cellophane – Synthetic SPM

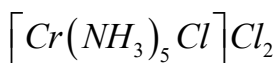


71. $\Delta T_f = 0.558^\circ \text{C} ; K_f = 1.86 \text{ k.kg mol}^{-1})$

$$\Delta T_f = i k_f m$$

$$0.558 = i \times 1.86 \times 0.1$$

$$i \approx 3$$



$$\therefore x = 5, y = 1, z = 2$$

72. Mole ratio of glucose and water is $\frac{1}{4}$

$$\text{Let } n_{(\text{glucose})} = 1 \quad n_{(H_2O)} = 4$$

$$X_{(\text{glucose})} = \frac{1}{5} = 0.2 \quad X_{(H_2O)} = \frac{4}{5}$$

$$\frac{P^0 - P}{P^0} = X_{(\text{glucose})}$$

$$\frac{10}{P^0} = 0.2 \dots (1)$$

$$\text{If } X_{(\text{glucose})} = 0.4 \text{ then}$$

$$\frac{P^0 - P}{P^0} = 0.4$$

$$\frac{x}{P^0} = 0.4 \dots (2)$$

$$\text{From (1) and (2) } \frac{x}{10} = \frac{0.4}{0.2}$$

$$x = 20$$

73. a) Ethanol and acetone

b) Ethanol and water and

c) CS_2 and acetone show positive deviation from Raoult's law

74. All four statements are true and specified in the NCERT text book.

75. $32 \text{ ml} \Rightarrow 32 \times 1.25 = 40 \text{ g solution}$

$40 \text{ g solution} \Rightarrow 10 \text{ gram water} + 30 \text{ gram } HNO_3$

$$\left(\frac{w}{W} \% \right) = \frac{30}{40} \times 100 = 75\%$$