

MELUHA INTERNATIONAL SCHOOL

HYDERABAD

SR MPC
Time: 3 Hours

JEE MAINS GT-6

Date: 12-07-2020
Max. Marks: 300

JEE MAIN MODEL MATHEMATICS

Section	Question type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I(Q.N : 01 – 20)	Questions with Single Answer Type	4	-1	20	80
Sec – II(Q.N : 21 – 25)	Questions with Numerical Answer Type (+/- Decimal Numbers)	4	0	5	20
Total				25	100

PHYSICS

Section	Question type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I(Q.N : 26 – 45)	Questions with Single Answer Type	4	-1	20	80
Sec – II(Q.N : 46 – 50)	Questions with Numerical Answer Type (+/- Decimal Numbers)	4	0	5	20
Total				25	100

CHEMISTRY

Section	Question type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I(Q.N : 51 – 70)	Questions with Single Answer Type	4	-1	20	80
Sec – II(Q.N : 71 – 75)	Questions with Numerical Answer Type (+/- Decimal Numbers)	4	0	5	20
Total				25	100

SECTION – I
(SINGLE CORRECT ANSWER TYPE)

This section contains 20 multiple choice questions. Each question has 4 options (A), (B), (C) and (D) for its answer, out of which **ONLY ONE** option can be correct.

Marking scheme: +4 for correct answer, 0 if not attempted and -1 if not correct.

MATHEMATICS

1. If $g(x) = x^2 + x - 1$ and $g \circ f(x) = 4x^2 - 10x + 5$ then $f\left(\frac{5}{4}\right)$ is equal to
A) $\frac{3}{2}$ B) $\frac{-1}{2}$ C) $\frac{-3}{2}$ D) $\frac{1}{2}$
2. The logical statement $(p \rightarrow q) \wedge (q \Rightarrow \sim p)$ is equivalent to
A) p B) q C) $\sim p$ D) $\sim q$
3. If $x = \sum_{n=0}^{\infty} (-1)^n \tan^{2n} \theta$ and $y = \sum_{n=0}^{\infty} \cos^{2n} \theta$, for $0 < \theta < \frac{\pi}{4}$, then:
A) $y(1+x) = 1$ B) $x(1+y) = 1$ C) $y(1-x) = 1$ D) $x(1-y) = 1$
4. The coefficient of x^4 in the expansion of $(1+x+x^2)^{10}$
A) 620 B) 625 C) 618 D) 615
5. The number of all 3×3 matrices A, with entries from the set $\{-1, 0, 1\}$ such that the sum of the principal diagonal elements of AA' is 3 are
A) 673 B) 677 C) 672 D) 675
6. Let \bar{a}, \bar{b} and \bar{c} be three vectors such that $|\bar{a}| = \sqrt{3}$, $|\bar{b}| = 5$, $\bar{b} \cdot \bar{c} = 10$ and the angle between \bar{b} and \bar{c} is $\frac{\pi}{3}$. If \bar{a} is perpendicular to the vector $\bar{b} \times \bar{c}$ then $|\bar{a} \times (\bar{b} \times \bar{c})|$ is
A) 32 B) 30 C) 35 D) 38
7. Six symmetrical dice are thrown simultaneously the probability of having different points on them is
A) $\frac{1}{6}$ B) $\frac{1}{36}$ C) $\frac{{}^6P_6}{6^6}$ D) $\frac{1}{8}$
8. The variance of first 20 natural numbers is
A) $\frac{133}{4}$ B) $\frac{379}{12}$ C) $\frac{133}{2}$ D) $\frac{399}{4}$
9. The locus of the point $z = x + iy$ satisfying $\left| \frac{z-2i}{z+2i} \right| = 1$ is
A) x-axis B) y-axis C) $y=2$ D) $x=23$
10. The system of linear equations $\lambda x + 2y + 2z = 5$, $2\lambda x + 3y + 5z = 8$, $4x + \lambda y + 6z = 10$ has
A) Infinitely many solutions when $\lambda = 2$ B) a unique solutions when $\lambda = -8$
C) no solution when $\lambda = 8$ D) no solution when $\lambda = 2$
11. If $8f(x) + 6f\left(\frac{1}{x}\right) = x + 5$ and $y = x^2 f(x)$ then $\frac{dy}{dx}$ at $x = -1$ is equal to
A) $\frac{1}{12}$ B) $\frac{1}{14}$ C) $\frac{19}{14}$ D) $\frac{-1}{14}$

12. If orthocentre and circumcentre of triangle are respectively $(1,1)$ and $(3,2)$, then the co-ordinates of its centroid are
- A) $\left(\frac{7}{3}, \frac{5}{3}\right)$ B) $\left(\frac{5}{3}, \frac{7}{3}\right)$ C) $(7,5)$ D) $(0,0)$
13. $\int \frac{x^2-1}{x^3\sqrt{2x^4-2x^2+1}} dx$ is equal to
- A) $\frac{\sqrt{2x^4-2x^2+1}}{x^2} + C$ B) $\frac{\sqrt{2x^4-2x^2+1}}{x^3} + C$
 C) $\frac{\sqrt{2x^4-2x^2+1}}{2x^2} + C$ D) $\frac{\sqrt{2x^4-2x^2+1}}{x} + C$
14. If $f(x) = \frac{1}{(x-4)(x-5)}$ and $g(x) = \frac{1}{x^2}$ then number of points of discontinuity of $f[g(x)]$ are
- A) 3 B) 4 C) 7 D) 2
15. If the lines $\frac{x}{1} = \frac{y}{2} = \frac{z}{3}$, $\frac{x-1}{3} = \frac{y-2}{-1} = \frac{z-3}{4}$ and $\frac{x+k}{3} = \frac{y-1}{2} = \frac{z-2}{h}$ are concurrent, then
- A) $h = -2, k = -6$ B) $h = \frac{1}{2}, k = 2$ C) $h = 6, k = 2$ D) $h = 2, k = \frac{1}{2}$
16. The point on the parabola $2y = x^2$, which is nearest to the point $(0,3)$ is
- A) $(\pm 4, 8)$ B) $\left(\pm 3, \frac{9}{2}\right)$ C) $(\pm 2, 2)$ D) $\left(\pm 1, \frac{1}{2}\right)$
17. In the mean value theorem $f(b) - f(a) = (b-a)f'(c)$, $(a < c < b)$. If $a = 4, b = 9$ and $f(x) = \sqrt{x}$, then the value of C is
- A) 8 B) 5.25 C) 4 D) 6.25
18. If $\Delta(x) = \begin{vmatrix} e^x & \text{Sin}x \\ \text{Cos}x & \ln(1+x^2) \end{vmatrix}$, then the value of $\lim_{x \rightarrow 0} \frac{\Delta(x)}{x}$ is
- A) 0 B) 2 C) -1 D) -2
19. The area bounded by the curve $y = 2x - x^2$ and the line $y = -x$ is
- A) $\frac{7}{2}$ B) $\frac{9}{2}$ C) $\frac{2}{9}$ D) $\frac{27}{3}$
20. $\frac{dy}{dx} + y = 2e^{2x}$, then y is
- A) $Ce^{-x} + \frac{2}{3}e^{2x}$ B) $(1+x)e^{-x} + \frac{2}{3}e^{2x} + C$ C) $Ce^{-x} + \frac{2}{3}e^{2x} + c$ D) $e^{-x} + \frac{2}{3}e^{2x} + c$

SECTION- II

(Numerical Value Answer Type)

This section contains 5 questions. The answer to each question is a Numerical values comprising of positive or negative decimal numbers. Marking scheme: +4 for correct answer, 0 in all other cases.

21. Let $x = \{n \in N; 1 \leq n \leq 50\}$. If
- $A = \{n \in x; n \text{ is a multiple of } 2\}$ and
- $B = \{n \in x; n \text{ is a multiple of } 7\}$, then the number of elements in the smallest subset of x containing both A and B is _____

22. The sum $\sum_{n=1}^7 \frac{n(n+1)(2n+1)}{4}$ is equal to _____
23. The number of 4 letter words (with or without meaning) than can be formed from the eleven letters of the word EXAMINATION is _____
24. If $\int \frac{11\cos x - 16\sin x}{2\cos x + 5\sin x} dx = -\lambda x + \mu \log|\lambda \cos x + \delta \sin x| + C$, then $(\lambda + \mu) + \delta =$ _____
25. The chord joining the points (5,5) and (11,227) on the curve $y = 3x^2 - 11x - 15$ is parallel to tangent at a point on the curve. Then the abscissa of the point is _____

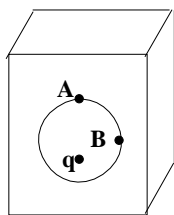
SECTION – I
(SINGLE CORRECT ANSWER TYPE)

This section contains 20 multiple choice questions. Each question has 4 options (A), (B), (C) and (D) for its answer, out of which **ONLY ONE** option can be correct.

Marking scheme: +4 for correct answer, 0 if not attempted and -1 if not correct.

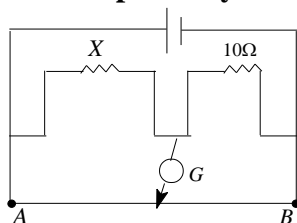
PHYSICS

26. Apparent frequency is 200Hz when listener is moving at 40 m/s towards a stationary source. Apparent frequency is 160 Hz when he moves away from the stationary source with the same speed. Velocity of sound is
A) 300ms^{-1} B) 330ms^{-1} C) 360ms^{-1} D) 310ms^{-1}
27. A light ray travels in two media A and B with speeds $2 \times 10^8 \text{m/s}$ and $2.4 \times 10^8 \text{m/s}$. The critical angle between them is
A) $\sin^{-1}\left(\frac{8}{9}\right)$ B) $\sin^{-1}\left(\frac{5}{6}\right)$ C) $\tan^{-1}\left(\frac{5}{6}\right)$ D) $\cos^{-1}\left(\frac{8}{9}\right)$
28. In a young's double slit experiment with wavelength 5890\AA , there are 60 fringes in the field of vision. How many fringes will be observed in the same field of vision if wavelength used is 5460\AA ?
A) 65 B) 60 C) 55 D) 50
29. An ellipsoidal cavity is carved with in a perfect conductor. A positive charge q is placed at the centre of the cavity. The points A and B are on the cavity surface as show in the figure then
a) Electric field near A in the cavity = Electric field near B in the cavity
b) Charge density at A = charge density at B
c) Potential at A= Potential at B
d) Total electric flux through the surface of the cavity is q/ϵ_0



- A) a,b,c,d are correct B) a,b,c are correct
C) Only a and b are correct D) Only c and d are correct
30. The torque required to keep a magnet of length 20cm at 30° to a uniform field is $2 \times 10^{-5} \text{N-m}$. The magnetic force on each pole is
A) $2 \times 10^{-3} \text{N}$ B) $2 \times 10^{-4} \text{N}$ C) $2 \times 10^{-6} \text{N}$ D) $4 \times 10^{-4} \text{N}$
31. In a induction coil, the coefficient of mutual inductance is 4H. If a current of 5 A in the primary circuit is cut off in $1/500\text{s}$, the emf induced in the secondary circuit will be
A) 30KV B) 20KV C) 10KV D) 5KV
32. If the charge on the body is increased by an amount of 2C. the energy stored in it is increases by 21%. The original charge on the body is
A) 2C B) 10C C) 15C D) 20C

33. In rutherford α particle scattering experiment with their gold foil is 8100 scintillations per minute are observed at an angle of 60° . The number of scintillations per minute at 120° will be
 A) 200 B) 500 C) 900 D) 1600
34. For a transistor, the current gain of a common base configuration is 0.8. if the transistor in common emitter configuration and the base current changes by 5mA. Then the change in collector current is
 A) 1mA B) 4mA C) 10mA D) 20mA
35. The KE of the photoelectrons is E when the incident wavelength is $\frac{\lambda}{2}$. The KE becomes 2E when the incident wavelength is $\frac{\lambda}{3}$. The work function of the metal is
 A) $\frac{hc}{\lambda}$ B) $\frac{2hc}{\lambda}$ C) $\frac{3hc}{\lambda}$ D) $\frac{hc}{3\lambda}$
36. A radioactive nucleus of mass M emits a photon of frequency ν and the nucleus recoils. The recoil energy will be
 A) $Mc^2 - h\nu$ B) $h^2 \nu^2 / 2Mc^2$ C) Zero D) $h\nu$
37. A charged particle is accelerated through a potential difference of 12KV and acquired a speed of 10^6 m/s. It is then injected perpendicularly in to a magnetic field of strength 0.6T the radius of the circle is
 A) 2cm B) 4cm C) 6cm D) 8cm
38. 5grams of steam at 100° C is passed in to calorimeter containing liquid. Temperature of liquid raises from 32° C to 40° C. then water equivalent of calorimeter and contents is
 A) 40gram B) 160gram C) 375gram D) 425gram
39. At pressure of 24×10^5 dyne/ cm^2 . The volume of O_2 is 10 liter and mass is 20 gram the r.m.s. velocity will be
 A) 800m/s B) 400m/s C) 600m/s D) 200m/s
40. A meter bridge is set up as shown to determine an unknown resistance X using a standard resistance 10Ω . The galvanometer shows null point when tapping jockey is at 52cm mark. The end corrections are 1cm as 2cm respectively for the ends A and B. The determine value of X is



- A) 10.6Ω B) 10.8Ω C) 10.10Ω D) 11.2Ω
41. The rms voltage V_L , V_C and V_R are across inductor L, capacitor C and resistance R in LCR series circuit. Their ratio is 1:2:3. If the rms voltage of AC source is 100V, then V_R is nearly equal to
 A) 40V B) 60V C) 90V D) 100V
42. The resultant of two equal forces is 141.4N when they are mutually perpendicular. When they are inclined at an angle 120° then the resultant force will be in N is _____
 A) 100 B) 200 C) 300 D) 400
43. If the particle is moving along a straight line given by the relation $x = 2 - 3t + 4t^3$ where x is in cm and t in sec. Its average velocity during the third second in cm/s is
 A) 63 B) 73 C) 84 D) 90
44. A horizontal jet of water coming up out of a pipe of area of cross section 20cm^2 hits a vertical wall with a velocity of 10 m/s and rebounds with the same speed the force exerted by the water on the wall in N is _____
 A) 200 B) 300 C) 400 D) 500
45. The youngs modules of the material of the rod is 20×10^{10} Pascal. When the longitudinal strain is 0.04%. The energy stored per unit volume is
 A) $16 \times 10^3 \text{J/m}^3$ B) $20 \times 10^3 \text{J/m}^3$ C) $30 \times 10^3 \text{J/m}^3$ D) $40 \times 10^3 \text{J/m}^3$

SECTION-II**(Numerical Value Answer Type)**

This section contains 5 questions. The answer to each question is a Numerical values comprising of positive or negative decimal numbers. Each question has 4 options (A), (B), (C) and (D) for its answer, out of which **ONLY ONE** option can be correct.

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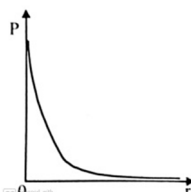
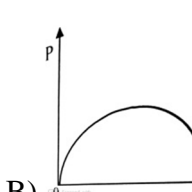
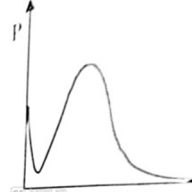
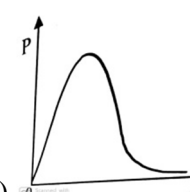
46. A ring and disc of same mass roll with out slipping along a horizontal surface with same velocity if the K.E of ring is 8J then that of the disc in joule is ____
47. Three masses 0.1kg, 0.3kg, 0.4kg are suspended at the end of the spring when the 0.4kg is removed the system oscillate with a period of 2S. when 0.3kg mass is also removed the system will oscillates with period in sec is ____
48. A satellite is launched in to a circular orbit of radius R around the earth while the second satellite is launched in to an orbit of radius 1.02R the percentage change in time periods of the two satellite is ____
49. A body of mass 6kg under a force which causes displacement in it which is given by $S = \frac{t^2}{4}m$ where t is time the work done in joule by the force in 2sec is ____
50. The work done in forming a soap films of size 10 cm×10cm will be if the surface tension of soap solution is $3 \times 10^{-2}N/m$ is ____× $10^{-4}J$

SECTION – I**(SINGLE CORRECT ANSWER TYPE)**

This section contains 20 multiple choice questions. Each question has 4 options (A), (B), (C) and (D) for its answer, out of which **ONLY ONE** option can be correct.

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CHEMISTRY

51. Consider a titration of potassium dichromate solution with acidified Mohr's salt solution using diphenylamine as indicator. The number of moles of Mohr's salt required per mole of dichromate is
- A) 3 B) 4 C) 5 D) 6
52. P is the probability of finding the 1s electron of hydrogen atom in a spherical shell of infinitesimal thickness, dr, at a distance r from the nucleus. The volume of this shell is $4\pi r^2 dr$. The qualitative sketch of the dependence of P on r is
- A)  B)  C)  D) 
53. Among the following species, identify the isostructural pair.
- $NF_3, NO_3^-, BF_3, H_3O^+, HN_3$
- A) $[NF_3, NO_3^-]$ and $[BF_3, H_3O^+]$ B) $[NF_3, HN_3]$ and $[NO_3^-, BF_3]$
- C) $[NF_3, H_3O^+]$ and $[NO_3^-, BF_3]$ D) $[NF_3, H_3O^+]$ and $[HN_3, BF_3]$
54. In van der waals equation of state for a non-ideal gas, the term that accounts for intermolecular forces is
- A) (V- b) B) RT C) $\left(P + \frac{a}{V^2}\right)$ D) $(RT)^{-1}$

55. For the reversible reaction, $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ at $500^\circ C$, the value of K_p is 1.44×10^{-5} when partial pressure is measured in atmospheres. The corresponding value of K_c , with concentration in mole litre⁻¹, is

- A) $\frac{1.44 \times 10^{-5}}{(0.082 \times 500)^{-2}}$ B) $\frac{1.44 \times 10^{-5}}{(8.314 \times 773)^{-2}}$ C) $\frac{1.44 \times 10^{-5}}{(0.082 \times 773)^2}$ D) $\frac{1.44 \times 10^{-5}}{(0.082 \times 773)^{-2}}$

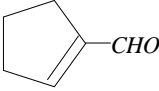
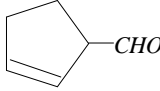
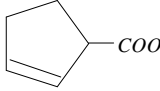
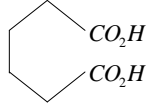
56. The following compounds have been arranged in order of their increasing thermal stabilities. $K_2CO_3(I)$, $MgCO_3(II)$, $CaCO_3(III)$, $BeCO_3(IV)$ Identify the correct order

- A) I<II<III<IV B) IV<II<III<I C) IV<II<I<III D) II<IV<III<I

57. Most stable carbonium ion is :

- A) $p-NO_2-C_6H_4-CH_2^+$ B) $C_6H_5CH_2^+$ C) $p-Cl-C_6H_4-CH_2^+$ D) $p-CH_3O-C_6H_4-CH_2^+$

58. Cyclohexene on ozonolysis followed by reaction with zinc dust and water gives compound E. Compound E on further treatment with aqueous KOH yields compound F. Compound F is

- A)  B)  C)  D) 

59. Among the following, the surfactant that will form micelles in aqueous solution at the lowest molar concentration at ambient condition is :-

- A) $CH_3(CH_2)_{15}N^+(CH_3)_3Br^-$ B) $CH_3(CH_2)_{11}OSO_3^-Na^+$
C) $CH_3(CH_2)_6COO^-Na^+$ D) $CH_3(CH_2)_{11}N^+(CH_3)_3Br^-$

60. The emf of the cell

$Zn|Zn^{2+}(0.01M)||Fe^{2+}(0.001M)|Fe$ at 298K is 0.2905 then the value of equilibrium constant for the cell reaction is

- A) $e^{\frac{0.32}{0.0295}}$ B) $10^{\frac{0.32}{0.0295}}$ C) $10^{\frac{0.26}{0.0295}}$ D) $10^{\frac{0.32}{0.0591}}$

61. The chemical composition of 'slag' formed during the smelting process in the extraction of copper is

- A) $Cu_2O + FeS$ B) $FeSiO_3$ C) $CuFeS_2$ D) $Cu_2S + FeO$

62. Which of the following represents the correct order of increasing first ionization enthalpy for Ca, Ba, S, Se and Ar ?

- A) $Ca < S < Ba < Se < Ar$ B) $S < Se < Ca < Ba < Ar$ C) $Ba < Ca < Se < S < Ar$ D) $Ca < Ba < S < Se < Ar$

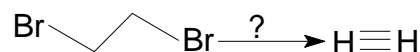
63. The reaction of white phosphorus with aqueous NaOH gives phosphine along with another phosphorus containing compound. The reaction type; the oxidation states of phosphorus in phosphine and the other product are respectively

- A) redox reaction; -3 and -5 B) redox reaction; 3 and +5
C) disproportionation reaction; -3 and +5 D) disproportionation reaction; -3 and +3

64. Among the following, the coloured compound is


- A) $CuCl$ B) $K_3[Cu(CN)_4]$ C) CuF_2 D) $[Cu(CH_3CN)_4]BF_4$

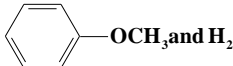



65. The reagent (s) for the following conversion,



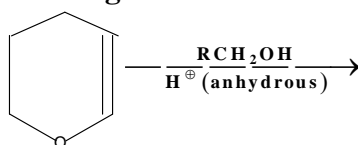
is / are

- A) Alcoholic KOH B) Alcoholic KOH followed by $NaNH_2$
C) aqueous KOH followed by $NaNH_2$ D) Zn/CH_3OH

66. In the reaction  \xrightarrow{HBr} The products are

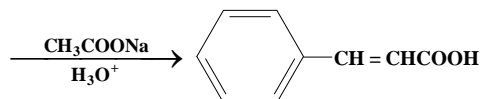
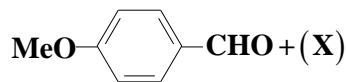
- A)  and H_2 B)  and CH_3Br C)  and CH_3OH D)  and CH_3Br

67. The major product of the following reaction is



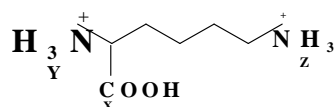
- A) a hemiacetal B) an acetal C) an ether D) an ester

68.



The compound (X) is

- A) CH_3COOH B) $\text{BrCH}_2-\text{COOH}$ C) $(\text{CH}_3\text{CO})_2\text{O}$ D) $\text{CHO}-\text{COOH}$
69. In the compound given below the correct order of the acidity of the positions X, Y and Z is



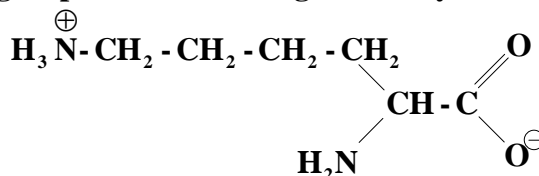
- A) $Z > X > Y$ B) $X > Y > Z$ C) $X > Z > Y$ D) $Y > X > Z$
70. The smog is essentially caused by the presence of
- A) Oxides of sulphur and nitrogen B) O_2 and N_2
 C) O_2 and O_3 D) O_3 and N_2

SECTION-II

(Numerical Value Answer Type)

This section contains 5 questions. The answer to each question is a Numerical values comprising of positive or negative decimal numbers. Each question has 4 options (A), (B), (C) and (D) for its answer, out of which **ONLY ONE** option can be correct.
Marking scheme: +4 for correct answer, 0 in all other cases.

71. 0.2molal acid HX is 20% ionised in solution. $K_f = 1.86\text{K molality}^{-1}$. The freezing point of the solution is _____
72. The enthalpy change involved in the isothermal reversible expansion of 2 mole of an ideal gas from a volume of 10 dm^3 to a volume of 100 dm^3 at 27°C is _____
73. Consider a reaction $a\text{G} + b\text{H} \rightarrow \text{Products}$. When concentration of both the reactants G and H is doubled, the rate increases by eight times. However, when concentration of G is doubled keeping the concentration of H fixed, the rate is doubled. The overall order of the reaction is _____
74. Total number of geometrical isomers for the complex $[\text{RhCOCl}(\text{PPh}_3)(\text{NH}_3)]$ is _____
75. The total number of basic groups in the following form of lysine is _____



MELUHA INTERNATIONAL SCHOOL

HYDERABAD

SR MPC
Time: 3 Hours

JEE MAINS GT-6

Date: 12-07-2020
Max. Marks: 300

KEY SHEET

MATHEMATICS

1) B	2) C	3) C	4) D	5) C	6) B	7) C	8) A	9) A	10) D
11) D	12) A	13) C	14) C	15) D	16) C	17) D	18) C	19) B	20) A
21) 29	22) 504	23) 2454	24) 10	25) 8					

PHYSICS

26) C	27) B	28) A	29) D	30) B	31) C	32) D	33) C	34) D	35) A
36) B	37) B	38) C	39) C	40) A	41) C	42) A	43) B	44) C	45) A
46) 6	47) 1	48) 3	49) 3	50) 6					

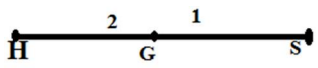
CHEMISTRY

51) D	52) D	53) C	54) C	55) B	56) B	57) D	58) A	59) B	60) C
61) B	62) C	63) C	64) C	65) B	66) D	67) B	68) C	69) B	70) A
71) -0.45	72) 38.03	73) 3	74) 3	75) 2					

HINTS & SOLUTIONS

MATHS

1. $g(x) = x^2 + x - 1$
 $g[f(x)] = 4x^2 - 10x + 5$
 $= (2 - 2x)^2 + (2 - 2x) - 1$
 $f(x) = 2 - 2x$
 $f\left(\frac{5}{4}\right) = 2 - 2\left(\frac{5}{4}\right) = \frac{-1}{2}$
2. $(P \rightarrow q) \wedge (q \rightarrow \sim P)$
 $\equiv (\sim P \vee q) \wedge (\sim q \vee \sim P)$
 $\equiv \sim P \vee (q \wedge \sim P)$
 $\equiv \sim P \vee C \equiv \sim P$
3. $x = \sum_{n=0}^{\infty} (-1)^n \tan^{2n} \theta = 1 - \tan^2 \theta + \tan^4 \theta - \dots$
 $x = \cos^2 \theta$
 $y = \sum_{n=0}^{\infty} \cos^{2n} \theta \Rightarrow y = 1 + \cos^2 \theta + \cos^4 \theta$
 $y = \frac{1}{\sin^2 \theta} \Rightarrow y = \frac{1}{1-x} \Rightarrow y(1-x) = 1$
4. $(1+x+x^2)^{10} = {}^{10}C_0 + {}^{10}C_1 x + {}^{10}C_2 x^2 + {}^{10}C_3 x^3 + {}^{10}C_4 x^4 + \dots$
 Coefficient of $x^4 = {}^{10}C_2 + {}^{10}C_3 \cdot 3C_1 + {}^{10}C_4 = 615$
5. Trace
 $(AA^T) = (a_{11}^2 + a_{12}^2 + a_{13}^2 + a_{21}^2 + a_{22}^2 + a_{23}^2 + a_{31}^2 + a_{32}^2 + a_{33}^2) = 3$
 $--(1)$
 $(a_{ij} \in \{-1, 0, 1\})$
 (1) Happen for 6 zeros and (1,1,1)
 $\rightarrow 1$ 6 zeros and (1,1,-1)
 $\rightarrow 3$ 6 zeroes and (1,-1,-1)
 $\rightarrow 3$ 6 zeroes and (-1,-1,-1)
 $\rightarrow 1$
 Total possible ways =
 ${}^9C_6 (1+3+3+1) = 672$
6. $\bar{b} \cdot \bar{c} = 10 \Rightarrow 5|\bar{c}| \times \cos \frac{\pi}{3} = 10$
 $|\bar{a} \times (\bar{b} \times \bar{c})| = |\bar{a}| |\bar{b} \times \bar{c}|$
 $\sqrt{3} \cdot 5 \cdot 4 \cdot \sin \frac{\pi}{3} = \sqrt{3} \cdot 5 \cdot 4 \cdot \frac{\sqrt{3}}{2} = 30$
 $= 4$
7. required probability $\frac{{}^6P_6}{6^6}$

8. $\sigma^2 = \frac{1}{20} [1^2 + 2^2 + \dots + 20^2] - \left[\frac{1}{20} (1+2+\dots+n^2) \right]^2$
 $\frac{1}{20} \times \frac{20 \times 21 \times (2(20)+1)}{6} + \left[\frac{1}{20} \frac{20 \times 1}{2} \right]^2$
 $\frac{7 \times 41}{2} - \frac{441}{4}$
 $\frac{133}{4}$
9. $|Z + ai| = |Z - ai|$ represents x-axis
10. $D = \begin{vmatrix} \lambda & 3 & 2 \\ 2\lambda & 3 & 5 \\ 4 & \lambda & 6 \end{vmatrix} = (\lambda+8)(2-\lambda)$
 For $\lambda = 2$
 Hence no solution for $\lambda = 2$
11. $8f(x) + 6f\left(\frac{1}{x}\right) = x + 5$ -----(1)
 Replace x by $\frac{1}{x}$
 $\Rightarrow 8f\left(\frac{1}{x}\right) + 6f(x) = \frac{1}{x} + 5$
 From (1) and (2) $f(x) = \frac{1}{28} \left(8x - \frac{6}{x} + 10 \right)$
 $y = x^2 f(x) = \frac{1}{28} (8x^3 - 6x + 10x^2)$
 $\frac{dy}{dx} = \frac{1}{28} (24x^2 - 6 + 20x)$
 $\left(\frac{dy}{dx} \right)_{x=-1} = \frac{1}{28} (24 - 6 - 20) = \frac{-1}{14}$
12. 
 G divides H₅ in the ratios 2:1 internally
 $\therefore G = (7/3, 5/3)$
13. $I = \int \frac{\frac{1}{x^3} - \frac{1}{x^5}}{\sqrt{2 - \frac{2}{x^2} + \frac{1}{x^4}}} dx$
 $I = \frac{1}{4} \int \frac{dt}{\sqrt{t}}$
 $= \frac{1}{2} \sqrt{t} + c$
 Put $2 - \frac{2}{x^2} + \frac{1}{x^4} = t$
 $\left(\frac{4}{x^3} - \frac{4}{x^5} \right) dx = dt$
 $= \frac{1}{2} \sqrt{2 - \frac{2}{x^2} + \frac{1}{x^4}} + C = \frac{\sqrt{2x^4 + 2x^2 + 1}}{2x^2} + c$

14. $f(g(x)) = \frac{1}{\left(\frac{1}{x^2}-4\right)\left(\frac{1}{x^2}-5\right)} = \frac{x^4}{(4x^2-1)(5x^2-1)}$
 $\therefore f(x)$ is not defined at 4, 5
 $g(x)$ is not defined at 0
 $\therefore f(g(x))$ is not defined at $\pm\frac{1}{2}, \pm\frac{1}{\sqrt{5}}$
 No of discontinuity points=5
15. Co-ordinates of a general point on first line can be taken as $(\lambda, 2\lambda, 3\lambda)$
 The general point on second line is $(3\mu+1, -\mu+2, 4\mu+3)$
 If the lines intersect, then they have a common point so, for some value of λ and μ must have
 $\lambda = 3\mu+1, 2\lambda = -\mu+2, 3\lambda = 4\mu+3$
 Solving $\lambda = 1, \mu = 0$
 \therefore The point of intersection is $(1, 2, 3)$ lies on third line
 $\frac{1+k}{3} = \frac{2-1}{2} = \frac{3-2}{h} \Rightarrow k = \frac{1}{2}, h = 2$
16. Let the point on the parabola $2y = x^2$ is
 $P = \left(x, \frac{x^2}{2}\right)$
 $Q = (0, 3)$
 $f(x) = PQ^2 = x^2 + \left(\frac{x^2}{2} - 3\right)^2$
 $f'(x) = 2x + 2\left(\frac{x^2}{2} - 3\right) \times \frac{1}{2} \times 2x = 2x\left(1 + \frac{x^2}{2} - 3\right)$
 $= x^3 - 4x$
 $f''(x) = 3x^2 - 4$
 If $f'(x) = 0$
 $\Rightarrow f''(\pm 2) = 8 > 0, \therefore f(x)$ has minimum at $x = \pm 2$
 \therefore The required point is $(\pm 2, 2)$
17. Given function is $f(x) = \sqrt{x}$
 $f'(x) = \frac{1}{2\sqrt{x}}$
 Now
 $\frac{f(b) - f(a)}{b - a} = f'(c) \Rightarrow \frac{\sqrt{9} - \sqrt{4}}{9 - 4} = \frac{1}{2\sqrt{c}}$
 $\frac{2}{5} = \frac{1}{\sqrt{c}} \Rightarrow \sqrt{c} = 5/2 \Rightarrow c = \frac{25}{4} = 6.25$

18. $\Delta(x) = \left| \begin{matrix} e^x & \text{Sin}x \\ \text{Cos}x & \ln(1+x^2) \end{matrix} \right|$
 $= e^x \ln(1+x^2) - \text{Sin}x \text{Cos}x$
 $\lim_{x \rightarrow 0} \frac{\Delta(x)}{x} = \lim_{x \rightarrow 0} \frac{e^x \ln(1+x^2) - \text{Sin}x \text{Cos}x}{x}$
 $\lim_{x \rightarrow 0} x e^x \left\{ \frac{\ln(1+x^2)}{x^2} \right\} - \lim_{x \rightarrow 0} \frac{\text{Sin}x}{x} \text{Cos}x$
 $= 0 \times 1 \times 1 - |1| = -1$
19. $-x = 2x - x^2 \Rightarrow x = 0, 3$
 Required area = $\int_0^3 [(2x - x^2) - (-x)] dx$
 $\int_0^3 (3x - x^2) dx = \left(\frac{3x^2}{2} - \frac{x^3}{3} \right)_0^3$
 $= \frac{27}{2} - \frac{27}{3} = \frac{9}{2}$
20. If $= e^{\int 1 dx} = e^x$
 $y \cdot If = \int 2e^{2x} \cdot If dx$
 $ye^x = \int 2e^{2x} \cdot e^x dx$
 $ye^x = \frac{2}{3} e^{3x} + C$
 $y = \frac{2}{3} e^{2x} + Ce^{-x}$
21. $n(X) = n(A \cup B) = n(A) + n(B) - n(A \cap B)$
 $= 25 + 7 - 3 = 29$
22. Sum = $\frac{1}{4} \sum_{n=1}^7 (2n^3 + 3n^2 + n)$
 $= \frac{1}{4} \left(2 \left(\frac{7.8}{2} \right)^2 + 3 \left(\frac{7.8.15}{6} \right) + \left(\frac{7.8}{2} \right) \right)$
 $= 504$
23. $2N, 2A, 2I, E, X, M, T, O$ (11 letters)
 Possibilities to form 4 letter words are as follows
 (All 4 distinct) = ${}^8P_4 = 1680$
 (2 same, 2 distinct) =
 $({}^3C_1)({}^7C_2) \left(\frac{4!}{2!} \right) = 756$
 (2 same, 2 same) = $({}^3C_2) \left(\frac{4!}{2!2!} \right) = 18$
 Total = $1680 + 756 + 18 = 2454$
24. $\int \frac{11 \cos x - 16 \sin x}{2 \cos x + 5 \sin x} dx = 3 \log |2 \cos x + 5 \sin x| - 2x + c$
 $\therefore \lambda = 2, \mu = 3, \delta = 5$
 $(\lambda + \mu) + 5 = (2 + 3) + 5 = 10$

$$25. \frac{dy}{dx} = 6x - 1 \Rightarrow 6x - 11 = \frac{227 - 5}{11 - 5} \Rightarrow 6x = 48 \Rightarrow x = 8$$

PHYSICS

$$26. n_1 = \frac{V + V_s}{V} n_s$$

$$n_2 = \frac{V - V_s}{V} n_s$$

$$\frac{200}{160} = \frac{V + 40}{V - 40}$$

$$27. \mu = \frac{C_B}{C_A} = \frac{1}{\sin C}$$

$$\frac{2.4 \times 10^8}{2 \times 10^8} = \frac{1}{\sin C}$$

$$\sin C = \frac{20}{24} = \frac{5}{6}$$

$$28. n_1 \lambda_1 = n_2 \lambda_2$$

$$(60)5890 = n_2(5460)$$

$$n_2 = 65$$

29. The total volume of a charged conduction is an equipotential surface and flux = $\sum q l \epsilon_0$

$$30. C = (mB) (2l) \sin \theta$$

$$C = F(2l) \sin \theta$$

$$31. E = M \frac{di}{dt}$$

$$E = 4 \left(\frac{1}{500} \right)$$

$$32. \frac{10Q}{100} = 2 \therefore \frac{U_2}{U_1} = \frac{Q_2^2}{Q_1^2} \Rightarrow \frac{121}{100} = \frac{Q_2^2}{Q_1^2}$$

$$\left(\frac{Q_2}{Q_1} - 1 \right) \times 100 = 10\%$$

$$\Rightarrow Q + \frac{10Q}{100} = \text{final charge}$$

$$33. \frac{N_2}{N_1} = \frac{\sin^4(60/2)}{\sin^4(120/2)} \Rightarrow N_2 = 8100 \frac{1}{(3)^2}$$

$$34. \beta = \frac{\alpha}{1 - \alpha} = \frac{\Delta I_c}{\Delta I_b}$$

$$35. \frac{hC}{(\lambda/2)} - \phi = E \text{ --- (1)}$$

$$\frac{hC}{(\lambda/3)} - \phi = 2E \text{ --- (2)}$$

Deviding (1),(2)

$$\phi = \frac{hC}{\lambda}$$

$$36. E = \frac{P^2}{2M}$$

$$P = \frac{h\gamma}{C}$$

$$37. \left(\therefore \frac{1}{2}mv^2 = ev \right) r = \frac{mv}{Be} \Rightarrow r = \left(\frac{v}{\left(\frac{e}{m} \right) B} \right)$$

$$r = \frac{2V}{vB} = \frac{2(12 \times 10^3)}{(10^6)(0.6)}$$

38. Heat lost = heat gained
 $5(540) + 5(1)(100 - 40) = 2ms (40 - 32)$
 $2ms = 375 \text{ gram}$

$$39. V = \sqrt{\frac{3PV}{M}}$$

Given $P = 24 \times 10^4$, $V = 10 \times 10^{-3}$,
 $M = 20 \times 10^{-3}$

$$40. \frac{X}{10} = \frac{52 + 1}{48 + 2}$$

$$X = \frac{530}{50} = 10.6$$

$$41. V_L = V_0, V_C = 2V_0, V_R = 3V_0$$

$$V = \sqrt{V_R^2 + (V_L - V_C)^2}$$

$$100 = \sqrt{9V_0^2 + (V_0 - 2V_0)^2}$$

$$10^4 = 10V_0^2 \Rightarrow V_0 = 10\sqrt{10}$$

$$V_R = 3V_0 = 30\sqrt{10} = 90V$$

$$42. R_1 = 2P \cos 90/2$$

$$R_2 = 2P \cos \frac{120}{2}$$

$$43. S_2 = 28 \text{ cm/s}$$

$$S_3 = 101 \text{ cm/s}$$

$$S_3 - S_2 = 73 \text{ cm/s}$$

$$44. F = 2A \Delta v^2$$

$$45. w = \frac{1}{2} Y (\text{stain})^2$$

$$46. \frac{1}{2} mV^2 \left(1 + \frac{K^2}{R^2} \right) = 8 \Rightarrow \frac{1}{2} mV^2 (1 + 1) = 8$$

$$\Rightarrow \frac{1}{2} mV^2 = 4J$$

$$E_{disc} = \frac{1}{2} mV^2 \left(1 + \frac{1}{2} \right) = 6J$$

$$47. 2 = 2\pi \sqrt{\frac{0.1 + 0.3}{K}} \text{ --- (1)}$$

$$T = 2\pi \sqrt{\frac{0.1}{K}} \text{ --- (2)}$$

$$48. \left(2 \frac{\Delta T}{T} \right) = 3 \frac{\Delta R}{R} \Rightarrow \frac{\Delta T}{T} = \frac{3}{2} \left[\frac{1.02R - R}{R} \right]$$

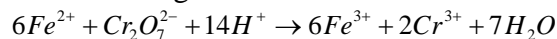
$$49. \quad V = \frac{2t}{4} = \frac{2(2)}{4} = 1$$

$$w = \frac{1}{2}m(v^2 - u^2) = \frac{1}{2}(6)(1^2 - 0^2) = 3J$$

$$50. \quad w = T(2A)$$

CHEMISTRY

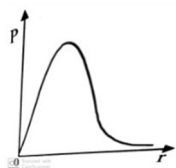
51. The following reaction occurs :



From the above equation, we find that Mohr's salt ($FeSO_4 \cdot (NH_4)_2SO_4 \cdot 6H_2O$) and dichromate reacts

6 : 1 molar ratio

52. Radial probability function curve for 1s is



53. structure of a molecule can be ascertained by knowing the number of hybrid bonds in the molecule. Thus

$$\text{In } NF_3 : H = \frac{1}{2}(5 + 3 - 0 + 0) = 4$$

Thus N in NO_3^- sp^3 hybridized as 4 orbital are involved in bonding.

$$\text{In } NO_3^- : H = \frac{1}{2}(5 + 0 - 0 + 1) = 3$$

Thus N in NO_3^- : sp^2 hybridized as 3 orbitals are involved in bonding.

$$\text{In } BF_3 : H = \frac{1}{2}(3 + 3 - 0 + 0) = 3$$

Thus B in BF_3 is sp^2 hybridized and 3 orbitals are involved in bonding

$$\text{In } H_3O^+ : H = \frac{1}{2}(6 + 3 - 0 + 0) = 4$$

Thus O in H_3O^+ is sp^3 hybridized and 3 orbital are involved in bonding

Thus, isostructural pairs are $[NF_3, H_3O^+]$ and $[NO_3^-, BF_3]$.

$$54. \quad \left(P + \frac{a}{V^2}\right)(V - b) = RT; \text{ Here } \left(P + \frac{a}{V^2}\right)$$

represents

The intermolecular forces.

$$55. \quad K_p = K_c \cdot (RT)^{\Delta n}$$

$$\Delta n = 2 - 4 = -2$$

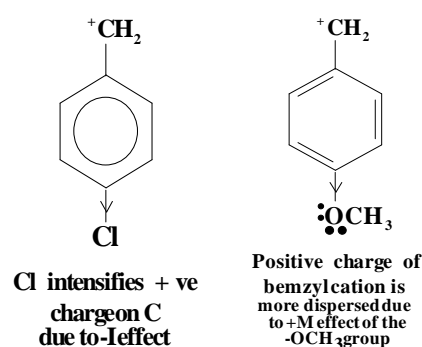
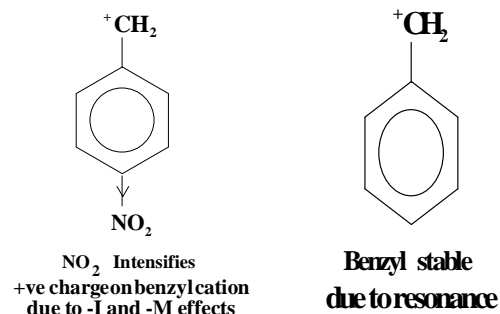
$$K_c = \frac{K_p}{(RT)^{\Delta n}} = \frac{1.44 \times 10^{-5}}{(0.082 \times 773)^{-2}}$$

(R in L. atm. $K^{-1} \text{ mole}^{-1}$)

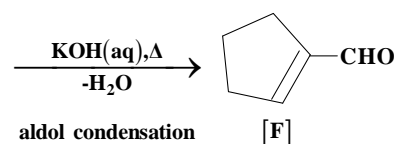
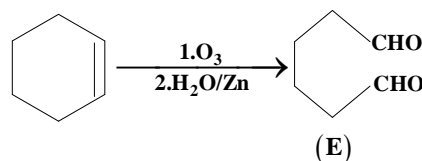
56. Increasing size of cation decreases its polarization ability towards carbonate, making the compound more stable.

The increasing thermal stability is $BeCO_3 < MgCO_3 < CaCO_3 < K_2CO_3$

57. The stability of carbonium ion is influenced by both resonance and inductive effect



58.



59. We know that surface acting agents (i.e. surfactants) such as soaps and detergents belong to the class of micelles. A micellar system when dissolved in water, dissociates to give ions. The anion consists of two parts. The polar groups such as (COO^- or SO_4^{2-}) ion is water loving (i.e. hydrophilic) in nature. Its is called head of the species. The hydrocarbon chain which is quite big in size is water repelling (i.e. hydrophobic) in nature. It is called tail of the species. Above the critical concentration.

Note : It may also be noted that the critical concentration for micelle formation hydrocarbon chain the two surfactant.

Here the two anions that are formed are in case of 'B' (i.e. $\text{CH}_3(\text{CH}_2)_{11}\text{OSO}_3^-$) and 'C' (i.e. $\text{CH}_3(\text{CH}_2)_6\text{COO}^-$)
The molecular weight of hydrocarbon chain is more in case of "B" so it has lower value of critical concentration for micelle formation in aqueous solution.

60. Cell reaction : $\text{Zn} + \text{Fe}^{2+} \rightarrow \text{Zn}^{2+} + \text{Fe}$

$$E_{\text{cell}} = E_{\text{cell}}^0 - \frac{0.0591}{n} \log \left[\frac{\text{Zn}^{2+}}{\text{Fe}^{2+}} \right]$$

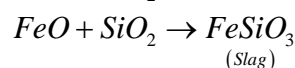
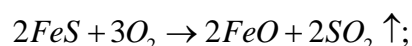
$$E = E^0 - \frac{0.0591}{2} \log \frac{10^{-2}}{10^{-3}}$$

$$E^0 = 0.2905 - \frac{0.0591}{2} = 0.261$$

Or

$$0.261 = \frac{0.0591}{2} \log K_{\text{eq}} \quad \text{or} \quad K_{\text{eq}} = 10^{0.0295}$$

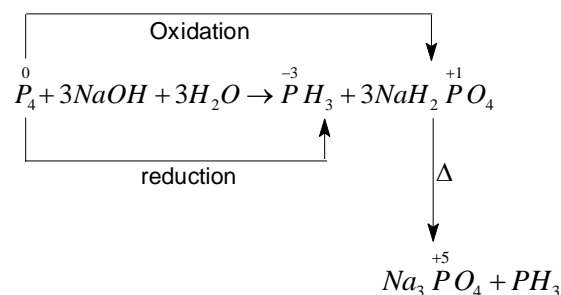
61. During the extraction of copper, iron is present in the ore as impurity (FeS). The ore together with a little coke and silica is smelted ; FeS present as impurity in the ore is oxidized to iron oxide, which then reacts with silica to form fusible ferrous silicate which is removed as slag.



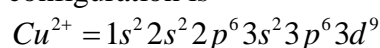
62. On moving along a period from left to right I.E. increases and on moving down a group I.E. decreases. Hence correct order is :




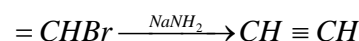
63.



64. Colour is due to d-d transitions. Coloured compounds contain partly filled d-orbital. The oxidation state of copper in various compounds is +1 and +2. In CuF_2 it is in +2 oxidation state. In +2 state its configuration is

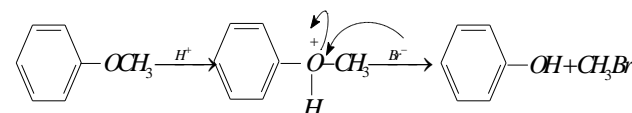


i.e. $3d$  it has one unpaired electron due to this it is coloured (CuF_2 possesses blue colour in crystalline form)

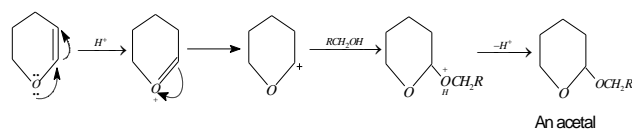


Elimination of HBr from $\text{CH}_2 = \text{CHBr}$ requires a stronger base because here, Br acquires partial double bond character due to resonance.

66.



67.



68. This reaction is an example of "Perkin reaction".

The compound X should be $(\text{CH}_3\text{CO})_2\text{O}$. In this step the carbanion is obtained by removal of an α -H atom from a molecule of an acid anhydride the anion of the corresponding acid acting as a necessary base.

69. (i) Position (X) is most acidic due to $-\text{COOH}$ group.

(ii) $-\text{NH}_3^+$ group at position Y is more acidic than at Z because of presence of electron withdrawing $-\text{COOH}$ group in close proximity. Hence $-\text{NH}_3^+$ group at position Z is least acidic.

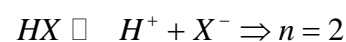
70. Photochemical smog is caused by oxides of sulphur and nitrogen.

71. Depression in freezing point,

$$\Delta T_f = i \times K_f \times m$$

Van't Hoff factor, $i = \frac{1 - \alpha + n\alpha}{1}$, where n =

no. of ions produced by complete dissociation of 1 mole of HX.



$$\therefore i = \frac{1 - 0.2 + 2 \times 0.2}{1} = 1.2$$

[For 20% ionization. $\alpha = \frac{20}{100} = 0.2$]

$$\therefore \Delta T_f = 1.2 \times 1.86 \times 0.2 = 0.45 [\because m = 0.2]$$

Hence freezing point of solution is -0.45

$[\because F.P \text{ water} = 0^{\circ}C]$

72. Enthalpy change for in isothermal reversible process is given by

$$\Delta H = nR \ln \frac{V_2}{V_1} = 2 \times 8.314 \times 2.303 \log \frac{100}{10}$$

$$= 38.3 \text{ J mol}^{-1} \text{ K}^{-1}$$

73. Overall order = sum of orders w.r.t each reactant.

Let the order be x and y for G and H respectively

Exp.No	[G] mole Litre ⁻¹	[H] mole litre ⁻¹	Rate (mole Litre ⁻¹ time ⁻¹)
1	a	b	r
2	2a	2b	8r
3	2a	b	2r

Applying $r = k[G]^x[H]^y$ we get, $x=1$. $y=2$

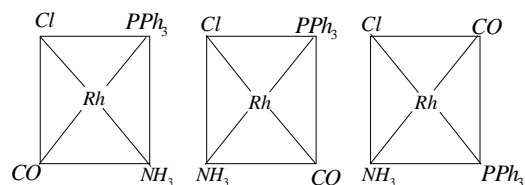
\therefore For (1) and (3), the rate is doubled when conc. Of G is doubled keeping that of H constant i.e., rate $\propto [G]$

$$\therefore x = 1$$

From (2) and (3), $y= 2$

\therefore Overall order is 3.

- 74.



The number of geometrical isomers is 3.

75. The basic group in the given form of lysine

is NH_2 (not NH_3^{\oplus}) and CO_2^- .

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