# BOOKLET CODE C

**Invigilator's Signature**

# ENTRANCE EXAMINATION – 2018

## M. Sc. Chemistry

**TIME: 2 HOURS** **MAXIMUM MARKS: 100**

**HALL TICKET NUMBER:**

## INSTRUCTIONS

1. Write your **HALL TICKET NUMBER** and the **BOOKLET CODE** in the space provided above and also on the **OMR** ANSWER SHEET given to you.
2. Make sure that pages numbered from **1 - 24** are present (excluding 4 pages assigned for rough work).
3. There are 100 questions in this paper. All questions carry equal marks.
4. **There is negative marking. Each wrong answer carries – 0.33 mark.**
5. Answers are to be marked on the OMR answer sheet following the instructions provided on it.
6. Hand over the OMR answer sheet at the end of the examination.
7. In case of a tie, the marks obtained in the first 25 questions (**PART A**) will be used to determine the order of merit.
8. No additional sheets will be provided. Rough work can be done in the space provided at the end of the booklet.
9. Calculators are allowed. **Cell phones are not allowed.**
10. Useful constants are provided at the beginning, before **PART A** in the question paper.
11. Candidate should write and darken the correct Booklet Code in the OMR Answer Sheet, without which the OMR will not be evaluated. The candidates defaulting in marking the Booklet Code in the OMR shall not have any claim on their examination and University shall not be held responsible.



Q-9

**Useful Constants:**

Rydberg constant = 109737 $cm^{-1}$; Faraday constant = 96500 C; Planck constant = $6.625 \times 10^{-34}$ J s; Speed of light = $2.998 \times 10^{8}$ m $s^{-1}$; Boltzmann constant = $1.380 \times 10^{-23}$ J $K^{-1}$; Gas constant = 8.314 J $K^{-1}$ $mol^{-1}$ = 0.082 L atm $K^{-1}$ $mol^{-1}$ = 1.986 cal $K^{-1}$ $mol^{-1}$; Mass of electron = $9.109 \times 10^{-31}$ kg; Mass of proton = $1.672 \times 10^{-27}$ kg; Charge of electron = $1.6 \times 10^{-19}$ C; 1 D = $3.336 \times 10^{-30}$ C m; 1 bar = $10^{5}$ N $m^{-2}$; RT/F (at 298.15 K) = 0.0257 V.

## PART – A

1. Identify the order of acid strength of $CH_3CO_2H$, $CF_3CO_2H$, $NO_2CH_2CO_2H$, and $CCl_3CO_2H$.

   [A] $CH_3CO_2H < NO_2CH_2CO_2H < CCl_3CO_2H < CF_3CO_2H$

   [B] $CH_3CO_2H < CCl_3CO_2H < NO_2CH_2CO_2H < CF_3CO_2H$

   [C] $CH_3CO_2H < NO_2CH_2CO_2H < CF_3CO_2H < CCl_3CO_2H$

   [D] $CH_3CO_2H > NO_2CH_2CO_2H > CCl_3CO_2H > CF_3CO_2H$

2. Among the following, the molecule having the longest bond length is:

   [A] NO [B] $NO^{+}$

   [C] $NO^{2+}$ [D] $NO^{-}$

3. The number of real roots to the pair of equations $x^2 + y^2 = 1$ and $9x^2 + 4y^2 = 36$ is:

   [A] 0 [B] 1

   [C] 2 [D] 3

4. One of the molecules present in turmeric is:

   [A] nicotine [B] curcumin

   [C] quinine [D] piperine

5. The integral $\int_{\pi/4}^{3\pi/4} \frac{dx}{(1+cos(x))} =$

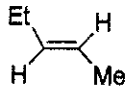
   [A] $-2$ [B] $-1$

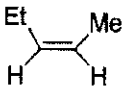
   [C] 4 [D] 2

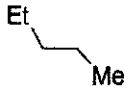


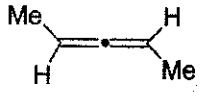
8-9

6. 2-Pentyne on reduction with Na/liq.$NH_3$ provides:

[A] 


[B] 


[C] 


[D] 


7. In an election there are 10 candidates for 4 seats. The voter may cast vote for $1, 2, 3$ or 4 seats. The total number of ways in which the voter can cast the vote is:

[A] 853 [B] 583

[C] 385 [D] 305

8. A circle is expanding in time; if the rate of increase of its radius is $r'$, the rate of increase of its area is given by:

[A] $r' \times area$ [B] $(r')^2$

[C] $r' \times radius$ [D] $r' \times circumference$

9. A solid cylinder with diameter 3 cm and height 10 cm is flattened into a circular disc with diameter 30 cm. Thickness of the resulting disc is:

[A] 100 cm [B] 1 cm

[C] 1 mm [D] 1 nm

10. Let $T_n$ be the number of all possible triangles formed by joining $n$ non-collinear points. Then, $T_6 - T_5 =$

[A] 10 [B] 8

[C] 5 [D] 7



9-9

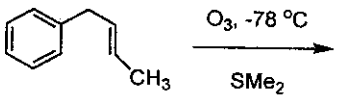
**11.** The value of the following determinant is:

$$\begin{vmatrix} 2 & 3 & 4 & 5 \\ 3 & 5 & 6 & 9 \\ 7 & -1 & 0 & 2 \\ 3 & 5 & 6 & 9 \end{vmatrix}$$

[A] $-27$ [B] $0$

[C] $1$ [D] $27$

**12.** Identify the products obtained from the following reaction:




[A] 3-phenylpropane-1,2-diol and methanol

[B] 2-phenylethanal and ethanol

[C] acetic acid and 2-phenylacetic acid

[D] 2-phenylethanal and ethanal

**13.** Which one of the following is an unusual base pairing in nucleic acids?

[A] A-T [B] G-T

[C] G-C [D] A-U

**14.** The amino acid that directly participates in the biosynthesis of heme is:

[A] glycine [B] methionine

[C] aspartate [D] tryptophan

**15.** A triangle with vertices $(4, 0)$, $(-1, -1)$ and $(3, 5)$ is:

[A] isosceles and not right angled [B] right angled but not isosceles

[C] isosceles and right angled [D] neither right angled nor isosceles



8-9

**16.** The graph of equation of $2x^2 + 2y^2 - 4x + y + 1 = 0$ is a:

[A] circle with center $(1, -\frac{1}{4})$ and radius $\frac{3}{4}$

[B] circle with center $(-\frac{1}{4}, 1)$ and radius $\frac{9}{16}$

[C] parabola with vertex at $(1, -\frac{1}{4})$

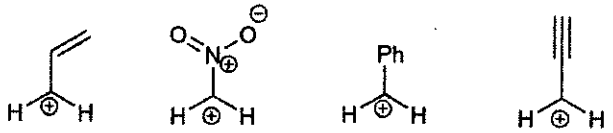
[D] parabola with vertex at $(-\frac{1}{4}, 1)$

**17.** If the point of intersection of the lines, $4ax + 2ay + c = 0$ and $5bx + 2by + d = 0$ lies in the fourth quadrant and is equidistant from the two axes ($a, b, c$ and $d$ are non-zero numbers), then:

[A] $3bc - 2ad = 0$ [B] $2bc - 3ad = 0$

[C] $2bc + 3ad = 0$ [D] $3bc + 2ad = 0$

**18.** Arrange the following intermediates in the decreasing order of their stability:




I II III IV

[A] II> IV > I > III [B] I > IIII > IV > II

[C] III > I > IV > II [D] III > II > I > IV

**19.** Excess acidity caused by acid rain to the soil can be neutralized by:

[A] addition of more fertilizer [B] removal of acidified soil

[C] addition of $Cs_2CO_3$ [D] addition of lime

**20.** Half-life of $^{14}C$ is 5730 years. The fraction of $^{14}C$ that remains in a 50,000 years old sample is:

[A] $2.36 \times 10^{-3}$ [B] $0.36 \times 10^{-3}$

[C] $1.36 \times 10^{-3}$ [D] $3.36 \times 10^{-3}$



9-9

**21.** The integral, $\int x \ln(x)\, dx =$

[A] $\frac{x^2}{2} + x\left(\ln(x) - \frac{1}{2}\right) + const.$

[B] $\frac{x \ln(x)}{2} + const.$

[C] $\frac{x^2}{2}\left(\ln(x) + \frac{1}{2}\right) + const.$

[D] $\frac{x^2}{2}\left(\ln(x) - \frac{1}{2}\right) + const.$

**22.** The molecule possessing non-zero dipole moment is:

[A] $CCl_4$

[B] $XeF_4$

[C] $SF_4$

[D] $PCl_5$

**23.** The hybridization of sulfur (as per VSEPR theory) in $SF_4$ molecule is:

[A] $sp^2$

[B] $sp^3d^2$

[C] $sp^3d$

[D] $sp^3$

**24.** Zinc uranyl acetate and Nessler's reagent are used in the confirmatory test of the following cations:

[A] $K^+$ and $NH_4^+$, respectively

[B] $Cs^+$ and $NH_4^+$, respectively

[C] $Na^+$ and $NH_4^+$, respectively

[D] $NH_4^+$ and $Na^+$, respectively

**25.** The $pK_a$ value of hydrofluoric acid is 3.2. The approximate degree of dissociation of 0.35 M solution of hydrofluoric acid is:

[A] 1.2%

[B] 2.4%

[C] 4.2%

[D] 12%



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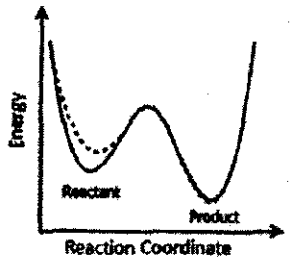
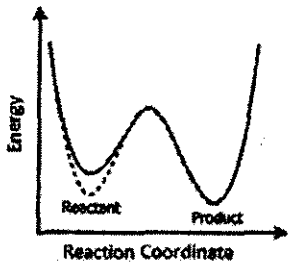
## PART-B

**26.** The energy diagram that correctly corresponds to an enzyme catalyzed reaction is:

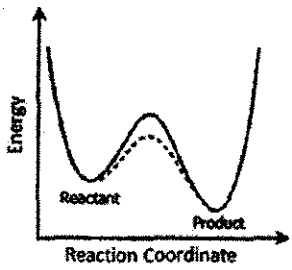
[A]



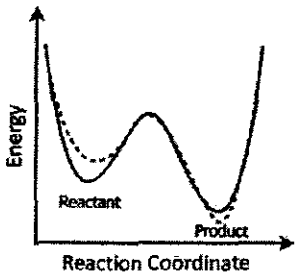

[B]




[C]




[D]



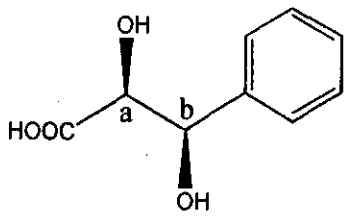

—— Non catalytic
----- Enzyme catalytic

**27.** Intermediate involved in the Reimer-Tiemann reaction is:

[A] carbene [B] carbanion

[C] free radical [D] carbocation

**28.** Absolute stereochemistry of the following compound is:



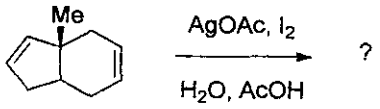

[A] a- (*S*) b- (*R*) [B] a- (*R*), b- (*R*)

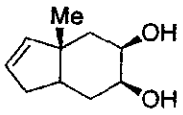
[C] a- (*S*) b- (*S*) [D] a- (*R*), b- (*S*)

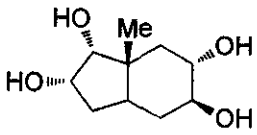


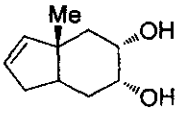
9-9

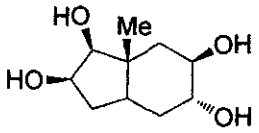
**29.** The major product obtained in the following transformation is:




[A] 


[B] 


[C] 


[D] 


**30.** Which one of the following reactions involves both oxidation and reduction processes?

[A] Robinson Annulation

[B] Claisen condensation

[C] Cannizaro reaction

[D] Perkin condensation

**31.** Contact angle of a liquid with glass wall of a capillary tube of length 10 cm is 90°. When the capillary tube is dipped vertically in the liquid, the liquid level in the capillary tube:

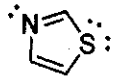
[A] increases

[B] decreases

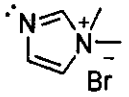
[C] remains same

[D] overflows out

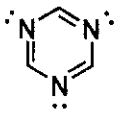
**32.** According to Hückel rule, which one of the following is not an aromatic compound?



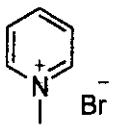

[A]




[B]




[C]




[D]



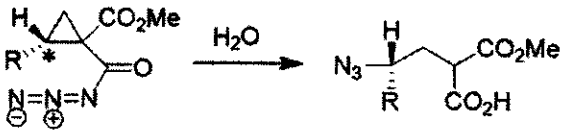
8-9

**33.** The rate of effusion of $O_2$ is 1.0 mL $s^{-1}$ at 300 K and 1.0 atm pressure. Under the same conditions, the rate of effusion (in mL $s^{-1}$) of $H_2$ is close to:

[A] 1.0 [B] 4.0

[C] 8.0 [D] 16.0

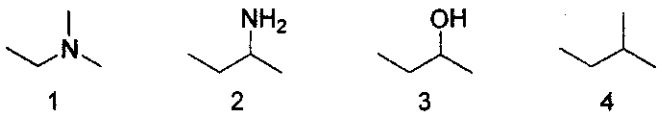
**34.** The stereochemical change at the reaction centre (C*) in the following ring-opening reaction is (R=Methyl):




[A] inversion [B] retention

[C] racemisation [D] double inversion

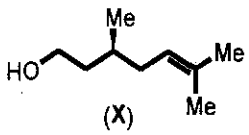
**35.** The decreasing order of boiling points of the following compounds is:




[A] 1>2>3>4 [B] 2>3>1>4

[C] 3>2>1>4 [D] 1>3>2>4

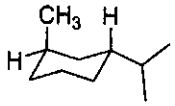
**36.** Ozonolysis of a given molecule (X) provides the product Y and acetone. The IUPAC name of Y is:



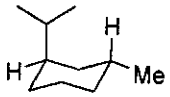

[A] (*S*)-5-hydroxy-3-methylpentanal [B] (*R*)-5-hydroxy-3-methylpentanol

[C] (*R*)-5-hydroxy-3-methylpentanal [D] (*S*)-3,6-dimethylhept-5-en-1-ol

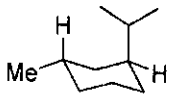
**37.** The most stable conformation of (1*R*,3*R*)-1-isopropyl-3-methylcyclohexane is:



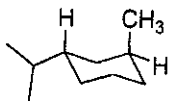

[A]




[B]




[C]

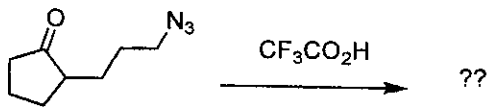



[D]

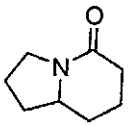
**38.** In the non-aqueous solvent $BrF_3$, the nature of $SbF_5$ is:

[A] basic
[B] acidic
[C] neutral
[D] mildly basic

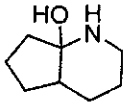
**39.** The product obtained in the following reaction is:



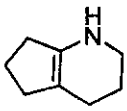

[A]



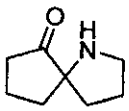

[B]




[C]




[D]




**40.** $ClF_3$ molecule is:

[A] T-shaped
[B] trigonal planar
[C] trigonal bipyramidal
[D] square planar

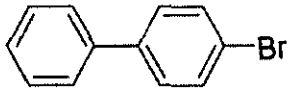
**41.** The paramagnetic species among the following is:

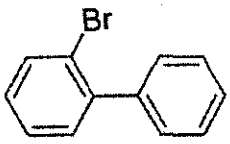
[A] $N_2O$
[B] $NO_2$
[C] $NO_3^-$
[D] $N_2O_4$

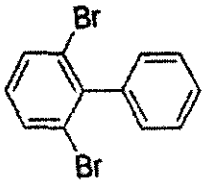


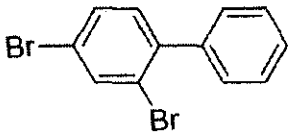
Q-9

**42.** The major product formed in the following reaction is:


[A] 


[B] 


[C] 


[D] 


**43.** Two gases have the same value of van der Waals gas constant *'a'* but different *'b'* values. The more compressible of the two gases is:

[A] the gas with lower *'b'* value.

[B] the gas with higher *'b'* value.

[C] both are equally compressible.

[D] cannot be predicted.

**44.** Among the complexes (i) $[Ni(CN)_4]^{2-}$, (ii) $[Fe(CO)_5]$, (iii) $[CuCl_5]^{3-}$ and (iv) $[PtCl_6]^{2-}$ the ones that obey the 18-electron rule are:

[A] (i) and (ii)

[B] (i) and (iii)

[C] (iii) and (iv)

[D] (ii) and (iv)

**45.** Penicillin contains:

[A] β-lactone unit

[B] β-lactam unit

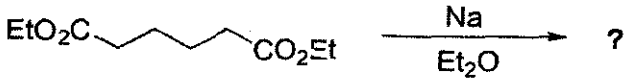
[C] γ-lactone unit

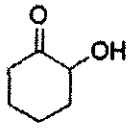
[D] γ -lactam unit

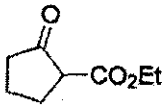


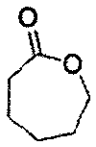
Q-9

**46.** The major product formed in the following reaction is:



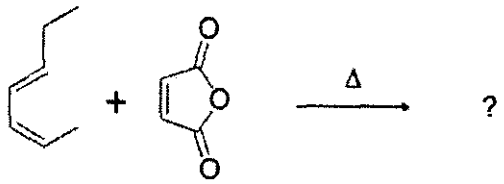

[A] 

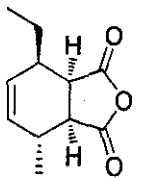

[B] 

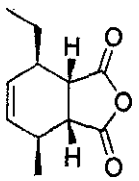

[C] 

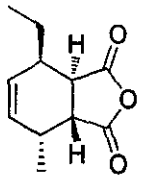

[D] 

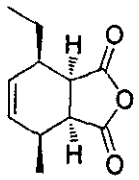

**47.** The major product obtained in the following transformation is:




[A] 


[B] 


[C] 


[D] 


**48.** Reaction of dichromate anion with iodide in acid medium gives:

[A] $Cr^{3+}$, iodine and water

[B] $Cr^{3+}$, iodate and water

[C] $Cr^{3+}$, iodate and oxygen

[D] $Cr^{2+}$, iodide and water



8-9

**49.** Carbon-based free radical intermediates are stabilized by

[A] electron donating groups

[B] both electron donating and withdrawing groups

[C] electron withdrawing groups

[D] neutral substituents

**50.** The reaction that involves the formation of both C-C and C-O bonds is:

[A] Diels-Alder reaction

[B] Darzen's glycidic ester condensation

[C] Aldol reaction

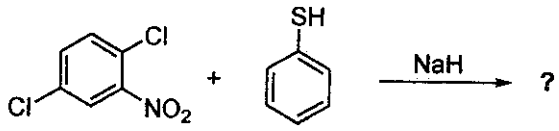
[D] Beckmann rearrangement

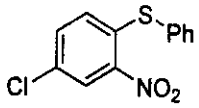
**51.** A complex of formula $[MA_2B_2]X_2$ is found to have no geometrical isomers. Both A and B are monodentate ligands and X is a halogen. The structure of the complex is:

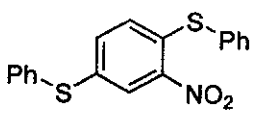
[A] tetrahedral [B] square-planar

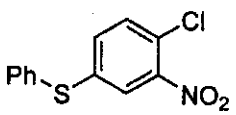
[C] square-pyramidal [D] octahedral

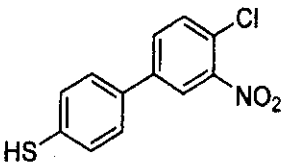
**52.** The product formed in the following reaction is:




[A]



[B]



[C]



[D]





8-9

**53.** The number of electrons involved in the following balanced redox reaction is:

$$2\ MnO_4^-(aq) + 10\ Br^-(aq) + 16\ H^+(aq) \rightarrow 2Mn^{2+}(aq) + 5\ Br_2(aq) + 8H_2O(l)$$

[A] 2 [B] 4

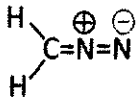
[C] 5 [D] 10

**54.** Names of $O_2^-$, $O_2^{2-}$, $O_2^+$ are respectively:

[A] superoxide, peroxide and dioxygenyl [B] peroxide, superoxide and dioxygenyl

[C] superoxide, dioxygenyl and peroxide [D] dioxygenyl, peroxide, and superoxide

**55.** The hybridization of carbon, central nitrogen, and terminal nitrogen in the following resonance structure of diazomethane are respectively :



[A] $sp^2$, $sp$, $sp$ [B] $sp^3$, $sp^2$, $sp$

[C] $sp^2$, $sp^2$, $sp$ [D] $sp^3$, $sp$, $sp$

**56.** The number of OH and P=O groups present in triphosphoric acid are respectively:

[A] 3 and 5 [B] 5 and 3

[C] 2 and 5 [D] 3 and 3

**57.** Among $BrO_4^-$, $SiF_4$, $TeF_4$, $ICl_4^-$, the species isostructural to xenon tetrafluoride are (is):

[A] $BrO_4^-$ and $ICl_4^-$ [B] $TeF_4$ and $ICl_4^-$

[C] Only $ICl_4^-$ [D] $SiF_4$ and $TeF_4$



8-9

**58.** Assuming an octahedral geometry the number of geometrical isomers that are possible in $[PF_3Cl_3]^-$ and $[PF_2Cl_4]^-$ are:

[A] 2, 2 [B] 2, 3

[C] 3, 2 [D] 4, 2

**59.** Among the following pair of diatomic molecules, choose the one where the bonding $\sigma(2p)$ orbital is lower in energy than the $\pi(2p)$ orbitals.

[A] $O_2$ and $F_2$ [B] $O_2$ and $B_2$

[C] $C_2$ and $O_2$ [D] $F_2$ and $B_2$

**60.** Among the following complexes, the pair which shows ionization isomerism is:

i. $[Co(NH_3)_4(H_2O)Cl]Br_2$ and $[Co(NH_3)_4Br_2]Cl{\cdot}H_2O$

ii. $[Co(NH_3)_4(H_2O)Cl]Cl_2$ and $[Co(NH_3)_4Cl_2]Cl{\cdot}H_2O$

iii. $[(ON)Ru(NO)_4(OH)]^{2-}$ and $[(NO)Ru(NO)_4(OH)]^{2-}$

iv. $[Co(en)_3][Cr(CN)_6]$ and $[Cr(en)_3][Co(CN)_6]$

[A] i [B] ii

[C] iii [D] iv

**61.** The most abundant transition metal in earth crust is:

[A] aluminium [B] copper

[C] iron [D] calcium

**62.** If the vectors $\boldsymbol{a} = \boldsymbol{i} - \boldsymbol{j} + 2\boldsymbol{k}$, $\boldsymbol{b} = 2\boldsymbol{i} + 4\boldsymbol{j} + \boldsymbol{k}$ and $\boldsymbol{c} = p\boldsymbol{i} + \boldsymbol{j} + q\boldsymbol{k}$ are mutually orthogonal, then $(p, q)$ is:

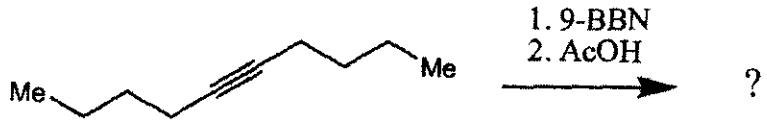
[A] $(2, -3)$ [B] $(-2, 3)$

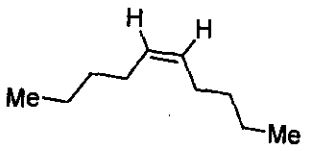
[C] $(-3, 2)$ [D] $(3, -2)$

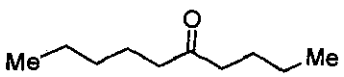


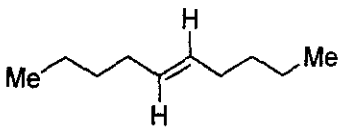
8-9

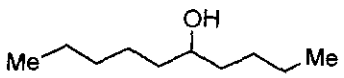
**63.** The most appropriate product obtained in the following reaction is:



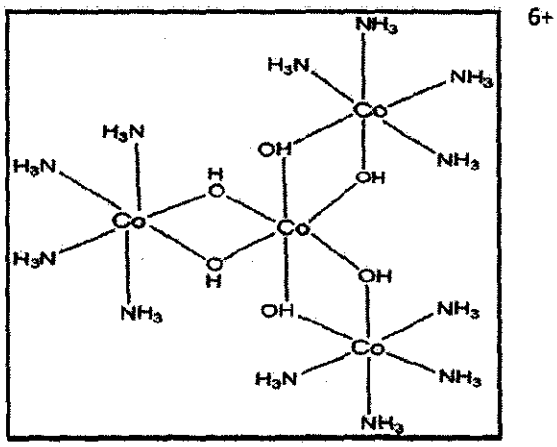

[A] 


[B] 


[C] 


[D] 


**64.** The correct IUPAC name of the following complex cation is:




[A] tris[tetraammine-$\mu$-dihydroxocobalt(III)]cobalt(III) ion

[B] tris($\mu$-dihydroxotetraamminecobalt)cobalt(6+) ion

[C] tris(tetraamminecobalt-hexahydroxo)cobalt(6+) ion

[D] tetra(tetraamminehexahydroxo)cobalt(6+) ion



Q-9

**65.** Metal '$M_1$' reacts with cyanide ion in the presence of air to form the complex anion $M_1(CN)_2^-$, which gives back '$M_1$' upon treatment with '$M_2$'. $M_1$ and $M_2$ are respectively:

[A] silver and copper
[B] copper and zinc
[C] gold and zinc
[D] gold and silver

**66.** If $x^m y^n = (x+y)^{(m+n)}$, then $dy/dx =$

[A] $x/y$
[B] $xy$
[C] $(m+n)y/x$
[D] $y/x$

**67.** The fractional surface coverage ($\theta$) in dissociative adsorption of a gas is ($K$= equilibrium constant for adsorption-desorption, $P$ = pressure of gas):

[A] $\theta = \frac{KP}{1+KP}$
[B] $\theta = \frac{KP^2}{1+KP^2}$
[C] $\theta = \frac{(KP)^{1/2}}{1+(KP)^{1/2}}$
[D] $\theta = \frac{(KP)^2}{1+(KP)^2}$

**68.** A mixture contains equal number of polymer molecules with molecular weights 20,000 and 40,000. The number average molar mass of the mixture (in amu) is:

[A] 30,000
[B] 25,000
[C] 35,000
[D] 42,000

**69.** A vessel contains a mixture of helium (He) and methane ($CH_4$). The ratio of the root mean square speed of the He atoms to that of the $CH_4$ molecules is:

[A] 1
[B] 2
[C] 4
[D] 16



Q-9

**70.** The fragment which is *isolobal* to $Fe(CO)_4$ is:

[A] $CH_2$ [B] $CH_3$

[C] $CH_4$ [D] CH

**71.** The spin only magnetic moment (in Bohr Magneton) of high-spin $Mn^{3+}$ ion is

[A] 1.73 [B] 3.88

[C] 2.83 [D] 4.90

**72.** The $n^{th}$ derivative of $\ln(x)$, where $n>1$, is:

[A] $\frac{(-1)^{n-1}(n-1)!}{x^n}$ [B] $\frac{(-1)^n(n-1)!}{x^n}$

[C] $\frac{(n-1)!}{x^n}$ [D] $\frac{(-1)^{n-1}n!}{x^n}$

**73.** The metal ions present in Chlorophyll and vitamin $B_{12}$ are respectively:

[A] Fe and Co [B] Fe and Mg

[C] Co and Mg [D] Mg and Co

**74.** Match the following:

| | | | |
|---|---|---|---|
| [1] | HgS | (a) | Pyrolusite |
| [2] | $MnO_2$ | (b) | Chalcopyrite |
| [3] | $CuFeS_2$ | (c) | Ilmenite |
| [4] | $FeTiO_3$ | (d) | Cassiterite |
| [5] | $SnO_2$ | (e) | Cinnabar |

[A] (1)-(e), (2)-(a), (3)-(b), (4)-(c), (5)-(d)

[B] (1)-(e), (2)-(c), (3)-(a), (4)-(d), (5)-(b)

[C] (1)-(b), (2)-(a), (3)-(e), (4)-(c), (5)-(d)

[D] (1)-(c), (2)-(d), (3)-(b), (4)-(a), (5)-(e)



8-9

**75.** The square of the matrix $\begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}$ is:

[A] $\begin{pmatrix} -1 & 0 \\ 0 & 1 \end{pmatrix}$ [B] $\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$

[C] $\begin{pmatrix} -1 & 0 \\ 0 & -1 \end{pmatrix}$ [D] $\begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}$

**76.** The crystal field stabilization of tetrahedral $[CoBr_4]^{2-}$ is:

[A] $4/9\Delta_t$ [B] $6/9\Delta_t$

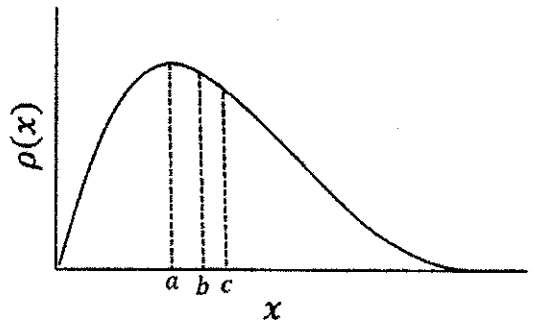
[C] $4/5\Delta_t$ [D] $6/5\Delta_t$

**77.** If the parabola, $y = 4x^2 + 3$ is rotated by $-90^\circ$ (anticlockwise $90^\circ$) about the origin, the resulting function is:

[A] $y = 4x^2 - 3$ [B] $x = -4y^2 - 3$

[C] $y = -4x^2 - 3$ [D] $x = 4y^2 - 3$

**78.** In the probability density distribution given below, $a$, $b$ and $c$ respectively represent:




[A] mode, mean and median [B] median, mode and mean

[C] mode, median and mean [D] mean, mode, median

**79.** If, $cos\ \varphi - sin\ \varphi = \sqrt{2}\ sin\ \varphi$, then $cos\ \varphi + sin\ \varphi =$

[A] $-\sqrt{2}\ sin\ \varphi$ [B] $\sqrt{2}\ cosec\ \varphi$

[C] $\sqrt{2}\ cos\ \varphi$ [D] $\sqrt{2}\ tan\ \varphi$



8-9

**80.** When two dice are thrown simultaneously, the probability of obtaining 4 as the total is:

[A] 1/36 [B] 3/36

[C] 5/36 [D] 7/36

**81.** The plane that is perpendicular to the (110) plane in a simple cubic lattice is:

[A] (010) [B] (001)

[C] (101) [D] (011)

**82.** The limiting molar conductivity of NaOH, NaF and $NH_4F$ are 24.8, 10.5 and 12.5 mS $m^2$ $mol^{-1}$, respectively. The limiting molar conductivity (in mS $m^2$ $mol^{-1}$) of $NH_4OH$ is:

[A] 27.1 [B] 22.5

[C] 17.8 [D] 16.4

**83.** The exact differential among the following for a perfect gas (where $P$, $T$ and $R$ are pressure, temperature and gas constant, respectively) is:

[A] $\frac{P}{RT}dT + RdP$ [B] $RPdT + RTdP$

[C] $\frac{RP}{T}dT + \frac{RT}{P}dP$ [D] $RdT + \frac{RT}{P}dP$

**84.** A real gas behaves more like an ideal gas at:

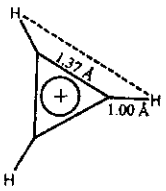
[A] low pressure and high temperature [B] high pressure and high temperature

[C] low pressure and low temperature [D] high pressure and low temperature



Q-9

**85.** In the cyclopropenium ion, the C-C and C-H bond lengths are respectively 1.37 Å and 1.00 Å. The non-bonded H---H distance (in Å) is:




[A] 2.24 [B] 2.74

[C] 3.10 [D] 3.37

**86.** The three quantum numbers ($n$, $l$, and $m$) of the unpaired electron of copper atom in its ground state are:

[A] $(4, 0, 0)$ [B] $(4, 1, 0)$

[C] $(3, 2, 0)$ [D] $(3, 2, -2)$

**87.** The ratio of the osmotic pressures of two solutions A and B ($P_A/P_B$) is 1.2. If the depression of freezing point of solution A is 0.3 K, the depression in the freezing point of B at the same temperature (in Kelvin) is close to:

[A] 0.36 [B] 0.43

[C] 0.50 [D] 0.29

**88.** At 298 K the standard free energy change ($\Delta G^o$, in kJ mol$^{-1}$) for the cell reaction $Cu^{2+}(aq) + Zn(s) \rightarrow Cu(s) + Zn^{2+}(aq)$ is:

$[E^0_{Cu^{2+}/Cu} = 0.339\ \text{V}$ and $E^0_{Zn^{2+}/Zn} = -0.762\ \text{V}]$

[A] $+106$ [B] $+212$

[C] $-106$ [D] $-212$



Q-9

**89.** The saturated vapour pressures of two liquids A and B are respectively 50 kPa and 20 kPa at 30°C; they are completely miscible and form ideal mixture. The vapour pressure (in kPa) of a mixture of 2 moles of A and 3 mols of B at 30°C is:

[A] 25 [B] 32

[C] 35 [D] 70

**90.** When Cu $K_\alpha$ X-ray with wavelength $\lambda = 1.54$ Å is used, the diffraction from the (3 2 0) plane of a crystal occurs at, $2\theta = 45.6^\circ$. If Mo $K_\alpha$ X-ray with $\lambda = 0.71$ Å is used, diffraction from the (3 2 0) plane will be found at $2\theta =$

[A] $20.6^\circ$ [B] $21.6^\circ$

[C] $22.8^\circ$ [D] $57.2^\circ$

**91.** The equilibrium constant for $A_2 \leftrightharpoons 2A$ is 2.0 at 30°C. The mole fraction of $A$ at equilibrium at the same temperature is:

[A] 0.25 [B] 0.50

[C] 0.67 [D] 0.80

**92.** The entropy change (in cal $K^{-1}$) in the isothermal reversible expansion of one mole of a perfect gas from 7.6 to 2.9 atm at 300 K is:

[A] 0.826 [B] 1.328

[C] 1.907 [D] 3.061

**93.** For the gas phase reaction, $H_2O + CH_4 = CO + 3H_2$, if $K_c = 3.8 \times 10^{-3}$ $M^2$ at 1000 K, the $K_p$ ($atm^2$) is:

[A] 16 [B] 26

[C] 12 [D] 14



8-9

**94.** The decomposition reaction $2H_2O_2$ (aq) $\rightarrow$ $2H_2O$ (l) + $O_2$ (g) is first order in $H_2O_2$ with a rate constant $1.8 \times 10^{-5}$ $s^{-1}$ at 300 K. If the initial concentration of $H_2O_2$ is 0.3 M, the concentration (in M) after 4 h is:

[A] 0.12 [B] 0.06

[C] 0.23 [D] 0.18

**95.** In a gas phase reaction, $A \rightarrow products$, depending on the initial pressure, $p_0$, the rate, $r$ is found to change as shown in the table. Order of the reaction is:

| $p_0$ / atm | 1 | 2 | 4 |
|---|---|---|---|
| $r$ / atm $s^{-1}$ | 6 | 17 | 48 |

[A] 0 [B] 1

[C] 1.5 [D] 2

**96.** The change in the internal energy of a gas is equal to the heat supplied. The correct statement among the following is:

[A] the gas is expanded isothermally

[B] the process is carried out at constant volume

[C] the gas is expanded under constant pressure

[D] the process is carried out irreversibly

**97.** When a capillary tube with a cross sectional area $a$ is dipped into a liquid, the liquid rises to a height of 15 cm. If another tube with cross sectional area $2a$ is dipped, the rise of the liquid in this tube will be:

[A] 10.6 cm [B] 15 cm

[C] 7.5 cm [D] 21.3 cm



Q-9

**98.** The number of possible lines in the emission spectrum of hydrogen atom from the principal quantum level $n = 7$ to $n = 3$ is:

[A] 10 [B] 9

[C] 8 [D] 7

**99.** The wavelength of a certain line in Balmer series is observed to be 4341 Å, it corresponds to an emission from the state with principal quantum number:

[A] 20 [B] 15

[C] 10 [D] 5

**100.** The speed of an electron in the first Bohr orbit of hydrogen is $x$, then the speed of the electron in $He^+$ in the second orbit is:

[A] $x/2$ [B] $x$

[C] $2x$ [D] $4x$



8-9