

ASSOCIATION OF CHEMISTRY TEACHERS

National Standard Examination in Chemistry – 2023

Date of Examination: November 26, 2023

Time: 11:30 AM to 1:30 PM

Question Paper Code: 31

Student's									
Roll No:									

Write the Question Paper Code (mentioned above) on YOUR OMR Answer Sheet (in the space provided), otherwise your Answer Sheet will NOT be evaluated. Note that the same Question Paper Code appears on each page of the Question Paper.

Instructions to Candidates:

1. Use of mobile phone, smart watch, and iPad during examination is STRICTLY PROHIBITED.
2. In addition to this Question Paper, you are given OMR Answer Sheet along with candidate's copy.
3. On the OMR sheet, make all the entries carefully in the space provided **ONLY** in **BLOCK CAPITALS** as well as by properly darkening the appropriate bubbles.
Incomplete/ incorrect/ carelessly filled information may disqualify your candidature.
4. On the OMR Answer Sheet, use only **BLUE** or **BLACK BALL POINT PEN** for making entries and filling the bubbles.
5. Your **Ten-digit roll number and date of birth** entered on the OMR Answer Sheet shall remain your login credentials means login id and password respectively for accessing your performance / result in National Standard Examination in Chemistry – 2023.

Question paper has two parts. In part A1 (Q. No.1 to 48) each question has four alternatives, out of which **only one** is correct. Choose the correct alternative and fill the appropriate bubble, as shown.

Q.No.12 a b c d

In part A2 (Q. No. 49 to 60) each question has four alternatives out of which any number of alternative(s) (1, 2, 3, or 4) may be correct. You have to choose **all** correct alternative(s) and fill the appropriate bubble(s), as shown

Q.No.52 a b c d

7. For **Part A1**, each correct answer carries 3 marks whereas 1 mark will be deducted for each wrong answer. In **Part A2**, you get 6 marks if all the correct alternatives are marked and no incorrect. No negative marks in this part.
8. Rough work may be done in the space provided. There are **14** printed pages in this paper
9. Use of **Non-programmable scientific** calculator is allowed.
10. No candidate should leave the examination hall before the completion of the examination.
11. After submitting Answer Paper, take away the Question Paper & Candidate's copy of OMR sheet for your future reference.

Please DO NOT make any mark other than filling the appropriate bubbles properly in the space provided on the OMR Answer Sheet.

OMR Answer Sheets are evaluated using machine, hence CHANGE OF ENTRY IS NOT ALLOWED. Scratching or overwriting may result in a wrong score.

DO NOT WRITE ON THE BACK SIDE OF THE OMR ANSWER SHEET.

Instructions to Candidates (Continued) :

You may read the following instructions after submitting the Answer Sheet.

12. **Comments/Inquiries/Grievances regarding this Question Paper, if any, can be shared on the Inquiry/Grievance column on www.iapt.org.in on the specified format till Dec 3, 2023.**
13. **The answers/solutions to this Question Paper will be available on the website: www.iapt.org.in by Dec 2, 2023.** The score card may be downloaded after Dec 24, 2023
14. **CERTIFICATES and AWARDS:**
Following certificates are awarded by IAPT/ACT to students, successful in the National Standard Examination in Chemistry – 2023
- “CENTRE TOP 10 %” To be downloaded from iapt.org.in after 30.01.24
 - “STATE TOP 1 %” Will be dispatched to the examinee
 - “NATIONAL TOP 1 %” Will be dispatched to the examinee
 - “GOLD MEDAL & MERIT CERTIFICATE” to all students who attend OCSC – 2024 at HBCSE Mumbai
- Certificate for centre toppers shall be uploaded on iapt.org.in
15. List of students (with centre number and roll number only) having score above **Minimum Admissible Score (MAS)** will be displayed on the website: www.iapt.org.in by **Dec 25, 2023.** See the **MAS clause** on the student’s brochure on the web.
16. List of students eligible to appear for Indian National Chemistry Olympiad (INChO – 2024) shall be displayed on www.iapt.org.in by Dec 30, 2023.

Useful constants

$$\begin{aligned} \text{Charge of electron, } e &= 1.602 \times 10^{-19} \text{ C} \\ \text{Mass of electron, } m_e &= 9.1 \times 10^{-31} \text{ kg} \\ \text{Planck's constant, } h &= 6.63 \times 10^{-34} \text{ J s} \\ \text{Speed of light, } c &= 3.0 \times 10^8 \text{ ms}^{-1} \\ \text{Avogadro constant, } N_A &= 6.022 \times 10^{23} \text{ mol}^{-1} \\ \text{Faraday constant } F &= 96500 \text{ C mol}^{-1} \\ \text{Molar gas constant, } R &= 0.082 \text{ Latm mol}^{-1} \text{ K}^{-1} \\ &= 8.314 \text{ J mol}^{-1} \text{ K}^{-1} \end{aligned}$$

ASSOCIATION OF CHEMISTRY TEACHERS
NATIONAL STANDARD EXAMINATION IN CHEMISTRY
(NSEC - 2023)

Time: 120 minute

Max. Marks: 216

*Attempt All Sixty Questions***A – 1****ONLY ONE OUT OF FOUR OPTIONS IS CORRECT. BUBBLE THE CORRECT OPTION.**

- The ligand with which the homoleptic octahedral complex of Co^{3+} will be most stable is:
 - Ethylenediamine tetra acetate ion
 - Dien (N-(2-aminoethyl)-1,2-ethanediamine)
 - Ethane-1,2-diamine
 - Ammonia
- Which of the following properties may have positive values of ΔH ?

(i) Lattice enthalpy	(ii) Hydration enthalpy
(iii) Electron gain enthalpy for noble gases	(iv) Ionisation enthalpy

 - (i) and (ii)
 - (iii) and (iv)
 - Only (iv)
 - (ii), (iii) and (iv)
- The correct IUPAC name of potassium permanganate is:

(a) potassium tetraoxomanganate(VI)	(b) potassium tetraoxidopermanganate(VII)
(c) potassium tetraoxidomanganese(VII)	(d) potassium tetraoxidomanganate(VII)
- Which of the following statements is true with respect to sodium salts of oxoanions of phosphorus NaH_2PO_2 and Na_2HPO_3
 - NaH_2PO_2 is reducing and Na_2HPO_3 is oxidizing
 - NaH_2PO_2 is more reducing than Na_2HPO_3
 - NaH_2PO_2 is more oxidizing than Na_2HPO_3
 - NaH_2PO_2 is oxidizing and Na_2HPO_3 is reducing
- The fluoride/s of xenon, XeF_n ($n = 2$ or 4 or 6), which on complete hydrolysis gives back xenon as one of the products, is/are _____.

I. XeF_2	II. XeF_4	III. XeF_6
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 - II only
 - I and II
 - III only
 - I, II and III
- If an element after oganesson (Og, atomic number 118 and electronic configuration $[\text{Rn}] 5f^{14} 6d^{10} 7s^2 7p^6$) was discovered, in which of the following orbital, will the 119^{th} electron be accommodated?
 - 7d
 - 6f
 - 8s
 - 5g
- The number of ‘two-center-two electron’ and ‘three-center-two electron’ bonds in $[\text{Al}(\text{BH}_4)_3]$ are respectively
 - twelve and zero
 - twelve and three
 - six and six
 - nine and three

8. Identify the correct matching of the following oxides in column **M** with their property in column **N**:

M	N
(i) Aluminium trioxide	(p) Acidic oxide
(ii) Calcium oxide	(q) Basic oxide
(iii) Arsenic pentoxide	(r) Amphoteric oxide

- (a) (i)-(p), (ii)-(q), (iii)-(r) (b) (i)-(q), (ii)-(r), (iii)-(p)
 (c) (i)-(r), (ii)-(q), (iii)-(p) (d) (i)-(r), (ii)-(p), (iii)-(q)

9. In each of the following reactions, role of water is:

- (i) $\text{H}_2\text{O} + \text{HCl} \rightarrow \text{H}_3\text{O}^+ + \text{Cl}^-$
 (ii) $6\text{H}_2\text{O} + \text{Mg}^{2+} \rightarrow [\text{Mg}(\text{H}_2\text{O})_6]^{2+}$
 (iii) $2\text{H}_2\text{O} + 2\text{F}_2 \rightarrow 4\text{HF} + \text{O}_2$

- (a) (i) oxidant; (ii) reductant; (iii) base (b) (i) reductant; (ii) oxidant; (iii) base
 (c) (i) base; (ii) base; (iii) reductant (d) (i) acid; (ii) base; (iii) reductant

10. The correct order of the following oxidizing agents in basic aqueous medium is:

- $\text{CrO}_4^{2-}/\text{Cr}^{3+}$ $E^0 = -0.11\text{ V}$
 $\text{FeO}_4^{2-}/\text{Fe}^{3+}$ $E^0 = +0.72\text{ V}$
 $\text{MnO}_4^{2-}/\text{Mn}^{3+}$ $E^0 = +0.46\text{ V}$

- (a) $[\text{CrO}_4]^{2-} > [\text{FeO}_4]^{2-} > [\text{MnO}_4]^{2-}$ (b) $[\text{FeO}_4]^{2-} > [\text{MnO}_4]^{2-} > [\text{CrO}_4]^{2-}$
 (c) $[\text{CrO}_4]^{2-} > [\text{MnO}_4]^{2-} > [\text{FeO}_4]^{2-}$ (d) $[\text{MnO}_4]^{2-} > [\text{FeO}_4]^{2-} > [\text{CrO}_4]^{2-}$

11. The correct order of ionic radii of Rb^+ , Br^- , Sr^{2+} and Se^{2-} is

- (a) $\text{Rb}^+ < \text{Br}^- < \text{Sr}^{2+} < \text{Se}^{2-}$ (b) $\text{Sr}^{2+} < \text{Rb}^+ < \text{Br}^- < \text{Se}^{2-}$
 (c) $\text{Se}^{2-} < \text{Br}^- < \text{Sr}^{2+} < \text{Rb}^+$ (d) $\text{Se}^{2-} < \text{Sr}^{2+} < \text{Rb}^+ < \text{Br}^-$

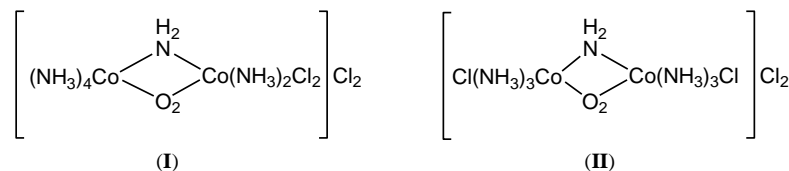
12. Consider the following statements:

- (i) Calcination is carried out in absence of air below the melting point of the ore
 (ii) Roasting and calcination are carried out in presence of flux
 (iii) Calcination is carried out in limited supply of air above the melting point of the ore
 (iv) Roasting is carried out in air below the melting point of ore

The correct set of statements is

- (a) (i) and (iv) (b) (ii) and (iii) (c) (i), (iii) and (iv) (d) (iii) and (iv)

13. The cobalt complexes (I) and (II) given below are examples of



- (a) linkage isomers (b) coordination isomers
 (c) ligand isomers (d) coordination position isomers

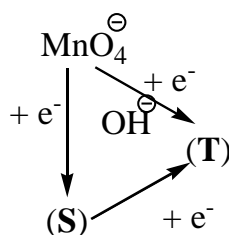
14. The magnetic moment (in units of BM) of copper in $[\text{Cu}(\text{H}_2\text{O})_4]^{2+}$ and $[\text{Cu}(\text{NH}_3)_4]^{2+}$ respectively is:

- (a) 1.73 and 0 (b) 1.73 and 1.73 (c) 2.83 and 2.83 (d) 0 and 2.83

15. In qualitative inorganic analysis of a water-soluble salt mixture (salt AB + salt XY) both the cations were identified as sulphides. In the tests for anions sodium carbonate extract when treated with AgNO_3 gave yellowish precipitate soluble with difficulty in NH_4OH while the other anion can be confirmed with brown ring test. (Given K_{sp} for AS = 1×10^{-44} and XS = 1.4×10^{-24}).

Identify the INCORRECT statement about the analysis.

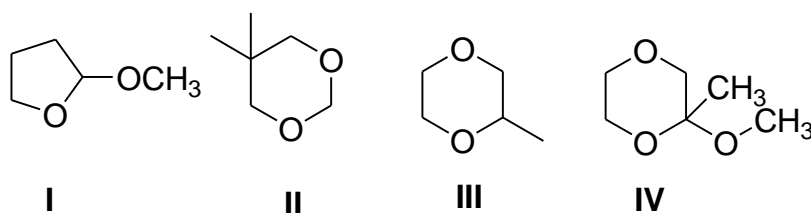
- (a) H_2S can be used under appropriate conditions of pH to separate and identify the cations.
 (b) Cation A will be precipitated under acidic condition as the concentration of sulphides ions required is low.
 (c) The anions are NO_3^- and Cl^- .
 (d) Cation X will be precipitated as sulphides under alkaline condition, as the concentration of sulphides ions required is very high.
16. The correct statement about the solubilities of Group 2 hydroxides is:
 (a) The solubilities increase because lattice energy increases as we go down Group 2
 (b) The solubilities increase because lattice energy decreases as we go down Group 2
 (c) The solubilities decrease because atomic size increases as we go down Group 2
 (d) The solubilities decrease because lattice energy decreases as we go down Group 2
17. A solution of $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ in methanol has $[\text{Cu}^{2+}] = 1.00 \text{ mg per } 1000 \text{ g of methanol}$. The molarity of Cu^{2+} in this solution is $Y \times 10^{-5} \text{ mol L}^{-1}$. Y is :
 (Given- density of methanol = 0.792 g mL^{-1})
 (a) 1.57 (b) 5.04 (c) 1.25 (d) 3.99
18. Following is the reaction flow chart for manganese oxidocomplexes under different alkaline pH conditions. Compounds (S) and (T) respectively are:



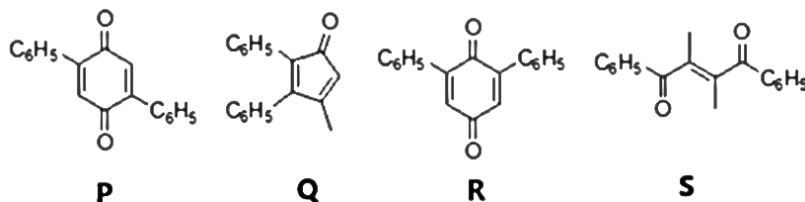
- (a) S= $\text{MnO}(\text{OH})_2$; T= $\text{Mn}(\text{OH})_2$ (b) S= MnO_2 ; T= $\text{MnO}(\text{OH})$
 (c) S= MnO_4^{2-} ; T= $\text{MnO}(\text{OH})$ (d) S= MnO_4^{2-} ; T= MnO_2
19. The correct order of relative strength for the following nucleophilic species is:
- | | | | |
|-----------------------|------------------------|---------------------------------|------------------------|
| NH_2^\ominus | OCH_3^\ominus | $\text{CH}_3\text{COO}^\ominus$ | CH_3OH |
| I | II | III | IV |
- (a) IV > III > II > I (b) II > III > IV > I (c) I > II > IV > III (d) I > II > III > IV
20. The product obtained on reaction of optically pure 1-bromo-1-phenyl ethane with CH_3OH , is:
 (a) phenyl ethene.
 (b) 1-methoxy-1-phenyl ethane with inverted configuration only.
 (c) 1-methoxy-1-phenyl ethane with retention of configuration.
 (d) a racemic mixture of 1-methoxy-1-phenyl ethane.

21. An alkane [X] contains five 1° , two 2° , one 3° and one 4° carbon atoms. The IUPAC name of [X] is:
- (a) 2,4,4-trimethylhexane (b) 3,5-dimethylheptane
(c) 2,4-dimethylheptane (d) 4,4-dimethylheptane
22. The number of isomeric alkenes with molecular formula C_5H_{10} is (taking stereoisomers into account):
- (a) 4 (b) 5 (c) 6 (d) 7
23. At $0^\circ C$, 1 equivalent bromine is added to 2,4-hexadiene to produce 4,5-dibromo-2-hexene and its isomer 'X'. 'X' is:
- (a) 5,5-dibromo-2-hexene (b) 2,5-dibromo-3-hexene
(c) 2,2-dibromo-3-hexene (d) 2,3-dibromo-4-hexene

24. Which of the following is/are example/s of an acetal?



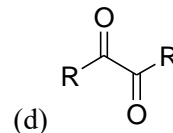
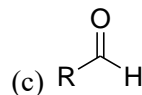
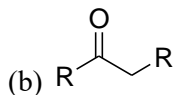
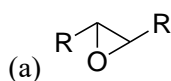
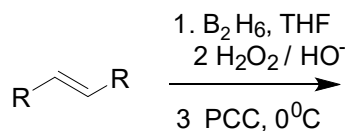
- (a) I and II (b) III and IV (c) Only IV (d) I, II and III
25. The compound which can be produced by double aldol condensation of 1-phenyl-1,2-propanedione:



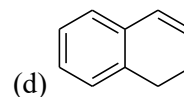
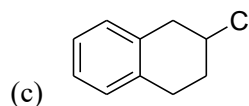
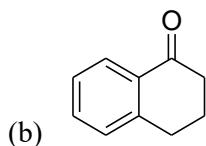
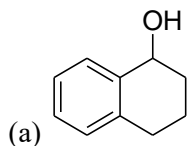
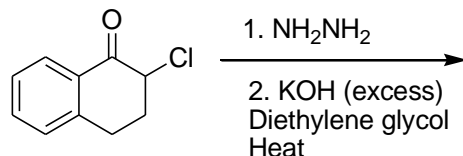
- (a) P (b) Q (c) R (d) S
26. 2,2-Dimethyl-1,3-propanediol is formed by heating 2-methylpropanal with an excess of formaldehyde and $Ca(OH)_2$. The sequence of reactions taking place in this synthesis is:
- (a) dehydrogenation to 2-methyl-2-propenal followed by addition of formaldehyde.
(b) dehydrogenation to penta-2,3-diene followed by addition of formaldehyde.
(c) a crossed aldol reaction followed by a crossed Cannizzaro reaction.
(d) a crossed Cannizzaro reaction followed by a crossed aldol reaction.
27. Number of different types of dipeptides produced using a mixture of glycine and L-valine, and number of optically active dipeptides formed in this mixture will be:
- (a) Four dipeptides, all optically active (b) Two dipeptides, all optically active
(c) Four dipeptides, three optically active (d) Two dipeptides, none optically active

28. Predict the major product in the following reaction.

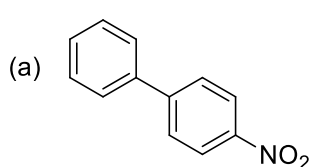
PCC is pyridinium chlorochromate



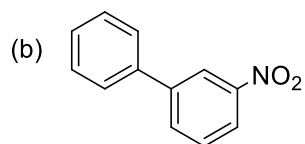
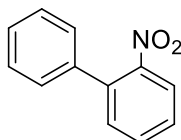
29. Find out the product in the following reaction.



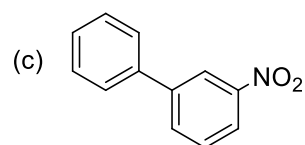
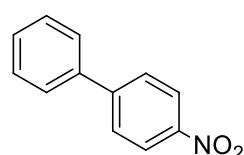
30. The product/s obtained on reaction of biphenyl (Ph-Ph) with nitrating mixture ($\text{HNO}_3 + \text{H}_2\text{SO}_4$) is/are:



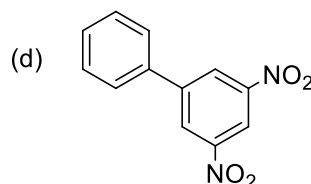
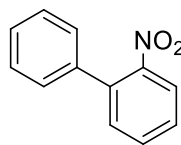
and



and



and



31. Chlorination of propane gives four dichloro products. One of them is optically active. The number of trichloro products possible from the optically active dichloro product is (excluding stereoisomers):

(a) 1

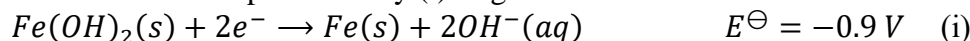
(b) 2

(c) 3

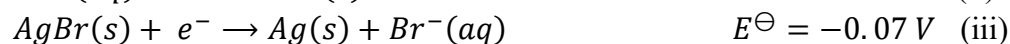
(d) 4

36. A student adds 'x' g of iron (Fe) powder to dil. HCl and measures the work done by the reaction between HCl and the added Fe to be 1000 J. If the experiment was conducted at a constant pressure of 1 atm at 27°C, mass of Fe powder added is:
 (a) 22.4 g (b) 2.24 g (c) 11.2 g (d) 1.12 g
37. Antacids are medicines that temporarily neutralize the acid in the stomach and prevent heartburns. The volume of an antacid syrup containing 2.9 g of $Mg(OH)_2$ per 100 mL to be given to a patient whose stomach contains 2 L of gastric juice with HCl concentration of $6.0 \times 10^{-3} M$ is :
 (Molar mass of $Mg(OH)_2 = 58.0 \text{ g mol}^{-1}$)
 (a) 4.0 mL (b) 7.8 mL (c) 12.0 mL (d) 120 mL

38. A half-cell reaction represented by (i) as given below

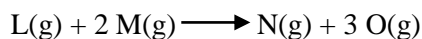


takes place in two different electrochemical cells, I and II, in which the other half cell reactions are (ii) and (iii) respectively:



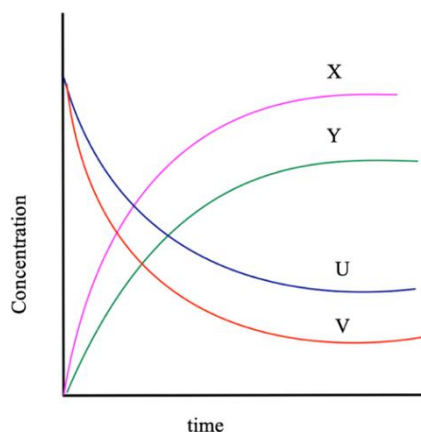
The correct option that represents the redox reactions in cells I and II is:

- (a) Fe is oxidised in cell I; Fe is oxidised in cell II
 (b) Fe is oxidised in cell I; Fe is reduced in cell II
 (c) Fe is reduced in cell I; Fe is reduced in cell II
 (d) Fe is reduced in cell I; Fe is oxidised in cell II
39. The following are the concentration vs time plots of the reactants and products represented by the reaction



The curves that represent M(g) and N(g) qualitatively are respectively

- (a) X, Y
 (b) Y, U
 (c) V, Y
 (d) U, X



40. The current produced due to photoelectric effect
 (a) increases with the increase of frequency of the incident radiation.
 (b) increases with the increase in intensity of the incident radiation.
 (c) decreases with time of irradiation.
 (d) is independent of the intensity of incident radiation.
41. The property of radiation that is not different at various regions of the electromagnetic spectrum is:
 (a) energy (b) frequency (c) velocity (d) wavelength

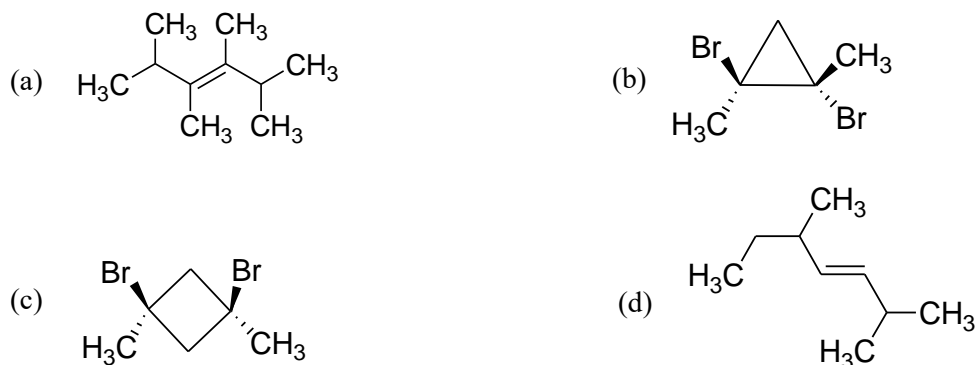
A – 2

ANY NUMBER OF OPTIONS (4, 3, 2 or 1) MAY BE CORRECT

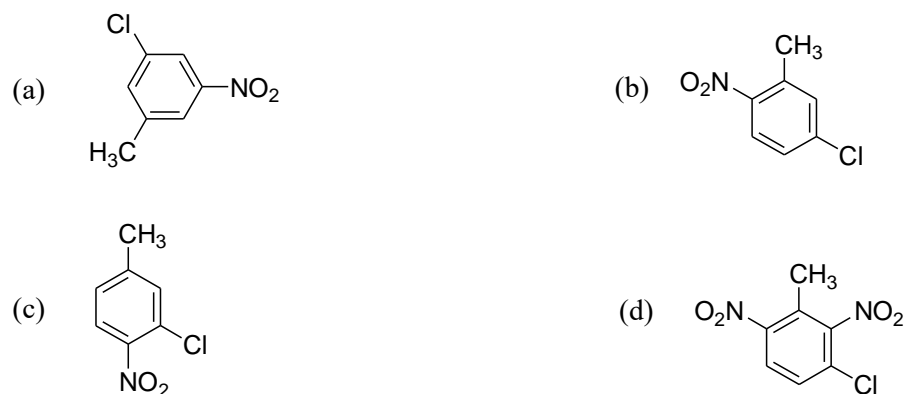
MARKS WILL BE AWARDED ONLY IF ALL THE CORRECT OPTIONS ARE BUBBLED AND NO INCORRECT.

49. Choose the correct statement(s) regarding zeolites:
- Silicon atoms are replaced by aluminium atoms in the zeolites.
 - The pores and cavities of the zeolites as well as size and shape of reactant decides the reactions taking place in the zeolites.
 - The cracking of hydrocarbons and isomerisation reactions are catalyzed by zeolites in the petrochemical industries.
 - Zeolites act as molecular sieves and can separate the molecules of different sizes.
50. Crystalline iron(III) nitrate nonahydrate, $\text{Fe}(\text{NO}_3)_3 \cdot 9\text{H}_2\text{O}$, has a very pale violet colour. When added to water, the crystals dissolve to form a brown solution. Treatment of this brown solution with concentrated nitric acid yields a very pale violet solution while treatment with HCl yields a yellow solution.
- Identify the correct statements regarding the above observations.
- The brown colour is due to $[\text{Fe}(\text{OH})(\text{H}_2\text{O})_5]^{2+}$, $[\text{Fe}(\text{OH})_2(\text{H}_2\text{O})_4]^+$
 - Violet colour is due to $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$ and yellow colour due to $[\text{FeCl}_4]^-$
 - Addition of HNO_3 shifts the equilibrium $[\text{Fe}(\text{H}_2\text{O})_6]^{3+} + \text{H}_2\text{O} \rightleftharpoons [\text{Fe}(\text{OH})(\text{H}_2\text{O})_5]^{2+} + \text{H}_3\text{O}^+$ to left giving pale violet colour
 - Addition of HNO_3 shifts the equilibrium $[\text{Fe}(\text{H}_2\text{O})_6]^{3+} + \text{H}_2\text{O} \rightleftharpoons [\text{Fe}(\text{OH})(\text{H}_2\text{O})_5]^{2+} + \text{H}_3\text{O}^+$ to right giving violet colour

51. The optically active compounds from the following are:



52. 3-chlorotoluene is reacted with a mixture of conc. H_2SO_4 and HNO_3 . The product/s formed is/are:



53. 2,4,6-trinitrophenol is more acidic than phenol. Identify the correct statement(s)
- pK_a for 2,4,6-trinitrophenol is less than that of phenol.
 - phenol is stabilized by intramolecular π hydrogen bonding.
 - The conjugate base of 2,4,6-trinitrophenol delocalizes the negative charge on the oxygen atom to a very large extent.
 - The conjugate base of phenol delocalizes the negative charge to a greater extent than the conjugate base of 2,4,6-trinitrophenol.

54. The correct statements for 1,3-butadiene from following are:
- Molar addition of Br_2 yields only 1,4-dibromo-2-butene as the major product when the reaction is performed for longer time period
 - Molar addition of Br_2 yields only 1,2-dibromo-2-butene for longer time period
 - $C_1 - C_2$ and $C_3 - C_4$ bonds are slightly longer than a $C=C$ bond
 - $C_2 - C_3$ single bond is slightly shorter than a $C - C$ bond

55. Which of the following representations will exhibit *cis-trans* isomerism?



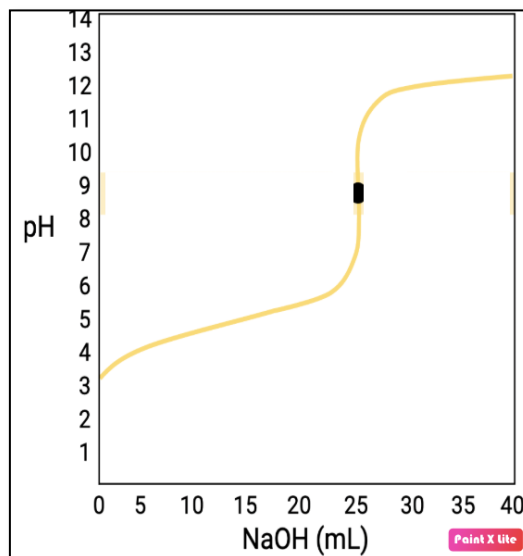
56. For an elementary dimerization reaction of the type $2R \rightarrow R_2$, the value of the steric factor was found to be 2.5. This indicates that
- the experimentally obtained rate is 2.5 times faster than the theoretical rate.
 - ratio of the number of collisions calculated from collision theory and that actually take place is 1: 2.5.
 - the activation energy of the reaction is the same for both the experimental and calculated values.
 - the molecules of reactant R may be of some complex structure.

57. The correct statement/s among the following is/are:
- The charge on the diffused layer of AgI colloidal solution by the addition of few drops of dilute aqueous solution of KI to an aqueous solution of $AgNO_3$ is negative.
 - The charge on the diffused layer of AgI colloidal solution by the addition of few drops of dilute aqueous solution of $AgNO_3$ to an aqueous solution of KI is positive.
 - When the ionic strength of a colloidal solution is increased, thickness of the double layer is increased, and the colloid gets precipitated.
 - When the ionic strength of a colloidal solution is increased, thickness of the double layer is decreased, and the colloid gets precipitated.

58. In reverse osmosis the flow of solvent across semi permeable membrane occurs
- when hydrostatic pressure is greater than osmotic pressure
 - when hydrostatic pressure is lower than osmotic pressure
 - from higher concentrated solution to lower concentrated solution
 - from lower concentrated solution to higher concentrated solution

59. Given below is the plot of pH vs volume of NaOH added in an acid-base titration. The correct statement/s among the following is/are:

- (a) Before the equivalence point, a series of buffer solutions determine the pH.
- (b) The graph represents the titration of a strong acid with NaOH.
- (c) At the equivalence point, hydrolysis of the anion of the acid determines the pH.
- (d) After the equivalence point acid/salt buffer solution determines the pH.



60. The correct statement/s among the following is/are:

- (a) The probability density (ψ^2) for a hydrogen atom is zero at $r = 0$.
- (b) In an atom, orbitals with the same quantum number have different energies.
- (c) The energy of a given orbital with same principal quantum number decreases as the atomic number 'Z', increases.
- (d) For a given atomic number, the configuration having the maximum number of parallel spins is of the lowest energy than any other arrangement arising from the same configuration.

PERIODIC TABLE OF ELEMENT

1 H Hydrogen 1											2 He Helium 4	
3 Be Beryllium 9											10 Ne Neon 20	
11 Na Sodium 23											18 H Argon 40	
19 K Potassium 39	20 Ca Calcium 40	21 Sc Scandium 45	22 Ti Titanium 48	23 V Vanadium 51	24 Cr Chromium 52	25 Mn Manganese 55	26 Fe Iron 56	27 Co Cobalt 59	28 Ni Nickel 59	29 Cu Copper 64	30 Zn Zinc 65	36 Kr Krypton 84
37 Rb Rubidium 86	38 Sr Strontium 88	39 Y Yttrium 89	40 Zr Zirconium 91	41 Nb Niobium 93	42 Nb Niobium 96	43 Tc Technetium 98	44 Ru Ruthenium 101	45 Rh Rhodium 103	46 Pd Palladium 106	47 Ag Silver 108	48 Cd Cadmium 112	54 Xe Xenon 131
55 Cs Cesium 133	56 Ba Barium 137	57 La Lanthanum 139	72 Hf Hafnium 179	73 Ta Tantalum 181	74 W Tungsten 184	75 Re Rhenium 186	76 Os Osmium 190	77 Ir Iridium 192	78 Pt Platinum 195	79 Au Gold 197	80 Hg Mercury 201	86 Rn Radon 222
87 Fr Francium 223	88 Ra Radium 226	89 Ac Actinium 227	104 Unq Unquadrium 257	105 Unp Unpentium 260	106 Unh Unhexium 263	107 Uns Unseptium 262	108 Uno Unoctium 265	109 Une Unenium 266				

← Proton number
 ← Symbol
 ← Name of element
 ← Relative atomic mass

58 Ce Cerium 140	59 Pr Praseodymium 141	60 Nd Neodymium 144	61 Pm Promethium 147	62 Sm Samarium 150	63 Eu Europium 152	64 Gd Gadolinium 157	65 Tb Terbium 159	66 Dy Dysprosium 162	67 Ho Holmium 165	68 Er Erbium 167	69 Tm Thulium 169	70 Yb Ytterbium 173	71 Lu Lutetium 175
90 Th Thorium 232	91 Pa Protactinium 231	92 U Uranium 238	93 Np Neptunium 237	94 Pu Plutonium 244	95 Am Americium 243	96 Cm Curium 247	97 Bk Berkelium 247	98 Cf Californium 249	99 Es Einsteinium 254	100 Fm Fermium 253	101 Md Mendelevium 256	102 No Nobelium 254	103 Lr Lawrencium 257

Rough Work