# 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.

1. On the OMR Answer Sheet, use only **BLUE** or **BLACK BALL POINT PEN** for making entries and filling the bubbles.
2. 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.
3. 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.

a

c

d

# Q.No.12

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

1. 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.
2. Rough work may be done in the space provided. There are **14** printed pages in this paper
3. Use of **Non- programmable scientific** calculator is allowed.
4. No candidate should leave the examination hall before the completion of the examination.
5. 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.***

###### Comments/Inquiries/Grievances regarding this Question Paper, if any, can be shared on the Inquiry/Grievance column on [www.iapt.org.in](http://www.iapt.org.in/) on the specified format till Dec 3, 2023.

1. **The answers/solutions to this Question Paper will be available on the website:** [**www.iapt.org.in**](http://www.iapt.org.in/) **by Dec 2, 2023.** The score card may be downloaded after Dec 24, 2023

###### CERTIFICATES and AWARDS:

Following certificates are awarded by IAPT/ACT to students, successful in the National Standard Examination in Chemistry – 2023

* 1. “CENTRE TOP 10 %” To be downloaded from iapt.org.in after 30.01.24
  2. “STATE TOP 1 %” Will be dispatched to the examinee
  3. “NATIONAL TOP 1 %” Will be dispatched to the examinee
  4. “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

1. 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**](http://www.iapt.org.in/)by **Dec 25, 2023. See the MAS clause** on the student’s brochure on the web.
2. List of students eligible to appear for Indian National Chemistry Olympiad (INChO – 2024) shall be displayed on [www.iapt.org.in](http://www.iapt.org.in/) by Dec 30, 2023.

# Useful constants

Charge of electron, *e* 1.6021019*C*

*e*

## Mass of electron,

*m*  9.11031*kg*

## Planck’s constant, Speed of light,

*A*

*h*  6.631034 *J s*

*c*  3.0108 *ms*1

## Avogadro constant,

*N*  6.0221023 *mol*1

## Faraday constant

*F*  96500 *Cmol* 1

## Molar gas constant,

*R*  0.082 *Latmmol*1*K* 1

 8.314 *J mol*1 *K* 1

**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.**

1. The ligand with which the homoleptic octahedral complex of Co3+ will be most stable is:
   1. Ethylenediamine tetra acetate ion
   2. Dien (N-(2-aminoethyl)-1,2-ethanediamine)
   3. Ethane-1,2-diamine
   4. Ammonia
2. Which of the following properties may have positive values of ∆H?

(i) Lattice enthalpy (ii) Hydration enthalpy

(iii) Electron gain enthalpy for noble gases (iv) Ionisation enthalpy

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

1. The correct IUPAC name of potassium permanganate is:
   1. potassium tetraoxomanganate(VI) (b) potassium tetraoxidopermanganate(VII)

(c) potassium tetraoxidomanganese(VII) (d) potassium tetraoxidomanganate(VII)

1. Which of the following statements is true with respect to sodium salts of oxoanions of phosphorus NaH2PO2 and Na2HPO3
   1. NaH2PO2 is reducing and Na2HPO3 is oxidizing
   2. NaH2PO2 is more reducing than Na2HPO3
   3. NaH2PO2 is more oxidizing than Na2HPO3
   4. NaH2PO2 is oxidizing and Na2HPO3 is reducing
2. The fluoride/s of xenon, XeFn (n = 2 or 4 or 6), which on complete hydrolysis gives back xenon as one of the products, is/are .
3. XeF2 II. XeF4 III. XeF6
   1. II only (b) I and II (c) III only (d) I, II and III
4. If an element after oganesson (Og, atomic number 118 and electronic configuration [Rn] 5f146d107s27p6) was discovered, in which of the following orbital, will the 119th electron be accommodated?

(a) 7d (b) 6f (c) 8s (d) 5g

1. The number of ‘two-center-two electron’ and ‘three-center-two electron’ bonds in [Al(BH4)3] are respectively
   1. twelve and zero (b) twelve and three (c) six and six (d) nine and three
2. 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)

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

(i) H2O + HCl  H3O+ + Cl-

(ii) 6H2O + Mg2+  [Mg(H2O)6]2+

1. 2H2O + 2F2  4 HF + O2
   1. (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

1. The correct order of the following oxidizing agents in basic aqueous medium is: CrO 2-/ Cr3+ E0= -0.11 V

4

FeO 2-/ Fe3+ E0= +0.72 V MnO 2-/ Mn3+ E0= +0.46 V

4

4

(a) [CrO4]2- > [FeO4]2- > [MnO4]2- (b) [FeO4]2- > [MnO4]2- > [CrO4]2-

(c) [CrO4]2- > [MnO4]2 > [FeO4]2- (d) [MnO4]2- > [FeO4]2- > [CrO4]2-

1. The correct order of ionic radii of Rb+, Br-, Sr2+ and Se2- is

(a) Rb+ < Br- < Sr2+ < Se2- (b) Sr2+ < Rb+ < Br- < Se2-

(c) Se2- < Br- < Sr2+ < Rb+ (d) Se2- < Sr2+ < Rb+ < Br-

1. Consider the following statements:
2. Calcination is carried out in absence of air below the melting point of the ore
3. Roasting and calcination are carried out in presence of flux
4. Calcination is carried out in limited supply of air above the melting point of the ore
5. Roasting is carried out in air below the melting point of ore The correct set of statements is
   1. (i) and (iv) (b) (ii) and (iii) (c) (i), (iii) and (iv) (d) (iii) and (iv)
6. The cobalt complexes (I) and (II) given below are examples of

(NH3)4Co

H2 N

Co(NH3)2Cl2 Cl2

O2

H2 N

Cl(NH3)3Co

O2

Co(NH3)3Cl

Cl2

|  |  |  |
| --- | --- | --- |
| (**I**) | (**II**) |  |
| (a) linkage isomers  (c) ligand isomers |  | (b) coordination isomers  (d) coordination position isomers |

1. The magnetic moment (in units of BM) of copper in [Cu(H2O)4]2+ and [Cu(NH3)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

1. 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 AgNO3 gave yellowish precipitate soluble with difficulty in NH4OH while the other anion can be confirmed with brown ring test. (Given Ksp for AS = 1x10-44 and XS = 1.4x10-24).

Identify the INCORRECT statement about the analysis.

* 1. H2S can be used under appropriate conditions of pH to separate and identify the cations.
  2. Cation A will be precipitated under acidic condition as the concentration of sulphides ions required is low.
  3. The anions are NO - and Cl-.

3

* 1. Cation X will be precipitated as sulphides under alkaline condition, as the concentration of sulphides ions required is very high.

1. The correct statement about the solubilities of Group 2 hydroxides is:
   1. The solubilities increase because lattice energy increases as we go down Group 2
   2. The solubilities increase because lattice energy decreases as we go down Group 2
   3. The solubilities decreases because atomic size increases as we go down Group 2
   4. The solubilities decrease because lattice energy decreases as we go down Group 2
2. A solution of CuSO4.5H2O in methanol has [Cu2+] = 1.00 mg per 1000 g of methanol. The molarity of Cu2+ in this solution is Y × 10-5 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

1. Following is the reaction flow chart for manganese oxidocomplexes under different alkaline pH conditions. Compounds (**S**) and (**T**) respectively are:

## MnO4

+ e-

+

* 1. S=MnO(OH)2; T=Mn(OH)2

(c) S= MnO 2-; T=MnO(OH)

## + e- OH (**S**)

(**T**)

e-

* 1. S=MnO2; T=MnO(OH)

(d) S= MnO 2-; T=MnO

4 4 2

1. The correct order of relative strength for the following nucleophilic species is:

NH2 OCH3 CH3COO CH3OH I II III IV

* 1. IV > III > II > I (b) II > III > IV > I (c) I > II > IV > III (d) I > II > III > IV

1. The product obtained on reaction of optically pure 1-bromo-1-phenyl ethane with CH3OH, is:
   1. phenyl ethene.
   2. 1-methoxy-1-phenyl ethane with inverted configuration only.
   3. 1-methoxy-1-phenyl ethane with retention of configuration.
   4. a racemic mixture of 1-methoxy-1-phenyl ethane.
2. An alkane [X] contains five 1º, two 2º, one 3º and one 4º carbon atoms. The IUPAC name of [X] is:
   1. 2,4,4-trimethylhexane (b) 3,5-dimethylheptane

(c) 2,4-dimethylheptane (d) 4,4-dimethylheptane

1. The number of isomeric alkenes with molecular formula C5H10 is (taking stereoisomers into account):

(a) 4 (b) 5 (c) 6 (d) 7

1. At 0º C, 1 equivalent bromine is added to 2,4-hexadiene to produce 4,5-dibromo-2-hexene and its isomer ‘X’. ‘X’ is:
   1. 5,5-dibromo-2-hexene (b) 2,5-dibromo-3-hexene

(c) 2,2-dibromo-3-hexene (d) 2,3-dibromo-4-hexene

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

#### OCH3 O

O

O

O

#### CH3

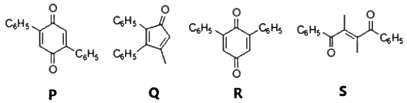
O O O

O CH3

**I II III IV**

* 1. I and II (b) III and IV (c) Only IV (d) I, II and III

1. The compound which can be produced by double aldol condensation of 1-phenyl-1,2- propanedione:



* 1. P (b) Q (c) R (d) S

1. 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:
   1. dehydrogenation to 2-methyl-2-propenal followed by addition of formaldehyde.
   2. dehydrogenation to penta-2,3-diene followed by addition of formaldehyde.
   3. a crossed aldol reaction followed by a crossed Cannizzaro reaction.
   4. a crossed Cannizzaro reaction followed by a crossed aldol reaction.
2. 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:
   1. Four dipeptides, all optically active (b) Two dipeptides, all optically active

(c) Four dipeptides, three optically active (d) Two dipeptides, none optically active

#### Predict the major product in the following reaction. PCC is pyridinium chlorochromate

1. B2 H6, THF 2 H2O2 / HO-

R

R 3 PCC, 00C

O

R R

* 1. O

O O

* 1. R R (c) R H

R R

(d) O

1. Find out the product in the following reaction.

O 1. NH2NH2

Cl

2. KOH (excess) Diethylene glycol Heat

OH O

Cl

(a)

(b)

(c)

(d)

1. The product/s obtained on reaction of biphenyl (Ph-Ph) with nitrating mixture (HNO3 + H2SO4) is/are:



1. 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

1. The suitable reagent for the following transformation is:

O OH

?

* 1. Na / liq. NH3 (b) H2, Pd/C

(c) LiAlH4 (d) Zn-Hg, HCl, heat

1. Column **A** represents a set of functional groups and Column **B** their respective electronic effects. The correct match is:

Column **A** Column **B**

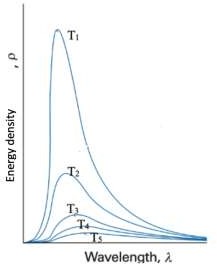
* 1. -NH2, -COCl, -SO3H, -COOH (*m*-directing, EWG, activating, *o/p*-directing)
  2. -X, -NHCOCH3, -CHO, -CH3 (*o/p* directing, EDG, *m*-directing, activating)
  3. -COCl, -COCH3, -NH2, -CN (EDG, EWG, deactivating, *m*-directing)
  4. -SO3H, -NH2, -OCH3, -CONH2 (activating, deactivating, EWG, EWG) [EDG: Electron donating group and EWG: Electron withdrawing group]

1. The correct order of reactivity of -CHO, -COR, -COOR, - CONR2 groups toward MeMgI in ether is:
   1. -CONR2 >-COOR >-COR > -CHO (b) -CHO >-COR > -COOR> -CONR2

(c) - CONR2 > -CHO > -COR > -COOR (d) -CHO > - CONR2 >-COOR > -COR

1. The plots of energy density (energy per unit area) vs wavelength for blackbody radiation at various temperatures is given below.

The correct option among the following is:



(i) T1 > T2 >T3 >T4 >T5

1. As temperature increases, the wavelength at which the intensity is maximum shifts towards the higher energy regions of the electromagnetic spectrum.
2. Radiations of all wave lengths are emitted, absorbed, reflected, and refracted by the black body.
3. The total energy density increases as the temperature is decreased.
   1. (i) and (ii) (b) (ii) and (iii) (c) (i), (iii) and (iv) (d) (ii), (iii) and (iv)
4. 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

1. 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 × 10−3𝑀 is :

(Molar mass of Mg(OH)2 = 58.0 𝑔 𝑚𝑜𝑙−1)

(a) 4.0 mL (b) 7.8 mL (c) 12.0 mL (d) 120 mL

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

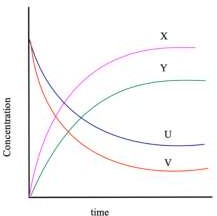
𝐹𝑒(𝑂𝐻)2(𝑠) + 2𝑒− ⟶ 𝐹𝑒(𝑠) + 2𝑂𝐻−(𝑎𝑞) 𝐸⊖ = −0.9 𝑉 (i)

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

𝐴𝑙3+(𝑎𝑞) + 3𝑒− ⟶ 𝐴𝑙(𝑠) 𝐸⊖ = −1. 7 𝑉 (ii)

#### 𝐴𝑔𝐵𝑟(𝑠) + 𝑒− ⟶ 𝐴𝑔(𝑠) + 𝐵𝑟−(𝑎𝑞) 𝐸⊖ = −0. 07 𝑉 (iii) The correct option that represents the redox reactions in cells I and II is:

* 1. Fe is oxidised in cell I; Fe is oxidised in cell II
  2. Fe is oxidised in cell I; Fe is reduced in cell II
  3. Fe is reduced in cell I; Fe is reduced in cell II
  4. Fe is reduced in cell I; Fe is oxidised in cell II

1. The following are the concentration vs time plots of the reactants and products represented by the reaction

L(g) + 2 M(g) N(g) + 3 O(g)

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

* 1. X, Y
  2. Y, U
  3. V, Y
  4. U, X

1. The current produced due to photoelectric effect
   1. increases with the increase of frequency of the incident radiation.
   2. increases with the increase in intensity of the incident radiation.
   3. decreases with time of irradiation.
   4. is independent of the intensity of incident radiation.
2. The property of radiation that is not different at various regions of the electromagnetic spectrum is:
   1. energy (b) frequency (c) velocity (d) wavelength
3. Among the following, the correct statements about the compressibility factor (Z) of real gases are:
4. If Z < 1, intermolecular repulsive forces are more dominant.
5. If Z < 1, intermolecular attractive forces are more dominant.
6. If Z > 1, intermolecular repulsive forces are more dominant.
7. If Z >1, intermolecular attractive forces are more dominant.
   1. (i) and (iv) (b) (i) and (iii) (c) (ii) and (iv) (d) (ii) and (iii)
8. The figure represents the processes AB, BC and CA undertaken by a certain mass of an ideal gas. Along the path AB, the gas is isothermally compressed with release of 800 J heat to the surroundings. It is then compressed adiabatically along the path



C

B

A

V

BC and the work done is 500 J. The gas then returns to the state P

A along path CA and absorbs 100 J heat from the surroundings.

The work done by the gas along the path CA is:

(a) – 300 J (b) – 900 J

(c) – 600 J (d) – 400 J

1. Two flasks I and II of equal volume are evacuated and connected by a tube of negligible volume fitted with a stopcock. They are then placed in two different constant temperature baths of 250 K and 750 K respectively. 20 moles of an ideal gas are introduced into the system of these flasks through the stopcock. When the system reaches equilibrium, the ratio of the moles of the gas in flasks I and II is:

(a) 1:1 (b) 2:1 (c) 3:1 (d) 4:1

1. When a certain amount of a univalent salt AB (molar mass = 54 𝑔 𝑚𝑜𝑙−1) was dissolved in 0.1

𝑑𝑚3 of water, the relative lowering of the vapour pressure was found to be 3.55%. The molality of the resulting solution is:

(Assume complete dissociation of the salt under given condition. Density of water = 1 𝑔 𝑐𝑚−3) (a) 0.5 m (b) 1.0 m (c) 2.0 m (d) 4.0 m

1. The rate constant values for the decay of radioisotopes X and Y, used in radio-medicine are 0.05 h-1 and 0.025 h-1 respectively. In a hospital, at a time ‘t0’ the activity of a sample of X was found to be twice that of Y. The activities of the two radioisotopes will be approximately equal when the time elapsed is:
   1. twice the half-life of Y (b) twice the half-life of X

(c) equal to the half-life of X (d) equal to ½ the half-life of Y

#### Lattimer diagrams are the compact representations of electrochemical equilibria in substances of multiple oxidation states. The value of the potential, *x*, in the Lattimer diagram of gold (at pH = 1.0) is:

(a) 2. 72 V (b) 3.18 V (c) -3.18 V (d) 1.36 V

1. Electrolysis of aqueous CuSO4 (0.1 M) was carried out in two cells I and II. In I, the electrodes are of Cu and in II they were of Pt. As the electrolysis proceeds pH of the electrolyte solution will:
   1. decrease in II and remain the same in I (b) remain the same in both I and II

(c) increase in both I and II (d) increase in I and decrease in II

###### 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.**

1. Choose the correct statement(s) regarding zeolites:
   1. Silicon atoms are replaced by aluminium atoms in the zeolites.
   2. The pores and cavities of the zeolites as well as size and shape of reactant decides the reactions taking place in the zeolites.
   3. The cracking of hydrocarbons and isomerisation reactions are catalyzed by zeolites in the petrochemical industries.
   4. Zeolites are acting as molecular sieve and separates the molecules of different sizes.
2. Crystalline iron(III) nitrate nonahydrate, Fe(NO3)3.9H2O, 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.

* 1. The brown colour is due to [Fe(OH)(H2O)5]2+, [Fe(OH)2(H2O)4]+
  2. Violet colour is due to [Fe(H2O)6]3+ and yellow colour due to [FeCl4]-
  3. Addition of HNO3 shifts the equilibrium [Fe(H2O)6] 3+ + H2O [Fe(OH)(H2O)5]2+ + H3O+ to left giving pale violet colour
  4. Addition of HNO3 shifts the equilibrium [Fe(H2O)6] 3+ + H2O [Fe(OH)(H2O)5]2+ + H3O+ to right giving violet colour

1. The optically active compounds from the following are:



CH3 CH3

Br CH

(a)

H3C

CH3

CH3 CH3

1. 3

##### H3C Br

CH3

(c)

##### Br Br

(d)

##### H3C

CH3

##### H3C CH3

H3C

1. 3-chlorotoluene is reacted with a mixture of conc. H2SO4 and HNO3. The product/s formed is/are:

(a)

Cl

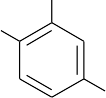
H3C

NO2

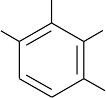
(b)

O2N

CH3

Cl

CH3

1. (d)

Cl

NO2

O2N

CH3

NO2

Cl

1. 2,4,6-trinitrophenol is more acidic than phenol. Identify the correct statement(s)
   1. pKa for 2,4,6-trinitrophenol is less than that of phenol.
   2. phenol is stabilized by intramolecular π hydrogen bonding.
   3. The conjugate base of 2,4,6-trinitrophenol delocalizes the negative charge on the oxygen atom to a very large extent.
   4. The conjugate base of phenol delocalizes the negative charge to a greater extent than the conjugate base of 2,4,6-trinitrophenol.
2. The correct statements for 1,3-butadiene from following are:
   1. Molar addition of Br2 yields only 1,4-dibromo-2-butene as the major product when the reaction is performed for longer time period
   2. Molar addition of Br2 yields only 1,2-dibromo-2-butene for longer time period
   3. C1 – C2 and C3-C4 bonds are slightly longer than a C=C bond
   4. C2 – C3 single bond is slightly shorter than a C – C bond
3. Which of the following representations will exhibit *cis-trans* isomerism?

(a)

(c)

CH3 CH3

COOH

(b)

1. (d)

H3C

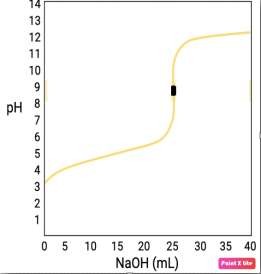
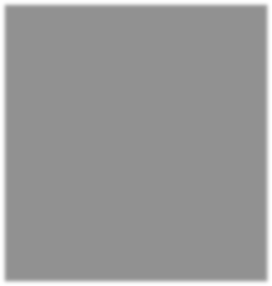
H3C

CH3 CH3

CH3

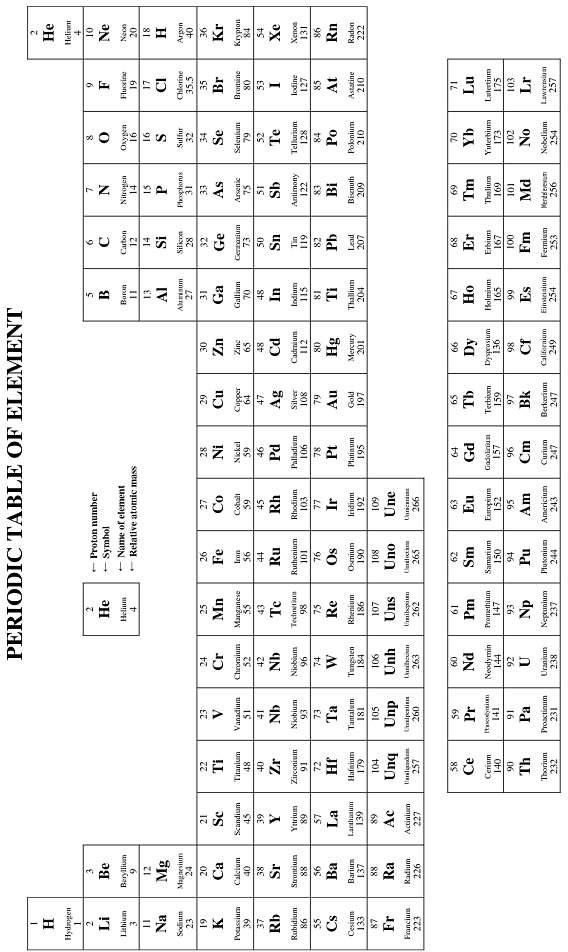
CH3

1. For an elementary dimerization reaction of the type 2R  R2, the value of the steric factor was found to be 2.5. This indicates that
   1. the experimentally obtained rate is 2.5 times faster than the theoretical rate.
   2. ratio of the number of collisions calculated from collision theory and that actually take place is 1: 2.5.
   3. the activation energy of the reaction is the same for both the experimental and calculated values.
   4. the molecules of reactant R may be of some complex structure.
2. The correct statement/s among the following is/are:
   1. 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 AgNO3 is negative.
   2. The charge on the diffused layer of AgI colloidal solution by the addition of few drops of dilute aqueous solution of AgNO3 to an aqueous solution of KI is positive.
   3. When the ionic strength of a colloidal solution is increased, thickness of the double layer is increased, and the colloid gets precipitated.
   4. When the ionic strength of a colloidal solution is increased, thickness of the double layer is decreased, and the colloid gets precipitated.
3. In reverse osmosis the flow of solvent across semi permeable membrane occurs
   1. when hydrostatic pressure is greater than osmotic pressure
   2. when hydrostatic pressure is lower than osmotic pressure
   3. from higher concentrated solution to lower concentrated solution
   4. from lower concentrated solution to higher concentrated solution
4. 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:



* 1. Before the equivalence point, a series of buffer solutions determines the pH.
  2. The graph represents the titration of a strong acid with NaOH.
  3. At the equivalence point, hydrolysis of the anion of the acid determines the pH.
  4. After the equivalence point acid/salt buffer solution determines the pH.

1. The correct statement/s among the following is/are:
   1. The probability density (ψ2) for a hydrogen atom is zero at r = 0.
   2. In an atom, orbitals with the same quantum number have different energies.
   3. The energy of a given orbital with same principal quantum number decreases as the atomic number ‘Z’, increases.
   4. 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.



**Rough Work**