

# NATIONAL STANDARD EXAMINATION IN CHEMISTRY (NSEC) 2023

Organized by  
**INDIAN ASSOCIATION OF CHEMISTRY TEACHERS (IACT)**

## QUESTION PAPER (QP), ANSWER KEY (AK) & TEXT SOLUTIONS (TS)

Sunday, November 26, 2023 | Time: 11:30 AM to 1:30 PM Hours | Max. Marks: 216

### JEE (Adv.) 2023 RESULT

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## INSTRUCTIONS

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.
6. 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. No negative marks in this part.
8. Rough work should be done only in the space provided. There are 16 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 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](http://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](http://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 to students, successful in the National Standard Examination in Chemistry - 2023.
- (i) "CENTRE TOP 10 %" To be downloaded from [iapt.org.in](http://iapt.org.in) after 30.01.24
  - (ii) "STATE TOP 1%" Will be dispatched to the examinee
  - (iii) "NATIONAL TOP 1%" Will be dispatched to the examinee
  - (iv) "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](http://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](http://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](http://www.iapt.org.in) by Dec 30, 2023.**

**Useful Constants**

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

# INDIAN ASSOCIATION OF PHYSICS TEACHERS NATIONAL STANDARD EXAMINATION IN CHEMISTRY (NSEC) 2023

Question Paper Code: 31

Time : 120 Minute

Max. Marks: 216

Attempt All Sixty Questions

PART-A1

**ONLY ONE OUT OF FOUR OPTIONS IS CORRECT. BUBBLE THE CORRECT OPTION.**

1. The ligand with which the homoleptic octahedral complex of  $\text{Co}^{3+}$  will be most stable is:

- (a) Ethylenediamine tetra acetate ion
- (b) Dien (N-(2-aminoethyl)-1,2-ethanediamine)
- (c) Ethane-1,2-diamine
- (d) Ammonia

**Ans. (a)**

Complex	Number of Chelate ring.
(a) $[\text{Co}(\text{EDTA})]^-$	5
(b) $[\text{Co}(\text{dien})_2]$	4
(c) $[\text{Co}(\text{en})_3]^{3+}$	3
(d) $[\text{Co}(\text{NH}_3)_6]^{3+}$	0

As option a have more number of chelate ring and have more stable complex.

2. Which of the following properties may have positive values of  $\Delta H$ ?

- (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)

**Ans. (b)**

Process	sign of $\Delta H$
(i) Lattice enthalpy	(-)
(ii) Hydration enthalpy	(-)
(iii) Electron gain enthalpy for noble gases	(+)
(iv) Ionisation enthalpy	(+)

So correct answer is (iii) & (iv).

3. The correct IUPAC name of potassium permanganate is:

- (a) potassium tetraoxomanganate(VI)
- (b) potassium tetraoxidopermanganate(VII)
- (c) potassium tetraoxidomanganese(VII)
- (d) potassium tetraoxidomanganate(VII)

**Ans. (d)**

**Sol.** potassium permanganate  
 formula =  $\text{K}[\text{MnO}_4]$   
 IUPAC Name  $\Rightarrow$  potassium tetraoxidomanganate(VII)

4. Which of the following statements is true with respect to sodium salts of oxoanions of phosphorus  $\text{NaH}_2\text{PO}_2$  and  $\text{Na}_2\text{HPO}_3$

- (a)  $\text{NaH}_2\text{PO}_2$  is reducing and  $\text{Na}_2\text{HPO}_3$  is oxidizing
- (b)  $\text{NaH}_2\text{PO}_2$  is more reducing than  $\text{Na}_2\text{HPO}_3$
- (c)  $\text{NaH}_2\text{PO}_2$  is more oxidizing than  $\text{Na}_2\text{HPO}_3$
- (d)  $\text{NaH}_2\text{PO}_2$  is oxidizing and  $\text{Na}_2\text{HPO}_3$  is reducing

**Ans. (b)**

Sodium salt	Oxidation state of P	Number of P-H bond
(i) $\text{NaH}_2\text{PO}_2$	+1	2
(ii) $\text{Na}_2\text{HPO}_3$	+3	1

order of reducing character  $\text{NaH}_2\text{PO}_2 > \text{Na}_2\text{HPO}_3$

5. The fluoride/s xenon,  $\text{XeF}_n$  ( $n = 2$  or  $4$  or  $6$ ), which on complete hydrolysis gives back xenon as one of the products, is/are \_\_\_\_\_.

- I.  $\text{XeF}_2$
  - II.  $\text{XeF}_4$
  - III.  $\text{XeF}_6$
- (a) II only      (b) I and II      (c) III only      (d) I, II and III

Ans. (b)

Sol. I.  $2\text{XeF}_2(\text{s}) + 2\text{H}_2\text{O}(\ell) \longrightarrow 2\text{Xe}(\text{g}) + 4\text{HF}(\text{aq.}) + \text{O}_2(\text{g})$   
 II.  $6\text{XeF}_4 + 12\text{H}_2\text{O} \longrightarrow 4\text{Xe} + 2\text{XeO}_3 + 24\text{HF} + 3\text{O}_2$   
 III.  $\text{XeF}_6 + 3\text{H}_2\text{O} \longrightarrow \text{XeO}_3 + 6\text{HF}$ .  
 So correct option is (b): I & II.

6. 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<sup>th</sup> electron be accommodated?

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

Ans. (c)

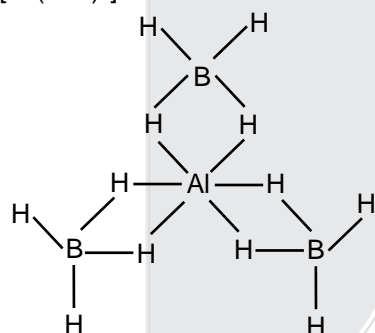
Sol. Atomic number = 118  
 $\text{Og}(118) = [\text{Rn}] 5f^{14} 6d^{10} 7s^2 7p^6$   
 $119 = [\text{Rn}] 5f^{14} 6d^{10} 7s^2 7p^6 8s^1$

7. The number of 'two-center-two electron' and 'three-center-two electron' bonds in  $[\text{Al}(\text{BH}_4)_3]$  are respectively

- (a) twelve and zero (b) twelve and three (c) six and six (d) nine and three

Ans. (c)

Sol.  $[\text{Al}(\text{BH}_4)_3]$



No. of two-Center-two electron bonds = 6  
 No. of three Center-two electron bonds = 6

8. Identify the correct matching of the following oxides in column M with their properties 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)

Ans. (c)

Sol. (i)  $\text{Al}_2\text{O}_3$  – (r) Amphoteric oxide.  
 (ii)  $\text{CaO}$  – (q) Basic oxide.  
 (iii)  $\text{As}_2\text{O}_5$  – (p) Acidic oxide.

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

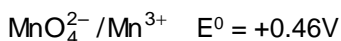
- (i)  $\text{H}_2\text{O} + \text{HCl} \longrightarrow \text{H}_3\text{O}^+ + \text{Cl}^-$   
 (ii)  $6\text{H}_2\text{O} + \text{Mg}^{2+} \longrightarrow [\text{Mg}(\text{H}_2\text{O})_6]^{2+}$   
 (iii)  $2\text{H}_2\text{O} + 2\text{F}_2 \longrightarrow 4\text{HF} + \text{O}_2$   
 (a) (i) oxidant;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

Ans. (c)

Sol.

Reaction	Role of water
(i) $\text{H}_2\text{O} + \text{HCl} \longrightarrow \text{H}_3\text{O}^+ + \text{Cl}^-$	Base
(ii) $6\text{H}_2\text{O} + \text{Mg}^{2+} \longrightarrow [\text{Mg}(\text{H}_2\text{O})_6]^{2+}$	Base
(iii) $2\text{H}_2\text{O} + 2\text{F}_2 \longrightarrow 4\text{HF} + \text{O}_2$	reductant

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

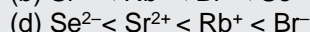
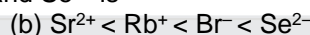
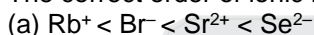


Ans. (b)

Sol. Higher the value of 'SRP' Higher is oxidizing power

so order of oxidizing power = (b)  $[\text{FeO}_4]^{2-} > [\text{MnO}_4]^{2-} > [\text{CrO}_4]^{2-}$

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



Ans. (b)

Sol. These all are isoelectron species having  $36e^-$

For isoelectronic  $Z \uparrow \quad r \downarrow$ ,  $q \uparrow$  than size decreases,  $q \downarrow$  than size increases.

12. Consider the following statements:

(i) Calcinations 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)

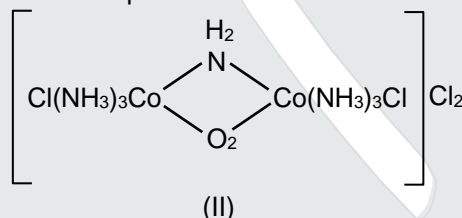
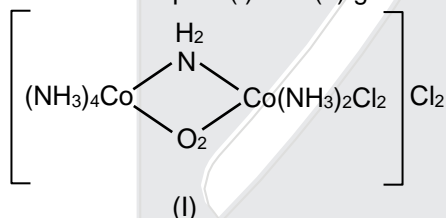
(c) (i), (iii) and (iv)

(d) (iii) and (iv)

Ans. (a)

Sol. Calcination is carried out in absence or in limited supply of air, below the melting point of ore roasting is carried in presence of air below melting point of ore.

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



(a) linkage isomers

(b) coordination isomers

(c) ligand isomers

(d) coordination position isomers

Ans. (d)

Sol. This is an example of coordination position isomerism, in which in bridging complex ligands are exchanged.

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

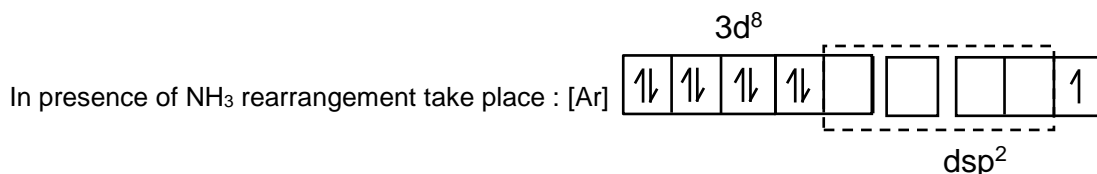
Ans. (b)

Sol.  $[\text{Cu}(\text{H}_2\text{O})_4]^{2+}$  has  $\text{Cu}^{+2}(3d^9)$  with Weak field ligand (WFL)  $\text{H}_2\text{O}$ , therefore no pairing of electron & hybridization is  $sp^3$

$$n = 1 \quad \sqrt{n(n+2)} \text{ BM} \sqrt{1(1+1)} \text{ or } \sqrt{3} \text{ BM}$$

In  $[\text{Cu}(\text{H}_2\text{O})_4]^{2+} \text{ dsp}^2 \quad n = 1$





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  $\text{AgNO}_3$  gave yellowish precipitate soluble with difficulty in  $\text{NH}_4\text{OH}$  while the other anion can be confirmed with brown ring test. (Given  $K_{sp}$  for AS =  $1 \times 10^{-44}$  and XS =  $1.4 \times 10^{-24}$ ).

Identify the INCORRECT statement about the analysis.

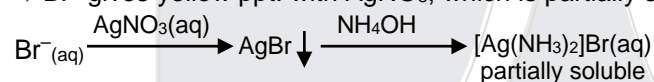
- (a)  $\text{H}_2\text{S}$  can be used under appropriate conditions of pH to separate and identify the cations.  
 (b) Cation A will be precipitated under acidic condition as the concentration of sulphides ions required is low.  
 (c) The anions are  $\text{NO}_3^-$  and  $\text{Cl}^-$ .  
 (d) Cation X will be precipitated as sulphides under alkaline condition, as the concentration of sulphides ions required is very high.

Ans. (c)

Sol. These cations are of II or IV group as they are identified as sulphides.

$K_{sp}$  of sulphide of group II cation  $< K_{sp}$  of sulphide of group IV cation.

→  $\text{Br}^-$  gives yellow ppt. with  $\text{AgNO}_3$ , which is partially soluble in  $\text{NH}_4\text{OH}$



→ Brown ring test is for  $\text{NO}_2^-$  &  $\text{NO}_3^-$

So anions of salts of may be  $\text{NO}_2^-$  or  $\text{NO}_3^-$  and  $\text{Br}^-$

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

Ans. (b)

Sol. solubility-order  $\text{Be}(\text{OH})_2 < \text{Mg}(\text{OH})_2 < \text{Ca}(\text{OH})_2 < \text{Sr}(\text{OH})_2 < \text{Ba}(\text{OH})_2$

The solubilities of hydroxides of group 2, increase 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  $\text{Cu}^{2+}$  in this solution is  $Y \times 10^{-5} \text{ mol L}^{-1}$ . Y is :

(Given – density of methanol =  $0.792 \text{ g mL}^{-1}$ )

- (a) 1.57                      (b) 5.04                      (c) 1.25                      (d) 3.99

Ans. (c)

Sol.  $[\text{Cu}^{2+}] = Y \times 10^{-5} = \frac{1 \times 10^{-3}}{V_{\text{solution}} \times 63.5}$

$$d = \frac{m}{V}$$

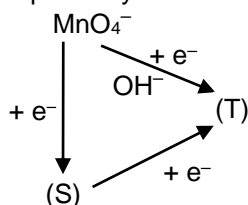
$$V_{\text{solution}} = \frac{m}{d} = \frac{1000}{0.792} \text{ mL} = \frac{1000 \times 10^{-3}}{0.792} \text{ L} = \frac{1}{0.792} \text{ L}$$

or  $[\text{Cu}^{2+}] = \frac{10^{-3}}{63.5} \times 0.792$

$$Y \times 10^{-5} = 0.0125 \times 10^{-3}$$

$$Y = 1.25 \text{ M}$$

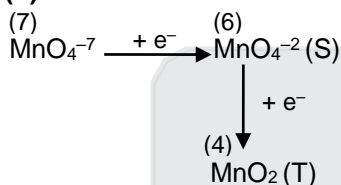
18. Following is the reaction flow chart for manganese oxidocomplexes under different alkaline pH conditions. Compounds (S) and (T) respectively are :



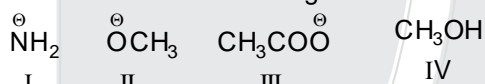
- (a) S = MnO(OH)<sub>2</sub> ; T = Mn(OH)<sub>2</sub>  
 (b) S = MnO<sub>2</sub> ; T = MnO(OH)  
 (c) S = MnO<sub>4</sub><sup>2-</sup> ; T = MnO(OH)  
 (d) S = MnO<sub>4</sub><sup>2-</sup> ; T = MnO<sub>2</sub>

Ans. (d)

Sol. (7)



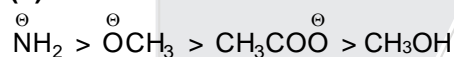
19. The correct order of relative strength for the following nucleophilic species is :



- (a) IV > III > II > I      (b) II > III > IV > I      (c) I > II > IV > III      (d) I > II > III > IV

Ans. (d)

Sol.



Conjugate base of weak acids are stronger nucleophile.

20. The product obtained on reaction of optically pure 1-bromo-1-phenylethane with CH<sub>3</sub>OH, is :

- (a) phenyl ethene  
 (b) 1-methoxy-1-phenylethane with inverted configuration only.  
 (c) 1-methoxy-1-phenylethane with retention of configuration.  
 (d) a racemic mixture of 1-methoxy-1-phenylethane.

Ans. (d)

Sol.

Reaction of optically pure 1-bromo-1-phenylethane with CH<sub>3</sub>OH proceed via S<sub>N</sub>1 and hence product is a racemic mixture of 1-methoxy-1-phenylethane.

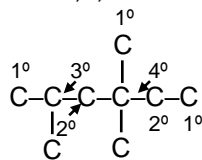
21. An alkane [X] contains five 1°, two 2°, one 3° and one 4° carbon atoms. The IUPAC name of [X] is :

- (a) 2,4,4-trimethylhexane      (b) 3,5-dimethylheptane  
 (c) 2,4-dimethylheptane      (d) 4,4-dimethylheptane

Ans. (a)

Sol.

X is 2,4,4-trimethylhexane.



22. The number of isomeric alkenes with molecular formula C<sub>5</sub>H<sub>10</sub> is (taking stereoisomers into account) :

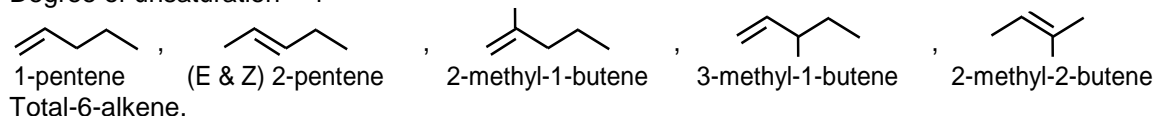
- (a) 4      (b) 5      (c) 6      (d) 7

Ans. (c)

Sol.

C<sub>5</sub>H<sub>10</sub>

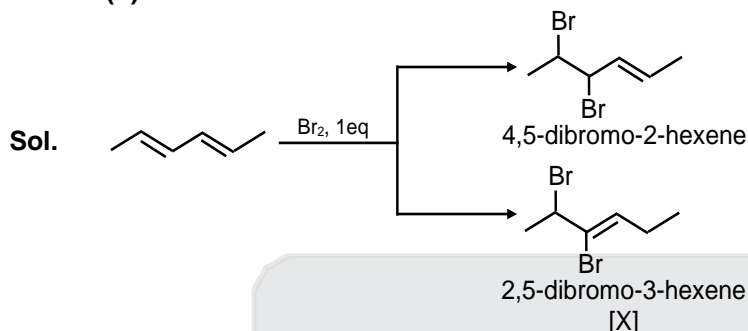
Degree of unsaturation = 1



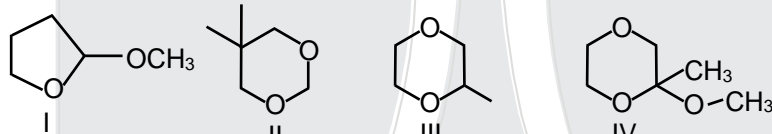


23. At 0°C, 1 equivalent bromine is added to 2,4-hexadiene to produce 4,5-dibromo-2-hexene and its isomer 'X'. 'X' is :
- (a) 5,5-dibromo-2-hexene (b) 2,5-dibromo-3-hexene  
(c) 2,2-dibromo-3-hexene (d) 2,3-dibromo-4-hexene

Ans. (b)



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

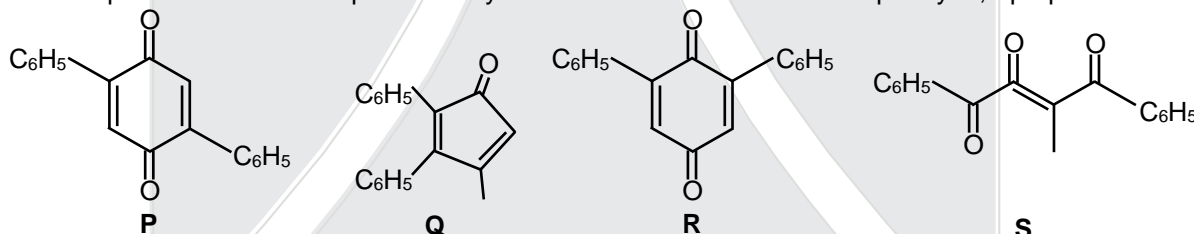


- (a) I and II (b) III and IV (c) Only IV (d) I, II and III

Ans. (a)

Sol. Acetal is functional group if a carbon atom has two ether group connected to it.

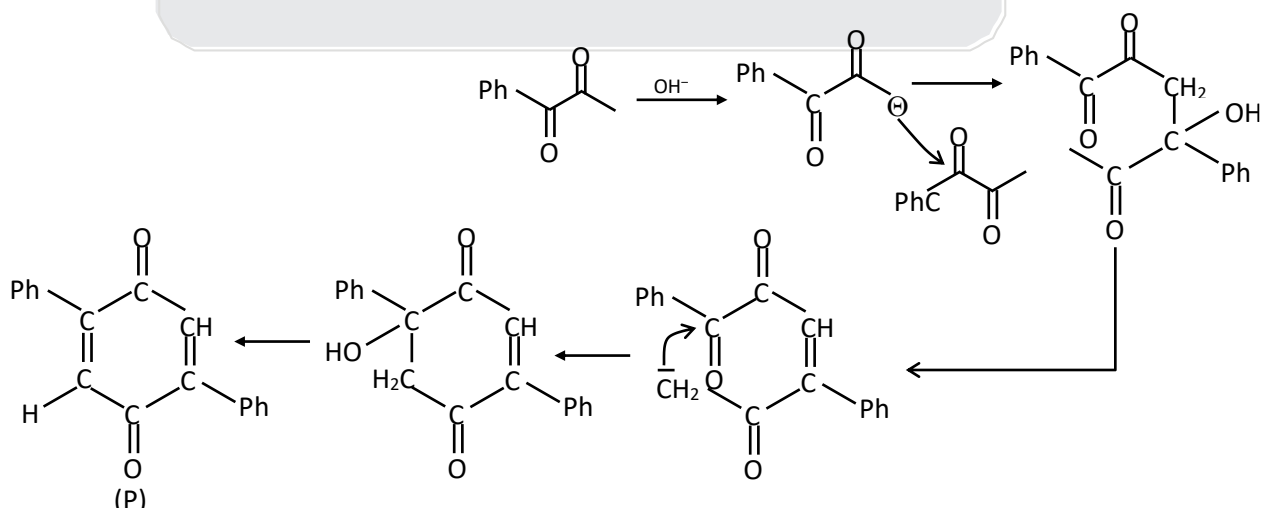
25. The compound which can be produced by double aldol condensation of 1-phenyl-1,2-propanedione :



- (a) P (b) Q (c) R (d) S

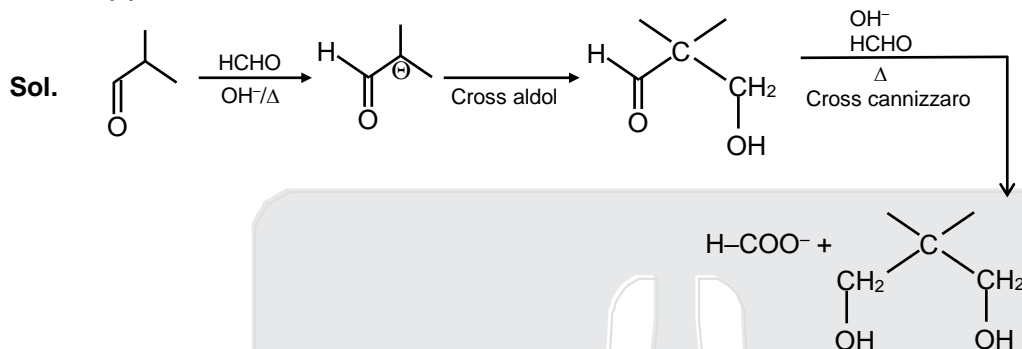
Ans. (a)

Sol.



26. 2,2-Dimethyl-1,3-propanediol is formed by heating 2-methylpropanal with an excess of formaldehyde and  $\text{Ca}(\text{OH})_2$ . The sequence of reactions taking place in this synthesis is :
- dehydrogenation to 2-methyl-2-propenal followed by addition of formaldehyde.
  - dehydrogenation to penta-2,3-diene followed by addition of formaldehyde.
  - a crossed aldol reaction followed by a crossed Cannizzaro reaction.
  - a crossed Cannizzaro reaction followed by a crossed aldol reaction.

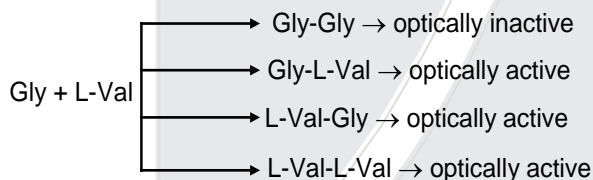
Ans. (c)



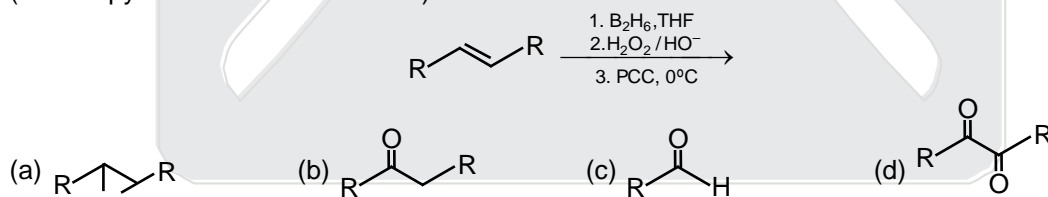
27. Number of different types of dipeptides produced using a mixture of glycine and L-valine, and number of optically active dipeptides formed in this mixture will be :
- Four dipeptides, all optically active
  - Two dipeptides, all optically active
  - Four dipeptides, three optically active
  - Two dipeptides, none optically active

Ans. (c)

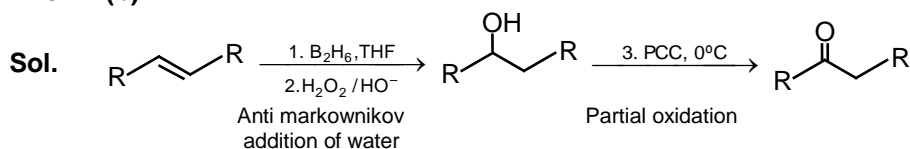
Sol. Four dipeptides, three optically active



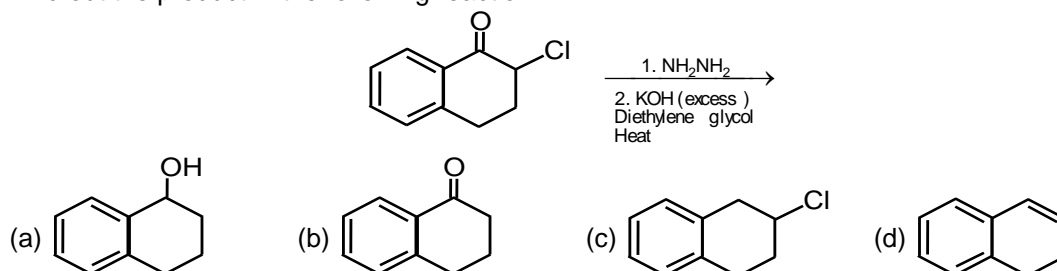
28. Predict the major product in the following reaction. (PCC is pyridinium chlorochromate)



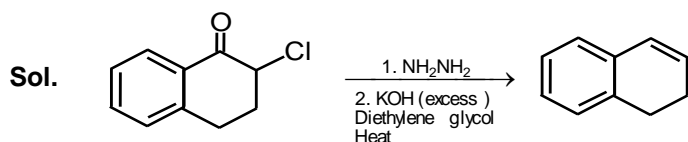
Ans. (b)



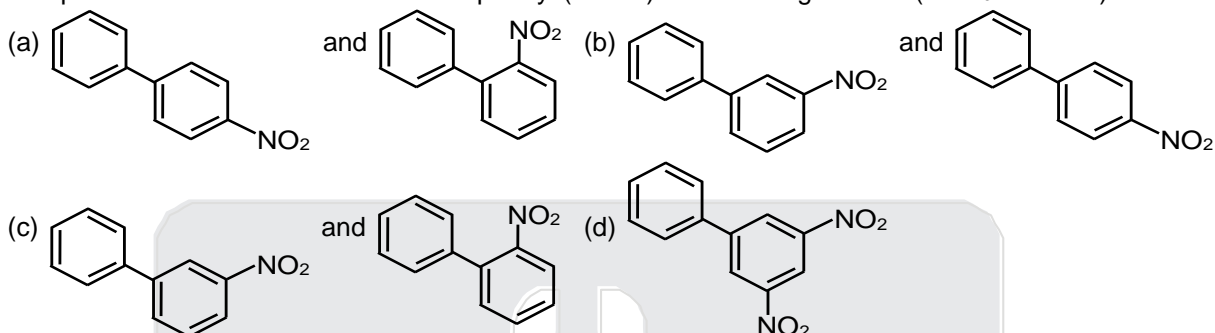
29. Find out the product in the following reaction.



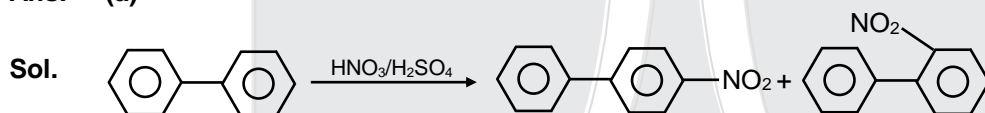
Ans. (d)



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 :



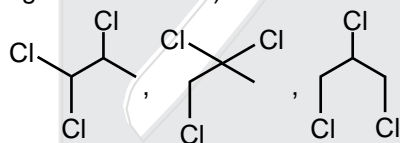
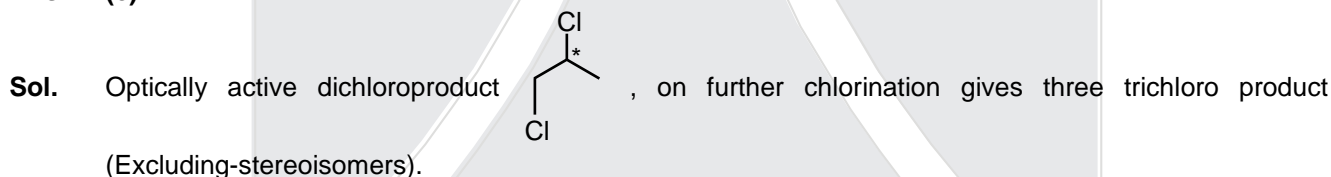
Ans. (a)



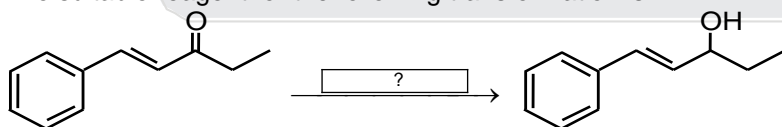
31. Chlorination of propane gives four dichloro products. One of them is optically active. The number of trichloro products possible from the optically active dichloro product is (excluding stereoisomers) :

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

Ans. (c)



32. The suitable reagent for the following transformation is :



- (a) Na, liq.  $\text{NH}_3$  (b)  $\text{H}_2$ , Pd/C (c)  $\text{LiAlH}_4$  (d) Zn-Hg, HCl, heat

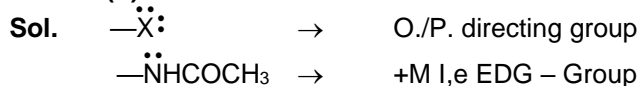
Ans. (c)

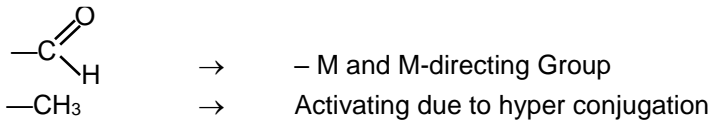
33. Column A represents a set of functional groups and Column B their respective electronic effects. The correct match is :

Column A	Column B
(a) $-\text{NH}_2$ , $-\text{COCl}$ , $-\text{SO}_3\text{H}$ , $-\text{COOH}$ ;	m-directing, EWG, activating, a/p-directing
(b) $-\text{X}$ , $-\text{NHCOCH}_3$ , $-\text{CHO}$ , $-\text{CH}_3$ ;	o/p directing, EDG, m-directing, activating
(c) $-\text{COCl}$ , $-\text{COCH}_3$ , $-\text{NH}_2$ , $-\text{CN}$ ;	EDG, EWG, deactivating, m-directing
(d) $-\text{SO}_3\text{H}$ , $\text{NH}_3$ , $-\text{OCH}_3$ , $-\text{CONH}_2$ ;	activating, deactivating, EWG, EWG

[EDG: Electron donating group and EWG: Electron withdrawing group]

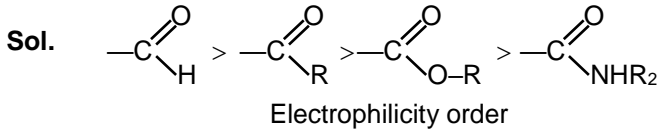
Ans. (b)



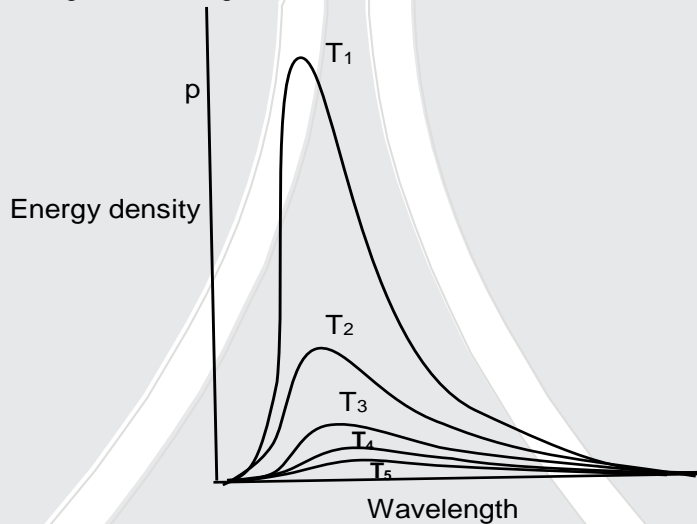


34. The correct order of reactivity of  $-\text{CHO}$ ,  $-\text{COR}$ ,  $-\text{COOR}$ ,  $-\text{CONR}_2$  groups toward  $\text{MeMgI}$  in ether is :  
 (a)  $-\text{CONR}_2 > -\text{COOR} > -\text{COR} > -\text{CHO}$       (b)  $-\text{CHO} > -\text{COR} > -\text{COOR} > -\text{CONR}_2$   
 (c)  $-\text{CONR}_2 > -\text{CHO} > -\text{COR} > -\text{COOR}$       (d)  $-\text{CHO} > -\text{CONR}_2 > -\text{COOR} > -\text{COR}$

Ans. (b)



35. 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)  $T_1 > T_2 > T_3 > T_4 > T_5$   
 (ii) As temperature increases, the wavelength at which the intensity is maximum shifts towards the higher energy regions of the electromagnetic spectrum.  
 (iii) Radiations of all wave length are emitted, absorbed, reflected, and refracted by the black body.  
 (iv) The total energy density increases as the temperature is decreased.  
 (a) (i) and (ii)      (b) (ii) and (iii)      (c) (i), (iii) and (iv)      (d) (ii), (iii) and (iv)

Ans. (a)

Sol. As the temperature of black body decreases the emitted radiation intensity decreases

$$T_1 > T_2 > T_3 > T_4$$

black body absorbs all radiations & no reflection takes place

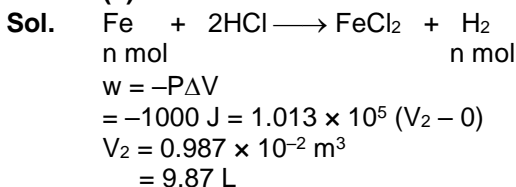
$$\lambda \propto \frac{1}{T} \quad \text{as temperature increases energy increases}$$

Ans (i) and (ii)

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

Ans. (a)



$$n = \frac{1 \times 9.87}{0.821 \times 300} = 0.4 \text{ mol}$$

$$M_{\text{Fe}} = 0.4 \times 56 = 22.4 \text{ g} \quad \text{Ans. (a)}$$

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  $\text{Mg}(\text{OH})_2$  per 100 mL to be given to a patient whose stomach contains 2 L of gastric juice with HCl concentration of  $6.0 \times 10^{-3} \text{ M}$  is :

(Molar mass of  $\text{Mg}(\text{OH})_2 = 58.0 \text{ g mol}^{-1}$ )

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

Ans. (c)

Sol.

Gastric Juice = 2L

$[\text{HCl}] = 6 \times 10^{-3} \text{ M}$

$n_{\text{HCl}} \Rightarrow 12 \times 10^{-3} \text{ mol}$

$n_{\text{mg}(\text{OH})_2}$  required to neutralize HCl

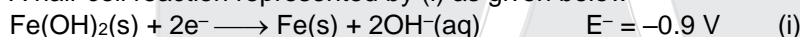
$\Rightarrow 6 \times 10^{-3} \text{ mol}$

$\Rightarrow 6 \times 10^{-3} \times 58 \text{ gram} \Rightarrow 0.348 \text{ g}$

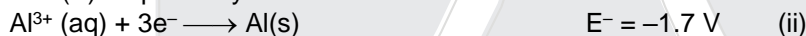
2.9 gram of  $\text{Mg}(\text{OH})_2$  required  $\Rightarrow 100 \text{ mL}$

0.348 gram of  $\text{Mg}(\text{OH})_2$  required  $\Rightarrow \frac{100}{2.9} \times 0.348 \Rightarrow 12 \text{ mL}$

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 :

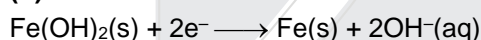


The correct option that represents the redox reactions in cells I and II is :

- (a) Fe is oxidized in cell I; Fe is oxidized in cell II  
 (b) Fe is oxidized 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 oxidized in cell II

Ans. (d)

Sol.



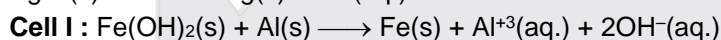
$$E^\circ = -0.9 \text{ V}$$



$$E^\circ = -1.7 \text{ V}$$

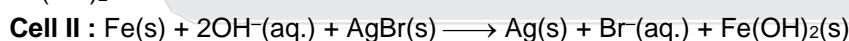


$$E^\circ = -0.07 \text{ V}$$



$$E^\circ_{\text{cell}} = -0.9 + 1.7 = +ve$$

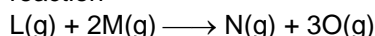
$\text{Fe}(\text{OH})_2$  is reduced



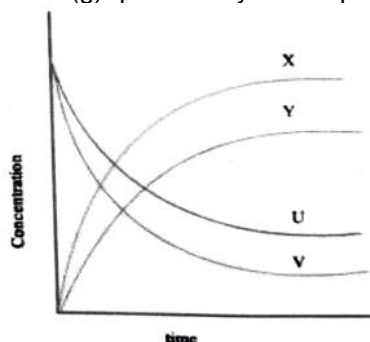
$$E^\circ_{\text{cell}} = +0.9 - .07 = +ve$$

Fe is oxidized.

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



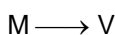
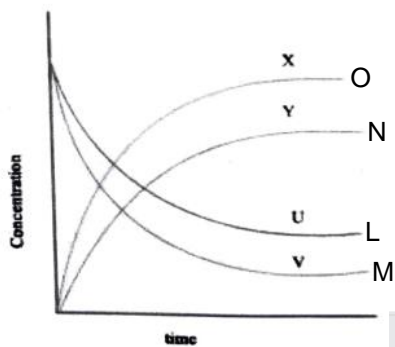
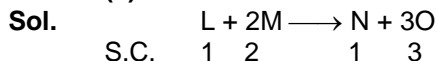
(a) X, Y

(b) Y, U

(c) V, Y

(d) U, X

Ans. (c)



40. The correct produced due to photoelectric effect  
(a) increases with the increase of frequency of the incident radiation.  
(b) increases with the increases in intensity of the incident radiation.  
(c) decreases with time of irradiation.  
(d) is independent of the intensity of incident radiation.

Ans. (b)

Sol. Current produced in photoelectric effect depends on 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

Ans. (c)

Sol. In spectrum, energy, frequency & wavelength are different in different region.

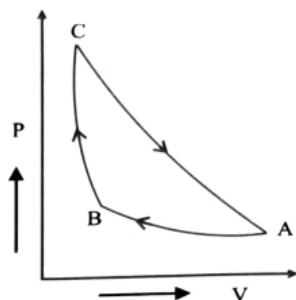
42. Among, the following, the correct statements about the compressibility factor (Z) of real gases are :  
(i) If  $Z < 1$ , intermolecular repulsive forces are more dominant.  
(ii) If  $Z < 1$ , intermolecular attractive forces are more dominant.  
(iii) If  $Z > 1$ , intermolecular repulsive forces are more dominant.  
(iv) If  $Z > 1$ , intermolecular attractive forces are more dominant.  
(a) (i) and (iv) (b) (i) and (iii) (c) (ii) and (iv) (d) (ii) and (iii)

Ans. (d)

Sol.  $Z = \frac{V_{m, \text{real}}}{V_{m, \text{ideal}}} < 1$ ; attractive forces are dominating

$Z > 1$ ; repulsive forces are dominating.

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

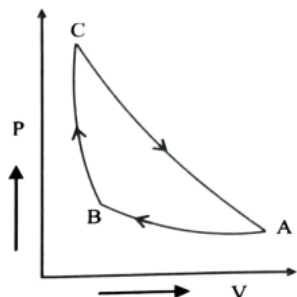
(b) - 900 J

(c) - 600 J

(d) - 400 J

Ans. (c)

Sol.



AB → Isothermal compression  $q = -800$  &  $\Delta E = 0$  so  $W = +800$

BC → Adiabatic compression  $W = +500 = \Delta E$

CA →  $q = 100$

$W_{CA} \rightarrow ?$

AB  $\Delta E = q + W = 0$

$W = +800$

BC  $\Delta E = q + W = 0 + (+500)$

$\Delta E = +500$

$\Delta E_{\text{Total}} = \Delta E_{AB} + \Delta E_{BC} + \Delta E_{CA} = 0$

$= 0 + (+500) + \Delta E_{CA} = 0$

$\Delta E_{CA} = -500$

$\Delta E_{CA} = q + W$

$-500 = +100 + W$

$W = -600$

44. 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 :

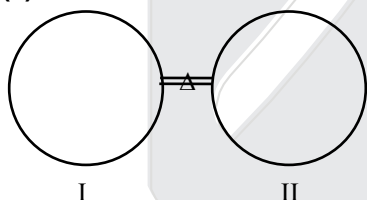
(a) 1 : 1

(b) 2 : 1

(c) 3 : 1

(d) 4 : 1

Ans. (c)



Sol.

$T = 250 \text{ K}$

$T = 750 \text{ K}$

$n_{\text{Total}} = 20$

Moles in flask I  $\Rightarrow n_1$

Moles in flask II  $\Rightarrow n_2$

$n_1 + n_2 = 20$

$n \propto \frac{1}{T}$

$n_1 : n_2 = T_2 : T_1$

$= 750 : 250 = 3 : 1$

45. When a certain amount of a univalent salt AB (molar mass = 54 g mol<sup>-1</sup>) was dissolved in 0.1 dm<sup>3</sup> 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<sup>-3</sup>)

(a) 0.5 m

(b) 1.0 m

(c) 2.0 m

(d) 4.0 m

Ans. (b)

Sol.

AB (molar mass = 54 g/mol)

$V = 0.1 \text{ dm}^3 = 0.1 \text{ L}$

RLVP = 3.55 %

Molality = ?

Complete dissociation of salt

so  $i = 2$

$$RLVP = \frac{3.55}{100} = \frac{m \times M_{\text{solvent}} \times i}{1000} = \frac{m \times 18 \times 2}{1000}$$

$m = 1$

46. The rate constant values for the decay of radioisotopes X and Y, used in radio-medicine are  $0.05 \text{ h}^{-1}$  and  $0.025 \text{ h}^{-1}$  respectively. In a hospital, at a time 't<sub>0</sub>' 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 :
- (a) twice the half-life of X  
(b) twice the half-life of Y  
(c) equal to the half-life of X  
(d) equal to  $\frac{1}{2}$  the half-life of Y

Ans. (b)

Sol.  $X = \frac{K_1 = 0.05 \text{ h}^{-1}}{\rightarrow}$

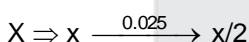
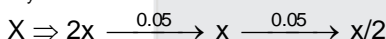
$Y = \frac{K_2 = 0.025 \text{ h}^{-1}}{\rightarrow}$

at  $t_0 (A_x = 2A_y)$

$N_x = 2N_y$

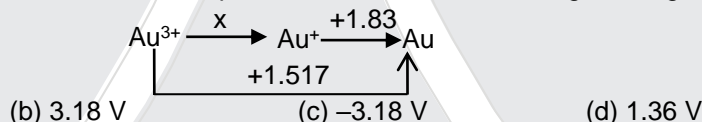
$N_x \Rightarrow 2x$

$N_y \Rightarrow x$



so activity of X & Y are equal after twice of Half life of X.

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



(a) 2.72 V

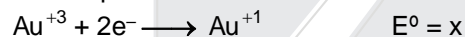
(b) 3.18 V

(c) -3.18 V

(d) 1.36 V

Ans. (d)

Sol. Gold at pH = 1.0



$-2x - 1.83 = 3(-1.517)$

$2x + 1.83 = 3 \times 1.517$

$x = 1.36$

48. Electrolysis of aqueous  $\text{CuSO}_4$  (0.1 M) was carried out in two cells I and II. In I, the electrodes are of Cu and in II they are of Pt. As the electrolysis proceeds pH of the electrolyte solution will :

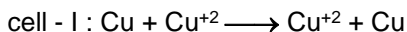
- (a) decrease in II and remain the same in I  
(b) remain the same in both I and II  
(c) increase in both I and II  
(d) increase in I and decrease in II

Ans. (a)

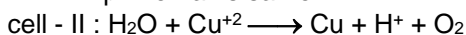
Sol. Electrolysis of as  $\text{CuSO}_4$

cell - I : electrodes of Cu

cell - II : electrodes of Pt



pH remains same



$[\text{H}^{+}]$  increases so pH decreases



**PART-A2**

**ANY NUMBER OF OPTIONS 4, 3, 2 or 1 MAY BE CORRECT  
MARKS WILL BE AWARDED ONLY IF ALL CORRECT OPTIONS ARE BUBBLED.**

49. Choose the correct statement(s) regarding zeolites :
- (a) Silicon atoms are replaced by aluminium atoms in the zeolites.
  - (b) The pores and cavities of the zeolites as well as size and shape of reactant decides the reactions taking place in the zeolites.
  - (c) The cracking of hydrocarbons and isomerization reactions are catalyzed by zeolites in the petrochemical industries.
  - (d) Zeolites act as molecular sieves and can separate the molecules of different sizes.

**Ans. (a, b, c, d)**

**Sol.** Si atoms are replaced by Al in zeolites are shape selective catalyst.

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.

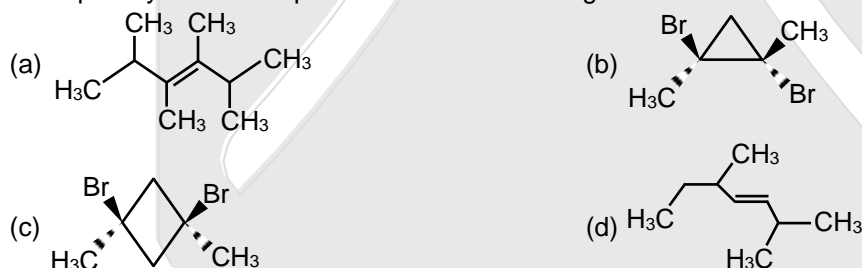
Identify the correct statements regarding the above observations.

- (a) The brown colour is due to  $[\text{Fe}(\text{OH})(\text{H}_2\text{O})_5]^{2+}$ ,  $[\text{Fe}(\text{OH})_2(\text{H}_2\text{O})_4]^+$
- (b) Violet colour is due to  $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$  and yellow colour due to  $[\text{FeCl}_4]^-$
- (c) Addition of  $\text{HNO}_3$  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
- (d) Addition of  $\text{HNO}_3$  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

**Ans. (a, b, c)**

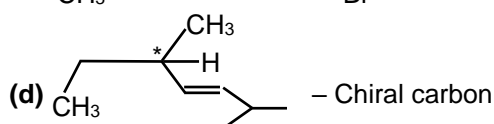
**Sol.**  $\text{Fe}(\text{NO}_3)_3 \cdot 9\text{H}_2\text{O}$  when dissolve in water under goes hydrolysis forming brown colour due to  $[\text{Fe}(\text{OH})(\text{H}_2\text{O})_5]^{2+}$  &  $[\text{Fe}(\text{OH})_2(\text{H}_2\text{O})_4]^+$  when nitric acid is added  $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$  is formed of pale violet colour which gives yellow coloured  $\text{FeCl}_4^-$  with HCl solution

51. The optically active compounds from the following are :

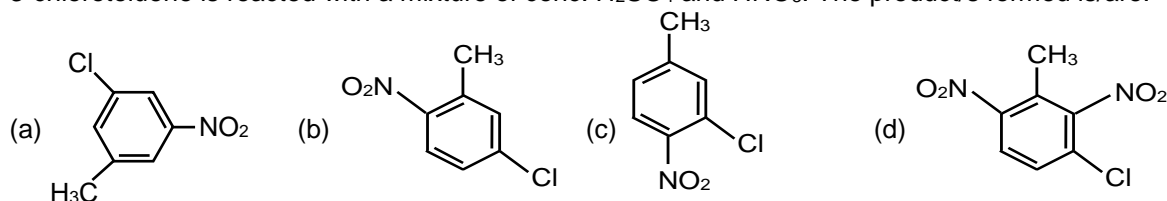


**Ans. (b,d)**

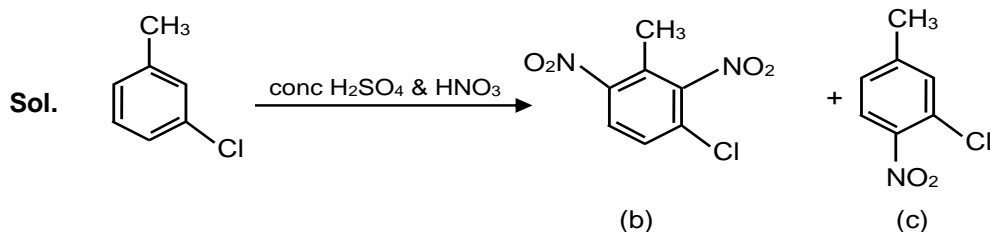
**Sol. (b)** – no. plane of symmetry no center of symmetry.



52. 3-chlorotoluene is reacted with a mixture of conc.  $\text{H}_2\text{SO}_4$  and  $\text{HNO}_3$ . The product/s formed is/are:



**Ans. (b,c)**



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

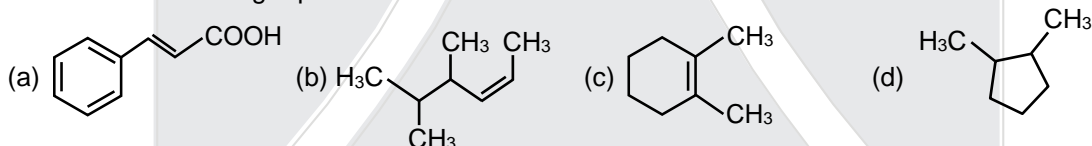
Ans. (a,c)

Sol. 2,4,6-Trinitrophenol (Picric acid) is much stronger acid than phenol. (lower  $pK_a$ ) as the  $-ve$  charge is extensively delocalized on the O atom of nitro group.

54. The correct statements for 1,3-butadiene from following are:  
 (a) 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  
 (b) Molar addition of  $Br_2$  yields only 1,2-dibromo-2-butene for longer time period  
 (c)  $C_1-C_2$  and  $C_3-C_4$  bonds are slightly longer than a  $C=C$  bond  
 (d)  $C_2-C_3$  single bond is slightly shorter than a  $C-C$  bond

Ans. (a,c,d)

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



Ans. (a,b,d)

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  
 (a) the experimentally obtained rate is 2.5 times faster than the theoretical rate.  
 (b) ratio of the number of collisions calculated from collision theory and that actually take place is 1:2.5.  
 (c) the activation energy of the reaction is the same for both the experimental and calculated values.  
 (d) the molecules of reactant R may be of some complex structure.

Ans. (a, b, c)

Sol. Steric factor  $\Rightarrow 2.5$   
 experimental rate is 2.5  
 times faster than theoretical  
 If steric factor is low than reactant is more complex  
 Activation energy is unaffected by steric factor.

57. The correct statement/s among the following is/are:  
 (a) 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.  
 (b) 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.  
 (c) When the ionic strength of a colloidal solution is increased, thickness of the double layer is increased, and the colloid gets precipitated.  
 (d) When the ionic strength of a colloidal solution is increased, thickness of the double layer is decreased, and the colloid gets precipitated.

Ans. (a,b,d)

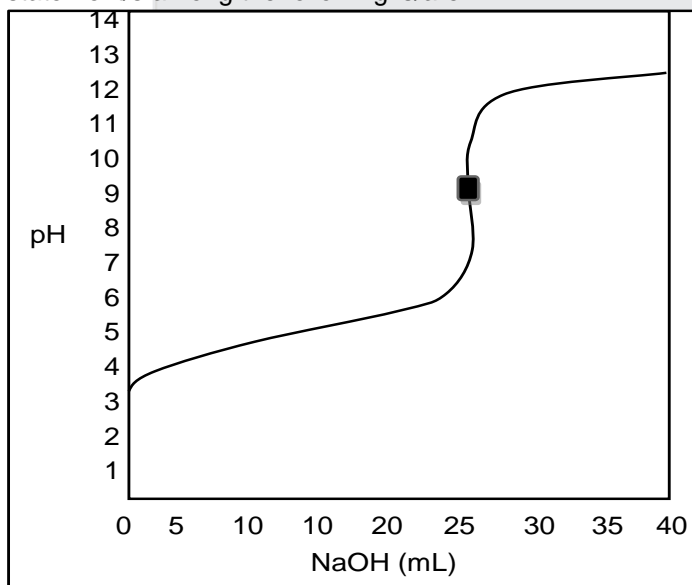
- Sol.** (a)  $\text{AgNO}_3 \xrightarrow{\text{KI}} \text{AgI} \downarrow / \text{Ag}^+$  (Positively charge collide and negatively charge diffused layer)  
 (b)  $\text{KI} \xrightarrow{\text{AgNO}_3} \text{AgI} \downarrow / \text{I}^-$  (Negatively charge collide and positive charge diffused layer)  
 (d) thickness of double layer is decreased if ionic strength is increased.

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

**Ans. (a, c)**

**Sol.** Osmosis occurs from dilute to conc. solution whereas Reverse osmosis occurs from conc. to dilute 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.

**Ans. (a, c)**

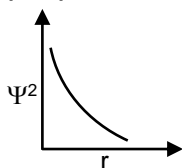
**Sol.** End point pH range in the given graph is 7 to 10.  
 It means this is WA v/s SB titration.  
 After equivalence point SB will determine the pH.

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

- (a) The probability density ( $\Psi^2$ ) 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.

**Ans. (c, d)**

**Sol.**



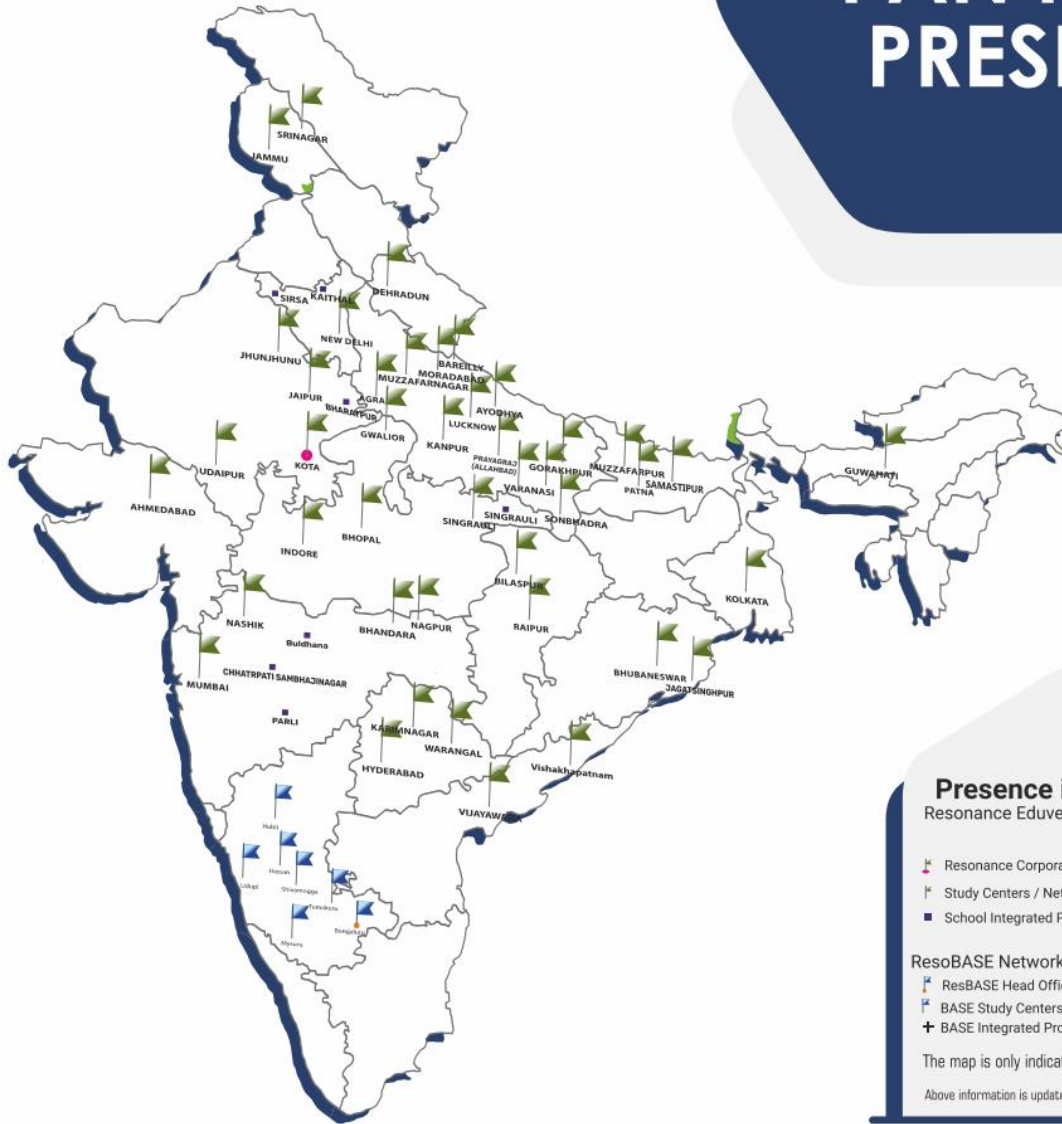
- (b) They will be degenerate orbitals  
 (c) True  
 (d) True (Hund's Rule)

## PERIODIC TABLE OF ELEMENT

-- Atomic number -- Symbol -- Name of element -- Relative atomic mass																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
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# PAN INDIA PRESENCE



## Presence in Cities: 77 Resonance Eduventures Ltd. Network

- Resonance Corporate/Head Office : 1
- Study Centers / Network Partners : 40
- School Integrated Program (ICCPs) : 7

Total  
48

## ResoBASE Network

- ResBASE Head Office : 1
- BASE Study Centers (BSC) : 17
- BASE Integrated Program (ICCPs) : 11

Total  
29

The map is only indicative and not to scale.

Above information is updated till 15.09.2023.

## REGISTERED & CORPORATE OFFICE (CIN: U80302RJ2007PLC024029)

CG Tower, A-46 & 52, IPIA, Near City Mall, Jhalawar Road, Kota (Rajasthan) - 324005

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