

JEE (Main) CHEMISTRY SOLVED PAPER

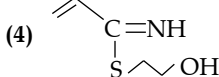
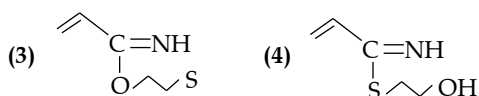
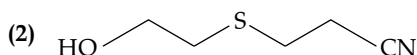
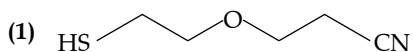
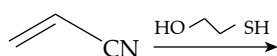
2023
13th April Shift 2

Section A

1. Which of the following are the Greenhouse gases?
(A) Water vapour (B) Ozone
(C) I₂ (D) Molecular hydrogen
Choose the most appropriate answer from the options given below :

(1) C and D only (2) A and B only
(3) B and C only (4) A and D only

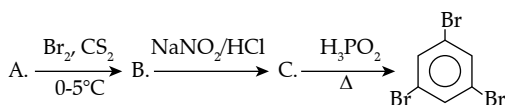
2. The major product for the following reaction is:



3. In the wet tests for detection of various cations by precipitation, Ba²⁺ cations are detected by obtaining precipitate of :

(1) Ba(OAc)₂ (2) BaCO₃
(3) BaSO₄ (4) Ba(ox) : Barium oxalate

4. Compound A from the following reaction sequence is:



(1) Phenol (2) Benzoic Acid
(3) Aniline (4) Salicylic Acid

5. Given below are two statements, one is labelled as Assertion A and the other is labelled as Reason R.
Assertion A: Isotopes of hydrogen have almost same chemical properties, but difference in their rates of reaction.

Reason R: Isotopes of hydrogen have different enthalpy of bond dissociation.

In the light of the above statements, choose the most appropriate answer from the options given below :

(1) A is not correct but R is correct
(2) Both A and R correct but R is NOT the correct explanation of A
(3) Both A and R are correct and R is the correct explanation of A
(4) A is correct but R is not correct

6. Given below are statements related to Ellingham diagram :

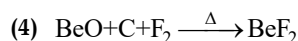
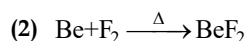
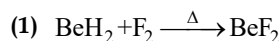
Statement I: Ellingham diagram can be constructed for oxides, sulfides and halides of metals.

Statement II: It consists of plots of $\Delta_f H^\circ$ vs for formation of oxides of Elements.

In the light of the above statements, choose the most appropriate answer from the options given below:

(1) Statement I is correct but Statement II is incorrect
(2) Statement I is incorrect but Statement II is correct
(3) Both Statement I and Statement II are incorrect
(4) Both Statement I and Statement II are correct

7. Better method for preparation of BeF₂ among the following is



8. Identify the correct order of standard enthalpy of formation of sodium halides.

(1) NaI < NaBr < NaF < NaCl
(2) NaF < NaCl < NaBr < NaI
(3) NaCl < NaF < NaBr < NaI
(4) NaI < NaBr < NaCl < NaF

9. Which of the following complexes will exhibit maximum attraction to an applied magnetic field?

(1) $[\text{Zn}(\text{H}_2\text{O})_6]^{2+}$ (2) $[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$
(3) $[\text{Co}(\text{en})_3]^{3+}$ (4) $[\text{Co}(\text{H}_2\text{O})_6]^{2+}$

10. The correct group of halide ions which can be oxidized by oxygen in acidic medium is

(1) Cl⁻, Br⁻ and I⁻ only (2) Br⁻ only
(3) Br⁻ and I⁻ only (4) I⁻ only

11. The total number of stereoisomers for the complex $[\text{Cr}(\text{ox})_2\text{ClBr}]^{3-}$ (where ox = oxalate) is :

(1) 3 (2) 1 (3) 4 (4) 2

12. Match List I with List II

I – Bromopropane is reacted with reagents in List I to give product in List II

LIST I Reagent	LIST II Product
(A) KOH (alc)	I. Nitrile
(B) KCN (alc)	II. Ester
(C) AgNO ₂	III. Alkene
(D) H ₃ CCOOAg	IV. Nitroalkane

Choose the correct answer from the options given below :

(1) A-IV, B-III, C-II, D-I (2) A-I, B-III, C-IV, D-II
(3) A-I, B-II, C-III, D-IV (4) A-III, B-I, C-IV, D-II

13. The covalency and oxidation state respectively of boron in $[\text{BF}_4]^-$ are :
 (1) 3 and 5 (2) 4 and 3 (3) 4 and 4 (4) 3 and 4
14. What happens when methane undergoes combustion in systems A and B respectively?

Adiabatic system	Diathermic container
System A	System B

- (1)
- | | |
|--------------------------|-------------------|
| System A | System B |
| Temperature remains same | Temperature rises |
- (2)
- | | |
|-------------------|-------------------|
| System A | System B |
| Temperature falls | Temperature rises |
- (3)
- | | |
|-------------------|--------------------------|
| System A | System B |
| Temperature falls | Temperature remains same |
- (4)
- | | |
|-------------------|--------------------------|
| System A | System B |
| Temperature rises | Temperature remains same |

15. The naturally occurring amino acid that contains only one basic functional group in its chemical structure is :

- (1) histidine (2) Lysine
 (3) Asparagine (4) Arginine

16. Given below are two statements:

Statement I: SO_2 and H_2O both possess V-shaped structure.

Statement II: The bond angle of SO_2 less than that of H_2O

In the light of the above statements, choose the most appropriate answer from the options given below:

- (1) Both statement I and statement II are incorrect
 (2) Both Statement I and statement II are correct
 (3) Statement I is correct but Statement II is incorrect
 (3) Statement I is incorrect but Statement II is correct

17. Given below are two statements, one is labelled as Assertion A and the other is labelled as Reason R.

Assertion A: The diameter of colloidal particles in solution should not be much smaller than wavelength of light to show Tyndall effect.

Reason R: The light scatters in all direction when the size of particles is large enough.

In the light of the above statements, choose the correct answer from the options given below :

- (1) Both A and R are correct but R is NOT the correct explanation of A

- (2) A is true but R is false
 (3) Both A and R are correct and R is the correct explanation of A
 (4) A is false but R is true

18. Match List I with List II

LIST I	LIST II
(A) Weak intermolecular forces of attraction	I. Hexamethylenediamine + adipic
(B) Hydrogen bonding	II. $\text{AlEt}_3 + \text{TiCl}_4$
(C) Heavily branched polymer	III. 2-chloro -1, 3 - butadiene
(D) High density polymer	IV. Phenol + formaldehyde

Choose the correct answer from the options given below :

- (1) A-IV, B-I, C-III, D-II (2) A-III, B-I, C-IV, D-II
 (3) A-II, B-IV, C-I, D-III (4) A-IV, B-II, C-III, D-I

19. Given below are two statements:

Statement I: Tropolone is an aromatic compound and has 8π electrons.

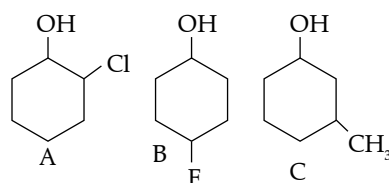
Statement II: π electrons of $> \text{C} = \text{O}$ group in tropolone is involved in aromaticity

In the light of the above statements, choose the correct answer from the options given below :

- (1) Statement I is false but Statement II is true
 (2) Statement I is true but Statement II is false
 (3) Both Statement I and Statement II are true
 (4) Both Statement I and Statement II are false

20. Given below are two statements, one is labelled as Assertion A and the other is labelled as Reason R.

Assertion A: Order of acidic nature of the following compounds is $\text{A} > \text{B} > \text{C}$.



Reason R: Fluoro is a stronger electron withdrawing group than Chloro group.

In the light of the above statements, choose the correct answer from the options given below :

- (1) Both A and R are correct and R is the correct explanation of A
 (2) A is false but R is true
 (3) Both A and R are correct but R is NOT the correct explanation of A
 (4) A is true but R is false

Section B

21. If the formula of Borax is $\text{Na}_2\text{B}_4\text{O}_x(\text{OH})_y \cdot z\text{H}_2\text{O}$, then $x + y + z =$ _____.
22. Sea water contains 29.25% NaCl and 19% MgCl_2 by weight of solution. The normal boiling point of the sea water is _____^oC (Nearest integer)
23. 20 mL of 0.1 M NaOH is added to 50 mL of 0.1 M acetic acid solution. The pH of the resulting solution is _____ $\times 10^{-2}$ (Nearest integer)
24. At 298 K, the standard reduction potential for Cu^{2+}/Cu electrode is 0.034 V.
Given: $K_{\text{sp}} \text{Cu}(\text{OH})_2 = 1 \times 10^{-20}$
Take $\frac{2.303RT}{F} = 0.059 \text{ V}$
The reduction potential at pH = 14 for the above couple is $(-x) \times 10^{-2} \text{ V}$.
The value of x is _____.
25. Sodium metal crystallizes in a body centred cubic lattice with unit cell edge length of 4 Å. The radius of sodium atom is _____ $\times 10^{-1} \text{ Å}$ (Nearest integer)
26. $\text{A (g)} \rightarrow 2\text{B (g)} + \text{C (g)}$ is first order reaction. The initial pressure of the system was found to be 800 mm Hg which increased to 1600 mm Hg after 10 min. The total pressure of the system after 30 min will be _____ mm Hg. (Nearest integer)
27. 1g of a carbonate (M_2CO_3) on treatment with excess HCl produces 0.01 mol of CO_2 . The molar mass of M_2CO_3 is _____ g mol^{-1} . (Nearest integer)
28. 0.400 g of an organic compound (X) gave 0.376 g of AgBr in Carius method for estimation of bromine. % of bromine in the compound (X) is _____. (Given: Molar mass AgBr = 188 g mol^{-1} , Br = 80 g mol^{-1})
29. The orbital angular momentum of an electron in 3s orbital is $\frac{xh}{2\pi}$. The value of x is _____ (nearest integer)
30. See the following chemical reaction:
 $\text{Cr}_2\text{O}_7^{2-} + \text{XH}^+ + 6\text{Fe}^{2+} \rightarrow \text{YCr}^{3+} + 6\text{Fe}^{3+} + \text{ZH}_2\text{O}$
The sum of X, Y and Z is _____

Answer Key

Q. No.	Answer	Topic name	Chapter name
1	(2)	Green House Effect	Environmental Chemistry
2	(2)	Nucleophilicity	Hydrocarbons
3	(2)	Qualitative Analysis of Salts	Principles Related to the Practical Chemistry
4	(3)	Amine Compounds	Amine
5	(3)	Hydrogen	Hydrogen
6	(1)	Thermodynamic Principles of Metallurgy	General Methods of Extraction and Isolation of Elements
7	(3)	Alkaline Earth Elements	s-block elements
8	(4)	Enthalpy of formation	Thermodynamics
9	(4)	Magnetic Properties of Coordination compounds	Coordination Compounds
10	(4)	Group-17 Elements	p-block elements
11	(1)	Isomerism in Coordination Compounds	Coordination Compounds
12	(4)	Chemical Properties of Alkyl Halides	Haloalkanes and Haloarenes
13	(2)	Group-13 Elements	p-block elements
14	(4)	System, boundary and surroundings	Thermodynamics
15	(3)	Amino Acids	Biomolecules
16	(3)	VSEPR Theory	Chemical Bonding and Molecular Structure
17	(3)	Optical Properties of Colloids	Surface chemistry
18	(2)	Types of Polymerization	Polymers
19	(4)	Aromaticity	Hydrocarbons
20	(3)	Electronic Effects in Organic Compounds	Basic Concepts of Organic Chemistry
21	[17]	Group-13 Elements	p-block elements
22	[116]	Colligative Properties of Solution	Solutions

23	[458]	Buffer Solutions	Ionic Equilibrium
24	[25]	Nernst Equation	Electrochemistry
25	[17]	Packing Efficiency of Unit Cell	The Solid State
26	[2200]	Order of Reactions	Chemical Kinetics
27	[100]	Stoichiometry	Basic Concepts of Chemistry
28	[40]	Purification and characterization of Organic Compounds	Basic Concepts of Organic Chemistry
29	[0]	Quantum Numbers	Atomic Structure
30	[23]	Balancing of Redox Reactions	Redox Reactions

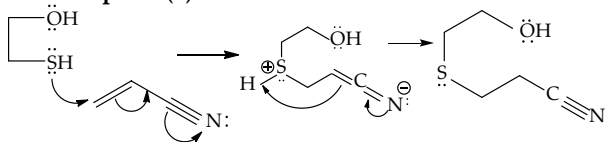
Solutions

Section A

1. **Option (2) is correct.**

Water vapour and ozone are greenhouse gases.

2. **Option (2) is correct.**



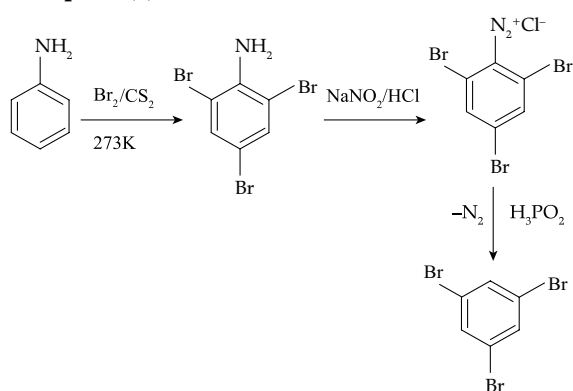
-SH is better nucleophile than -OH due to lower electronegativity of sulphur

3. **Option (2) is correct.**

Water vapour and ozone are greenhouse gases.

Ammonium carbonate is used for the detection of 5th group basic radicals such as Ba²⁺, Ca²⁺ and Sr²⁺.

4. **Option (3) is correct.**



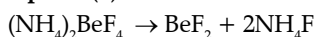
5. **Option (3) is correct.**

The chemical properties depend on the number of electrons in the valance shell. Since, the isotopes have the same number of electrons, they have nearly the same chemical properties.

6. **Option (1) is correct.**

Ellingham diagram can be constructed for the formation of oxides, sulphides and halides of metals.

7. **Option (3) is correct.**



8. **Option (4) is correct.**

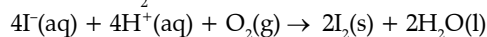
The enthalpy of formation becomes less negative from fluoride to iodide.

9. **Option (4) is correct.**

The complex with a greater number of unpaired d-electrons is attracted strongly by the applied magnetic field. The complex $[\text{Co}(\text{H}_2\text{O})_6]^{2+}$ has three unpaired electrons. The electronic configuration is $t_{2g}^5 e_g^2$. Thus, it is attracted strongly by the magnetic field.

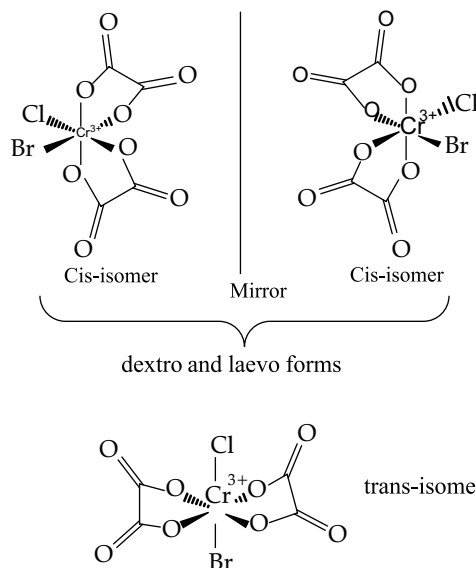
10. **Option (4) is correct.**

The I⁻ ion is the good reducing agent. Hence, it readily gets oxidized by the oxygen in acidic medium to I₂.

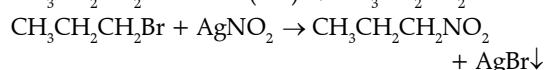
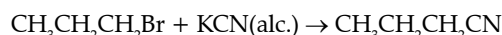
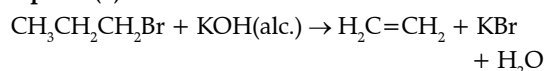


11. **Option (1) is correct.**

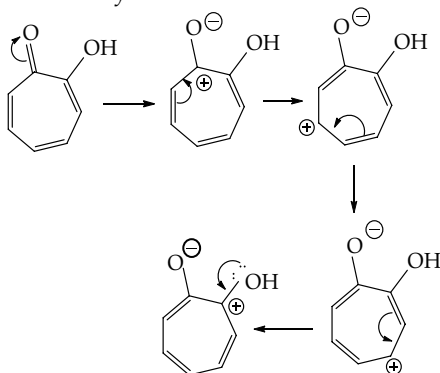
Total 3-stereoisomers are formed by the complex compounds.



12. **Option (4) is correct.**



13. **Option (2) is correct.**
The covalency is 4 and the oxidation state is 3.
14. **Option (4) is correct.**
Adiabatic boundary does not allow the heat transfer. The heat transfer at a constant temperature can take place in a diathermic container.
15. **Option (3) is correct.**
The asparagine contains only one basic functional group.
16. **Option (3) is correct.**
The bond angle in H₂O is less than SO₂ because of small size and high electronegativity of oxygen.
17. **Option (3) is correct.**
Tyndall effect is observed only when following conditions are satisfied:
(i) The diameter of the dispersed particle is not much smaller than the wavelength of the light used.
(ii) Refractive indices of dispersed phase and dispersion medium should vary greatly.
18. **Option (2) is correct.**
Hexamethylene diamine forms Nylon 66 on condensation with adipic acid.
AlEt₃ + TiCl₄ is a Ziegler-Natta catalyst used to prepare HDPE.
2-Chloro-1,3-butadiene is monomer of neoprene which is rubber.
Phenol-formaldehyde forms Bakelite which is a cross-linked polymer.
19. **Option (4) is correct.**
Tropolone is aromatic with 6 electrons. The electrons of >C=O group are not involved in the aromaticity.



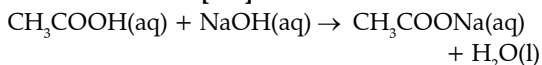
20. **Option (3) is correct.**
The inductive effect is a distance dependent effect. The negative inductive effect increases the acidic strength by stabilizing the anion. Hence, the correct order of acidity is (A) > (B) > (C).
- Section B**
21. **Correct answer is [17].**
The formula of the Borax is Na₂B₄O₅(OH)₄ • 8H₂O. Thus, x = 2, y = 4, z = 8. Thus, x + y + z = 17
22. **Correct answer is [116].**
Formula mass of NaCl and MgCl₂ is 58.5 and 95 gmol⁻¹ respectively.
The mass of water is 100 - 29.25 - 19 = 51.75 g.
The Van't Hoff factor (i) for NaCl and MgCl₂ is 2 and 3 respectively assuming complete ionization.

$$\Delta T_b = T_s - 100 = 0.52 \times \left(\frac{2 \times 29.25 \times 1000}{58.5 \times 51.75} + \frac{3 \times 19 \times 1000}{95 \times 51.75} \right)$$

$$= 16.07$$

$$\therefore T_s = 116.07^\circ \text{C}$$

23. **Correct answer is [458].**



\therefore millimoles of acetic acid reacted = millimoles of sodium hydroxide

$$\therefore \text{millimoles of acid reacted} = M \times V(\text{mL}) = 20 \times 0.1 = 2$$

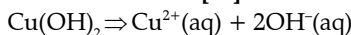
$$\therefore \text{millimoles of left} = 5 - 2 = 3$$

$$= \text{millimoles of salt formed}$$

$$\therefore \text{pH} = \text{p}K_a + \log \frac{[\text{salt}]}{[\text{acid}]}$$

$$\therefore \text{pH} = 4.76 + \log \frac{2}{3} = 4.58 = 458 \times 10^{-2}$$

24. **Correct answer is [25].**



$$\text{At pH} = 14, [\text{OH}^{-}] = 1\text{M}$$

$$K_{sp} = [\text{Cu}^{2+}][\text{OH}^{-}]^2, K_{sp} = [\text{Cu}^{2+}][1]^2, [\text{Cu}^{2+}] = 10^{-2}$$

By Nernst Equation:

$$E = E^\circ - \frac{0.059}{2} \log_{10} \frac{1}{[\text{Cu}^{2+}]}$$

$$E = 0.34 - \frac{0.059}{2} \log_{10} \frac{1}{10^{-2}} = -25 \times 10^{-2}$$

25. **Correct answer is [17].**

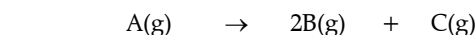
In a body centred cubic unit cell,

$$\sqrt{3}a = 4r \quad \therefore \sqrt{3} \times 4 = 4r \quad \therefore r = 17.32 \times 10^{-1}$$

26. **Correct answer is [2200].** $t_{1/2} = 10$ minutes

$$(P_A)_{30 \text{ min}} = (P_A)_0 \left(\frac{1}{2} \right)^{30/10}$$

$$(P_A)_{30 \text{ min}} = 100 \text{ mm Hg}$$



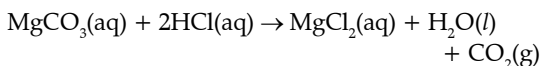
$$\text{At } t = 0 \quad 800 \text{ mm} \quad 0 \quad 0$$

$$\text{At } t = 30 \quad 100 \text{ mm} \quad 1400 \text{ mm} \quad 700 \text{ mm}$$

$$\text{Total pressure after 30 minutes} = 2200 \text{ mm Hg}$$

27. **Correct answer is [100].**

The reaction of MgCO₃ and HCl takes place as follows:



From the reaction,

$$\therefore \frac{1 \text{ g}}{\text{Mol. Mass}} = 0.01 \Rightarrow \text{Mol. Mass} = 100 \text{ g mol}^{-1}$$

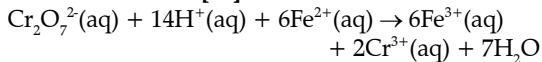
28. **Correct answer is [40].**

$$\% \text{Br} = \frac{80x}{188} \times \frac{100}{w}, \quad \% \text{Br} = \frac{80 \times 0.376}{188} \times \frac{100}{0.400} = 40$$

29. **Correct answer is [0].**

For s-orbital, the azimuthal quantum number (l) = 0.

30. **Correct answer is [23].**



$$\therefore x = 14, y = 2, z = 7 \quad \therefore x + y + z = 23$$