

JEE (Main) CHEMISTRY SOLVED PAPER

2023
01st Feb. Shift 1

Section A

Q. 1. A solution of FeCl_3 when treated with $\text{K}_4[\text{Fe}(\text{CN})_6]$ gives a prussian blue precipitate due to the formation of

- (1) $\text{K}[\text{Fe}_2(\text{CN})_6]$ (2) $\text{Fe}_4[\text{Fe}(\text{CN})_6]_3$
(3) $\text{Fe}[\text{Fe}(\text{CN})_6]$ (4) $\text{Fe}_3[\text{Fe}(\text{CN})_6]_2$

Q. 2. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R)

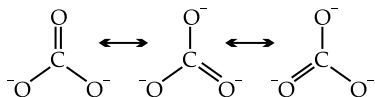
Assertion A: Hydrogen is an environment friendly fuel.

Reason R: Atomic number of hydrogen is 1 and it is a very light element.

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

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

Q. 3. Resonance in carbonate ion (CO_3^{2-}) is



Which of the following is true?

- (1) All these structures are in dynamic equilibrium with each other.
(2) It is possible to identify each structure individually by some physical or chemical method.
(3) Each structure exists for equal amount of time.
(4) CO_3^{2-} has a single structure i.e., resonance hybrid of the above three structures.

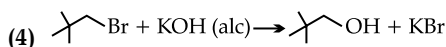
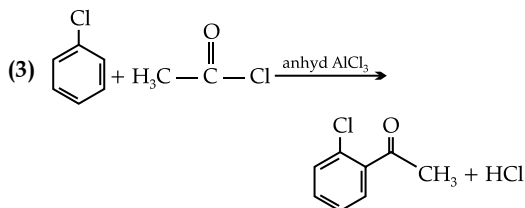
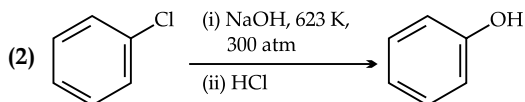
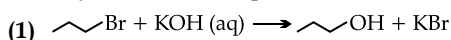
Q. 4. Match List I with List II

List I	List II
(A) Tranquilizers	(I) Anti blood clotting
(B) Aspirin	(II) Salvarsan
(C) Antibiotic	(III) antidepressant drugs
(D) Antiseptic	(IV) soframycin

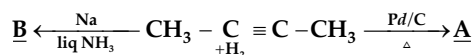
Choose the correct answer from the options given below:

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

Q. 5. Identify the incorrect option from the following:



Q. 6. But-2-yne is reacted separately with one mole of Hydrogen as shown below:

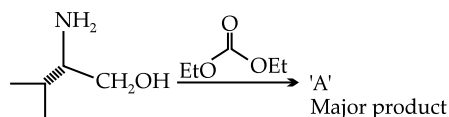


- A. A is more soluble than B.
B. The boiling point & melting point of A are higher and lower than B respectively.
C. A is more polar than B because dipole moment of A is zero.
D. Br_2 adds easily to B than A.

Identify the correct statements from the options given below:

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

Q. 7. In the following reaction, 'A' is



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

Q. 8. Highest oxidation state of Mn is exhibited in Mn_2O_7 . The correct statements about Mn_2O_7 are

- (A) Mn is tetrahedrally surrounded by oxygen atoms.
(B) Mn is octahedrally surrounded by oxygen atoms.
(C) Contains Mn-O-Mn bridge.
(D) Contains Mn-Mn bond.

Choose the correct answer from the options given below:

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

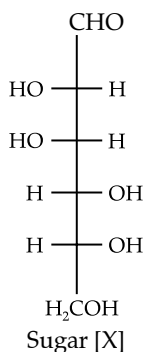
Q. 9. Match List I with List II:

List I	List II
(A) Slaked lime	(I) NaOH
(B) Dead burnt plaster	(II) Ca(OH) ₂
(C) Caustic soda	(III) Na ₂ CO ₃ · 10H ₂ O
(D) Washing soda	(IV) CaSO ₄

Choose the correct answer from the options given below:

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

Q. 10. The correct representation in six membered pyranose form for the following sugar [X] is



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

Q. 11. Which of the following complex will show largest splitting of d-orbitals ?

- (1) [FeF₆]³⁻ (2) [Fe(C₂O₄)₃]³⁻
(3) [Fe(CN)₆]³⁻ (4) [Fe(NH₃)₆]³⁺

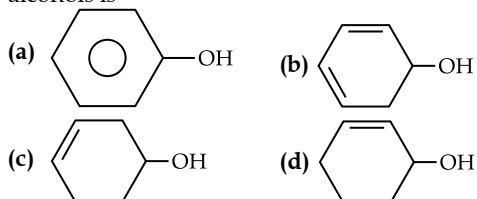
Q. 12. Which of the following are the example of double salt?

- (A) FeSO₄ · (NH₄)₂SO₄ · 6H₂O
(B) CuSO₄ · 4NH₃ · H₂O
(C) K₂SO₄ · Al₂(SO₄)₃ · 24H₂O
(D) Fe(CN)₂ · 4KCN

Choose the correct answer

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

Q. 13. Decreasing order of dehydration of the following alcohols is



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

Q. 14. Given below are two statements:

Statement I: Chlorine can easily combine with oxygen to form oxides; and the product has a tendency to explode.

Statement II: Chemical reactivity of an element can be determined by its reaction with oxygen and halogens.

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

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

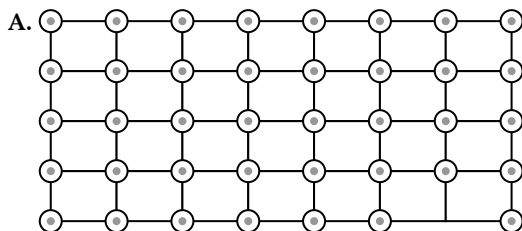
Q. 15. Choose the correct statement(s):

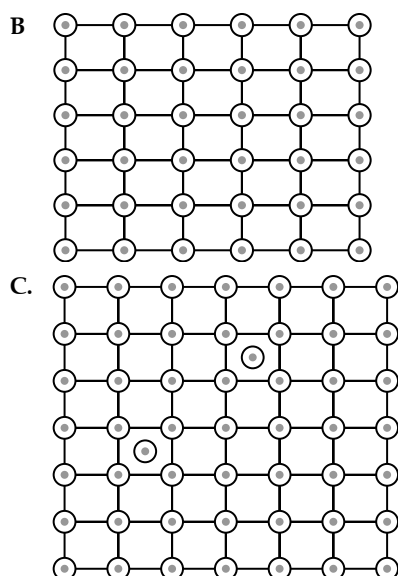
- A. Beryllium oxide is purely acidic in nature.
B. Beryllium carbonate is kept in the atmosphere of CO₂.
C. Beryllium sulphate is readily soluble in water.
D. Beryllium shows anomalous behavior.

Choose the correct answer from the options given below:

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

Q. 16. Which of the following represents the lattice structure of A_{0.95}O containing A²⁺, A³⁺ and O²⁻ ions an are of same representation write correct one?





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

Q. 17. Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R
Assertion A: In an Ellingham diagram, the oxidation of carbon to carbon monoxide shows a negative slope with respect to temperature.

Reason R: CO tends to get decomposed at higher temperature.

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

Q. 18. Given below are two statements: One is labelled as Assertion A and the other is labelled as Reason R
Assertion A: Amongst He, Ne, Ar and Kr; 1 g of activated charcoal adsorbs more of Kr.

Reason R: The critical volume V_c ($\text{cm}^3 \text{mol}^{-1}$) and critical pressure P_c (atm) is highest for Krypton but the compressibility factor at critical point Z_c is lowest for Krypton.

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

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

Q. 19. Match List I with List II

List I Test	List II Functional group / Class of Compound
(A) Molisch's Test	(I) Peptide
(B) Biuret Test	(II) Carbohydrate
(C) Carbylamine Test	(III) Primary amine
(D) Schiff's Test	(IV) Aldehyde

Choose the correct answer from the options given below:

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

Q. 20. How can photochemical smog be controlled?

- (1) By using catalytic converters in the automobiles/industry.
 (2) By complete combustion of fuel.
 (3) By using tall chimneys.
 (4) By using catalyst.

Section B

Q. 21. (i) $X(g) \rightleftharpoons Y(g) + Z(g)$ $K_{p1} = 3$

(ii) $A(g) \rightleftharpoons 2 B(g)$ $K_{p2} = 1$

If the degree of dissociation and initial concentration of both the reactants X(g) and A(g) are equal, then the ratio of the total pressure at

equilibrium $\left(\frac{p_1}{p_2}\right)$ is equal to $x : 1$. The value of x

is ____ (Nearest integer)

Q. 22. Electrons in a cathode ray tube have been emitted with a velocity of 1000 m s^{-1} . The number of following statements which is/are true about the emitted radiation is

Given: $h = 6 \times 10^{-34} \text{ Js}$, $m_e = 9 \times 10^{-31} \text{ kg}$.

- (A) The deBroglie wavelength of the electron emitted is 666.67 nm.
 (B) The characteristic of electrons emitted depend upon the material of the electrodes of the cathode ray tube.
 (C) The cathode rays start from cathode and move towards anode.
 (D) The nature of the emitted electrons depends on the nature of the gas present in cathode ray tube.

Q. 23. A and B are two substances undergoing radioactive decay in a container.

The half life of A is 15 min and that of B is 5 min. If the initial concentration of B is 4 times that of A and they both start decaying at the same time, how much time will it take for the concentration of both of them to be same? _____ min.

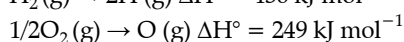
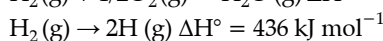
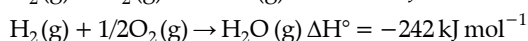
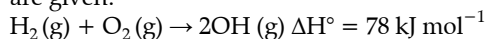
Q. 24. Sum of oxidation states of bromine in bromic acid and perbromic acid is

Q. 25. 25 mL of an aqueous solution of KCl was found to require 20 mL of 1M AgNO_3 solution when titrated using K_2CrO_4 as an indicator. What is the depression in freezing point of KCl solutions of the given concentration? _____ (Nearest integer). (Given: $K_f = 2.0 \text{ K kg mol}^{-1}$)

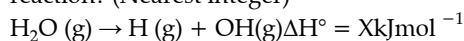
Assume:

- 1) 100% ionization and
 2) density of the aqueous solution as 1 g mL^{-1}

Q. 26. At 25°C , the enthalpy of the following processes are given:



What would be the value of X for the following reaction? (Nearest integer)



- Q. 27. At what pH, given half cell MnO_4^- (0.1M) | Mn^{2+} (0.001M) will have electrode potential of 1.282 V? (Nearest Integer)

$$\text{Given } E^\circ_{\text{MnO}_4^-, \text{Mn}^{2+}} = 1.54\text{V}, \frac{2.303RT}{F} = 0.059\text{V}$$

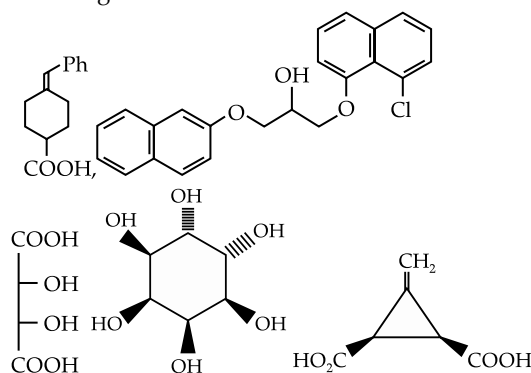
- Q. 28. The density of 3M solution of NaCl is 1.0 g mL^{-1} . Molality of the solution is $\times 10^{-2} \text{ m}$. (Nearest integer).

Given: Molar mass of Na and Cl is 23 and 35.5 g mol^{-1} respectively.

- Q. 29. Number of isomeric compounds with molecular formula $\text{C}_9\text{H}_{10}\text{O}$ which (i) do not dissolve in NaOH (ii) do not dissolve in HCl. (iii) do not give orange

precipitate with 2,4DNP (iv) on hydrogenation give identical compound with molecular formula $\text{C}_9\text{H}_{12}\text{O}$ is

- Q. 30. The total number of chiral compound/s from the following is



Answer Key

Q. No.	Answer	Topic Name	Chapter Name
1	(1)	Separation technique	General organic chemistry
2	(2)	Qualitative analysis	Qualitative analysis
3	(4)	Properties of hydrogen	Hydrogen
4	(4)	Resonating structure	Chemical bonding
5	(3)	Classification of drugs	Chemistry in everyday life
6	(4)	Mixed organic reaction	Halo arenes and Halo alkane
7	(2)	Properties of hydrocarbons	Hydrocarbon
8	(3)	Properties of enol	Alcohol phenol and ether
9	(1)	Compounds of d block	d and f block
10	(4)	Compounds of s block elements	s block
11	(2)	Pyranose form of sugar	Biomolecules
12	(3)	Crystal field splitting	Coordination chemistry
13	(2)	Example of double salt	Coordination chemistry
14	(4)	Dehydration of alcohol	Alcohol phenol and ether
15	(1)	Properties of chlorine	p block
16	(1)	Properties of beryllium	s block
17	(1)	Defects in solids	Solid state
18	(3)	Ellingham. diagram	Metallurgy
19	(1)	Critical constant of gases	States of matter
20	(2)	Types of test for identification of functional group	Practical organic chemistry
21	[1]	Photochemical smog	Environmental chemistry
22	[12]	Relationship between degree of dissociation and concentration	Chemical equilibrium
23	[2]	Mixed concept of structure of atom	Structure of atom
24	[15]	Calculation of time by the help of concentration	Chemical kinetics
25	[12]	Calculation of oxidation state	Redox reaction
26	[3]	Depression in freezing point	Liquid solution
27	[499]	Calculation of enthalpy change	Thermodynamics
28	[3]	Calculation of pH in electrochemical cell	Electro chemistry
29	[364]	Calculation of molality	Liquid solution
30	[2]	Calculation of number of isomers	General organic chemistry

Solutions

Section A

1. Option (2) is correct.

The reaction of FeCl_3 with potassium hexacyanidoferrate(II) $\text{K}_4[\text{Fe}(\text{CN})_6]$, gives Iron(III) hexacyanidoferrate(II) which has Prussian blue color.

$$4\text{FeCl}_3 + 3\text{K}_4[\text{Fe}(\text{CN})_6] \rightarrow 12\text{KCl} + \text{Fe}_4[\text{Fe}(\text{CN})_6]_3$$

Prussian blue

2. Option (4) is correct.

Hydrogen is an environments friendly feed because on combustion it produces water

Also its atomic number is 1 and it is a very light element.

3. Option (4) is correct.

The resonating structures are the hypothetical structures whereas the resonance hybrid is the real structure of the molecule. Thus CO_3^{2-} has a single structure

4. Option (3) is correct.

Tranquilizers \rightarrow Anti-depressants

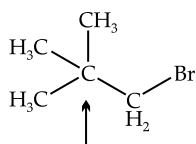
Aspirin \rightarrow Anti-blood clotting,

Anti-biotic \rightarrow Salvarsan

Anti-septic \rightarrow Soframycin

5. Option (4) is correct.

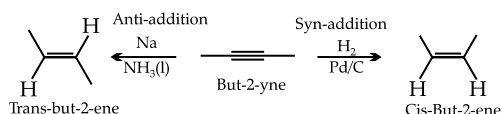
The neo-pentyl bromide does not undergo an elimination reaction in presence of alcoholic KOH because of the absence of β -hydrogen.



No Hydrogen on β -carbon.
(Neopentyl Bromide)

6. Option (2) is correct.

In presence of liquid ammonia, But-2-yne is hydrogenated to form trans-but-2-ene by anti-addition (Birch Reduction) whereas catalytic hydrogenation produces cis-but-2-ene by syn-addition.



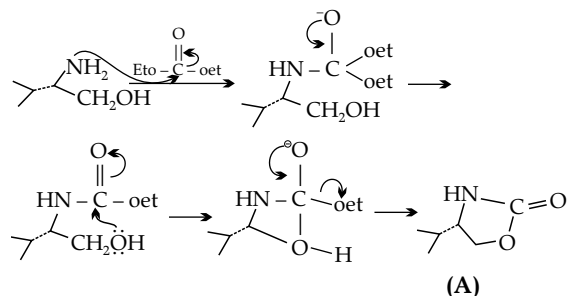
Cis But-2-ene is more polar that is why its solubility is more than trans But-2-ene: statement (A) is correct.

Compound (A) has a lower melting point than (B) because the trans isomer is symmetrical and fits in to crystal lattice. (A) is more polar so it has higher boiling then trans from statement (B) is correct.

Cis isomer is not symmetrical thus it will have not dipole moment: It is more polar. Statement (c) is incorrect.

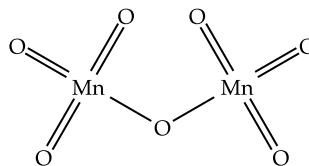
Trans isomer (B) is more stable than isomer (A): It will be more reactive and will add easily to A than B: Statement (D) is incorrect.

7. Option (3) is correct.



8. Option (1) is correct.

In Mn_2O_7 , there is Mn-O double bond forming a tetrahedral structure and an Mn-O-Mn bridge.



The oxidation state of Mn is +7 in Mn_2O_7 .

9. Option (4) is correct.

Slaked Lime $\rightarrow \text{Ca}(\text{OH})_2$

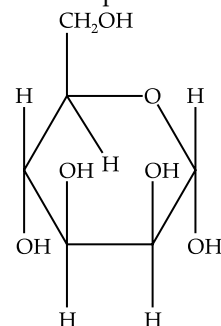
Dead Burnt Plaster $\rightarrow \text{CaSO}_4$

Caustic Soda $\rightarrow \text{NaOH}$

Washing Soda $\rightarrow \text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$

10. Option (2) is correct.

The $-\text{OH}$ groups present on LHS of the Fischer projection are above the plane of the ring.



11. Option (3) is correct.

The crystal field splitting of orbitals depends on the oxidation state of the metal ion and the strength of the ligands. Higher oxidation states of the metal ion

and higher strength of the ligands cause the greater splitting of d-orbitals. In the given complex, CN^- is the strongest ligand. Thus, the maximum splitting of orbitals takes place in $[\text{Fe}(\text{CN})_6]^{3-}$.

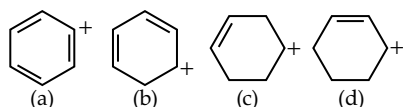
12. Option (2) is correct.

$\text{FeSO}_4 \cdot (\text{NH}_4)_2 \text{SO}_4 \cdot 6\text{H}_2\text{O}$ -mohr salt $\text{K}_2\text{SO}_4 \cdot \text{Al}_4(\text{SO}_4)_3 \cdot 24\text{H}_2\text{O}$ -Potash alum.

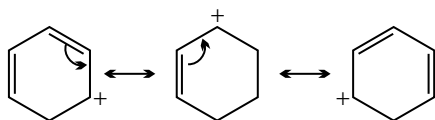
The ions of double salts lose their identity in a solution. These compounds are in the solid state but when dissolved in water, their constituent ions, however, their individual properties are retained.

13. Option (4) is correct.

Dehydration of alcohol is directly proportion to the stability of carbocation formed.



Carbocation (b) is stabilised due to resonance, while (c) should be as:



14. Option (1) is correct.

When chlorine reacts with oxygen, it can form various oxides such as ClO , ClO_2 , Cl_2O . These oxides are highly unstable and have a tendency to explode. Statement (I) is true.

Chemical reactivity of an element can be determined by its reaction with oxygen and halogens. These elements which readily react with oxygen and halogens, are considered highly reactive whereas those which don't react easily are considered to be less reactive. Thus statement (II) is also true.

15. Option (1) is correct.

(A) BeO is amphoteric i.e. it shows both acidic and basic character.

(B) BeCO_3 is kept in the atmosphere of CO_2 because it is thermally less stable.

(C) Due to its small size and high hydration enthalpy, BeSO_4 is readily soluble in water.

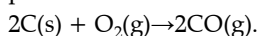
(D) The anomalous behavior of Be is due to its small size, high ionization enthalpy, and absence of d-orbitals in its valence shell.

16. Option (1) is correct.

$\text{A}_{0.95}\text{O}$ has a metal deficiency defect due to the absence of metal ions where the metal ion (A^{2+}) is absent from its lattice site. The electrical neutrality is maintained by the presence of metal ions in a higher oxidation state (A^{3+}). Where 3A^{2+} are replaced by A^{3+} and these one vacant site per pair of A^{3+} is created.

17. Option (3) is correct.

The oxidation of carbon to carbon monoxide takes place as:



The oxidation reaction is an exothermic reaction with negative ΔH and with the temperature rise, becomes positive as the gaseous product is obtained which makes ΔG negative. Thus, the decomposition of CO is not favored at a higher temperature.

18. Option (1) is correct.

The adsorption depends on the magnitude of the intermolecular forces. A gas with high intermolecular forces gets adsorbed readily. Amongst those listed above, Kr has the highest magnitude of intermolecular forces and thus gets adsorbed more on charcoal.

19. Option (2) is correct.

Molisch's Test \rightarrow Carbohydrate detection.

Biuret Test \rightarrow Peptide detection.

Carbyl amine Test \rightarrow Primary amine functional group detection.

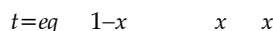
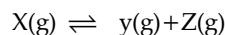
Schiff's Test \rightarrow Aldehyde group detection.

20. Option (1) is correct.

With the use of catalytic converters in the engine of automobile vehicles, the release of oxides of nitrogen and hydrocarbons can be prevented which can control the formation of photochemical smog.

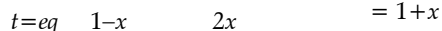
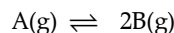
Section B

21. The correct answer is [12].



$$\text{total moles} = (1+x)$$

$$P_x \frac{1-x}{1+x} \times P, P_y \frac{x}{1+x} \times P, P_z = \frac{x \times P_1}{1+x}$$



$$\text{Partial Pressure } P_A = \frac{1-x}{1+x} \times P, P_B = \frac{2x}{1+x} \times P_2$$

$$K_{P_1} = \frac{\left(\frac{xP_1}{1+x}\right)\left(\frac{xP_1}{1+x}\right)}{\left(\frac{1-x}{1+x}P_1\right)}$$

$$K_{P_2} = \frac{(2x)^2 \times P_2^2}{\left(\frac{1-x}{1+x}\right)P_2}$$

$$\frac{K_{P_1}}{K_{P_2}} = \frac{3}{1} = \frac{P_1}{4P_2}$$

$$\frac{P_1}{P_2} = \frac{12}{1}$$

Thus the value of x is 12.

22. The correct answer is [2].

$$(A) \lambda = \frac{h}{mv} = \frac{6 \times 10^{-34}}{9 \times 10^{-31} \times 1000} = 666.7 \times 10^{-9} m$$

$$(C) = 666.67 \text{ nm}$$

The cathode ray starts from cathode and moves towards anode.

23. The correct answer is [15].

The concentration of B is four times of A.

$$\therefore [B] = 4[A]$$

After 15 min, the concentration of A will be:

$$[A]_{\text{final}} = \frac{[A]}{2}$$

The concentration of B will be

$$[B]_{\text{final}} = \frac{4[A]}{2} = 2[A] \text{ (after 5 minutes)}$$

$$[B]_{\text{final}} = \frac{2[A]}{2} = [A] \text{ (after 5 minutes i.e., 10 min)}$$

$$[B]_{\text{final}} = \frac{[A]}{2} \text{ (after 5 minutes i.e., 15 min)}$$

Total time = 5 + 5 + 5 = 15 min

24. The correct answer is [12].

Bromic acid is HBrO_3 . The bromine is in +5 oxidation state. Perbromic acid is HBrO_4 . The oxidation state of bromine is +7. The summation is (7+5) = 12

25. The correct answer is [3].

Millimoles of KCl = Millimoles of AgNO_3

$$\therefore 25 \text{ mL} \times M = 20 \text{ mL} \times 1$$

$$\therefore M = 0.8$$

$$\Delta T_f = i \times K_f \times \text{Molality}$$

$$\Delta T_f = 2 \times 2 \times 0.8 = 3.2 \approx 3 \text{ (For complete ionization, } i=2, d=1 \text{ g/mL, Molarity = molality)}$$

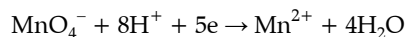
26. The correct answer is [499].

Taking arithmetic mean of (i) and (iii) and eliminating (ii) from it we get the desired equation.

$$\Delta_r H = \frac{78 + 436}{2} - (-242) = 499 \text{ kJ}$$

27. The correct answer is [3].

The reduction reaction of MnO_4^- in acidic medium is:



As per Nernst Equation:

$$E_{\text{cell}} = E_{\text{cell}}^\circ - \frac{0.059}{n} \log \frac{[\text{Mn}^{2+}]}{[\text{MnO}_4^-][\text{H}^+]^8}$$

$$1.282 = 1.54 - \frac{0.059}{5} \log \frac{[10^{-3}]}{[10^{-1}][\text{H}^+]^8}$$

$$\therefore \text{pH} = 2.98 \approx 3$$

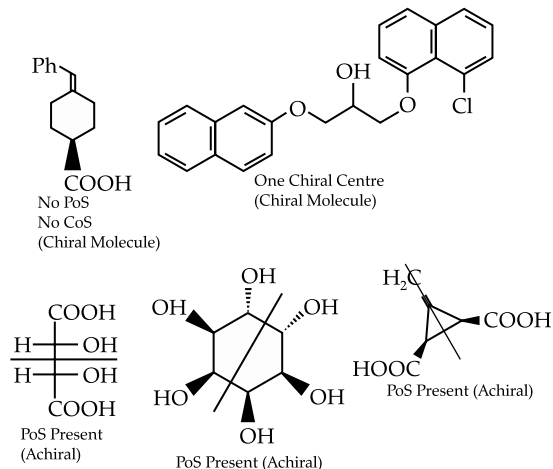
28. The correct answer is [364].

$$\begin{aligned} \text{Molality} &= \frac{(\text{Molarity}) \times 1000}{(d \times V) - (M \times \text{Mol. Mass})} \\ &= \frac{3 \times 1000}{(1000 \times 1) - (3 \times 58.5)} \\ &= 3.64 = 364 \times 10^{-2} \end{aligned}$$

29. The correct answer is [2].

- Compound does not get dissolved in NaOH nor in HCl . Hence, there is no acidic or basic group respectively present in the compound.
- Compound does not form precipitates with 2,4-DNP which indicates the absence of the carbonyl group.
- The compound $\text{C}_9\text{H}_{10}\text{O}$ has D.U = 5 which on hydrogenation produces $\text{C}_9\text{H}_{12}\text{O}$ with D.U = 4. Hence, there is one C-C double bond in the chain that gets hydrogenated. The presence of double bond can have the possible two isomers cis- and trans-isomers.

30. The correct answer is [2].



Where POS = Plane of symmetry.

COS = Center of symmetry.