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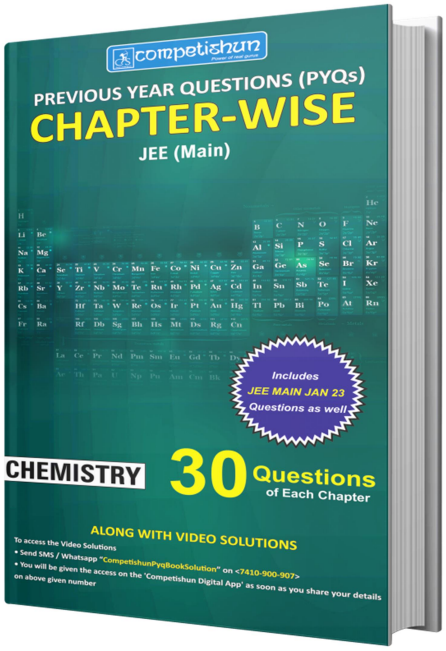
CHEMISTRY

Important Previous Year Questions (PYQ's)

CONTENT



CONTENT SOLUTIONS

CHEMISTRY

JEE MAIN PREVIOUS YEARS QUESTIONS – 2018-2023

Chapter Name :- MOLE CONCEPT

(Important Questions Only)

1. $N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$

$20\ g \quad 5\ g$

Consider the above reaction, the limiting reagent of the reaction and number of moles of NH_3 formed respectively are: **[JEE-Main 29-7-22_S1]**

(1) H_2, 1.42 moles (2) H_2, 0.71 moles (3) N_2, 1.42 moles (4) N_2, 0.71 moles

2. $C(s) + O_2(g) \rightarrow CO_2(g) + 400\ kJ$

$C(s) + \frac{1}{2} O_2(g) \rightarrow CO(g) + 100\ kJ$

When coal of purity 60% is allowed to burn in presence of insufficient oxygen, 60% of carbon is converted into 'CO' and the remaining is converted into 'CO_2'. The heat generated when 0.6 kg of coal is burnt is _____. **[JEE-Main 29-7-22_S2]**

(1)1600 kJ (2) 3200kJ (3) 4400 kJ (4) 6600 kJ

3. SO_2Cl_2 on reaction with excess of water results into acidic mixture

$SO_2Cl_2 + 2H_2O \rightarrow H_2SO_4 + 2HCl$

16 moles of NaOH is required for the complete neutralisation of the resultant acidic mixture. The number of moles of SO_2Cl_2 used is : **[JEE-Main 25-7-22_S1]**

(1) 16 (2) 8 (3) 4 (4) 2

4. Production of iron in blast furnace follows the following equation

$Fe_3O_4(s) + 4CO(g) \rightarrow 3Fe(l) + 4CO_2(g)$

when 4.640 kg of Fe_3O_4 and 2.520 kg of CO are allowed to react then the amount of iron (in g) produced is :

[Given : Molar Atomic mass (g mol^{-1}): Fe = 56

Molar Atomic mass (g mol^{-1}) : 0 = 16

Molar Atomic mass (g mol^{-1}): = C = 12 **[JEE-Main 29-6-22_S1]**

(1) 1400 (2) 2200 (3) 3360 (4) 4200

5. A commercially sold conc. HCl is 35% HCl by mass. If the density of this commercial acid is 1.46 g/mL, the molarity of this solution is :

(Atomic mass : Cl = 35.5 amu, H = 1 amu) **[JEE-Main 26-6-22_S1]**

(1) 10.2 M (2) 12.5 M (3) 14.0 M (4) 18.2 M

6. What is the mass ratio of ethylene glycol ($C_2H_6O_2$, molar mass = 62 g/mol) required for making 500 g of 0.25 molal aqueous solution and 250 mL of 0.25 molar aqueous solution ?

[JEE-Main 25-1-23_S2]

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

7. The molarity of HNO_3 in a sample which has density 1.4 g/mL and mass percentage of 63% is _____. (Molecular Weight of HNO_3 = 63) **[JEE-Main 9-1-20_S2]**

8. The mass of ammonia in grams produced when 2.8 kg of dinitrogen quantitatively reacts with 1 kg of dihydrogen is _____. **[JEE-Main 4-9-20_S2]**

9. An aqueous KCl solution of density 1.20 g mL^{-1} has a molality of 3.30 mol kg^{-1}. The molarity of the solution in mol L^{-1} is _____ (Nearest integer) [Molar mass of KCl = 74.5]

[JEE-Main 26-8-21_S2]

10. Sodium oxide reacts with water to produce sodium hydroxide. 20.0 g of sodium oxide is dissolved in 500 mL of water. Neglecting the change in volume, the concentration of the resulting NaOH solution is ____ × 10^{-1} M. (Nearest integer)

[Atomic mass : Na = 23.0, O = 16.0, H = 1.0] **[JEE-Main_31-8-21_S2]**

11. The molarity of the solution prepared by dissolving 6.3 g of oxalic acid ($H_2C_2O_4.2H_2O$) in 250 mL of water in mol L^{-1} is x × 10^{-2}. The value of x is _____. (Nearest integer)

[Atomic mass : H : 1.0, C : 12.0, O : 16.0] **[JEE-Main 31-8-21_S2]**

12. The density of NaOH solution is 1.2 g cm^{-3}. The molality of this solution is _____ m.

(Round off to the Nearest Integer)

[Use : Atomic masses : Na : 23.0 u O : 16.0 u H : 1.0 u Density of H_2O : 1.0 g cm^{-3}]

[JEE-Main_27-7-21_S2]

13. If 80 g of copper sulphate $CuSO_4 \cdot 5H_2O$ is dissolved in deionised water to make 5 L of solution. The concentration of the copper sulphate solution is x × 10^{-3} mol L^{-1}. The value of x is _____.

[Atomic masses Cu : 63.54 u, S : 32 u, O : 16 u, H : 1 u] **[JEE-Main_1-9-21_S2]**

14. 100 mL of Na_3PO_4 solution contains 3.45 g of sodium. The molarity of the solution is ___×10^{-2} mol L^{-1}. (Nearest integer) [Atomic Masses - Na : 23.0 u, O : 16.0 u, P : 31.0 u] **[JEE-Main 26-8-21_S2]**

15. 4.5 g of compound A (MW = 90) was used to make 250 mL of its aqueous solution. The molarity of the solution in M is x × 10^{-1}. The value of x is _____. (Rounded off to the nearest integer)

[JEE-Main 24-2-21_S2]

16. If the concentration of glucose ($C_6H_{12}O_6$) in blood is 0.72 g L^{-1}, the molarity of glucose in blood is _____ × 10^{-3}M. (Nearest integer)

[Given : Atomic mass of C = 12, H = 1, O = 16 u] **[JEE-Main_22-7-21_S2]**

17. A 1.84 mg sample of polyhydric alcoholic compound 'X' of molar mass 92.0 g/mol gave 1.344 mL of H_2 gas at STP. The number of alcoholic hydrogens present in compound 'X' is ____.

[JEE-Main 29-7-22_S2]

18. In the given reaction,

$$X + Y + 3Z \rightleftarrows XYZ_3$$

if one mole of each of X and Y with 0.05 mol of Z gives compound XYZ_3. (Given : Atomic masses of X, Y and Z are 10, 20 and 30 amu, respectively). The yield of XYZ_3 is _____ g. (Nearest integer)

[JEE-Main 28-7-22_S1]

19. On complete combustion of 0.492 g of an organic compound containing C, H and O, 0.7938 g of CO_2 and 0.4428 g of H_2O was produced. The % composition of oxygen in the compound is _____.

[JEE-Main 28-7-22_S1]

20. 2L of 0.2 M H_2SO_4 is reacted with 2L of 0.1 M NaOH solution, the molarity of the resulting product Na_2SO_4 in the solution is ____ millimolar. (Nearest integer). **[JEE-Main 28-7-22_S2]**

21. When 800 mL of 0.5 M nitric acid is heated in a beaker, its volume is reduced to half and 11.5 g of nitric acid is evaporated. The molarity of the remaining nitric acid solution is x × 10^{-2} M. (Nearest Integer) (Molar mass of nitric acid is 63 g mol^{-1}) **[JEE-Main 26-7-22_S1]**

22. In the estimation of bromine, 0.5 g of an organic compound gave 0.40 g of silver bromide. The percentage of bromine in the given compound is _____% (nearest integer)
(Relative atomic masses of Ag and Br are 108u and 80u, respectively). **[JEE-Main 28-6-22_S1]**

23. On complete combustion 0.30 g of an organic compound gave 0.20 g of carbon dioxide and 0.10 g of water. The percentage of carbon in the given organic compound is _____ (Nearest Integer)

[JEE-Main 26-6-22_S1]

24. 0.25 g of an organic compound containing chlorine gave 0.40 g of silver chloride in Carius estimation. The percentage of chlorine present in the compound is _____. [in nearest integer]
(Given: Molar mass of Ag is 108 g mol^{-1} and that of Cl is 35.5 g mol^{-1}) **[JEE-Main 27-6-22_S2]**

25. The complete combustion of 0.492 g of an organic compound containing 'C', 'H' and 'O' gives 0.793g of CO_2 and 0.442 g of H_2O. The percentage of oxygen composition in the organic compound is _____. (nearest integer) **[JEE-Main 28-6-22_S2]**

26. A protein 'A' contains 0.30% of glycine (molecular weight 75). The minimum molar mass of the protein 'A' is_____ × 10^3 g mol^{-1} [nearest integer] **[JEE-Main 25-6-22_S2]**

27. The number of N atoms is 681 g of $C_7H_5N_3O_6$ is x × 10^{21}. The value of x is __ (N_A = 6.02 × 10^{23} mol^{-1}) (Nearest Integer) **[JEE-Main 25-6-22_S1]**

28. 1 L aqueous solution of H_2SO_4 contains 0.02 mmol H_2SO_4. 50% of this solution is diluted with deionized water to give 1 L solution (A). In solution (A), 0.01 m mol of H_2SO_4 are added. Total mmoles of H_2SO_4 in the final solution is _____ × 10^3 mmoles. **[JEE-Main 25-6-22_S1]**

29. When 0.01 mol of an organic compound containing 60% carbon was burnt completely, 4.4 g of CO_2 was produced. The molar mass of compound is _____ g mol^{-1} (Nearest integer) **[JEE-Main 29-1-23_S2]**

30. Number of hydrogen atoms per molecule of a hydrocarbon A having 85.8% carbon is _____
(Given : Molar mass of A = 84 g mol^{-1}) **[JEE-Main 25-1-23_S2]**

ANSWERKEY_MOLE CONCEPT

1.	**(3)**	**2.**	**(4)**	**3.**	**(3)**	**4.**	**(3)**	**5.**	**(3)**
6.	**(3)**	**7.**	**14**	**8.**	**3400**	**9.**	**3**	**10.**	**13**
11.	**20**	**12.**	**5**	**13.**	**64**	**14.**	**50**	**15.**	**2**
16.	**4**	**17.**	**3**	**18.**	**2**	**19.**	**46**	**20.**	**25**
21.	**54**	**22.**	**34**	**23.**	**18**	**24.**	**40**	**25.**	**46**
26.	**25**	**27.**	**5418**	**28.**	**0**	**29.**	**200**	**30.**	**12**

CHEMISTRY

JEE MAIN PREVIOUS YEARS QUESTIONS – 2018-2023

Chapter Name :- SOLID STATE + ATOMIC STRUCTURE

(Important Questions Only)

1. The one that is extensively used as a piezoelectric material is **[JEE-Main 9-1-19_S1]**

(1) Tridymite (2) Mica (3) Quartz (4) Amorphous silica

2. At 100°C, copper (Cu) has FCC unit cell structure with cell edge length of x Å. What is the approximate density of Cu (in g cm^{-3}) at this temperature?

[Atomic Mass of Cu = 63.55 u] **[JEE-Main 9-1-19_S2]**

(1) $\frac{422}{x^3}$ (2) $\frac{205}{x^3}$ (3) $\frac{105}{x^3}$ (4) $\frac{211}{x^3}$

3. A compound of formula A_2B_3 has the hcp lattice. Which atom forms the hcp lattice and what fraction of tetrahedral voids is occupied by the other atoms: **[JEE-Main 10-1-19_S2]**

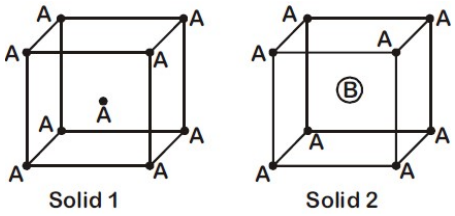
(1) hcp lattice - B, $\frac{1}{3}$ Tetrahedral voids - A (2) hcp lattice - A, $\frac{2}{3}$ Tetrahedral voids - B

(3) hcp lattice - B, $\frac{2}{3}$ Tetrahedral voids - A (4) hcp lattice - A, $\frac{1}{3}$ Tetrahedral voids - B

4. The radius of the largest sphere which fits properly at the centre of the edge of a body centred cubic unit cell is : (Edge length is represented by 'a') **[JEE-Main 11-1-19_S2]**

(1) 0.027 a (2) 0.047 a (3) 0.067 a (4) 0.134 a

5. Consider the bcc unit cells of the solids 1 and 2 with the position of atoms as shown below. The radius of atom B is twice that of atom A. The unit cell edge length is 50% more in solid 2 than in 1. What is the approximate packing efficiency in solid 2? **[JEE-Main 8-4-19_S2]**



(1) 45% (2) 65% (3) 75% (4) 90%

6. Which of the following compounds is likely to show both Frenkel and Schottky defects in its crystalline form ? **[JEE-Main 8-1-20_S2]**

(1) ZnS (2) CsCl (3) AgBr (4) KBr

7. In a binary compound, atoms of element A form a hcp structure and those of element M occupy 2/3 of the tetrahedral voids of the hcp structure. The formula of the binary compound is : **[JEE-Main_18-3-21_S1]**

(1) M_2A_3 (2) M_4A_3 (3) M_4A (4) MA_3

8. Given below are two statements. One is labelled as Assertion A and the other is labelled as Reason R. Assertion A : Sharp glass edge becomes smooth on heating it upto its melting point.
Reason R : The viscosity of glass decreases on melting.
Choose the most appropriate answer from the options given below. **[JEE-Main 20-7-21_S1]**

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

9. The parameters of the unit cell of a substance are a = 2.5, b = 3.0, c = 4.0, $\alpha = 90°$, $\beta = 120°$ $\gamma = 90°$. The crystal system of the substance is : **[JEE-Main 27-7-21_S1]**

(1) Hexagonal (2) Orthorhombic (3) Monoclinic (4) Triclinic

10. Given below are two statements.
Statement I: Frenkel defects are vacancy as well as interstitial defects.
Statement II: Frenkel defect leads to colour in ionic solids due to presence of F-centres. Choose the most appropriate answer for the statements from the options given below :**[JEE-Main 26-8-21_S1]**

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

11. The incorrect statement about the imperfections in solids is : **[JEE-Main 28-6-22_S1]**

(1) Schottky defect decreases the density of the substance.
(2) Interstitial defect increases the density of the substance.
(3) Frenkel defect does not alter the density of the substance.
(4) Vacancy defect increases the density of the substance.

12. The ratio of the shortest wavelength of two spectral series of hydrogen spectrum is found to be about 9. The spectral series are : **[JEE-Main 10-4-19_S1]**

(1) Paschen and Pfund (2) Brackett and Pfund
(3) Lyman and Paschen (4) Balmer and Brackett

13. The ground state energy of hydrogen atom is –13.6 eV. The energy of second excited state of He^+ ion in eV is : **[JEE-Main 10-1-19_S1]**

(1) –27.2 (2) –6.04 (3) –54.4 (4) –3.4

14. The isoelectronic set of ions is : **[JEE-Main 10-4-19_S1]**

(1) N^{3-}, Li^{+}, Mg^{2+} and O^{2-} (2) Li^{+}, Na^{+}, O^{2-} and F^{-}

(3) N^{3-}, O^{2-}, F^{-} and Na^{+} (4) F^{-}, Li^{+}, Na^{+} and Mg^{2+}

15. The de Broglie wavelength of an electron in the 4^{th} Bohr orbit is **[JEE-Main 9-1-20_S1]**

(1) $4\pi a_0$ (2) $6\pi a_0$ (3) $8\pi a_0$ (4) $2\pi a_0$

16. Among the following, number of metal/s which can be used as electrodes in the photoelectric cell is _____ (Integer answer) **[JEE-Main 25-2-21_S2]**

(1) Li (2) Na (3) Rb (4) Cs

17. The spin only magnetic moments (in BM) for free Ti^{3+}, V^{2+} and Sc^{3+} ions respectively are

(At.No. Sc : 21, Ti : 22, V : 23) **[JEE-Main 25-7-21_S2]**

(1) 3.87, 1.73, 0 (2) 1.73, 3.87, 0 (3) 1.73, 0, 3.87 (4) 0, 3.87, 1.73

18. Which of the following statements are correct ?

(A) The electronic configuration of Cr is [Ar] $3d^5$ $4s^1$.

(B) The magnetic quantum number may have a negative value.

(C) In the ground state of an atom, the orbitals are filled in order of their increasing energies.

(D) The total number of nodes are given by n – 2 .

Choose the most appropriate answer from the options given below : **[JEE-Main 29-6-22_S2]**

(1) (A), (C) and (D) only (2) (A) and (B) only

(3) (A) and (C) only (4) (A), (B) and (C) only

19. Given below are the quantum numbers for 4 electrons.

A. n = 3, l = 2, m_ℓ = 1, m_s = +1/2

B. n = 4, l = 1, m_ℓ = 0, m_s = +1/2

C. n = 4, l = 2, m_ℓ = -2, m_s = -1/2

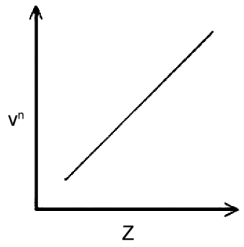
D. n = 3, l = 1, m_ℓ = -1, m_s = +1/2

The correct order of increasing energy is : **[JEE-Main 29-7-22_S2]**

(1) D < B < A < C (2) D < A < B < C (3) B < D < A < C (4) B < D < C < A

20. It is observed that characteristic X-ray spectra of elements show regularity. When frequency to the power 'n' i.e. ν^n of X-rays emitted is plotted against atomic number 'Z', following graph is obtained.

[JEE-Main_24-1-23_S1]



The value of 'n' is

(1) 1 (2) 2 (3) $\frac{1}{2}$ (4) 3

21. The shortest wavelength of hydrogen atom in Lyman series is λ. The longest wavelength in Balmer series of He^+ is **[JEE-Main 29-1-23_S2]**

(1) $\frac{5}{9\lambda}$ (2) $\frac{9\lambda}{5}$ (3) $\frac{36\lambda}{5}$ (4) $\frac{5\lambda}{9}$

22. A certain element crystallises in a bcc lattice of unit cell edge length 27 Å. If the same element under the same conditions crystallises in the fcc lattice, the edge length of the unit cell in Å will be _____. (Round off to the Nearest Integer).

[Assume each lattice point has a single atom]

[Assume $\sqrt{3}$ = 1.73, $\sqrt{2}$ = 1.41] **[JEE-Main 16-3-21_S1]**

23. Ga (atomic mass 70 u) crystallizes in a hexagonal close packed structure. The total number of voids in 0.581 g of Ga is ___ × 10^{21}. (Round off to the Nearest Integer). **[JEE-Main 16-3-21_S2]**

24. The empirical formula for a compound with a cubic close packed arrangement of anions and with cations occupying all the octahedral sites in A_xB. The value of x is _____ (Integer answer)

[JEE-Main 31-8-21_S2]

25. A certain orbital has n = 4 and m_ℓ = –3. The number of radial nodes in this orbital is _____. (Round off to the Nearest Integer). **[JEE-Main 17-3-21_S1]**

26. A 50 watt bulb emits monochromatic red light of wavelength of 795 nm. The number of photons emitted per second by the bulb is x × 10^{20}. The value of x is _____.

[Given : h = 6.63 × 10^{-34} Js and c = 3.0 × 10^8 ms^{-1}] **[JEE-Main 1-9-21_S1]**

27. In a solid AB. A atoms are in ccp arrangement and B atoms occupy all the octahedral sites. If two atoms from the opposite faces are removed, then the resultant stoichiometry of the compound is A_xB_y. The value of x is_____. [nearest integer] **[JEE-Main 26-6-22_S2]**

28. A metal M forms hexagonal close-packed structure. The total number of voids in 0.02 mol of it is _____ × 10^{21} (Nearest integer) **[JEE-Main 29-1-23_S1]**

(Given $N_A = 6.02 \times 10^{23}$)

29. The number of given orbitals which have electron density along the axis is _____

$p_x, p_y, p_z, d_{xy}, d_{yz}, d_{xz}, d_{z^2}, d_{x^2-y^2}$ **[JEE-Main 25-1-23_S2]**

30. Assume that the radius of the first Bohr orbit of hydrogen atom is 0.6 Å. The radius of the third Bohr orbit of He^+ is _____ picometer. (Nearest Integer) **[JEE-Main 29-1-23_S2]**

ANSWERKEY_SOLID STATE + ATOMIC STRUCTURE

1.	**(3)**	**2.**	**(1)**	**3.**	**(1)**	**4.**	**(3)**	**5.**	**(4)**
6.	**(3)**	**7.**	**(2)**	**8.**	**(2)**	**9.**	**(3)**	**10.**	**(3)**
11.	**(4)**	**12.**	**(3)**	**13.**	**(2)**	**14.**	**(3)**	**15.**	**(3)**
16.	**(1)**	**17.**	**(2)**	**18.**	**(4)**	**19.**	**(2)**	**20.**	**(3)**
21.	**(2)**	**22.**	**33**	**23.**	**15**	**24.**	**1**	**25.**	**0**
26.	**2**	**27.**	**3**	**28.**	**36**	**29.**	**5**	**30.**	**270**

CHEMISTRY

JEE MAIN PREVIOUS YEARS QUESTIONS – 2018-2023

Chapter Name :- PERIODIC TABLE

(Important Questions Only)

1. The five successive ionization enthalpies of an element are 800, 2427, 3658, 25024 and 32824 kJ mol^{-1}. The number of valence electrons in the element is **[JEE-Main 3-9-20_S2]**

(1) 3 (2) 4 (3) 2 (4) 5

2. B has a smaller first ionization enthalpy than Be. Consider the following statements.

(I) It is easier to remove 2p electron than 2s electron

(II) 2p electron of B is more shielded from the nucleus by the inner core of electrons than the 2s electrons of Be

(III) 2s electron has more penetration power than 2p electron

(IV) Atomic radius of B is more than Be (atomic number B = 5, Be = 4)

The correct statements are **[JEE-Main 9-1-20_S1]**

(1) (I), (II) and (IV) (2) (I), (III) and (IV) (3) (I), (II) and (III) (4) (II), (III) and (IV)

3. In general the property (magnitudes only) that show an opposite trend in comparison to other properties across a period is **[JEE-Main 2-9-20_S1]**

(1) Electron gain enthalpy (2) Electronegativity

(3) Ionization enthalpy (4) Atomic radius

4. The first ionization energy (in kJ/mol) of Na, Mg, Al and Si respectively, are **[JEE-Main 8-1-20_S1]**

(1) 786, 737, 577, 496 (2) 496, 577, 786, 737

(3) 496, 737, 577, 786 (4) 496, 577, 737, 786

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

Assertion (A) : Metallic character decreases and non-metallic character increases on moving from left to right in a period.

Reason (R) : It is due to increase in ionisation enthalpy and decrease in electron gain enthalpy, when one moves from left to right in a period. In the light of the above statements, choose the most appropriate answer from the options given below : **[JEE-Main 31-8-21_S1]**

(1) (A) is false but (R) is true.

(2) (A) is true but (R) is false

(3) Both (A) and (R) are correct and (R) is the correct explanation of (A)

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

6. The CORRECT order of first ionisation enthalpy is : **[JEE-Main 27-7-21_S2]**

(1) Mg < S < Al < P (2) Mg < Al < S < P (3) Al < Mg < S < P (4) Mg < Al < P < S

7. Identify the element for which electronic configuration in +3 oxidation state is $[Ar]3d^5$: **[JEE-Main 1-9-21_S2]**

(1) Ru (2) Mn (3) Co (4) Fe

8. Chalcogen group elements are : **[JEE-Main 26-8-21_S2]**

(1) Se, Tb and Pu. (2) Se, Te and Po. (3) S, Te and Pm. (4) O, Ti and Po.

9. The correct order of ionic radii for the ions, P^{3-}, S^{2-},Ca^{2+}, K^+, Cl^- is : **[JEE-Main 27-8-21_S2]**

(1) $P^{3-} > S^{2-} > Cl^- > K^+ > Ca^{2+}$ (2) $Cl^- > S^{2-} > P^{3-} > Ca^{2+} > K^+$

(3) $P^{3-} > S^{2-} > Cl^- > Ca^{2+} > K^+$ (4) $K^+ > Ca^{2+} > P^{3-} > S^{2-} > Cl^-$

10. The ionic radii of K^+, Na^+, Al^{3+} and Mg^{2+} are in the order : **[JEE-Main 25-7-21_S1]**

(1) $Na^+ < K^+ < Mg^{2+} < Al^{3+}$ (2) $Al^{3+} < Mg^{2+} < K^+ < Na^+$

(3) $Al^{3+} < Mg^{2+} < Na^+ < K^+$ (4) $K^+ < Al^{3+} < Mg^{2+} < Na^+$

11. The first ionization energy of magnesium is smaller as compared to that of elements X and Y, but higher than that of Z. the elements X, Y and Z, respectively, are : **[JEE-Main 18-3-21_S2]**

(1) chlorine, lithium and sodium (2) argon, lithium and sodium

(3) argon, chlorine and sodium (4) neon, sodium and chlorine

12. The ionic radius of Na^+ ions is 1.02 Å. The ionic radii (in Å) of Mg^{2+} and Al^{3+}, respectively, are- **[JEE-Main 18-3-21_S1]**

(1) 1.05 and 0.99 (2) 0.72 and 0.54 (3) 0.85 and 0.99 (4) 0.68 and 0.72

13. The ionic radii of F^- and O^{2-} respectively are 1.33 Å and 1.4 Å, while the covalent radius of N is 0.74 Å. The correct statement for the ionic radius of N^{3-} from the following is : **[JEE-Main 25-7-21_S2]**

(1) It is smaller than F^- and N

(2) It is bigger than O^{2-} and F^-

(3) It is bigger than F^- and N, but smaller than of O^{2-}

(4) It is smaller than O^{2-} and F^-, but bigger than of N

14. The characteristics of elements X,Y and Z with atomic numbers, respectively, 33, 53 and 83 are : **[JEE-Main 16-3-21_S2]**

(1) X and Y are metalloids and Z is a metal.

(2) X is a metalloid, Y is a non-metal and Z is a metal.

(3) X, Y and Z are metals.

(4) X and Z are non-metals and Y is a metalloid

15. The set of elements that differ in mutual relationship from those of the other sets is :

[JEE-Main 17-3-21_S2]

(1) Li – Mg (2) B – Si (3) Be – Al (4) Li – Na

16. The common positive oxidation states for an element with atomic number 24, are :

[JEE-Main 17-3-21_S2]

(1) +2 to +6 (2) +1 and +3 to +6 (3) +1 and +3 (4) +1 to +6

17. The absolute value of the electron gain enthalpy of halogens satisfies: **[JEE-Main 17-3-21_S1]**

(1) I > Br > Cl > F (2) Cl > Br > F > I (3) Cl > F > Br > I (4) F > Cl > Br > I

18. Match List -I with List - II

List - I **Electronic configuration of elements**	**List - II** Δ_i **in kJ mol^{-1}**
(a) $1s^2 2s^2$	(i) 801
(b) $1s^2 2s^2 2p^4$	(ii) 899
(c) $1s^2 2s^2 2p^3$	(iii)1314
(d) $1s^2 2s^2 2p^1$	(iv)1402

Choose the most appropriate answer from the options given below - **[JEE-Main 26-2-21_S1]**

(1) (a) $\rightarrow$ (ii), (b) $\rightarrow$ (iii), (c) $\rightarrow$ (iv),(d) $\rightarrow$ (i)

(2) (a) $\rightarrow$ (i), (b) $\rightarrow$ (iv), (c) $\rightarrow$ (iii),(d) $\rightarrow$ (ii)

(3) (a) $\rightarrow$ (i), (b) $\rightarrow$ (iii), (c) $\rightarrow$ (iv),(d) $\rightarrow$ (ii)

(4) (a) $\rightarrow$ (iv), (b) $\rightarrow$ (i), (c) $\rightarrow$ (ii),(d) $\rightarrow$ (iii)

19. The incorrect statement is **[JEE-Main 27-7-22_S1]**

(1) The first ionization enthalpy of K is less than that of Na and Li

(2) Xe does not have the lowest first ionization enthalpy in its group

(3) The first ionization enthalpy of element with atomic number 37 is lower than that of the element with atomic number 38.

(4) The first ionization enthalpy of Ga is higher than that of the d-block element with atomic number 30.

20. In which of the following pairs, electron gain enthalpies of constituent elements are nearly the same or identical ?

(A) Rb and Cs (B) Na and K (C) Ar and Kr (D) I and At

Choose the correct answer from the options given below : **[JEE-Main 28-7-22_S1]**

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

21. The first ionization enthalpy of Na, Mg and Si, respectively, are: 496, 737 and 786 kJ mol^{-1}. The first ionization enthalpy (kJ mol^{-1}) of Al is: **[JEE-Main 29-7-22_S1]**

(1) 487 (2) 768 (3) 577 (4) 856

22. Element "E" belongs to the period 4 and group 16 of the periodic table. The valence shell electron configuration of the element, which is just above 'E' in the group is **[JEE-Main 28-6-22_S1]**

(1) $3s^2 . 3p^4$ (2) $3d^{10}. 4s^2, 4p^4$ (3) $4d^{10}. 5s^2, 5p^4$ (4) $2s^2, p^4$

23. The first ionization enthalpies of Be, B, N and O follow the order **[JEE-Main 25-7-22_S2]**

(1) O < N < B < Be (2) Be < B < N < O (3) B < Be < N < O (4) B < Be < O < N

24. The IUPAC nomenclature of an element with electronic configuration $[Rn]5f^{14}6d^{1}7s^{2}$ is : **[JEE-Main 25-7-22_S1]**

(1) Unnilbium (2) Unnilunium (3) Unnilquadium (4) Unniltrium

25. Outermost electronic configurations of four elements A, B, C, D are given below:

(A) $3s^2$ (B) $3s^2\ 3P^1$ (C) $3s^2 3p^3$ (D) $3s^2\ 3p^4$

The **correct** order of first ionization enthalpy for them is: **[JEE-Main 27-7-22_S2]**

(1) (A) < (B) < (C) < (D) (2) (B) < (A) < (D) < (C)

(3) (B) < (D) < (A) < (C) (4) (B) < (A) < (C) < (D)

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

Assertion (A): The ionic radii of O^{2-} and Mg^{2+} are same.

Reason (R) : Both O^{2-} and Mg^{2+} are isoelectronic species

In the light of the above statements, choose the correct answer from the options given below **[JEE-Main 27-6-22_S1]**

(1) Both (A) and (R) are true and (R) is the correct explanation of (A)

(2) Both (A) and (R) are true but (R) is not the correct explanation of (A)

(3) (A) is true but (R) is false

(4) (A) is false but (R) is true

27. Given below are two statements:

Statement I : The decrease in first ionization enthalpy from B to Al is much larger than that from Al to Ga.

Statement II : The d orbitals in Ga are completely filled.

In the light of the above statements, choose the most appropriate answer from the options given below **[JEE-Main 29-6-23_S2]**

(1) Statement I is incorrect but statement II is correct.

(2) Both the statements I and II are correct

(3) Statement I is correct but statement II is incorrect

(4) Both the statements I and II are incorrect

28. The set of correct statements is:

(i) Manganese exhibits +7 oxidation state in its oxide.

(ii) Ruthenium and Osmium exhibit +8 oxidation in their oxides.

(iii) Sc shows +4 oxidation state which is oxidizing in nature.

(iv) Cr shows oxidising nature in +6 oxidation state. **[JEE-Main 29-6-23_S2]**

(1) (ii) and (iii) (2) (i), (ii) and (iv) (3) (i) and (iii) (4) (ii), (iii) and (iv)

29. The atomic number of Unnilunium is _____. **[JEE-Main 6-9-20_S2]**

30. The number of 4*f* electrons in the ground state electronic configuration of Gd^{2+} is _____.

[Atomic number of Gd = 64] **[JEE-Main 26-8-21_S1]**

ANSWERKEY_PERIODIC TABLE

1.	**(1)**	**2.**	**(3)**	**3.**	**(4)**	**4.**	**(3)**	**5.**	**(2)**
6.	**(3)**	**7.**	**(4)**	**8.**	**(2)**	**9.**	**(1)**	**10.**	**(3)**
11.	**(3)**	**12.**	**(2)**	**13.**	**(2)**	**14.**	**(2)**	**15.**	**(4)**
16.	**(1)**	**17.**	**(3)**	**18.**	**(1)**	**19.**	**(4)**	**20.**	**(3)**
21.	**54**	**22.**	**34**	**23.**	**18**	**24.**	**40**	**25.**	**46**
26.	**25**	**27.**	**5418**	**28.**	**0**	**29.**	**200**	**30.**	**12**

CHEMISTRY

JEE MAIN PREVIOUS YEARS QUESTIONS – 2018-2023

CHAPTER NAME :- CHEMICAL BONDING

(IMPORTANT QUESTIONS ONLY)

1. According to molecular orbital theory, which of the following will not be a viable molecule? **[JEE-Main 2018_CB_E]**

(1) H_2^- (2) H_2^{2-} (3) He_2^{2+} (4) He_2^+

2. In which of the following processes, the bond order has increased and paramagnetic character has changed to diamagnetic? **[JEE-Main 9-1-19_S2]**

(1) $N_2 \rightarrow N_2^+$ (2) $O_2 \rightarrow O_2^+$ (3) $O_2 \rightarrow O_2^{2-}$ (4) $NO \rightarrow NO^+$

3. Among the following, the molecule expected to be stabilized by anion formation is

C_2, O_2, NO, F_2 **[JEE-Main 9-4-19_S1]**

(1) F_2 (2) NO (3) C_2 (4) O_2

4. The correct statement about ICl_5 and ICl_4^- is : **[JEE-Main 8-4-19_S2]**

(1) ICl_5 is square pyramidal and ICl_4^- is tetrahedral.

(2) both are isostructural.

(3) ICl_5 is square pyramidal and ICl_4^- is square planar.

(4) ICl_5 is trigonal bipyramidal and ICl_4^- is tetrahedral.

5. The shape / structure of $[XeF_5]^-$ and XeO_3F_2, respectively, are **[JEE-Main 2-9-20_S2]**

(1) Pentagonal planar and trigonal bipyramidal

(2) Trigonal bipyramidal and pentagonal planar

(3) Octahedral and square pyramidal

(4) Trigonal bipyramidal and trigonal bipyramidal

6. In which one of the following molecules strongest back donation of an electron pair from halide to boron is expected? **[JEE-Main 27-8-21_S2]**

(1) BCl_3 (2) BF_3 (3) BBr_3 (4) BI_3

7. Match List-I with List-II :

List-I	**List-II**
(Species)	(Hybrid Orbitals)
(a) SF_4	(i) sp^3d^2
(b) IF_5	(ii) d^2sp^3
(c) NO_2^+	(iii) sp^3d
(d) NH_4^+	(iv) sp^3
	(v) sp

Choose the correct answer from the options given below : **[JEE-Main 22-7-21_S2]**

(1) (a)-(i), (b)-(ii), (c)-(v) and (d)-(iii) (2) (a)-(ii), (b)-(i), (c)-(iv) and (d)-(v)

(3) (a)-(iii), (b)-(i), (c)-(v) and (d)-(iv) (4) (a)-(iv), (b)-(iii), (c)-(ii) and (d)-(v)

8. Given below are the statements about diborane

(a) Diborane is prepared by the oxidation of $NaBH_4$ with I_2

(b) Each boron atom is in sp_2 hybridized state

(c) Diborane has one bridged 3 centre-2-electron bond

(d) Diborane is a planar molecule

The option with correct statement(s) is - **[JEE-Main 22-7-21_S1]**

(1) (c) and (d) only (2) (a) only (3) (c) only (4) (a) and (b) only

9. In the following the correct bond order sequence is: **[JEE-Main 25-7-21_S1]**

(1) $O_2^{2-} > O_2^+ > O_2^- > O_2$ (2) $O_2^+ > O_2^- > O_2^{2-} > O_2$

(3) $O_2^+ > O_2 > O_2^- > O_2^{2-}$ (4) $O_2 > O_2^- > O_2^{2-} > O_2^+$

10. Which one of the following species doesn't have a magnetic moment of 1.73 BM, (spin only value) ? **[JEE-Main 20-7-21_S2]**

(1) O_2^+ (2) CuI (3) $[Cu(NH_3)_4]Cl_2$ (4) O_2^-

11. The secondary valency and the number of hydrogen bonded water molecule(s) in $CuSO_4.5H_2O$, respectively, are : **[JEE-Main 18-3-21_S2]**

(1) 6 and 4 (2) 4 and 1 (3) 6 and 5 (4) 5 and 1

12. The oxidation states of nitrogen in NO, NO_2, N_2O and NO_3^- are in the order of : **[JEE-Main 18-3-21_S2]**

(1) $NO_3^- > NO_2 > NO > N_2O$ (2) $NO_2 > NO_3^- > NO > N_2O$

(3) $NO_2 > N_2O > NO > NO_3^-$ (4) $NO > NO_2 > N_2O > NO_3^-$

13. Match List-I with List-II :

List-I	**List-II**
Name of oxo acid	Oxidation state of 'P'
(a) Hypophosphorous acid	(i) +5
(b) Orthophosphoric acid	(ii) +4
(c) Hypophosphoric acid	(iii) +3
(d) Orthophosphorous acid	(iv) +2
	(v) +1

Choose the correct answer from the options given below : **[JEE-Main 16-3-21_S1]**

(1) (a)-(v), (b)-(i), (c)-(ii), (d)-(iii) (2) (a)-(iv), (b)-(i), (c)-(ii), (d)-(iii)

(3) (a)-(iv), (b)-(v), (c)-(ii), (d)-(iii) (4) (a)-(v), (b)-(iv), (c)-(ii), (d)-(iii)

14. Which of the following are isostructural pairs ?

A. SO_4^{2-} and CrO_4^{2-}

B. $SiCl_4$ and $TiCl_4$

C. NH_3 and NO_3^-

D. BCl_3 and $BrCl_3$ **[JEE-Main 24-2-21_S1]**

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

15. The correct shape and I–I–I bond angles respectively in I_3^- ion are :- **[JEE-Main 24-2-21_S2]**

(1) Distorted trigonal planar; 135° and 90° (2) T-shaped; 180° and 90°

(3) Trigonal planar; 120° (4) Linear; 180°

16. Given below are two statements : One is labeled as **Assertion A** and the other is labeled as **Reason R**

Assertion A : Zero orbital overlap is an out of phase overlap.

Reason R : It results due to different orientation/ direction of approach of orbitals. In the light of the above statements. Choose the correct answer from the options given below

[JEE-Main 28-7-22_S2]

(1) Both **A** and **R** are true and **R** is the correct explanation of **A**

(2) Both **A** and **R** are true but **R** is NOT the correct explanation of **A**

(3) **A** is true but **R** is false

(4) **A** is false but **R** is true

17. Which of the following pair of molecules contain odd electron molecule and an expanded octet molecule? **[JEE-Main 29-7-22_S1]**

(1) BCl_3 and SF_6 (2) NO and H_2SO_4 (3) SF_6 and H_2SO_4 (4) BCl_3 and NO

18. Match List - I with List - II.

List - I	**List – II**
(Compound)	**(Shape)**
(A) BrF_5	(I) bent
(B) $[CrF_6]^{3-}$	(II) square pyramidal
(C) O_3	(III) trigonal bipyramidal
(D) PCl_5	(IV) octahedral

Choose the correct answer from the options given below : **[JEE-Main 26-7-22_S1]**

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

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

19. In the structure of SF_4, the lone pair of electrons on S is in. **[JEE-Main 28-6-22_S2]**

(1) equatorial position and there are two lone pair-bond pair repulsions at 90°

(2) equatorial position and there are three lone pair-bond pair repulsions at 90°

(3) axial position and there are three lone pair – bond pair repulsion at 90°.

(4) axial position and there are two lone pair – bond pair repulsion at 90°.

20. Identify the incorrect statement for PCl_5 from the following. **[JEE-Main 27-6-22_S2]**

(1) In this molecule, orbitals of phosphorous are assumed to undergo sp^3d hybridization.

(2) The geometry of PCl_5 is trigonal bipyramidal.

(3) PCl_5 has two axial bonds stronger than three equatorial bonds.

(4) The three equatorial bonds of PCl_5 lie in a plane.

21. Consider the species CH_4, NH_4^+ and BH_4^-. Choose the correct option with respect to the there species: **[JEE-Main 29-6-22_S2]**

(1) They are isoelectronic and only two have tetrahedral structures

(2) They are isoelectronic and all have tetrahedral structures

(3) Only two are isoelectronic and all have tetrahedral structures

(4) Only two are isoelectronic and only two have tetrahedral structures

22. According to MO theory the bond orders for O_2^{2-}, CO and NO^+ respectively, are **[JEE-Main 29-1-23_S2]**

(1) 1, 3 and 3 (2) 1, 3 and 2 (3) 1, 2 and 3 (4) 2, 3 and 3

23. The magnetic behaviour of Li_2O, Na_2O_2 and KO_2, respectively, are **[JEE-Main 29-1-23_S1]**

(1) diamagnetic, paramagnetic and diamagnetic

(2) paramagnetic, paramagnetic and diamagnetic

(3) paramagnetic, diamagnetic and paramagnetic

(4) diamagnetic, diamagnetic and paramagnetic

24. The number of interhalogens from the following having square pyramidal structure is :

ClF_3, IF_7, BrF_5, BrF_3, I_2Cl_6, IF_5, ClF, ClF_5 **[JEE-Main 28-7-22_S1]**

25. Consider, PF_5, BrF_5, PCl_3, SF_6, $[ICl_4]^-$, ClF_3 and IF_5.

Amongst the above molecule(s)/ion(s), the number of molecule(s)/ion(s) having sp^3d^2 hybridisation is ____ . **[JEE-Main 29-7-22_S2]**

26. Amongst the following the number of oxide(s) which are paramagnetic in nature is

Na_2O, KO_2, NO_2, N_2O, ClO_2, NO, SO_2, Cl_2O **[JEE-Main 27-7-22_S1]**

27. The number of paramagnetic species among the following is _____.

B_2, Li_2, C_2, C_2^-, O_2^{2-}, O_2^+; and He_2^+ **[JEE-Main 28-7-22_S1]**

28. The number of molecule(s) or ion(s) from the following having non-planar structure is_____.

NO_3, H_2O_2, BF_3, PCl_3, XeF_4, SF_4, XeO_3, PH_4^+, SO_3, $[Al(OH)_4]^-$ **[JEE-Main 27-7-22_S2]**

29. Amongst BeF_2, BF_3, H_2O, NH_3, CCl_4 and HCl, the number of molecules with non-zero net dipole moment is _____. **[JEE-Main 25-6-22_S2]**

30. Total number of acidic oxides among

N_2O_3, NO_2, N_2O, Cl_2O_7, SO_2, CO, CaO, Na_2O and NO is _____ .

[JEE-Main 29-1-23_S2]

ANSWERKEY_CHEMICAL BONDING

1.	**(2)**	**2.**	**(4)**	**3.**	**(3)**	**4.**	**(3)**	**5.**	**(1)**
6.	**(2)**	**7.**	**(3)**	**8.**	**(2)**	**9.**	**(3)**	**10.**	**(2)**
11.	**(2)**	**12.**	**(1)**	**13.**	**(1)**	**14.**	**(2)**	**15.**	**(4)**
16.	**(1)**	**17.**	**(2)**	**18.**	**(3)**	**19.**	**(1)**	**20.**	**(3)**
21.	**(2)**	**22.**	**(1)**	**23.**	**(4)**	**24.**	**3**	**25.**	**4**
26.	**4**	**27.**	**4**	**28.**	**6**	**29.**	**3**	**30.**	**4**

CHEMISTRY

JEE MAIN PREVIOUS YEARS QUESTIONS – 2018-2023

CHAPTER NAME :- EQUIVALENT CONCEPT + GASEOUS STATE

(IMPORTANT QUESTIONS ONLY)

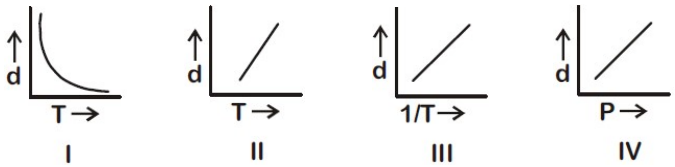
1. Given Gas H_2 CH_4 CO_2 SO_2

Critical Temperature/K 33 190 304 630

On the basis of data given above, predict which of the following gases shows least adsorption on a definite amount of charcoal? **[JEE-Main 12-1-19_S1]**

(1) SO_2 (2) CO_2 (3) CH_4 (4) H_2

2. Which one of the following graphs is not correct for ideal gas?



d = Density, P = Pressure, T = Temperature **[JEE-Main 2-9-20_S1]**

(1) II (2) III (3) I (4) IV

3. The redox reaction among the following is: **[JEE-Main 7-1-20_S2]**

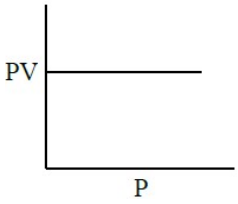
(1) Reaction of $[Co(H_2O)_6]Cl_3$ with $AgNO_3$

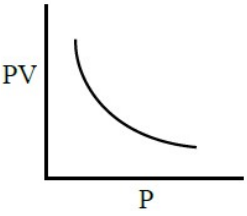
(2) Formation of ozone from atmospheric oxygen in the presence of sunlight.

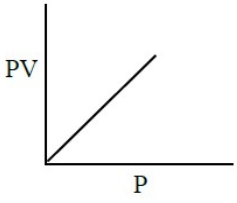
(3) Combination of dinitrogen with dioxygen at 2000 K

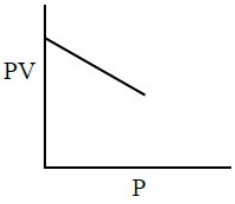
(4) Reaction of H_2SO_4 with NaOH

4. Which one of the following is the correct PV vs P plot at constant temperature for an ideal gas ? (P and V stand for pressure and volume of the gas respectively) **[JEE-Main 31-8-21_S1]**

(1)


(2)


(3)


(4)


5. Given below are two statements : One is labeled as **Assertion A** and the other is labeled as **Reason R**

Assertion A : Permanganate titrations are not performed in presence of hydrochloric acid.

Reason R : Chlorine is formed as a consequence of oxidation of hydrochloric acid.

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

[JEE-Main 28-7-22_S2]

(1) Both **A** and **R** are true and **R** is the correct explanation of **A**

(2) Both **A** and **R** are true but **R** is NOT the correct explanation of **A**

(3) **A** is true but **R** is false

(4) **A** is false but **R** is true

6. In neutral or faintly alkaline medium, $KMnO_4$ being a powerful oxidant can oxidize, thiosulphate almost quantitatively, to sulphate. In this reaction overall change in oxidation state of manganese will be :

[JEE-Main 29-7-22_S1]

(1) 5 (2) 1 (3) 0 (4) 3

7. Which of the given reactions is not an example of disproportionation reaction ?

[JEE-Main 26-7-22_S1]

(1) $2H_2O_2 \rightarrow 2H_2O + O_2$

(2) $2NO2 + H_2O \rightarrow HNO_3 + HNO_2$

(3) $MnO_4^- + 4H^+ + 3e^- \rightarrow MnO_2 + 2H_2O$

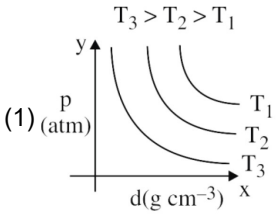
(4) $3MnO_4^{2-} + 4H^+ \rightarrow 2MnO_4^- + MnO_2 + 2H_2O$

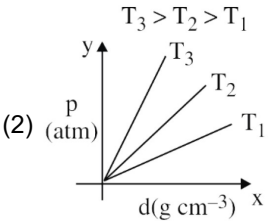
8. In base vs. Acid titration, at the end point methyl orange is present as **[JEE-Main 25-7-22_S2]**

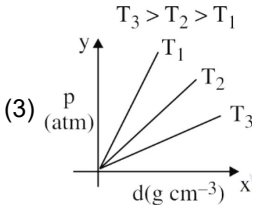
(1) quinonoid form (2) heterocyclic form (3) phenolic form (4) benzenoid form

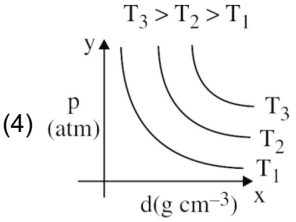
9. Which amongst the given plots is the correct plot for pressure (p) vs density (d) for an ideal gas?

[JEE-Main 27-6-22_S2]

(1)


(2)


(3)


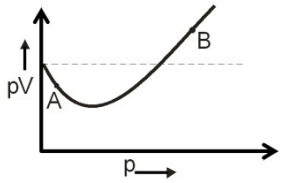
(4)


10. An indicator 'X' is used for studying the effect of variation in concentration of iodide on the rate of reaction of iodide ion with H_2O_2 at room temp. The indicator 'X' forms blue colored complex with compound 'A' present in the solution. The indicator 'X' and compound 'A' respectively are

[JEE-Main 29-1-23_S2]

(1) Starch and iodine
(2) Methyl orange and H_2O_2
(3) Starch and H_2O_2
(4) Methyl orange and iodine

11. For 1 mol of gas, the plot of pV vs p is shown below. p is the pressure and V is the volume of the gas.



What is the value of compressibility factor at point A? **[JEE-Main 29-1-23_S1]**

(1) $1-\frac{a}{RTV}$
(2) $1+\frac{b}{V}$
(3) $1-\frac{b}{V}$
(4) $1+\frac{a}{RTV}$

12. The volume strength of 8.9 M H_2O_2 solution calculated at 273 K and 1 atm is _____. (R = 0.0821 L atm K^{-1} mol^{-1}) (rounded off to the nearest integer) **[JEE-Main 3-9-20_S1]**

13. A 100 mL solution was made by adding 1.43 g of $Na_2CO_3 \cdot xH_2O$. The normality of the solution is 0.1 N. The value of x is _____.

(The atomic mass of Na is 23 g/mol) **[JEE-Main 4-9-20_S2]**

14. A 20.0 mL solution containing 0.2 g impure H_2O_2 reacts completely with 0.316 g of $KMnO_4$ in acid solution. The purity of H_2O_2 (in %) is _____ (mol. wt. of H_2O_2 = 34; mol. wt. of $KMnO_4$ = 158)

[JEE-Main 4-9-20_S1]

15. 15 mL of aqueous solution of Fe^{2+} in acidic medium completely reacted with 20 mL of 0.03 M aqueous $Cr_2O_7^{2-}$. The molarity of the Fe^{2+} solution is _____ × 10^{-2} M (Round off to the Nearest Integer).

[JEE-Main 17-3-21_S1]

16. 10.0 ml of Na_2CO_3 solution is titrated against 0.2 M HCl solution. The following titre values were obtained in 5 readings.

4.8 ml, 4.9 ml, 5.0 ml, 5.0 ml and 5.0 ml

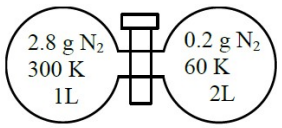
Based on these readings, and convention of titrimetric estimation of concentration of Na_2CO_3 solution is _____mM. (Round off to the Nearest integer) **[JEE-Main 18-3-21_S2]**

17. When 10 mL of an aqueous solution of Fe^{2+} ions was titrated in the presence of dil H_2SO_4 using diphenylamine indicator, 15 mL of 0.02 M solution of $K_2Cr_2O_7$ was required to get the end point. The molarity of the solution containing Fe^{2+} ions is $x \times 10^{-2}$ M. The value of x is _____.
(Nearest integer) **[JEE-Main 25-7-21_S1]**

18. 10.0 mL of 0.05 M $KMnO_4$ solution was consumed in a titration with 10.0 mL of given oxalic acid dihydrate solution. The strength of given oxalic acid solution is ..... $\times 10^{-2}$ g/L.
(Round off to the nearest integer) **[JEE-Main 27-7-21_S2]**

19. When 10 mL of an aqueous solution of $KMnO_4$ was titrated in acidic medium, equal volume of 0.1 M of an aqueous solution of ferrous sulphate was required for complete discharge of colour. The strength of $KMnO_4$ in grams per litre is _____ $\times 10^{-2}$. (Nearest integer)
[Atomic mass of K = 39, Mn = 55, O = 16] **[JEE-Main 27-8-21_S1]**

20. Two flasks I and II shown below are connected by a valve of negligible volume.



When the valve is opened, the final pressure of the system in bar is $x \times 10^{-2}$. The value of x is _____.
(Integer answer)
[Assume–Ideal gas; 1 bar = 10^5 Pa; Molar mass of N_2 = 28.0 g mol^{-1} ; R = 8.31 J $mol^{-1}K^{-1}$]
[JEE-Main 27-8-21_S2]

21. An LPG cylinder contains gas at a pressure of 300 kPa at 27°C. The cylinder can withstand the pressure of 1.2×10^6 Pa. The room in which the cylinder is kept catches fire. The minimum temperature at which the bursting of cylinder will take place is _____ °C. (Nearest integer)
[JEE-Main 25-7-21_S2]

22. A certain gas obeys $P(V_m - b) = RT$. The value of $\left(\frac{\partial Z}{\partial P}\right)_T$ is $\frac{xb}{RT}$. The value of x is _____.
(Integer answer) (Z : compressibility factor) **[JEE-Main 26-2-21_S1]**

23. The volume occupied by 4.75 g of acetylene gas at 50°C and 740 mmHg pressure is _____ L.
(Rounded off to the nearest integer)
[Given R = 0.0826 L atm K^{-1} mol^{-1}] **[JEE-Main 24-2-21_S2]**

24. The normality of H_2SO_4 in the solution obtained on mixing 100 mL of 0.1 M H_2SO_4 with 50 mL of 0.1 M NaOH is _____ $\times 10^{-1}$ N. (Nearest Integer) **[JEE-Main 27-7-22_S2]**

25. 20 mL of 0.02 M $K_2Cr_2O_7$ solution is used for the titration of 10 mL of Fe^{2+} solution in the acidic medium.
The molarity of Fe^{2+} solution is _____ × 10^{-2} M. (Nearest Integer) **[JEE-Main 27-7-22_S1]**

26. 0.01 M $KMnO_4$ solution was added to 20.0 mL of 0.05 M Mohr's salt solution through a burette. The initial reading of 50 mL burette is zero. The volume of $KMnO_4$ solution left in the burette after the end point is _____ mL. (nearest integer) **[JEE-Main 28-6-22_S2]**

27. A 2.0 g sample containing MnO_2 is treated with HCl liberating Cl_2. The Cl_2 gas is passed into a solution of KI and 60.0 mL of 0.1 M $Na_2S_2O_3$ is required to titrate the liberated iodine. The percentage of MnO_2 in the sample is _____. (Nearest integer)
[Atomic masses (in u) Mn = 55; Cl = 35.5; O = 16,
I = 127, Na = 23, K = 39, S = 32] **[JEE-Main 28-6-22_S1]**

28. 20 mL of 0.02 M hypo solution is used for the titration of 10 mL of copper sulphate solution, in the presence of excess of KI using starch as an indicator. The molarity of Cu^{2+} is found to be _____ × 10^{-2} M [nearest integer]
Given : $2Cu^{2+} + 4I^- \rightarrow Cu_2I_2 + I_2$
$I_2 + 2S_2O_3^{2-} \rightarrow 2I^- + S_4O_6^{2-}$ **[JEE-Main 26-7-22_S2]**

29. A 10 g mixture of hydrogen and helium is contained in a vessel of capacity 0.0125 m^3 at 6 bar and 27°C. The mass of helium in the mixture is _____ g. (nearest integer)
Given : R = 8.3 $JK^{-1}mol^{-1}$ (Atomic masses of H and He are 1u and 4u, respectively)
[JEE-Main 26-7-22_S2]

30. The volume of HCl, containing 73 g L^{-1}, required to completely neutralise NaOH obtained by reacting 0.69 g of metallic sodium with water, is _____ mL. (Nearest Integer)
(Given : molar Masses of Na, Cl, O, H are 23, 35.5, 16 and 1 g mol^{-1} respectively)
[JEE-Main 29-1-23_S2]

ANSWERKEY_EQUIVALENT CONCEPT + GASEOUS STATE

1.	**(4)**	**2.**	**(1)**	**3.**	**(3)**	**4.**	**(1)**	**5.**	**(1)**
6.	**(4)**	**7.**	**(3)**	**8.**	**(1)**	**9.**	**(2)**	**10.**	**(1)**
11.	**(1)**	**12.**	**100**	**13.**	**10**	**14.**	**85**	**15.**	**24**
16.	**50**	**17.**	**18**	**18.**	**1575**	**19.**	**316**	**20.**	**84**
21.	**927**	**22.**	**1**	**23.**	**5**	**24.**	**1**	**25.**	**24**
26.	**30**	**27.**	**13**	**28.**	**4**	**29.**	**8**	**30.**	**15**

CHEMISTRY

JEE MAIN PREVIOUS YEARS QUESTIONS – 2018-2023

CHAPTER NAME :- THERMODYNAMICS AND THERMOCHEMISTRY

(IMPORTANT QUESTIONS ONLY)

1. The combustion of benzene (l) gives $CO_2(g)$ and $H_2O(l)$. Given that heat of combustion of benzene at constant volume is –3263.9 kJ mol^{-1} at 25ºC; heat of combustion (in kJ mol^{-1}) of benzene at constant pressure will be : (R = 8.314 JK^{-1} mol^{-1}) **[JEE-Main 2018]**

(1) 3260 (2) –3267.6 (3) 4152.6 (4) –452.46

2. 5 moles of an ideal gas at 100 K are allowed to undergo reversible compression till its temperature becomes 200 K. If C_V = 28 J K^{-1} mol^{-1}, calculate ΔU and ΔpV for this process. (R = 8.0 J K^{-1} mol^{-1}) **[JEE-Main 8-4-19_S2]**

(1) ΔU = 14 kJ; $\Delta(pV)$ = 18 kJ (2) ΔU = 2.8 kJ; $\Delta(pV)$ = 0.8 kJ

(3) ΔU = 14 J; $\Delta(pV)$ = 0.8 J (4) ΔU = 14 kJ; $\Delta(pV)$ = 4 kJ

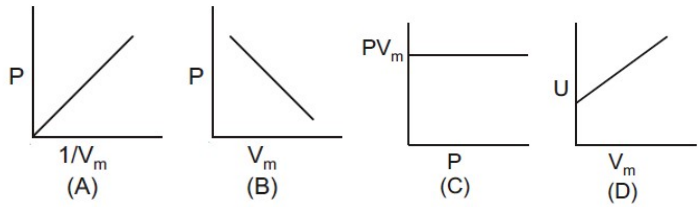
3. A process will be spontaneous at all temperatures if : **[JEE-Main 10-4-19_S1]**

(1) $\Delta H < 0$ and $\Delta S > 0$ (2) $\Delta H > 0$ and $\Delta S < 0$ (3) $\Delta H > 0$ and $\Delta S > 0$ (4) $\Delta H < 0$ and $\Delta S < 0$

4. An ideal gas is allowed to expand from 1 L to 10 L against a constant external pressure of 1 bar. The work done in kJ is : **[JEE-Main 12-4-19_S1]**

(1) –9.0 (2) –0.9 (3) –2.0 (4) +10.0

5. The combination of plots which does not represent isothermal expansion of an ideal gas is **[JEE-Main 12-1-19_S2]**



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

6. Among the following, the set of parameters that represents path functions, is

(A) q + w (B) q (C) w (D) H – TS **[JEE-Main 9-4-19_S1]**

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

7. A process had $\Delta H = 200\ Jmol^{-1}$ and $\Delta S = 40\ JK^{-1}\ mol^{-1}$. Out of the values given below, choose the minimum temperature above which the process will be spontaneous. **[JEE-Main 10-1-19_S1]**

(1) 4 K (2) 12 K (3) 5 K (4) 20 K

8. The true statement amongst the following is **[JEE-Main 9-1-20_S2]**

(1) S is not a function of temperature but ΔS is a function of temperature

(2) S is a function of temperature but ΔS is not a function of temperature

(3) Both ΔS and S are functions of temperature

(4) Both S and ΔS are not functions of temperature

9. Match List-I with List-II

List-I	**List-II**
(A) Spontaneous process	(I) $\Delta H < 0$
(B) Process with $\Delta P = 0, \Delta T = 0$	(II) $\Delta G_{T,P} < 0$
(C) $\Delta H_{reaction}$	(III) Isothermal and isobaric process
(D) Exothermic process	(IV) [Bond energies of molecules in reactants] - [Bond energies of product molecules

Choose the correct answer from the options given below: **[JEE-Main 27-6-22_S1]**

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

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

10. At 25ºC and 1 atm pressure, the enthalpy of combustion of benzene (ℓ) and acetylene (g) are –3268 kJ mol^{-1} and –1300 kJ mol^{-1}, respectively. The change in enthalpy for the reaction

$3\ C_2H_2(g) \rightarrow C_6H_6(\ell)$, is **[JEE-Main 25-6-22_S2]**

(1) + 324 kJ mol^{-1} (2) +632 kJ mol^{-1} (3) – 632 kJ mol^{-1} (4) – 732 kJ mol^{-1}

11. At 25°C and 1 atm pressure, the enthalpies of combustion are as given below:

Substance	H_2	C(graphite)	$C_2H_6(g)$
$\frac{\Delta_c H^{\ominus}}{kJmol^{-1}}$	–286.0	–394.0	–1560.0

The enthalpy of formation of ethane is **[JEE-Main 24-6-22_S2]**

(1) +54.0 kJ mol^{-1} (2) –68.0 kJ mol^{-1} (3) –86.0 kJ mol^{-1} (4) +97.0 kJ mol^{-1}

12. The standard heat of formation $\left(\Delta_f H^0_{298}\right)$ of ethane (in kJ/mol), if the heat of combustion of ethane, hydrogen and graphite are –1560, –393.5 and –286 kJ/mol, respectively is_____. (magnitude) **[JEE-Main 7-1-20_S2]**

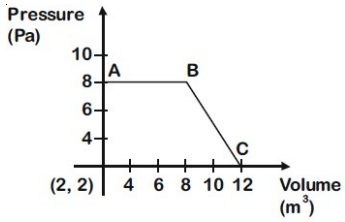
13. For the reaction

$A(l) \rightarrow 2B(g)$

$\Delta U = 2.1$ kcal, $\Delta S = 20$ cal K^{-1} at 300 K.

Hence ΔG in kcal is _____. (magnitude) **[JEE-Main 7-1-20_S1]**

14. The magnitude of work done by a gas that undergoes reversible expansion along the path ABC shown in the figure is _____.



[JEE-Main 8-1-20_S1]

15. At 298 K, the enthalpy of fusion of a solid (X) is 2.8 kJ mol^{-1} and the enthalpy of vaporisation of the liquid (X) is 98.2 kJ mol^{-1}. The enthalpy of sublimation of the substance (X) in kJ mol^{-1} is _____ . (in nearest integer) **[JEE-Main 25-7-21_S2]**

16. 200 mL of 0.2 M HCl is mixed with 300 mL of 0.1 M NaOH. The molar heat of neutralization of this reaction is –57.1 kJ. The increase in temperature in °C of the system on mixing is $x \times 10^{-2}$.

The value of x is _____ . (Nearest integer)

[Given : Specific heat of water = 4.18 J g^{-1} K^{-1}

Density of water = 1.00 g cm^{-3}]

(Assume no volume change on mixing) **[JEE-Main 27-8-21_S1]**

17. For the reaction

$C_2H_6 \longrightarrow C_2H_4 + H_2$

the reaction enthalpy Δ_rH = _____ kJ mol^{-1}.

(Round off to the Nearest Integer).

[Given : Bond enthalpies in kJ mol^{-1} : C–C : 347,

C=C : 611; C–H : 414, H–H : 436] **[JEE-Main 18-3-21_S2]**

18. If the standard molar enthalpy change for combustion of graphite powder is -2.48×10^2 kJ mol^{-1}, the amount of heat generated on combustion of 1 g of graphite powder is _____ kJ. (Nearest integer)

[JEE-Main 22-7-21_S2]

19. The standard enthalpies of formation of Al_2O_3 and CaO are –1675 kJ mol^{-1} and –635 kJ mol^{-1} respectively. For the reaction

$3CaO + 2Al \rightarrow 3Ca + Al_2O_3$ the standard reaction enthalpy Δ_rH^0 = _____ kJ.

(Round off to the Nearest Integer). **[JEE-Main 17-3-21_S1]**

20. For the reaction $2NO_2(g) \rightleftharpoons N_2O_4(g)$, when $\Delta S = -176.0\ JK^{-1}$ and $\Delta H = -57.8\ kJ\ mol^{-1}$, the magnitude of ΔG at 298 K for the reaction is_____ $kJ\ mol^{-1}$. (Nearest integer)

[JEE-Main 1-9-21_S2]

21. The enthalpy of combustion of propane, graphite and dihydrogen at 298 K are: $-2220.0\ kJ\ mol^{-1}$, – 393.5 kJ mol–1 and $-285.8\ kJ\ mol^{-1}$ respectively. The magnitude enthalpy of formation of propane (C_3H_8) is……$kJ\ mol^{-1}$. (Nearest integer) **[JEE-Main 25-7-2022_S1]**

22. For combustion of one mole of magnesium in an open container at 300 K and 1 bar pressure, $\Delta_C H^{\ominus} = -601.70\ kJ\ mol^{-1}$, the magnitude of change in internal energy for the reaction is _____ kJ. (Nearest integer) (Given : $R = 8.3\ J\ K^{-1}\ mol^{-1}$) **[JEE-Main 28-6-22_S2]**

23. 17.0 g of NH_3 completely vapourises at – 33.42°C and 1 bar pressure and the enthalpy change in the process is 23.4 $kJ\ mol^{-1}$. The enthalpy change for the vapourisation of 85 g of NH_3 under the same conditions is _____ kJ. **[JEE-Main 29-6-22_S1]**

24. While performing a thermodynamics experiment, a student made the following observations,

$HCl + NaOH \rightarrow NaCl + H_2O\ \Delta H = -57.3\ kJ\ mol^{-1}$

$CH_3COOH + NaOH \rightarrow CH_3COONa + H_2O$

$\Delta H = -55.3\ kJ\ mol^{-1}$.

The enthalpy of ionization of CH_3COOH as calculated by the student is _____ $kJ\ mol^{-1}$. (nearest integer) **[JEE-Main 25-7-22_S2]**

25. For complete combustion of methanol $CH_3OH(\ell) + \frac{3}{2}O_2(g) \rightarrow CO_2(g) + 2H_2O(\ell)$

the amount of heat produced as measured by bomb calorimeter is 726 $kJ\ mol^{-1}$ at 27°C. The enthalpy of combustion for the reaction is $-x\ kJ\ mol^{-1}$,

where x is _____. (Nearest integer) (Given : $R = 8.3\ JK^{-1}\ mol^{-1}$) **[JEE-Main 26-6-22_S1]**

26. Among the following the number of state variable is _____.

Internal energy (U)

Volume (V)

Heat (q)

Enthalpy (H) **[JEE-Main 28-7-2022_S2]**

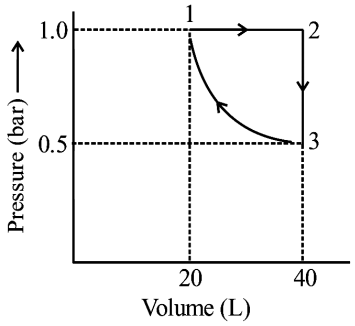
27. A fish swimming in water body when taken out from the water body is covered with a film of water of weight 36 g. When it is subjected to cooking at 100°C, then the internal energy for vaporization in $kJ\ mol^{-1}$ is _____.

[nearest integer]

[Assume steam to be an ideal gas. Given $A_{vap}H^{\ominus}$ for water at 373 K and 1 bar is $41.1 kJmol^{-1}$; $R=8.31JK^{-1}mol^{-1}$] **[JEE-Main 26-6-22_S2]**

28. One mole of an ideal monoatomic gas is subjected to changes as shown in the graph. The magnitude of the work done (by the system or on the system) is _____ J (nearest integer).

[JEE-Main 24-1-23_S2]



Given : log 2 = 0.3, ln 10 = 2.3

29. For independent process at 300 K.

Process	ΔH/kJ mol^{-1}	ΔS/J K^{-1}
A	–25	–80
B	–22	40
C	25	–50
D	22	20

The number of non-spontaneous process from the following is _____. **[JEE-Main_24-1-23_S1]**

30. 28.0 L of CO_2 is produced on complete combustion of 16.8 L gaseous mixture of ethane and methane at 25°C and 1 atm. Heat evolved during the combustion process is _____ kJ.

Given : ΔH_C (CH_4) = –900 kJ mol^{-1}, ΔH_C (C_2H_4) = –1400 kJ mol^{-1} **[JEE-Main_25-1-23_S2]**

ANSWER KEY_THERMODYNAMICS & THERMOCHEMISTRY

1.	(2)	**2.**	(4)	**3.**	(1)	**4.**	(2)	**5.**	(4)
6.	(2)	**7.**	(3)	**8.**	(3)	**9.**	(2)	**10.**	(3)
11.	(3)	**12.**	**192**	**13.**	**3**	**14.**	**48**	**15.**	**101**
16.	**82**	**17.**	**128**	**18.**	**21**	**19.**	**230**	**20.**	**5**
21.	**104**	**22.**	**600**	**23.**	**117**	**24.**	**2**	**25.**	**727**
26.	**3**	**27.**	**38**	**28.**	**620**	**29.**	**2**	**30.**	**847**

CHEMISTRY

JEE MAIN PREVIOUS YEARS QUESTIONS – 2018-2023

CHAPTER NAME :- CHEMICAL EQUILIBRIUM

(IMPORTANT QUESTIONS ONLY)

1. Two solids dissociate as follows

$A(s) \rightleftharpoons B(g) + C(g); K_{P_1} = x\ atm^2$

$D(s) \rightleftharpoons C(g) + E(g); K_{P_2} = y\ atm^2$

The total pressure when both the solids dissociate simultaneously is **[JEE-Main 12-1-19_S1]**

(1) $x^2 + y^2$ atm (2) (x + y) atm (3) $\sqrt{x+y}$ atm (4) $2\sqrt{x+y}$) atm

2. In which one of the following equilibria, **[JEE-Main 12-4-19_S2]**

$K_P \neq K_C$?

(1) $2HI(g) \rightleftharpoons H_2(g) + I_2(g)$ (2) $2NO(g) \rightleftharpoons N_2(g) + O_2(g)$

(3) $NO_2(g) + SO_2(g) \rightleftharpoons NO(g) + SO_3(g)$ (4) $2C(s) + O_2(g) \rightleftharpoons 2CO(g)$

3. For the reaction,

$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$,

$\Delta H = -57.2\ kJ\ mol^{-1}$ and $K_c = 1.7 \times 10^{16}$.

Which of the following statement is INCORRECT? **[JEE-Main 10-4-19_S2]**

(1) The equilibrium constant is large suggestive of reaction going to completion and so no catalyst is required.

(2) The addition of inert gas at constant volume will not affect the equilibrium constant.

(3) The equilibrium will shift in forward direction as the pressure increases.

(4) The equilibrium constant decreases as the temperature increases.

4. Consider the reaction

$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$

The equilibrium constant of the above reaction is K_P. If pure ammonia is left to dissociate, the partial pressure of ammonia at equilibrium is given by (Assume that $P_{NH3} << P_{total}$ at equilibrium)

[JEE-Main 11-1-19_S1]

(1) $\frac{K_P^{1/2}P^2}{4}$ (2) $\frac{3^{3/2}K_P^{1/2}P^2}{4}$ (3) $\frac{K_P^{1/2}P^2}{16}$ (4) $\frac{3^{1/2}K_P^{1/2}P^2}{16}$

5. For the following reactions, equilibrium constants are given :

$S(s)+O_2(g)\rightleftharpoons SO_2(g);K_1=10^{52}$

$2S(s)+3O_2(g)\rightleftharpoons 2SO_3(g);K_2=10^{129}$

The equilibrium constant for the reaction,

$2SO_2(g)+O_2(g)\rightleftharpoons 2SO_3(g)$ is : **[JEE-Main 8-4-19_S2]**

(1) 10^{154} (2) 10^{25} (3) 10^{77} (4) 10^{181}

6. The INCORRECT match in the following is **[JEE-Main 12-4-19_S2]**

(1) $\Delta G^\circ = 0, K = 1$ (2) $\Delta G^\circ < 0, K < 1$ (3) $\Delta G^\circ > 0, K < 1$ (4) $\Delta G^\circ < 0, K > 1$

7. In a chemical reaction, $A+2B\overset{K}{\rightleftharpoons}2C+D$, the initial concentration of B was 1.5 times of the concentration of A, but the equilibrium concentrations of A and B were found to be equal. The equilibrium constant (K) for the aforesaid chemical reaction is **[JEE-Main 12-1-19_S1]**

(1) 1 (2) 16 (3) 4 (4) $\frac{1}{4}$

8. 5.1 g NH_4SH is introduced in 3.0 L evacuated flask at 327ºC. 30% of the solid NH_4SH decomposed to NH_3 and H_2S as gases. The K_p of the reaction at 327ºC is (R = 0.082 L atm $mol^{-1}K^{-1}$, Molar mass of S = 32 g mol^{-1}, molar mass of N = 14 g mol^{-1}) **[JEE-Main 10-1-19_S2]**

(1) 4.9×10^{-3} atm^2 (2) 0.242 atm^2 (3) 1×10^{-4} atm^2 (4) 0.242×10^{-4} atm^2

9. Consider the following reaction :

$N_2O_4(g)\rightleftharpoons 2NO_2(g);\ \Delta H^0=+58$ kJ

For each of the following cases (a, b), the direction in which the equilibrium shifts is :

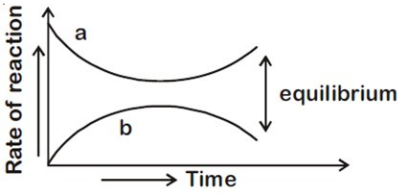
(a) Temperature is decreased

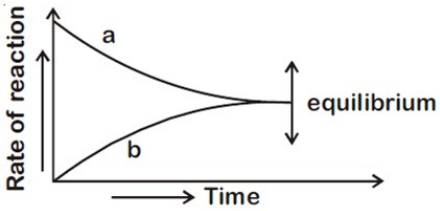
(b) Pressure is increased by adding N_2 at constant T. **[JEE-Main 5-9-20_S1]**

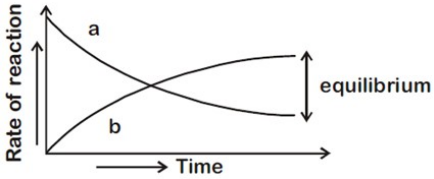
(1) (a) Towards product, (b) towards reactant (2) (a) Towards reactant, (b) no change

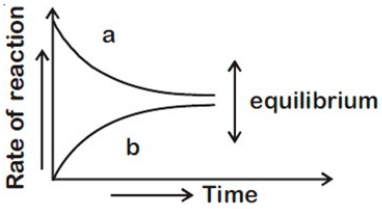
(3) (a) Towards reactant, (b) towards product (4) (a) Towards product, (b) no change

10. For the equilibrium $A \rightleftharpoons B$, the variation of the rate of the forward (a) and reverse (b) reaction with time is given by **[JEE-Main 4-9-20_S1]**

(1) 

(2) 

(3) 

(4) 

11. For the reaction

$$Fe_2N(s) + \frac{3}{2}H_2(g) \rightleftharpoons 2Fe(s) + NH_3(g)$$ **[JEE-Main 6-9-20_S1]**

(1) $K_C = K_p (RT)^{1/2}$ (2) $K_C = K_p (RT)$ (3) $K_C = K_p (RT)^{3/2}$ (4) $K_C = K_p(RT)^{-1/2}$

12. If the equilibrium constant for $A \rightleftharpoons B + C$ is $K_{eq}^{(1)}$ and that of $B + C \rightleftharpoons P$ is $K_{eq}^{(2)}$, the equilibrium constant for $A \rightleftharpoons P$ is **[JEE-Main 4-9-20_S2]**

(1) $K_{eq}^{(1)} / K_{eq}^{(2)}$ (2) $K_{eq}^{(1)} + K_{eq}^{(2)}$ (3) $K_{eq}^{(2)} - K_{eq}^{(1)}$ (4) $K_{eq}^{(1)} K_{eq}^{(2)}$

13. For a reaction X + Y = 2Z, 1.0 mol of X, 1.5 mol of Y and 0.5 mol of Z were taken in a 1 L vessel and allowed to react. At equilibrium, the concentration of Z was 1.0 mol L^{-1}. The equilibrium constant of the reaction is $\frac{x}{15}$. The value of x is _____. **[JEE-Main 5-9-20_S2]**

14. The stepwise formation of $[Cu(NH_3)_4]^{2+}$ is given below

$$Cu^{2+} + NH_3 \overset{K_1}{\rightleftharpoons} [Cu(NH_3)]^{2+}$$

$$[Cu(NH_3)]^{2+} + NH_3 \overset{K_2}{\rightleftharpoons} [Cu(NH_3)_2]^{2+}$$

$$[Cu(NH_3)_2]^{2+} + NH_3 \overset{K_3}{\rightleftharpoons} [Cu(NH_3)_3]^{2+}$$

$$[Cu(NH_3)_3]^{2+} + NH_3 \overset{K_4}{\rightleftharpoons} [Cu(NH_3)_4]^{2+}$$

The value of stability constants K_1, K_2, K_3 and K_4 are 10^4, 1.58×10^3, 5×10^2 and 10^2 respectively. The overall equilibrium constants for dissociation of $[Cu(NH_3)_4]^{2+}$ is $x \times 10^{-12}$.

The value of x is _____. (Rounded off to the nearest integer) **[JEE-Main 24-2-21_S1]**

15. The equilibrium constant Kc at 298 K for the reaction A + B $\rightleftharpoons$ C + D is 100. Starting with an equimolar solution with concentrations of A, B, C and D all equal to 1M, the equilibrium concentration of D is_____ × 10^{-2} M. (Nearest integer) **[JEE-Main 26-8-21_S2]**

16. Consider the reaction $N_2O_4(g) \rightleftharpoons 2NO_2(g)$. The temperature at which K_C = 20.4 and K_P = 600.1, is _____ K. (Round off to the Nearest Integer)

[Assume all gases are ideal and R = 0.0831 L bar K^{-1} mol^{-1}] **[JEE-Main 17-3-21_S2]**

17. The gas phase reaction

$2A(g) \rightleftharpoons A_2(g)$

at 400 K has ΔG^0 = + 25.2 kJ mol^{-1}.

The equilibrium constant K_C for this reaction is ___ × 10^{-2}. (Round off to the Nearest integer)

[Use : R = 8.3 J mol^{-1} K^{-1}, ln 10 2.3 $\log_{10}$ 2 = 0.30, 1 atm = 1 bar] [antilog (–0.3) = 0.501]

[JEE-Main 18-3-21_S2]

18. The number of moles of NH_3, that must be added to 2 L of 0.80 M $AgNO_3$ in order to reduce the concentration of Ag^+ ions to 5.0 × 10^{-8} M ($K_{formation}$ for $[Ag(NH_3)_2]^+$ = 1.0 × 10^8) is _____ . (Nearest integer)

[Assume no volume change on adding NH_3] **[JEE-Main 27-8-21_S1]**

19. The equilibrium constant for the reaction

$$A(s) \rightleftharpoons M(s) + \frac{1}{2}O_2(g)$$

is K_p = 4. At equilibrium, the partial pressure of O_2 is _____ atm. (Round off to the nearest integer)

[JEE-Main 27-7-21_S2]

20. Value of K_P for the equilibrium reaction N_2O_4 (g) $\rightleftharpoons$ $2NO_{2(g)}$ at 288 K is 47.9. The K_C for this reaction at same temperature is _____.

(Nearest integer)

(R = 0.083 L bar K^{-1} mol^{-1}) **[JEE-Main 22-7-21_S2]**

21. At 298 K, the equilibrium constant is 2 × 10^{15} for the reaction :

$Cu(s) + 2Ag^+(aq) \rightleftharpoons Cu^{2+}(aq) + 2Ag(s)$

The equilibrium constant for the reaction

$$\frac{1}{2}Cu^{2+}(aq) + Ag(s) \rightleftharpoons \frac{1}{2}Cu(s) + Ag^+(aq)$$

is x × 10^{-8}. The value of x is_____. **[JEE-Main 26-7-22_S1]**

22. The standard free energy change ($\Delta G°$) for 50% dissociation of N_2O_4 into NO_2 at 27°C and 1 atm pressure is –x J mol^{-1}. The value of x is _____. (Nearest Integer)
[Given : R = 8.31 J K^{-1} mol^{-1}, log 1.33 = 0.1239 ln 10 = 2.3] **[JEE-Main 25-6-22_S1]**

23. $2O_3(g) \rightleftharpoons 3O_2(g)$

At 300 K, ozone is fifty percent dissociated. The standard free energy change at this temperature and 1 atm pressure is (–) __J mol^{-1}
(Nearest integer)
[Given: ln 1.35 = 0.3 and R = 8.3 J K^{-1} mol^{-1}] **[JEE-Main 24-6-22_S1]**

24. PCl_5 dissociates as

$$PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$$

5 moles of PCl5 are placed in a 200 litre vessel which contains 2 moles of N_2 and is maintained at 600 K. The equilibrium pressure is 2.46 atm. The equilibrium constant Kp for the dissociation of PCl_5 is_____ × 10^{-3}. (nearest integer)
(Given: R = 0.082 L atm K^{-1} mol^{-1} : Assume ideal gas behaviour) **[JEE-Main 24-6-22_S2]**

25. 40% of HI undergoes decomposition to H_2 and I_2 at 300 K. $\Delta G^{\ominus}$ for this decompostion reaction at one atmosphere pressure is_____ J mol^{-1}. [nearest integer]
(Use R = 8.31 J K^{-1} mol^{-1}; log 2 = 0.3010. ln 10 = 2.3, log 3 = 0.477) **[JEE-Main 26-6-22_S2]**

26. Consider the following reaction approaching equilibrium at 27ºC and 1 atm pressure

$$A + B \underset{K_b=10^2}{\overset{K_f=10^3}{\rightleftharpoons}} C + D$$

The standard Gibb's energy change ($\Delta_r G°$) at 27ºC is (–) _____ kJ mol^{-1} (Nearest integer).
(Given : R = 8.3 J K^{-1} mol^{-1} and ln 10 = 2.3) **[JEE-Main 29-1-23_S1]**

27. Water decomposes at 2300 K

$$H_2O(g) \rightarrow H_2(g) + \frac{1}{2}O_2(g)$$

The percent of water decomposing at 2300 K and 1 bar is _____ (Nearest integer).
Equilibrium constant for the reaction is 2 × 10^{-3} at 2300 K **[JEE-Main 29-1-23_S1]**

28. At 298 K

$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$, $K_1 = 4 \times 10^5$

$N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$, $K_2 = 1.6 \times 10^{12}$

$H_2(g) + \frac{1}{2}O_2(g) \rightleftharpoons H_2O(g)$, $K_3 = 1.0 \times 10^{-13}$

Based on above equilibria, the equilibrium constant of the reaction,

$2NH_3(g) + \frac{5}{2}O_2(g) \rightleftharpoons 2NO(g) + 3H_2O(g)$ is ___ $\times 10^{-33}$ (Nearest integer)

[JEE-Main 29-1-23_S2]

29. For reaction : $SO_2(g) + \frac{1}{2}O_2(g) \rightleftharpoons SO_3(g)$, $K_P = 2 \times 10^{12}$ at 27°C and 1 atm pressure. The K_c for the same reaction is _____ $\times 10^{13}$. (Nearest integer)
(Given R = 0.082 L atm K^{-1} mol^{-1})

[JEE-Main 31-1-23_S1]

30. (i) $X(g) \rightleftharpoons Y(g) + Z(g)$ $\quad K_{p_1} = 3$

(ii) $A(g) \rightleftharpoons 2B(g)$ $\quad K_{p_2} = 1$

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)

[JEE-Main_01-2-23_S1]

ANSWER KEY_CHEMICAL EQUILIBRIUM

1.	(4)	**2.**	(4)	**3.**	(1)	**4.**	(4)	**5.**	(2)
6.	(2)	**7.**	(3)	**8.**	(2)	**9.**	(2)	**10.**	(2)
11.	(1)	**12.**	(4)	**13.**	**16**	**14.**	**1**	**15.**	**182**
16.	**354**	**17.**	**2**	**18.**	**4**	**19.**	**16**	**20.**	**2**
21.	**2**	**22.**	**710**	**23.**	**747**	**24.**	**1107**		
25.	**2735**	**26.**	**6**	**27.**	**2**	**28.**	**4**	**29.**	**1**
30.	**12**								

CHEMISTRY

JEE MAIN PREVIOUS YEARS QUESTIONS – 2018-2023

CHAPTER NAME :- IONIC EQUILIBRIUM

(IMPORTANT QUESTIONS ONLY)

1. Which of the following salts is the most basic in aqueous solution? **[JEE-Main 2018]**

(1) $FeCl_3$ (2) $Pb(CH_3COO)_2$ (3) $Al(CN)_3$ (4) CH_3COOK

2. An alkali is titrated against an acid with methyl orange as indicator, which of the following is a correct combination? **[JEE-Main 2018]**

(1) **Base** → Weak, **Acid** → Strong, **End point** → Yellow to pinkish red

(2) **Base** → Strong, **Acid** →Strong, **End point** → Pink to colourless

(3) **Base** → Weak, **Acid** →Strong, **End point** → Colourless to pink

(4) **Base** → Strong, **Acid** →Strong, **End point** → Pinkish red to yellow

3. 20 ml of 0.1 M H_2SO_4 solution is added to 30 mL of 0.2 M NH_4OH solution. The pH of the resultant mixture is : [pK_b of NH_4OH = 4.7] **[JEE-Main 9-1-19_S1]**

(1) 9.0 (2) 5.2 (3) 5.0 (4) 9.4

4. Consider the following statements

(a) The pH of a mixture containing 400 mL of 0.1 M H_2SO_4 and 400 mL of 0.1 M NaOH will be approximately 1.3.

(b) Ionic product of water is temperature dependent.

(c) A monobasic acid with $K_a = 10^{-5}$ has a pH = 5. The degree of dissociation of this acid is 50%.

(d) The Le Chatelier's principle is not applicable to common-ion effect.

The correct statements are : **[JEE-Main 10-4-19_S1]**

(1) (a), (b) and (d) (2) (b) and (c) (3) (a) and (b) (4) (a), (b) and (c)

5. If solubility product of $Zr_3(PO_4)_4$ is denoted by K_{sp} and its molar solubility is denoted by S, then which of the following relation between S and K_{sp} is correct? **[JEE-Main 8-4-19_S1]**

(1) $S = \left(\frac{K_{sp}}{929}\right)^{\frac{1}{9}}$ (2) $S = \left(\frac{K_{sp}}{216}\right)^{\frac{1}{7}}$ (3) $S = \left(\frac{K_{sp}}{144}\right)^{\frac{1}{6}}$ (4) $S = \left(\frac{K_{sp}}{6912}\right)^{\frac{1}{7}}$

6. Arrange the following solutions in the decreasing order of pOH **[JEE-Main 6-9-20_S1]**

(A) 0.01 M HCl

(B) 0.01 M NaOH

(C) 0.01 M CH_3COONa

(D) 0.01 M NaCl

(1) (B) > (C) > (D) > (A) (2) (A) > (D) > (C) > (B)

(3) (A) > (C) > (D) > (B) (4) (B) > (D) > (C) > (A)

7. An acidic buffer is obtained on mixing **[JEE-Main 3-9-20_S1]**

(1) 100 mL of 0.1 M HCl and 200 mL of 0.1 M NaCl

(2) 100 mL of 0.1 M HCl and 200 mL of 0.1 M CH_3COONa

(3) 100 mL of 0.1 M CH_3COOH and 100 mL of 0.1 M NaOH

(4) 100 mL of 0.1 M CH_3COOH and 200 mL of 0.1 M NaOH

8. For the following Assertion and Reason, the correct option is

Assertion (A): When Cu (II) and sulphide ions are mixed, they react together extremely quickly to give a solid.

Reason (R): The equilibrium constant of $Cu^{2+}(aq) + S^{2-}(aq) \rightleftharpoons CuS(s)$ is high because the solubility product is low. **[JEE-Main 2-9-20_S1]**

(1) (A) is false and (R) is true.

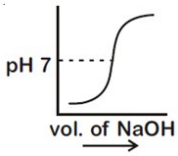
(2) Both (A) and (R) are true but (R) is not the explanation for (A).

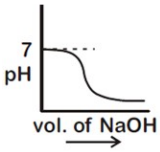
(3) Both (A) and (R) are true and (R) is the explanation for (A).

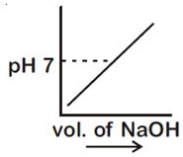
(4) Both (A) and (R) are false.

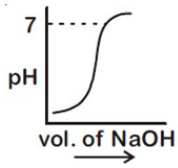
9. 100 mL of 0.1 M HCl is taken in a beaker and to it 100 mL of 0.1 M NaOH is added in steps of 2 mL and the pH is continuously measured. Which of the following graphs correctly depicts the change in pH?

[JEE-Main 3-9-20_S2]

(1) 

(2) 

(3) 

(4) 

10. The solubility product of $Cr(OH)_3$ at 298 K is 6.0×10^{-31}. The concentration of hydroxide ions in a saturated solution of $Cr(OH)_3$ will be **[JEE-Main 9-1-20_S2]**

(1) $(2.22 \times 10^{-31})^{1/4}$ (2) $(18 \times 10^{-31})^{1/2}$ (3) $(18 \times 10^{-31})^{1/4}$ (4) $(4.86 \times 10^{-29})^{1/4}$

11. For the following Assertion and Reason, the correct option is

Assertion : The pH of water increases with increase in temperature.

Reason : The dissociation of water into H^+ and OH^- is an exothermic reaction. **[JEE-Main 8-1-20_S2]**

(1) Both assertion and reason are false

(2) Assertion is not true, but reason is true

(3) Both assertion and reason are true, and the reason is the correct explanation for the assertion

(4) Both assertion and reason are true, but the reason is not the correct explanation for the assertion

12. The solubility of AgCN in a buffer solution of pH = 3 is x. The value of x is:

[Assume : No cyano complex is formed; K_{sp}(AgCN) = 2.2×10^{-16} and K_a(HCN) = 6.2×10^{-10}] **[JEE-Main 25-2-21_S1]**

(1) 0.625×10^{-6} (2) 1.9×10^{-5} (3) 2.2×10^{-16} (4) 1.6×10^{-6}

13. The solubility of $Ca(OH)_2$ in water is :

[Given : The solubility product of $Ca(OH)_2$ in water = 5.5×10^{-6}] **[JEE-Main 25-2-21_S2]**

(1) 1.77×10^{-6} (2) 1.11×10^{-6} (3) 1.11×10^{-2} (4) 1.77×10^{-2}

14. 200 mL of 0.01 M HCl is mixed with 400 mL of 0.01M H_2SO_4. The pH of the mixture is ____.

[JEE-Main 29-7-22_S2]

(1) 1.14 (2) 1.78 (3) 2.34 (4) 3.02

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

Assertion A : Phenolphthalein is a pH dependent indicator, remains colourless in acidic solution and gives pink colour in basic medium

Reason R : Phenolphthalein is a weak acid. It doesn't dissociate in basic medium.

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

[JEE-Main 26-7-22_S2]

(1) Both A and R are true and R is the correct explanation of A

(2) Both A and R are true but R is NOT the correct explanation of A.

(3) A is true but R is false

(4) A is false but R is true

16. The solubility of AgCl will be maximum in which of the following ? **[JEE-Main 29-6-22_S1]**

(1) 0.01 M KCl (2) 0.01 M HC1 (3) 0.01 M $AgNO_3$ (4) Deionised water

17. Ka_1, Ka_2 and Ka_3 are the respective ionization constants for the following reactions (a),(b), and (c).

(a) $H_2C_2O_4 \rightleftharpoons H^+ + HC_2O_4^-$ (b) $HC_2O_4^- \rightleftharpoons H^+ + C_2O_4^{2-}$ (c) $H_2C_2O_4 \rightleftharpoons 2H^+ + C_2O_4^{2-}$

The relationship between K_{a_1}, K_{a_2} and K_{a_3} is given as **[JEE-Main 25-7-22_S2]**

(1) $K_{a_3} = K_{a_1} + K_{a_2}$ (2) $K_{a_3} = K_{a_1} - K_{a_2}$ (3) $K_{a_3} = K_{a_1} / K_{a_2}$ (4) $K_{a_3} = K_{a_1} \times K_{a_2}$

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

Assertion A : The amphoteric nature of water is explained by using Lewis acid/base concept.

Reason R : Water acts as an acid with NH_3 and as a base with H_2S.

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

[JEE-Main 25-6-22_S2]

(1) Both A and R are true and R is the correct explanation of A.

(2) Both A and R are true but R is NOT the correct explanation of A.

(3) A is true but R is false.

(4) A is false but R is true.

19. When the hydrogen ion concentration $[H^+]$ changes by a factor of 1000, the value of pH of the solution _____. **[JEE-Main_25-1-23_S2]**

(1) increases by 1000 units (2) decreases by 3 units

(3) decreases by 2 units (4) increases by 2 units

20. If the solubility product of AB_2 is $3.20 \times 10^{-11}\ M^3$, then the solubility of AB_2 in pure water is _____ $\times 10^{-4}$ mol L^{-1}. [Assuming that neither kind of ion reacts with water] **[JEE-Main 6-9-20_S2]**

21. 3 g of acetic acid is added to 250 mL of 0.1 M HCl and the solution made up to 500 mL. To 20 mL of this solution $\frac{1}{2}$mL of 5 M NaOH is added. The pH of the solution is_____.

[Given : pK_a of acetic acid = 4.75, molar mass of acetic acid = 60 g/mol, log3 = 0.4771]

Neglect any changes in volume. **[JEE-Main 7-1-20_S2]**

22. A_3B_2 is a sparingly soluble salt of molar mass M (g mol^{-1}) and solubility x g L^{-1}. The solubility product satisfies $K_{sp} = a\left(\frac{x}{M}\right)^5$. The value of a is _____. (Integer answer) **[JEE-Main 31-8-21_S1]**

23. In order to prepare a buffer solution of pH 5.74, sodium acetate is added to acetic acid. If the concentration of acetic acid in the buffer is 1.0 M, the concentration of sodium acetate in the buffer is _____ M. (Round off to the Nearest Integer). [Given : pKa (acetic acid) = 4.74]

[JEE-Main 18-3-21_S1]

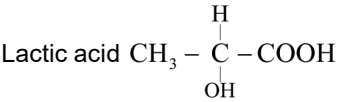
24. The OH^- concentration in a mixture of 5.0 mL of 0.0504 M NH_4Cl and 2 mL of 0.0210 M NH_3 solution is $x \times 10^{-6}$ M. The value of x is _____. (Nearest integer) **[JEE-Main 26-8-21_S1]**

[Given $K_w = 1 \times 10^{-14}$ and Kb = 1.8×10^{-5}]

25. At 310 K, the solubility of CaF_2 in water is 2.34×10^{-3} g /100 mL. The solubility product of CaF_2 is ___ $\times 10^{-8}$ $(mol/L)^3$. (Given molar mass : CaF_2 = 78 g mol^{-1}) **[JEE-Main 27-7-22_S1]**

26. K_a for butyric acid (C_3H_7COOH) is 2×10^{-5}. The pH of 0.2 M solution of butyric acid is ___ $\times 10^{-1}$. (Nearest integer) [Given log 2 = 0.30] **[JEE-Main 28-7-22_S1]**

27. If the pKa of lactic acid is 5, then the pH of 0.005 M calcium lactate solution at 25° C is _____ $\times 10^{-1}$ (Nearest integer)

Lactic acid  **[JEE-Main_24-1-23_S2]**

28. The dissociation constant of acetic is $x \times 10^{-5}$. When 25 mL of 0.2 M CH_3COONa solution is mixed with 25 mL of 0.02 M CH_3COOH solution, the pH of the resultant solution is found to be equal to 5. The value of x is _____. **[JEE-Main_24-1-23_S1]**

29. A litre of buffer solution contains 0.1 mole of each of NH_3 and NH_4Cl. On the addition of 0.02 mole of HCl by dissolving gaseous HCl, the pH of the solution is found to be _____ $\times 10^{-3}$ (Nearest integer) [**Given** : pKb(NH_3) = 4.745, log 2 = 0.301, log 3 = 0.477, T = 298 K]

[JEE-Main_25-1-23_S1]

30. Millimoles of calcium hydroxyide required to produce 100 mL of the aqueous solution of pH 12 is $x \times 10^{-1}$. The value of x is _____ (Nearest integer).
Assume complete dissociation. **[JEE-Main_29-1-23_S1]**

ANSWER KEY_IONIC EQUILIBRIUM

1.	(4)	**2.**	(1)	**3.**	(1)	**4.**	(4)	**5.**	(4)
6.	(2)	**7.**	(2)	**8.**	(3)	**9.**	(1)	**10.**	(3)
11.	(1)	**12.**	(2)	**13.**	(3)	**14.**	(2)	**15.**	(3)
16.	(4)	**17.**	(4)	**18.**	(4)	**19.**	(2)	**20.**	**2**
21.	**5.23**	**22.**	**108**	**23.**	**10**	**24.**	**3**	**25.**	**0**
26.	**27**	**27.**	**85**	**28.**	**10**	**29.**	**9079**	**30.**	**5**

CHEMISTRY

JEE MAIN PREVIOUS YEARS QUESTIONS – 2018-2023

CHAPTER NAME :- LIQUID SOLUTION & COLLIGATIVE PROPERTIES

(IMPORTANT QUESTIONS ONLY)

1. For 1 molal aqueous solution of the following compounds, which one will show the highest freezing point ? **[JEE-Main 2018]**

(1) $[Co(H_2O)_4Cl_2]Cl.2H_2O$ (2) $[Co(H_2O)_3Cl_3].3H_2O$

(3) $[Co(H_2O)_6]Cl_3$ (4) $[Co(H_2O)_5Cl]Cl_2.H_2O$

2. Which one of the following statements regarding Henry's law is not correct? **[JEE-Main 9-1-19_S1]**

(1) Different gases have different K_H (Henry's law constant) values at the same temperature

(2) The value of K_H increases with increase of temperature and K_H is function of the nature of the gas

(3) The partial pressure of the gas in vapour phase is proportional to the mole fraction of the gas in the solution

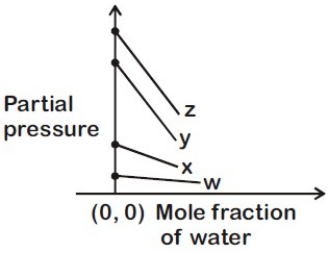
(4) Higher the value of K_H at a given pressure, higher is the solubility of the gas in the liquids.

3. Molecules of benzoic acid (C_6H_5COOH) dimerise in benzene. 'w' g of the acid dissolved in 30 g of benzene shows a depression in freezing point equal to 2 K. If the percentage association of the acid to form dimer in the solution is 80, then w is (Given that K_f = 5 K kg mol^{-1}, Molar mass of benzoic acid = 122 g mol^{-1}) **[JEE-Main 12-1-19_S2]**

(1) 1.5 g (2) 2.4 g (3) 1.8 g (4) 1.0 g

4. For the solution of the gases w, x, y and z in water at 298 K, the Henrys law constants (K_H) are 0.5, 2, 35 and 40 kbar, respectively. The correct plot for the given data is : **[JEE-Main 8-4-19_S2]**

(1)



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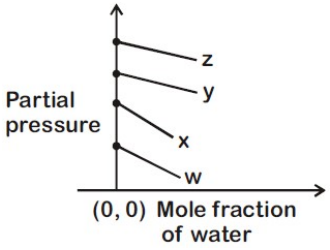

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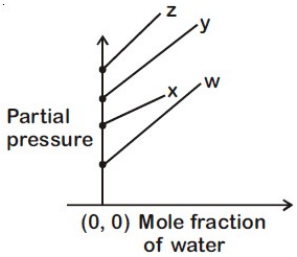

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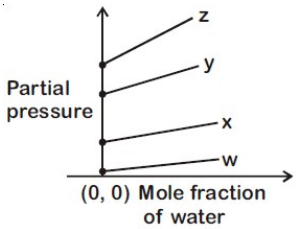


5. Liquid 'M' and liquid 'N' form an ideal solution. The vapour pressures of pure liquids 'M' and 'N' are 450 and 700 mmHg, respectively, at the same temperature. Then correct statement is

(x_M = Mole fraction of 'M' in solution;

x_N = Mole fraction of 'N' in solution;

y_M = Mole fraction of 'M' in vapour phase;

y_N = Mole fraction of 'N' in vapour phase) **[JEE-Main 9-4-19_S1]**

(1) $\frac{x_M}{x_N} = \frac{y_M}{y_N}$ (2) $\frac{x_M}{x_N} > \frac{y_M}{y_N}$ (3) $\frac{x_M}{x_N} < \frac{y_M}{y_N}$ (4) $(x_M - x_y) < (x_N - y_N)$

6. The osmotic pressure of a dilute solution of an ionic compound XY in water is four times that of a solution of 0.01 M $BaCl_2$ in water. Assuming complete dissociation of the given ionic compounds in water, the concentration of XY (in mol L^{-1}) in solution is **[JEE-Main 9-4-19_S1]**

(1) 16×10^{-4} (2) 4×10^{-4} (3) 6×10^{-2} (4) 4×10^{-2}

7. Molal depression constant for a solvent is 4.0 K kg mol^{-1}. The depression in the freezing point of the solvent for 0.03 mol kg^{-1} solution of K_2SO_4 is

(Assume complete dissociation of the electrolyte) **[JEE-Main 9-4-19_S2]**

(1) 0.36 K (2) 0.18 K (3) 0.12 K (4) 0.24 K

8. At room temperature, a dilute solution of urea is prepared by dissolving 0.60 g of urea in 360 g of water. If the vapour pressure of pure water at this temperature is 35 mmHg, lowering of vapour pressure will be : (molar mass of urea = 60 g mol^{-1}) **[JEE-Main 10-4-19_S1]**

(1) 0.031 mmHg (2) 0.017 mmHg (3) 0.028 mmHg (4) 0.027 mmHg

9. At 35°C, the vapour pressure of CS_2 is 512 mm Hg and that of acetone is 344 mm Hg. A solution of CS_2 in acetone has a total vapour pressure of 600 mm Hg. The false statement amongst the following is **[JEE-Main 7-1-20_S1]**

(1) Raoult's law is not obeyed by this system

(2) A mixture of 100 mL CS_2 and 100 mL acetone has a volume < 200 mL

(3) Heat must be absorbed in order to produce the solution at 35°C

(4) CS_2 and acetone are less attracted to each other than to themselves

10. Two open beakers one containing a solvent and the other containing a mixture of that solvent with a non volatile solute are together sealed in a container over time: **[JEE-Main 7-1-20_S2]**

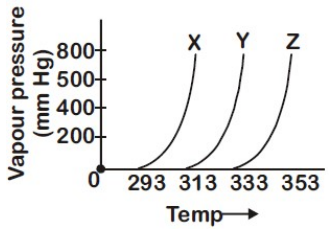
(1) The volume of the solution and the solvent does not change

(2) The volume of the solution increases and the volume of the solvent decreases

(3) The volume of the solution does not change and the volume of the solvent decreases

(4) The volume of the solution decreases and the volume of the solvent increases.

11. A graph of vapour pressure and temperature for three different liquids X, Y, and Z is shown below



The following inferences are made **[JEE-Main 8-1-20_S1]**

(A) X has higher intermolecular interactions compared to Y.

(B) X has lower intermolecular interactions compared to Y

(C) Z has lower intermolecular interactions compared to Y.

The correct inferences is/are

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

12. An open beaker of water in equilibrium with water vapour is in a sealed container. When a few grams of glucose are added to the beaker of water, the rate at which water molecules **[JEE-Main 2-9-20_S1]**

(1) leaves the solution increases (2) leaves the vapour increases

(3) leaves the vapour decreases (4) leaves the solution decreases

13. The size of a raw mango shrinks to a much smaller size when kept in a concentrated salt solution. Which one of the following processes can explain this? **[JEE-Main 2-9-20_S2]**

(1) Osmosis (2) Reverse osmosis (3) Diffusion (4) Dialysis

14. Henry's constant (in kbar) for four gases α, β, γ and δ in water at 298 K is given below

	α	β	γ	δ
K_H	50	2	2×10^{-5}	0.5

(density of water = 10^3 kg m^{-3} at 298 K)

This table implies that **[JEE-Main 3-9-20_S1]**

(1) The pressure of a 55.5 molal solution of γ is 1 bar

(2) Solubility of γ at 308 K is lower than at 298 K

(3) α has the highest solubility in water at a given pressure

(4) The pressure of a 55.5 molal solution of δ is 250 bar

15. Which one of the following 0.06 M aqueous solutions has lowest freezing point ? **[JEE-Main 22-7-21_S2]**

(1) $Al_2(SO_4)_3$ (2) $C_6H_{12}O_6$ (3) KI (4) K_2SO_4

16. Match List I with List II.

	LIST-I		LIST-II
A	van't Hoff factor, i	**I**	Cryoscopic constant
B	k_f	**II**	Isotonic solutions
C	Solutions with same osmotic pressure	**III**	$\frac{\text{Normal molar mass}}{\text{Abnormal molar mass}}$
D	Azeotropes	**IV**	Solutions with same composition of vapour above it

Choose the correct answer from the options given below : **[JEE-Main 29-1-23_S2]**

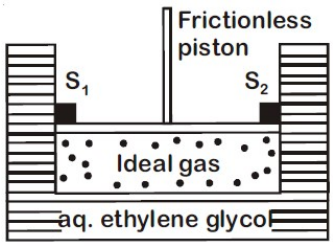
(1) A–III, B–I, C–II, D–IV (2) A–III, B–II, C–I, D–IV

(3) A–III, B–I, C–IV, D–II (4) A–L B–III, C–II, D–IV

17. How much amount of NaCl should be added to 600 g of water (ρ = 1.00 g/mL) to decrease the freezing point of water to –0.2°C? _____.

(The freezing point depression constant for water = 2 K kg mol^{-1}) **[JEE-Main 9-1-20_S1]**

18. A cylinder containing an ideal gas (0.1 mol of 1.0 dm^3) is in thermal equilibrium with a large volume of 0.5 molal aqueous solution of ethylene glycol at its freezing point. If the stoppers S_1 and S_2 (as shown in the figure) are suddenly withdrawn, the volume of the gas in litres after equilibrium is achieved will be _____ . (Given, K_f (water) = 2.0 K kg mol^{-1}, R = 0.08 dm^3 atm K^{-1} mol^{-1}) **[JEE-Main 9-1-20_S2]**



19. If 250 cm^3 of an aqueous solution containing 0.73 g of a protein A is isotonic with one litre of another aqueous solution containing 1.65 g of a protein B, at 298 K, the ratio of the molecular masses of A and B is _____ × 10^{-2} (to the nearest integer). **[JEE-Main 3-9-20_S2]**

20. At 300 K, the vapour pressure of a solution containing 1 mole of n-hexane and 3 moles of n-heptane is 550 mm of Hg. At the same temperature, if one more mole of n-heptane is added to this solution, the vapour pressure of the solution increases by 10 mm of Hg. What is the vapour pressure in mm Hg of n-heptane in its pure state _____? **[JEE-Main 4-9-20_S1]**

21. The osmotic pressure of a solution of NaCl is 0.10 atm and that of a glucose solution is 0.20 atm. The osmotic pressure of a solution formed by mixing 1 L of the sodium chloride solution with 2 L of the glucose solution is x × 10^{-3} atm. x is _____. (nearest integer) **[JEE-Main 4-9-20_S2]**

22. The elevation of boiling point of 0.10 m aqueous $CrCl_3 . xNH_3$ solution is two times that of 0.05 m aqueous $CaCl_2$ solution. The value of x is _____.
[Assume 100% ionisation of the complex and $CaCl_2$, coordination number of Cr as 6, and that all NH_3 molecules are present inside the coordination sphere] **[JEE-Main 6-9-20_S1]**

23. When 9.45 g of $ClCH_2COOH$ is added to 500 mL of water, its freezing point drops by 0.5ºC. The dissociation constant of $ClCH_2COOH$ is $x \times 10^{-3}$. The value of x is _____.
(Rounded off to the nearest integer)
$\left[K_{f(H_2O)} = 1.86 K \text{ kg mol}^{-1}\right]$ **[JEE-Main 24-2-21_S1]**

24. C_6H_6 freezes at 5.5°C. The temperature at which a solution 10 g of C_4H_{10} in 200 g of C_6H_6 freeze is _____ °C. (The molal freezing point depression constant of C_6H_6 is 5.12°C/m.)
[JEE-Main 24-2-21_S2]

25. 224 mL of $SO_{2(g)}$ at 298 K and 1 atm is passed through 100 mL of 0.1 M NaOH solution. The non-volatile solute produced is dissolved in 36 g of water. The lowering of vapour pressure of solution (assuming the solution is dilute) ($P_{(H2O)}$ = 24 mm of Hg) is $x \times 10^{-2}$ mm of Hg, the value of x is _____.
[JEE-Main 26-2-21_S1]

26. The oxygen dissolved in water exerts a partial pressure of 20 kPa in the vapour above water. The molar solubility of oxygen in water is _____ $\times 10^{-5}$ mol dm^{-3}.
(Round off to the Nearest Integer).
[Given : Henry's law constant
= $K_H = 8.0 \times 10^4$ kPa for O_2.
Density of water with dissolved oxygen = 1.0 kg dm^{-3}] **[JEE-Main 17-3-21_S1]**

27. A 1 molal $K_4Fe(CN)_6$ solution has a degree of dissociation of 0.4. Its boiling point is equal to that of another solution which contains 18.1 weight percent of a non electrolytic solute A. The molar mass of A is_____ u. (Round off to the Nearest Integer).
[Density of water = 1.0 g cm^{-3}] **[JEE-Main 17-3-21_S2]**

28. 1.46 g of a biopolymer dissolved in a 100 mL water at 300 K exerted an osmotic pressure of 2.42×10^{-3} bar.
The molar mass of the biopolymer is _____ $\times 10^4$ g mol^{-1}. (Round off to the Nearest Integer)
[Use : R = 0.083 L bar mol^{-1} K^{-1}] **[JEE-Main 27-7-21_S1]**

29. The Total pressure observed by mixing two liquid A and B is 350 mm Hg when their mole fractions are 0.7 and 0.3 respectively.

The Total pressure becomes 410 mm Hg if the mole fractions are changed to 0.2 and 0.8 respectively for A and B. The vapour pressure of pure A is _____ mm Hg. (Nearest integer)

Consider the liquids and solutions behave ideally. **[JEE-Main_24-1-23_S2]**

30. The number of pairs of the solution having the same value of the osmotic pressure from the following is _____. (Assume 100% ionization)

A. 0.500 M C_2H_5OH (aq) and 0.25 M KBr (aq)

B. 0.100 M $K_4[Fe(CN)_6]$ (aq) and 0.100 M $FeSO_4(NH_4)_2SO_4$ (aq)

C. 0.05 M $K_4[Fe(CN)_6]$ (aq) and 0.25 M NaCl (aq)

D. 0.15 M NaCl (aq) and 0.1 M $BaCl_2$ (aq)

E. 0.02 M KCl. $MgCl_2$. $6H_2O$ (aq) and 0.05 M KCl (aq) **[JEE-Main_25-1-23_S2]**

ANSWER KEY_LIQUID SOLUTION & COLLIGATIVE PROPERTIES

1.	(2)	**2.**	(4)	**3.**	(2)	**4.**	(1)	**5.**	(2)
6.	(3)	**7.**	(1)	**8.**	(2)	**9.**	(2)	**10.**	(2)
11.	(1)	**12.**	(4)	**13.**	(1)	**14.**	(2)	**15.**	(1)
16.	(1)	**17.**	**1.76**	**18.**	**2.18**	**19.**	**177**	**20.**	**600**
21.	**167.00**	**22.**	**5.00**	**23.**	**36**	**24.**	**1**	**25.**	**18**
26.	**1389**	**27.**	**85**	**28.**	**15**	**29.**	**314**	**30.**	**4.00**

CHEMISTRY

JEE MAIN PREVIOUS YEARS QUESTIONS – 2018-2023

CHAPTER NAME :- ELECTROCHEMISTRY

(IMPORTANT QUESTIONS ONLY)

1. How long (approximate) should water be electrolysed by passing through 100 amperes current so that the oxygen released can completely burn 27.66 g of diborane?
(Atomic weight of B = 10.8u) **[JEE-Main 2018_EC_M]**

(1) 3.2 hours (2) 1.6 hours (3) 6.4 hours (4) 0.8 hours

2. The anodic half-cell of lead-acid battery is recharged using electricity of 0.05 Faraday. The amount of $PbSO_4$ electrolyzed in g during the process is (Molar mass of $PbSO_4$ = 303 g mol^{-1})
[JEE-Main 9-1-19_S1]

(1) 7.6 (2) 15.2 (3) 11.4 (4) 22.8

3. Consider the following reduction processes:
$Zn^{2+} + 2e^- \rightarrow Zn(s)$; $E^o = -0.76$ V
$Ca^{2+} + 2e^- \rightarrow Ca(s)$; $E^o = -2.87$ V
$Mg^{2+} + 2e^- \rightarrow Mg(s)$; $E^o = -2.36$ V
$Ni^{2+} + 2e^- \rightarrow Ni(s)$; $E^o = -0.25$ V
The reducing power of the metals increases in the order : **[JEE-Main 10-1-19_S1]**

(1) Ca < Mg < Zn < Ni (2) Ni < Zn < Mg < Ca
(3) Ca < Zn < Mg < Ni (4) Zn < Mg < Ni < Ca

4. For the cell $Zn(s)|Zn^{2+}(aq)||M^{x+}(aq)|M(s)$, different half cells and their standard electrode potentials are given below **[JEE-Main 11-1-19_S1]**

$M^{x+}(aq)/M(s)$	$Au^{3+}(aq)/Au(s)$	$Ag^{+}(aq)/Ag(s)$	$Fe^{3+}(aq)/Fe^{2+}(aq)$	$Fe^{2+}(aq)/Fe(s)$
$E^\circ_{M^{x+}/M}$/(V)	1.40	0.80	0.77	– 0.44

If $E^\circ_{Zn^{2+}/Zn} = -0.76V$, which cathode will give a maximum value of E°_{cell} per electron transferred?

(1) Fe^{2+}/Fe (2) Ag^{+}/Ag (3) Fe^{3+}/Fe^{2+} (4) Au^{3+}/Au

5. Given the equilibrium constant :

K_C of the reaction :

$Cu(s) + 2Ag^+(aq) \rightarrow Cu^{2+}(aq) + 2Ag(s)$ is

10×10^{15}, calculate the E^0_{cell} of this reaction at 298K

$\left[2.303\frac{RT}{F}\text{at}\,298\,K = 0.059\,V\right]$ **[JEE-Main 11-1-19_S2]**

(1) 0.4736 mV (2) 0.4736 V (3) 0.04736 V (4) 0.04736 mV

6. The standard electrode potential E° and its temperature coefficient $\left(\frac{dE^\circ}{dT}\right)$ for a cell are 2V and -5×10^{-4} VK^{-1} at 300 K respectively. The cell reaction is

$Zn(s) + Cu^{2+}(aq) \rightarrow Zn^{2+}(aq) + Cu(s)$

The standard reaction enthalpy $(\Delta_r H^\circ)$ at 300 K in kJ mol^{-1} is,

[Use R = 8 JK^{-1} mol^{-1} and F = 96,000 C mol^{-1}] **[JEE-Main 12-1-19_S1]**

(1) 206.4 (2) –384.0 (3) –412.8 (4) 192.0

7. Λ°_m for NaCl, HCl and NaA are 126.4, 425.9 and 100.5 S cm^2mol^{-1}, respectively. If the conductivity of 0.001 M HA is 5×10^{-5} S cm^{-1}, degree of dissociation of HA is **[JEE-Main 12-1-19_S2]**

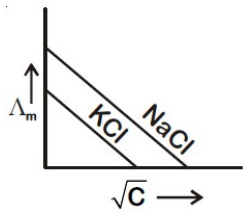
(1) 0.25 (2) 0.125 (3) 0.50 (4) 0.75

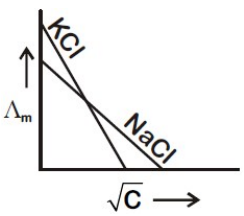
8. A solution of $Ni(NO_3)_2$ is electrolysed between platinum electrodes using 0.1 Faraday electricity. How many mole of Ni will be deposited at the cathode? **[JEE-Main 9-4-19_S2]**

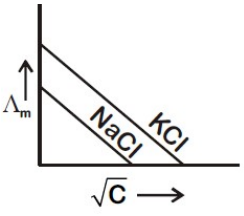
(1) 0.20 (2) 0.15 (3) 0.10 (4) 0.05

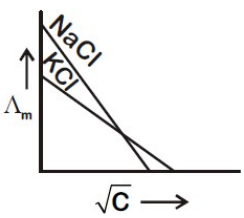
9. Which one of the following graphs between molar conductivity (Λ_m) versus $\sqrt{C}$ is correct?

[JEE-Main 10-4-19_S2]

(1) 

(2) 

(3) 

(4) 

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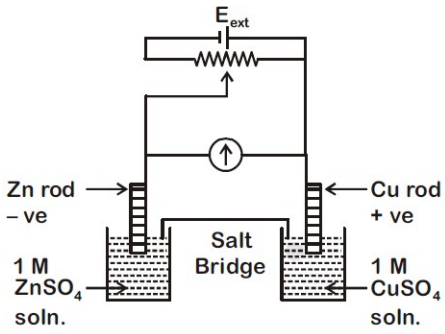


$E^0_{Cu^{2+}|Cu} = +0.34\ V$

$E^0_{Zn^{2+}|Zn} = -0.76\ V$

Identify the incorrect statement from the option below for the above cell: **[JEE-Main 4-9-20_S1]**

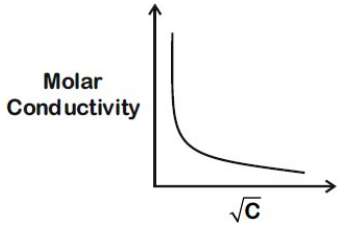
(1) If E_{ext} < 1.1 V, Zn dissolves at anode and Cu deposits at cathode

(2) If E_{ext} = 1.1 V, no flow of e^- or current occurs

(3) If E_{ext} > 1.1 V, e^- flows from Cu to Zn

(4) If E_{ext} > 1.1 V, Zn dissolves at Zn electrode and Cu deposits at Cu electrode

11. The variation of molar conductivity with concentration of an electrolyte (X) in aqueous solution is shown in the given figure. **[JEE-Main 5-9-20_S2]**



The electrolyte X is

(1) NaCl (2) HCl (3) CH_3COOH (4) KNO_3

12. Given below are two statements :

Statement I : The E° value of Ce^{4+} / Ce^{3+} is + 1.74 V.

Statement II : Ce is more stable in Ce^{4+} state than Ce^{3+} state.

In the light of the above statements, choose the most appropriate answer from the options given below : **[JEE-Main 16-3-21_S1]**

(1) Both statement I and statement II are correct

(2) Statement I is incorrect but statement II is correct

(3) Both statement I and statement II are incorrect

(4)Statement I is correct but statement II is incorrect

13. Given below are two statements : **[JEE-Main 26-8-21_S1]**

Statement I : The limiting molar conductivity of KCl (strong electrolyte) is higher compared to that of CH_3COOH (weak electrolyte).

Statement II : Molar conductivity decreases with decrease in concentration of electrolyte. In the light of the above statements, choose the most appropriate answer from the options given below :

(1) Statement I is true but Statement II is false.

(2) Statement I is false but Statement II is true.

(3) Both Statement I and Statement II are true.

(4) Both Statement I and Statement II are false.

14. The standard electrode potential (M^{3+}/M^{2+}) for V, Cr, Mn and Co are –0.26 V, –0.41 V, +1.57 V and +1.97 V, respectively. The metal ions which can liberate H_2 from a dilute acid are

[JEE-Main_29-1-23_S1]

(1) V^{2+} and Mn^{2+} (2) Cr^{2+} and Co^{2+} (3) V^{2+} and Cr^{2+} (4) Mn^{2+} and Co^{2+}

15. For an electrochemical cell, $Sn(s)|Sn^{2+}(aq, 1M)\ ||Pb^{2+}(aq, 1M)|Pb(s)$ the ratio $\frac{[Sn^{2+}]}{[Pb^{2+}]}$ when this cell attains equilibrium is _____.

(Given: $E^0_{Sn^{2+}|Sn} = -0.14V$

$E^0_{Pb^{2+}|Pb} = -0.13V.\ \frac{2.303RT}{F} = 0.06$) **[JEE-Main 8-1-20_S2]**

16. 108 g of silver (molar mass 108 g mol^{-1}) is deposited at cathode from $AgNO_3(aq)$ solution by a certain quantity of electricity. The volume (in L) of oxygen gas produced at 273 K and 1 bar pressure from water by the same quantity of electricity is _____. **[JEE-Main 9-1-20_S1]**

17. The Gibbs energy change (in J) for the given reaction at $[Cu^{2+}] = [Sn^{2+}] = 1$ M and 298 K is:

$Cu(s) + Sn^{2+}(aq.) \rightarrow Cu^{2+}(aq.) + Sn(s)$;

($E^0_{Sn^{2+}|Sn} = -0.16$ V, $E^0_{Cu^{2+}|Cu} = 0.34$ V

Take F = 96500 C mol^{-1}) **[JEE-Main 2-9-20_S1]**

18. The photoelectric current from Na (work function, w_0 = 2.3 eV) is stopped by the output voltage of the cell $Pt(s)|H_2(g, 1\ bar)|HCl(aq., pH = 1)|AgCl(s)|Ag(s)$. The pH of aq. HCl required to stop the photoelectric current from K(w_0 = 2.25 eV), all other conditions remaining the same, is _____ × 10^{-2} (to the nearest integer).

Given, $2.303\frac{RT}{F} = 0.06\,V;\ E^0_{AgCl|Ag|Cl^-} = 0.22\,V$ **[JEE-Main 3-9-20_S1]**

19. An acidic solution of dichromate is electrolyzed for 8 minutes using 2 A current. As per the following equation

$Cr_2O_7^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{3+} + 7H_2O$

The amount of Cr^{3+} obtained was 0.104 g. The efficiency of the process (in%) is (Take : F = 96000 C, At. mass of chromium = 52)_____. **[JEE-Main 3-9-20_S2]**

20. Potassium chlorate is prepared by the electrolysis of KCl in basic solution.

$6OH^- + Cl^- \rightarrow ClO_3^- + 3H_2O + 6e^-$

If only 60% of the current is utilized in the reaction, the time (rounded to the nearest hour) required to produce 10 g of $KClO_3$ using a current of 2 A is_____.

(Given : F = 96,500 C mol^{-1}; molar mass of $KClO_3$ = 122 g mol^{-1}) **[JEE-Main 6-9-20_S1]**

21. The magnitude of the change in oxidising power of the MnO_4^-/Mn^{2+} couple is x × 10^{-4} V, if the H^+ concentration is decreased from 1 M to 10^{-4} M at 25°C. (Assume concentration of MnO_4^- and Mn^{2+} to be same on change in H^+ concentration). The value of x is _____.

(Rounded off to the nearest integer)

$\left[\text{Given}: \frac{2.303\,RT}{F} = 0.059\right]$ **[JEE-Main 24-2-21_S2]**

22. Emf of the following cell at 298 K in V is x × 10^{-2}. $Zn|Zn^{2+}$ (0.1 M)$||Ag^+$ (0.01 M)| Ag. The value of x is _____. (Rounded off to the nearest integer)

$[\text{Given}: E^0_{Zn^{2+}/Zn} = -0.76\,V; E^0_{Ag^+|Ag} = +0.80\,V; \frac{2.303RT}{F} = 0.059]$ **[JEE-Main 26-2-21_S2]**

23. A 5.0 m mol dm^{-3} aqueous solution of KCl has a conductance of 0.55 mS when measured in a cell constant 1.3 cm^{-1}. The molar conductivity of this solution is _____ $mSm^2\ mol^{-1}$.

(Round off to the Nearest Integer) **[JEE-Main 16-3-21_S2]**

24. The molar conductivities at infinite dilution of barium chloride, sulphuric arid and hydrochloric acid are 280, 860 and 426 $Scm^2\ mol^{-1}$ respectively. The molar conductivity at infinite dilution of barium sulphate is _____S $cm^2\ mol^{-1}$ (Round off to the Nearest Integer). **[JEE-Main 18-3-21_S2]**

25. For the reaction

$2Fe^{3+}(aq) + 2I^-(aq) \rightarrow 2Fe^{2+}(aq) + I_2(s)$

the magnitude of the standard molar free energy change, $\Delta_r G^0_m$ = –..... kJ (Round off to the Nearest Integer).

$\left[\begin{matrix} E_{Fe^{2+}/Fe(s)} = -0.440\,V; & E^0_{Fe^{3+}/Fe(s)} = -0.036\,V \\ E^0_{I_2/2I^-} = 0.539\ V; & F = 96500\,C \end{matrix}\right]$ **[JEE-Main 18-3-21_S1]**

26. Potassium chlorate is prepared by electrolysis of KCl in basic solution as shown by following equation.

$6OH^- + Cl^- \rightarrow ClO_3^- + 3H_2O + 6e^-$

A current of xA has to be passed for 10h to produce 10.0g of potassium chlorate. the value of x is _____. (Nearest integer) (Molar mass of $KClO_3$ = 122.6 g mol^{-1}, F = 96500 C)

[JEE-Main 20-7-21_S2]

27. Assume a cell with the following reaction

$Cu_{(s)} + 2Ag^+(1 \times 10^{-3}\ M) \rightarrow Cu^{2+}(0.250\ M) + 2Ag_{(s)}$

$E^o_{cell} = 2.97V$

E_{cell} for the above reaction is _____V.

(Nearest integer)

[Given : log 2.5 = 0.3979, T = 298 K] **[JEE-Main 22-7-21_S2]**

28. The conductivity of a weak acid HA of concentration 0.001 mol L^{-1} is 2.0×10^{-5} S cm^{-1}. If $\Lambda^o_m(HA) = 190\,S\ cm^2\ mol^{-1}$, the ionization constant (Ka) of HA is equal to _____ $\times 10^{-6}$.

(Round off to the Nearest Integer) **[JEE-Main 27-7-21_S1]**

29. Consider the cell

$Pt(s) \mid H_2(g)(1\ atm) \mid H^+(aq, [H^+] = 1M) \parallel Fe^{3+}(aq), Fe^{2+}(aq) \mid Pt(s)$

Given : $E^\circ_{Fe^{3+}/Fe^{2+}} = 0.771V$ and $E^\circ_{H^+/\frac{1}{2}H_2} = 0V$, T = 298K

If the potential of the cell is 0.712 V the ratio of concentration of Fe^{2+} to Fe^{3+} is_____

(Nearest integer) **[JEE-Main_25-1-23_S1]**

30. The equilibrium constant for the reaction $Zn(s) + Sn^{2+}(aq) \rightleftharpoons Zn^{2+}(aq) + Sn(s)$ is 1×10^{20} at 298 K. The magnitude of standard electrode potential of Sn/Sn^{2+} if $E^\circ_{Zn^{2+}/Zn} = -0.76\,V$ is ____ $\times 10^{-2}$ V.

(Nearest integer) Given: $\frac{2.303\,RT}{F} = 0.059\,V$ **[JEE-Main_29-1-23_S2]**

ANSWER KEY_ELECTROCHEMISTRY

1.	(1)	**2.**	(1)	**3.**	(2)	**4.**	(4)	**5.**	(2)
6.	(3)	**7.**	(2)	**8.**	(4)	**9.**	(3)	**10.**	(4)
11.	(3)	**12.**	(4)	**13.**	(4)	**14.**	(3)	**15.**	**2.15**
16.	**5.68**	**17.**	**96500**	**18.**	**142**	**19.**	**60.00**	**20.**	**11**
21.	**3776**	**22.**	**147**	**23.**	**14**	**24.**	**288**	**25.**	**45**
26.	**1**	**27.**	**3**	**28.**	**12**	**29.**	**10**	**30.**	**17**

CHEMISTRY

JEE MAIN PREVIOUS YEARS QUESTIONS – 2018-2023

CHAPTER NAME :- CHEMICAL KINETICS

(IMPORTANT QUESTIONS ONLY)

1. It is true that **[JEE-Main 3-9-20_S1]**

(1) A zero order reaction is a single step reaction

(2) A zero order reaction is a multistep reaction

(3) A first order reaction is always a single step reaction

(4) A second order reaction is always a multistep reaction

2. The rate of a certain biochemical reaction at physiological temperature (T) occurs 10^6 times faster with enzyme than without. The change in the activation energy upon adding enzyme is

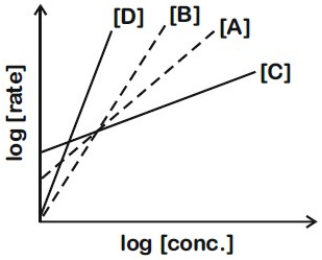
[JEE-Main 8-1-20_S1]

(1) – 6RT (2) + 6RT (3) + 6(2.303)RT (4) – 6(2.303)RT

3. Consider the following reactions

$A \rightarrow P1$; $B \rightarrow P2$; $C \rightarrow P3$; $D \rightarrow P4$,

The order of the above reactions are a, b, c, and d, respectively. The following graph is obtained when log[rate] vs. log[conc.] are plotted **[JEE-Main 6-9-20_S1]**



Among the following, the correct sequence for the order of the reactions is

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

4. A flask contains a mixture of compounds A and B. Both compounds decompose by first-order kinetics. The half-lives for A and B are 300 s and 180 s, respectively. If the concentrations of A and B are equal initially, the time required for the concentration of A to be four times that of B (in s) is : (Use In 2 = 0.693) **[JEE-Main 5-9-20_S1]**

(1) 120 (2) 300 (3) 180 (4) 900

5. The results given in the below table were obtained during kinetic studies of the following reaction

$2\ A + B \rightarrow C + D$

Experiment	[A]/ $molL^{-1}$	[B]/ $molL^{-1}$	Initial rate/ $molL^{-1}\ min^{-1}$
I	0.1	0.1	6.00×10^{-3}
II	0.1	0.2	2.40×10^{-2}
III	0.2	0.1	1.20×10^{-2}
IV	X	0.2	7.20×10^{-2}
V	0.3	Y	2.88×10^{-1}

X and Y in the given table are respectively **[JEE-Main 2-9-20_S2]**

(1) 0.4, 0.3 (2) 0.3, 0.4 (3) 0.4, 0.4 (4) 0.3, 0.3

6. At 30°C, the half life for the decomposition of AB_2 is 200 s and is independent of the initial concentration of AB_2. The time required for 80% of the AB_2 to decompose is (Given: log 2 = 0.30; log 3 = 0.48)

[JEE-Main 26-7-22_S2]

(1) 200 s (2) 323 s (3) 467 s (4) 532 s

7. For a first order reaction, the time required for completion of 90% reaction is 'x' times the half life of the reaction. The value of 'x' is

(Given: ln 10 = 2.303 and log 2 = 0.3010) **[JEE-Main 24-6-22_S2]**

(1) 1.12 (2) 2.43 (3) 3.32 (4) 33.31

8. A student has studied the decomposition of a gas AB_3 at 25°C. He obtained the following data.

p (mm Hg)	50	100	200	400
Relative $t_{1/2}$ (s)	4	2	1	0.5

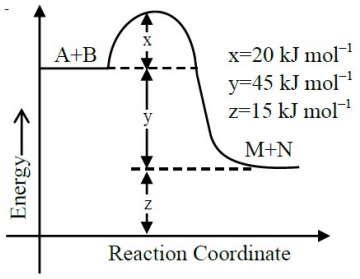
The order of the reaction is **[JEE-Main 24-1-23_S2]**

(1) 0.5 (2) 2 (3) 1 (4) 0

9. During the nuclear explosion, one of the products is ^{90}Sr with half life of 6.93 years. If 1 μg of ^{90}Sr was absorbed in the bones of a newly born baby in place of Ca, how much time, in years, is required to reduce it by 90% if it is not lost metabolically _____. **[JEE-Main 7-1-20_S1]**

10. According to the following figure, the magnitude of the enthalpy change of the reaction

$A + B \rightarrow M + N$ in kJ mol^{-1} is equal to _____. (Integer answer) **[JEE-Main 31-8-21_S1]**



11. For the reaction $A \rightarrow B$, the rate constant k(in s^{-1}) is given by

$$\log_{10} k = 20.35 - \frac{(2.47 \times 10^3)}{T}$$

The energy of activation in kJ mol^{-1} is _____.

(Nearest integer)

[Given : R = 8.314 J K^{-1} mol^{-1}] **[JEE-Main 31-8-21_S2]**

12. The first order rate constant for the decomposition of $CaCO_3$ at 700 K is $6.36 \times 10^{-3} s^{-1}$ and activation energy is 209 kJ mol^{-1}. Its rate constant (in s^{-1}) at 600 K is $x \times 10^{-6}$. The value of x is _____.

(Nearest integer)

[Given R = 8.31 J K^{-1} mol^{-1}; log 6.36×10^{-3} = –2.19, 10^{-4}.79 = 1.62×10^{-5}] **[JEE-Main 27-8-21_S2]**

13. The following data was obtained for chemical reaction given below at 975 K.

$2NO_{(g)} + 2H_{2(g)} \rightarrow N_{2(g)} + 2H_2O_{(g)}$

[NO]	$[H_2]$	Rate
mol L^{-1}	mol L^{-1}	mol $L^{-1}s^{-1}$
(A) 8×10^{-5}	8×10^{-5}	7×10^{-9}
(B) 24×10^{-5}	8×10^{-5}	2.1×10^{-8}
(C) 24×10^{-5}	32×10^{-5}	8.4×10^{-8}

The order of the reaction with respect to NO is _____. [Integer answer] **[JEE-Main 26-8-21_S1]**

14. The inactivation rate of a viral preparation is proportional to the amount of virus. In the first minute after preparation, 10% of the virus is inactivated. The rate constant for viral inactivation is _____ $\times 10^{-3}$ min^{-1}. (Nearest integer)

[Use : ln 10 = 2.303 ; $\log_{10}$ 3 = 0.477;

property of logarithm : log x^y = y log x] **[JEE-Main 20-7-21_S1]**

15. $PCl_5(g) \rightarrow PCl_3(g) + Cl_2(g)$

In the above first order reaction the concentration of PCl_5 reduces from initial concentration 50 mol L^{-1} to 10 mol L^{-1} in 120 minutes at 300 K. The rate constant for the reaction at 300 K is $x \times 10^{-2}$ min^{-1}. The value of x is _____. [Given log5 = 0.6989] **[JEE-Main 20-7-21_S2]**

16. The rate constant of a reaction increases by five times on increase in temperature from 27°C to 52°C. The value of activation energy in kJ mol^{-1} is _____ (Rounded-off to the nearest integer)
[R = 8.314 J K^{-1} mol^{-1}] **[JEE-Main 25-2-21_S2]**

17. An exothermic reaction X $\rightarrow$ Y has an activation energy 30 kJ mol^{-1}. If energy change ΔE during the reaction is –20 kJ, then the activation energy for the reverse reaction in kJ is ____.(Integer answer)
[JEE-Main 26-2-21_S1]

18. For the given first order reaction

$A \rightarrow B$

the half life of the reaction is 0.3010 min. The ratio of the initial concentration of reactant to the concentration of reactant at time 2.0 min will be equal to _____. (Nearest integer)
[JEE-Main 28-7-22_S1]

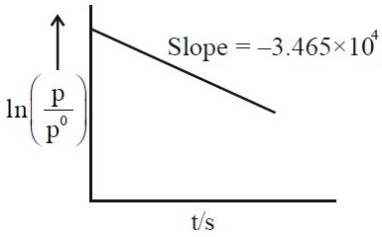
19. The reaction between X and Y is first order with respect to X and zero order with respect to Y.

Experiment	[X] / mol L^{-1}	[Y] / mol L^{-1}	Initial rate / mol L^{-1} min^{-1}
I.	0.1	0.1	2×10^{-3}
II.	L	0.2	4×10^{-3}
III.	0.4	0.4	$M \times 10^{-3}$
IV.	0.1	0.2	2×10^{-3}

Examine the data of table and calculate ratio of numerical values of M and L. (Nearest Inetger)
[JEE-Main 29-7-22_S1]

20. Assuming 1μg of trace radioactive element X with a half life of 30 years is absorbed by a growing tree. The amount of X remaining in the tree after 100 years is ___ $\times 10^{-1}$ μg.
[Given : In 10 = 2.303; log 2 = 0.30] **[JEE-Main 29-7-22_S2]**

21. For the decomposition of azomethane.
$CH_3N_2CH_3(g) \rightarrow CH_3CH_3(g)+N_2(g)$ a first order reaction, the variation in partial pressure with time at 600 K is given as



The half life of the reaction is _____ $\times 10^{-5}$s. [Nearest integer] **[JEE-Main 25-7-22_S2]**

22. For a reaction A $\rightarrow$ 2B + C the half lives are 100 s and 50 s when the concentration of reactant A is 0.5 and 1.0 mol L^{-1} respectively. The order of the reaction is___ _____. (Nearest Integer)

[JEE-Main 26-7-22_S1]

23. The activation energy of one of the reactions in a biochemical process is 532611 J mol^{-1}. When the temperature falls from 310 K to 300 K, the change in rate constant observed is $k_{300} = x \times 10^{-3} k_{310}$. The value of x is _____.

[Given: ln10 = 2.3

R = 8.3 J K^{-1} mol^{-1}]

[JEE-Main 29-6-22_S1]

24. The rate constant for a first order reaction is given by the following equation:

$$\ln k = 33.24 - \frac{2.0 \times 10^4 K}{T}$$

The Activation energy for the reaction is given by _____ kJ mol^{-1}. (In Nearest integer)

(Given: R = 8.3 J K^{-1} mol^{-1})

[JEE-Main 27-6-22_S1]

25. It has been found that for a chemical reaction with rise in temperature by 9K the rate constant gets doubled. Assuming a reaction to be occurring at 300 K, the value of activation energy is found to be _____ kJ mol^{-1}. [nearest integer]

(Given ln 10 = 2.3, R = 8.3 $JK^{-1}mol^{-1}$, log2 = 0.30)

[JEE-Main 27-6-22_S2]

26. A flask is filled with equal moles of A and B. The half lives of A and B are 100 s and 50 s respectively and are independent of the initial concentration. The time required for the concentration of A to be four times that of B is _____s.

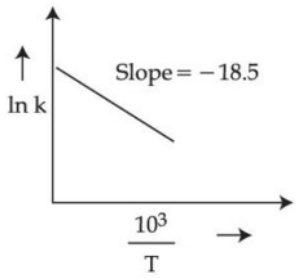
(Given : ln 2 = 0.693)

[JEE-Main 26-6-22_S1]

27. The rate constants for decomposition of acetaldehyde have been measured over the temperature range 700 –1000 K. The data has been analysed by plotting ln k vs $\frac{10^3}{T}$ graph.The value of activation energy for the reaction is___ kJ mol^{-1}.

(Nearest integer) (Given : R = 8.31 J K^{-1} mol^{-1})

[JEE-Main 24-6-22_S1]



28. At 345 K, the half life for the decomposition of a sample of a gaseous compound initially at 55.5 kPa was 340 s. When the pressure was 27.8 kPa, the half life was found to be 170 s. The order of the reaction is_____. [integer answer] **[JEE-Main 25-6-22_S2]**

29. The number of correct statement/s from the following is _____.

A. Larger the activation energy, smaller is the value of the rate constant.

B. The higher is the activation energy, higher is the value of the temperature coefficient.

C. At lower temperatures, increase in temperature causes more change in the value of k than at higher temperature.

D. A plot of ln k vs $\frac{1}{T}$ is a straight line with slope equal to $-\frac{Ea}{R}$ **[JEE-Main 24-1-23_S1]**

30. A first order reaction has the rate constant, k = 4.6×10^{-3} s^{-1}. The number of correct statement/s from the following is/are _____. Given : log 3 = 0.48

A. Reaction completes in 1000 s.

B. The reaction has a half–life of 500 s.

C. The time required for 10% completion is 25 times the time required for 90% completion.

D. The degree of dissociation is equal to $(1 - e^{-kt})$.

E. The rate and the rate constant have the same unit. **[JEE-Main 25-1-23_S2]**

ANSWER KEY_CHEMICAL KINETICS

1.	(2)	**2.**	(4)	**3.**	(1)	**4.**	(4)	**5.**	(2)
6.	(3)	**7.**	(3)	**8.**	(2)	**9.**	**23.03**	**10.**	**45**
11.	**47**	**12.**	**16**	**13.**	**1**	**14.**	**106**	**15.**	**1**
16.	**52**	**17.**	**50**	**18.**	**100**	**19.**	**40**	**20.**	**1**
21.	**2**	**22.**	**2**	**23.**	**1**	**24.**	**166**	**25.**	**59**
26.	**200**	**27.**	**154**	**28.**	**0**	**29.**	**3**	**30.**	**2.00**

CHEMISTRY

JEE MAIN PREVIOUS YEARS QUESTIONS – 2018-2023

CHAPTER NAME :- METALLURGY

(IMPORTANT QUESTIONS ONLY)

1. For a reaction,

$4M(s) + nO_2(g) \rightarrow 2M_2O_n(s)$

the free energy change is plotted as a function of temperature. The temperature below which the oxide is stable could be inferred from the plot as the point at which **[JEE-Main 6-9-20_S2]**

(1) the free energy change shows a change from negative to positive value

(2) the slope changes from positive to negative

(3) the slope changes from negative to positive

(4) the slope changes from positive to zero

2. An Ellingham diagram provides information about **[JEE-Main 5-9-20_S1]**

(1) the temperature dependence of the standard Gibbs energies of formation of some metal oxides

(2) the pressure dependence of the standard electrode potentials of reduction reactions involved in the extraction of metals

(3) the conditions of pH and potential under which a species is thermodynamically stable

(4) the kinetics of the reduction process

3. Cast iron is used for the manufacture of **[JEE-Main 2-9-20_S2]**

(1) wrought iron, pig iron and steel

(2) pig iron, scrap iron and steel

(3) wrought iron and pig iron

(4) wrought iron and steel

4. Among statements (a) - (d), the correct ones are **[JEE-Main 4-9-20_S1]**

(a) Lime stone is decomposed to CaO during the extraction of iron from its oxides.

(b) In the extraction of silver, silver is extracted as an anionic complex.

(c) Nickel is purified by Mond's process.

(d) Zr and Ti are purified by Van Arkel method.

(1) (a), (c) and (d) only

(2) (c) and (d) only

(3) (b), (c) and (d) only

(4) (a), (b), (c) and (d)

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

Assertion (A) : Aluminium is extracted from bauxite by the electrolysis of molten mixture of Al_2O_3 with cryolite.

Reason (R) : The oxidation state of Al in cryolite is +3. **[JEE-Main 31-8-21_S1]**

In the light of the above statements, choose the most appropriate 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 correct and (R) is the correct explanation of (A)

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

6. Which refining process is generally used in the purification of low melting metals ? **[JEE-Main 27-8-21_S1]**

(1) Chromatographic method (2) Liquation

(3) Electrolysis (4) Zone refining

7. Given below are two statements :

Statement I : Sphalerite is a sulphide ore of zinc and copper glance is a sulphide ore of copper.

Statement II : It is possible to separate two sulphide ores by adjusting proportion of oil to water or by using 'depressants' in a froth flotation method.

Choose the most appropriate answer from the options given below : **[JEE-Main 26-8-21_S2]**

(1) Statement I is true but Statement II is false. (2) Both Statement I and Statement II are true.

(3) Statement I is false but Statement II is true. (4) Both Statement I and Statement II are false.

8. Match List I with List II : (Both having metallurgical terms)

List-I	**List-II**
(a) Concentration of Ag ore	(i) Reverberatory furnace
(b) Blast furnace	(ii) Pig iron
(c) Blister copper	(iii) Leaching with dilute NaCN solution
(d) Froth floatation method	(iv) Sulfide ores

Choose the correct answer from the options given below : **[JEE-Main 25-7-21_S2]**

(1) (a)–(iii), (b)–(ii), (c)–(i), (d)–(iv) (2) (a)–(iii), (b)–(iv), (c)–(i), (d)–(ii)

(3) (a)–(iv), (b)–(i), (c)–(iii), (d)–(ii) (4) (a)–(iv), (b)–(iii), (c)–(ii), (d)–(i)

9. The statement that is INCORRECT about Ellingham diagram is **[JEE-Main 27-7-21_S1]**

(1) provides idea about the reaction rate.

(2) provides idea about free energy change.

(3) provides idea about changes in the phases during the reaction.

(4) provides idea about reduction of metal oxide.

10. Consider two chemical reactions (A) and (B) that take place during metallurgical process :

(A) $ZnCO_{3(s)} \xrightarrow{\Delta} ZnO_{(s)} + CO_{2(g)}$

(B) $2ZnS_{(s)} + 3O_{2(g)} \xrightarrow{\Delta} 2ZnO_{(s)} + 2SO_{2(g)}$

The correct option of names given to them respectively is : **[JEE-Main 20-7-21_S2]**

(1) (A) is calcination and (B) is roasting

(2) Both (A) and (B) are producing same products so both are roasting

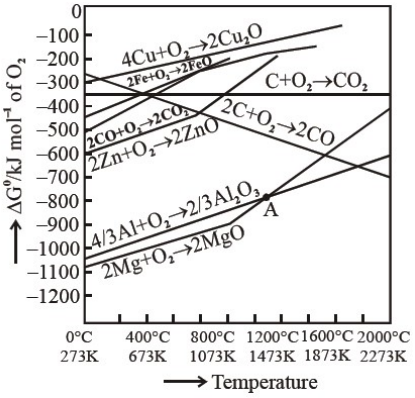
(3) Both (A) and (B) are producing same product so both are calcination

(4) (A) is roasting and (B) is calcination

11. Which of the following reduction reaction CANNOT be carried out with coke ? **[JEE-Main 16-3-21_S2]**

(1) $Al_2O_3 \rightarrow Al$ (2) $ZnO \rightarrow Zn$ (3) $Fe_2O_3 \rightarrow Fe$ (4) $Cu_2O \rightarrow Cu$

12. The point of intersection and sudden increase in the slope, in the diagram given below, respectively, indicates : **[JEE-Main 17-3-21_S1]**



(1) $\Delta G = 0$ and melting or boiling point of the metal oxide

(2) $\Delta G > 0$ and decomposition of the metal oxide

(3) $\Delta G < 0$ and decomposition of the metal oxide

(4) $\Delta G = 0$ and reduction of the metal oxide

13. Match List-I with List-II.

List-I	**List-II**
(a) Siderite	(i) Cu
(b) Calamine	(ii) Ca
(c) Malachite	(iii) Fe
(d) Cryolite	(iv) Al
	(v) Zn

Choose the correct answer from the options given below : **[JEE-Main 26-2-21_S2]**

(1) (a) → (iii), (b) → (i), (c) → (v), (d) → (ii) (2) (a) → (i), (b) → (ii), (c) → (v), (d) → (iii)

(3) (a) → (iii), (b) → (v), (c) → (i), (d) → (iv) (4) (a) → (i), (b) → (ii), (c) → (iii), (d) → (iv)

14. Match List -I with List - II

List - I	**List - II**
(Ore)	**(Element Present)**
(a) Kernite	(i) Tin
(b) Cassiterite	(ii) Boron
(c) Calamine	(iii) Fluorine
(d) Cryolite	(iv) Zinc

Choose the most appropriate answer from the options given below. **[JEE-Main 26-2-21_S1]**

(1) (a) → (i), (b) → (iii), (c) → (iv), (d) → (ii) (2) (a) → (ii), (b) → (i), (c) → (iv), (d) → (iii)

(3) (a) → (ii), (b) → (iv), (c) → (i), (d) → (iii) (4) (a) → (iii), (b) → (i), (c) → (ii), (d) → (iv)

15. Which of the following ore is concentrated using group 1 cyanide salt ? **[JEE-Main 24-2-21_S1]**

(1) Sphalerite (2) Calamine (3) Siderite (4) Malachite

16. Al_2O_3 was leached with alkali to get X. The solution of X on passing of gas Y, forms Z. X, Y and Z respectively are : **[JEE-Main 24-2-21_S1]**

(1) X = $Na[Al(OH)_4]$, Y = SO_2, Z = Al_2O_3 (2) X = $Na[Al(OH)_4]$, Y = CO_2, Z = $Al_2O_3.xH_2O$

(3) X = $Al(OH)_3$, Y = CO_2, Z = Al_2O_3 (4) X = $Al(OH)_3$, Y = SO_2, Z = $Al_2O_3.xH_2O$

17. Which of the reaction is suitable for concentrating ore by leaching process ?**[JEE-Main 28-7-22_S1]**

(1) $2Cu_2S + 3O_2 \rightarrow 2Cu_2O + 2SO_2$ (2) $Fe_3O_4 + CO \rightarrow 3FeO + CO_2$

(3) $Al_2O_3 + 2NaOH + 3H_2O \rightarrow 2Na[Al(OH)_4]$ (4) $Al_2O_3 + 6Mg \rightarrow 6MgO + 4Al$

18. Refining using liquation method is the most suitable for metals with : **[JEE-Main 26-7-22_S1]**

(1) Low melting point

(2) High boiling point

(3) High electrical conductivity

(4) Less tendency to be soluble in melts than impurities

19. The compound(s) that is(are) removed as slag during the extraction of copper is :

(1) CaO (2) FeO (3) Al_2O_3 (4) ZnO (5) NiO

Choose the correct answer from the options given below : **[JEE-Main 25-7-22_S1]**

(1) (3) (4) Only (2) (1), (2), (5) Only (3) (1), (2) Only (4) (2) Only

20. Given below are two statements.

Statement I : Pig iron is obtained by heating cast iron with scrap iron.

Statement II: Pig iron has a relatively lower carbon content than that of cast iron. In the light of the above statements, choose the correct answer from the options given below.**[JEE-Main 25-7-22_S2]**

(1) Both Statement I and Statement II are correct.

(2) Both Statement I and Statement II are not correct.

(3) Statement I is correct but Statement II is not correct

(4) Statement I is not correct but Statement II is correct.

21. Given are two statements one is labelled as Assertion A and other is labelled as Reason R.

Assertion A : Magnesium can reduce Al_2O_3 at a temperature below 1350°C, while above 1350°C aluminium can reduce MgO.

Reason R : The melting and boiling points of magnesium are lower than those of aluminium.

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

[JEE-Main 28-6-22_S1]

(1) Both A and R are correct. and R is correct explanation of A.

(2) Both A and R are correct. but R is NOT the correct explanation of A.

(3) A is correct R is not correct.

(4) A is not correct. R is correct.

22. Given below are two statements.

Statement I: During electrolytic refining, blister copper deposits precious metals

Statement II: In the process of obtaining pure copper by electrolysis method, copper blister is used to make the anode.

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

[JEE-Main 25-6-22_S2]

(1) Both Statement I and Statement II are true. (2) Both Statement I and Statement II are false.

(3) Statement I is true but Statement II is false. (4) Statement I is false but Statement II is true.

23. Given below are two statements:

Statement I : According to the Ellingham diagram, any metal oxide with higher ΔG° is more stable than the one with lower ΔG°.

Statement II : The metal involved in the formation of oxide placed lower in the Ellingham diagram can reduce the oxide of a metal placed higher in the diagram.

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

[JEE-Main 26-6-22_S1]

(1) Both Statement I and Statement II are correct.

(2) Both Statement I and Statement II are incorrect.

(3) Statement I is correct but Statement II is incorrect.

(4) Statement I is incorrect but Statement II is correct.

24. Match List – I with List – II

	List – I		**List - II**
(A)	Sphalerite	(I)	$FeCO_3$
(B)	Calamine	(II)	PbS
(C)	Galena	(III)	$ZnCO_3$
(D)	Siderite	(IV)	ZnS

Choose the most appropriate answer from the options given below: **[JEE-Main 24-6-22_S1]**

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

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

25. The metal which is extracted by oxidation and subsequent reduction from its ore is :

[JEE-Main_24-1-23_S2]

(1) Al (2) Ag (3) Cu (4) Fe

26. Match List I with List II. **[JEE-Main_24-1-23_S1]**

	LIST-I		LIST-II
A	Reverberatory furnace	**I**	Pig Iron
B	Electrolytic cell	**II**	Aluminium
C	Blast furnace	**III**	Silicon
D	Zone Refining furnace	**IV**	Copper

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

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

27. Given below are two statements :–

Statement I : In froth floatation method a rotating paddle agitates the mixture to drive air out of it.

Statement II : Iron pyrites are generally avoided for extraction of iron due to environmental reasons.

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

[JEE-Main_25-1-23_S2]

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

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

28. In the electrolytic refining of blister copper, the total number of main impurities, from the following, removed as anode mud is _____

Pb, Sb, Se, Te, Ru, Ag, Au and Pt **[JEE-Main 31-8-21_S2]**

29. Among the following ores Bauxite, Siderite, Cuprite, Calamine, Haematite, Kaolinite, Malachite, Magnetite, Sphalerite, Limonite, Cryolite, the number of principal ores if (of) iron is_____.

[JEE-Main 27-7-22_S2]

30. (a) Baryte, (b) Galena, (c) Zinc blende and (d) Copper pyrites. How many of these minerals are sulphide based? **[JEE-Main 24-6-22_S2]**

ANSWER KEY_METALLURGY

1.	(1)	**2.**	(1)	**3.**	(4)	**4.**	(4)	**5.**	(4)
6.	(2)	**7.**	(2)	**8.**	(1)	**9.**	(1)	**10.**	(1)
11.	(1)	**12.**	(1)	**13.**	(3)	**14.**	(2)	**15.**	(1)
16.	(2)	**17.**	(3)	**18.**	(1)	**19.**	(4)	**20.**	(2)
21.	(2)	**22.**	(1)	**23.**	(4)	**24.**	(1)	**25.**	(2)
26.	(1)	**27.**	(2)	**28.**	**6**	**29.**	**4**	**30.**	**3**

CHEMISTRY

JEE MAIN PREVIOUS YEARS QUESTIONS – 2018-2023

CHAPTER NAME :- COORDINATION COMPOUND

(IMPORTANT QUESTIONS ONLY)

1. Consider the following reaction and statements :

$[Co(NH_3)_4Br_2]^+ + Br^- \rightarrow [Co(NH_3)_3Br_3] + NH_3$

(I) Two isomers are produced if the reactant complex ion is a cis-isomer.

(II) Two isomers are produced if the reactant complex ion is a trans-isomer.

(III) Only one isomer is produced if the reactant complex ion is a trans-isomer.

(IV) Only one isomer is produced if the reactant complex ion is a cis-isomer.

The correct statements are : **[JEE-Main 2018]**

(1) (III) and (IV) (2) (II) and (IV) (3) (I) and (II) (4) (I) and (III)

2. A reaction of cobalt (III) chloride and ethylenediamine in a 1 : 2 mole ratio generates two isomeric products A (violet coloured) and B (green coloured). A can show optical activity, but, B is optically inactive. What type of isomers does A and B represent? **[JEE-Main 10-1-19_S2]**

(1) Ionisation isomers (2) Coordination isomers

(3) Geometrical isomers (4) Linkage isomers

3. The total number of isomers for a square planar complex $[M(F)(Cl)(SCN)(NO_2)]$ is **[JEE-Main 10-1-19_S1]**

(1) 8 (2) 12 (3) 4 (4) 16

4. The coordination number of Th in $K_4[Th(C_2O_4)_4(OH_2)_2]$ is **[JEE-Main 11-1-19_S2]**

$\left(C_2O_4^{2-} = \text{Oxalato}\right)$

(1) 10 (2) 6 (3) 14 (4) 8

5. The pair of metal ions that can give a spin only magnetic moment of 3.9 BM for the complex $[M(H_2O)_6]Cl_2$, is **[JEE-Main 12-1-19_S1]**

(1) V^{2+} and Co^{2+} (2) Co^{2+} and Fe^{2+} (3) V^{2+} and Fe^{2+} (4) Cr^{2+} and Mn^{2+}

6. The calculated spin-only magnetic moments (BM) of the anionic and cationic species of $[Fe(H_2O)_6]_2$ and $[Fe(CN)_6]$, respectively, are: **[JEE-Main 8-4-19_S2]**

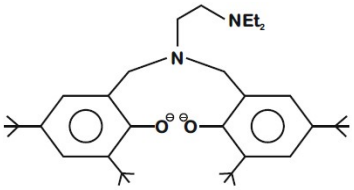
(1) 2.84 and 5.92 (2) 4.9 and 0 (3) 0 and 5.92 (4) 0 and 4.9

7. The correct order of the spin-only magnetic moment of metal ions in the following low-spin complexes, $[V(CN)_6]^{4-}$, $[Fe(CN)_6]^{4-}$, $[Ru(NH_3)_6]^{3+}$ and $[Cr(NH_3)_6]^{2+}$, is: **[JEE-Main 8-4-19_S1]**

(1) $V^{2+} > Cr^{2+} > Ru^{3+} > Fe^{2+}$ (2) $Cr^{2+} > V^{2+} > Ru^{3+} > Fe^{2+}$

(3) $V^{2+} > Ru^{3+} > Cr^{2+} > Fe^{2+}$ (4) $Cr^{2+} > Ru^{3+} > Fe^{2+} > V^{2+}$

8. The following ligand is **[JEE-Main 8-4-19_S1]**



(1) Tetradentate (2) Tridentate (3) Bidentate (4) Hexadentate

9. The degenerate orbitals of $[Cr(H_2O)_6]^{3+}$ are **[JEE-Main 9-4-19_S1]**

(1) d_{xz} and d_{yz} (2) $d_{x^2-y^2}$ and d_{xy} (3) d_{z^2} and d_{xz} (4) d_{yz} and d_{z^2}

10. The INCORRECT statement is : **[JEE-Main 10-4-19_S2]**

(1) The spin-only magnetic moments of $[Fe(H_2O)_6]^{2+}$ and $[Cr(H_2O)_6]^{2+}$ are nearly similar.

(2) The gemstone, ruby, has Cr^{3+} ions occupying the octahedral sites of beryl.

(3) The spin-only magnetic moment of $[Ni(NH_3)_4(H_2O)_2]^{2+}$ is 2.83 BM.

(4) The color of $[CoCl(NH_3)_5]^{2+}$ is violet as it absorbs the yellow light.

11. The crystal field stabilization energy (CFSE) of $[Fe(H_2O)_6]Cl_2$ and $K_2[NiCl_4]$, respectively, are : **[JEE-Main 10-4-19_S2]**

(1) $-2.4\Delta_o$ and $-1.2\Delta_t$ (2) $-0.6\Delta_o$ and $-0.8\Delta_t$ (3) $-0.4\Delta_o$ and $-0.8\Delta_t$ (4) $-0.4\Delta_o$ and $-1.2\Delta_t$

12. The highest value of the calculated spin only magnetic moment (in BM) among all the transition metal complexes is **[JEE-Main 9-1-19_S1]**

(1) 5.92 (2) 6.93 (3) 4.90 (4) 3.87

13. The complex that has highest crystal field splitting energy (Δ), is **[JEE-Main 9-1-19_S2]**

(1) $[Co(NH_3)_5Cl]Cl_2$ (2) $K_2[CoCl_4]$ (3) $K_3[Co(CN)_6]$ (4) $[Co(NH_3)_5(H_2O)]Cl_3$

14. Among the statements (a)-(d), the incorrect ones are

(a) Octahedral Co(III) complexes with strong field ligands have very high magnetic moments

(b) When $\Delta_0 < P$, the d-electron configuration of Co(III) in an octahedral complex is $t_{2g}^4 e_g^2$

(c) Wavelength of light absorbed by $[Co(en)_3]^{3+}$ is lower than that of $[CoF_6]^{3-}$

(d) If the Δ_0 for an octahedral complex of Co(III) is 18,000, cm^{-1} the Δ_t for its tetrahedral complex with the same ligand will be 16,000 cm^{-1} **[JEE-Main 7-1-20_S2]**

(1) (c) and (d) only (2) (a) and (d) only (3) (a) and (b) only (4) (b) and (c) only

15. The IUPAC name of the complex $[Pt(NH_3)_2\ Cl(NH_2CH_3)]Cl$ is : **[JEE-Main 7-1-20_S1]**

(1) Diamminechlorido(methanamine)platinum (II) chloride

(2) Diammine(methanamine)chloridoplatinum (II) Chloride

(3) Bisammine(methanamine)chloridoplatinum (II) chloride

(4) Diamminechlorido(aminomethane)platinum (II) chloride

16. The correct order of the calculated spin-only magnetic moments of complexes (A) to (D) is

(A) $Ni(CO)_4$ (B) $[Ni(H_2O)_6]Cl_2$ (C) $Na_2[Ni(CN)_4]$ (D) $PdCl_2(PPh_3)_2$

[JEE-Main 8-1-20_S2]

(1) (A) ≈ (C) ≈ (D) < (B) (2) (C) ≈ (D) < (B) < (A) (3) (A) ≈ (C) < (B) ≈ (D) (4) (C) < (D) < (B) < (A)

17. Among (a) – (d), the complexes that can display geometrical isomerism are **[JEE-Main 8-1-20_S2]**

(a) $[Pt(NH_3)_3Cl]^+$ (b) $[Pt(NH_3)Cl_5]^-$

(c) $[Pt(NH_3)_2Cl(NO_2)]$ (d) $[Pt(NH_3)_4ClBr]^{2+}$

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

18. The complex that can show fac-and mer-isomers is **[JEE-Main 8-1-20_S1]**

(1) $[CoCl_2(en)_2]$ (2) $[Co(NH_3)_3(NO_2)_3]$ (3) $[Pt(NH_3)_2Cl_2]$ (4) $[Co(NH_3)_4Cl_2]^+$

19. Consider that a d^6 metal ion (M^{2+}) forms a complex with aqua ligands, and the spin only magnetic moment of the complex is 4.90 BM. The geometry and the crystal field stabilization energy of the complex is **[JEE-Main 2-9-20_S1]**

(1) tetrahedral and – 1.6 Δ_t + 1P (2) octahedral and –2.4 Δ_0 + 2P

(3) tetrahedral and –0.6 Δ_t (4) octahedral and –1.6 Δ_0

20. The electronic spectrum of $[Ti(H_2O)_6]^{3+}$ shows a single broad peak with a maximum at 20,300 cm^{-1}. The crystal field stabilization energy (CFSE) of the complex ion, in kJ mol^{-1}, is

(1 kJ mol^{-1} = 83.7 cm^{-1}) **[JEE-Main 3-9-20_S1]**

(1) 145.5 (2) 97 (3) 242.5 (4) 83.7

21. The Crystal Field Stabilization Energy

(CFSE) of $[CoF_3(H_2O)_3]$ (Δ_0 < P) is **[JEE-Main 4-9-20_S2]**

(1) –0.8 Δ_0 (2) –0.8 Δ_0 + 2P (3) –0.4 Δ_0 (4) –0.4 Δ_0 + P

22. In following pairs, the one in which both transition metal ions are colourless is :

[JEE-Main 29-7-22_S1]

(1) Sc^{3+}, Zn^{2+} (2) Ti^{4+}, Cu^{2+} (3) V^{2+}, Ti^{3+} (4) Zn^{2+}, Mn^{2+}

23. Which of the following cannot be explained by crystal field theory? **[JEE-Main 24-1-23_S2]**

(1) The order of spectrochemical series (2) Magnetic properties of transition metal complexes

(3) Colour of metal complexes (4) Stability of metal complexes

24. The primary and secondary valencies of cobalt respectively in $[Co(NH_3)_5Cl]Cl_2$ are : **[JEE-Main 24-1-23_S1]**

(1) 3 and 5 (2) 2 and 6 (3) 2 and 8 (4) 3 and 6

25. The oxidation states of iron atoms in compounds (A), (B) and (C), respectively, are x, y and z. The sum of x, y and z is _____.

$Na_4[Fe(CN)_5(NOS)]$ $Na_4[FeO_4]$ $[Fe_2(CO)_9]$ **[JEE-Main 2-9-20_S1]**

(A) (B) (C)

26. The number of statement(s) correct from the following for copper (at no. 29) is/are _____ **[JEE-Main 27-6-22_S1]**

(A) Cu(II) complexes are always paramagnetic

(B) Cu(I) complexes are generally colourless

(C) Cu(I) is easily oxidized

(D) In Fehling solution, the active reagent has Cu(I)

27. The spin only magnetic moment of the complex present in Fehling's reagent is_____ B.M. (Nearest integer). **[JEE-Main 27-7-22_S2]**

28. The spin-only magnetic moment value of the compound with strongest oxidizing ability among MnF_4, MnF_3 and MnF_2 is _____ B.M. [nearest integer] **[JEE-Main 26-7-22_S2]**

29. Number of complexes which will exhibit synergic bonding amongst, $[Cr(CO)_6]$, $[Mn(CO)_5]$ and $[Mn_2(CO)_{10}]$ is _____. **[JEE-Main 28-6-22_S1]**

30. The d-electronic configuration of $[CoCl_4]^{2-}$ in tetrahedral crystal field is $e^m t_2^n$. Sum of 'm' and 'number of unpaired electrons is _____. **[JEE-Main_24-1-23_S1]**

ANSWER KEY_COORDINATION COMPOUND

1.	(4)	**2.**	(3)	**3.**	(2)	**4.**	(1)	**5.**	(1)
6.	(2)	**7.**	(1)	**8.**	(1)	**9.**	(1)	**10.**	(2)
11.	(3)	**12.**	(1)	**13.**	(3)	**14.**	(2)	**15.**	(1)
16.	(1)	**17.**	(1)	**18.**	(2)	**19.**	(3)	**20.**	(2)
21.	(3)	**22.**	(1)	**23.**	(1)	**24.**	(4)	**25.**	**6**
26.	**3**	**27.**	**2**	**28.**	**5**	**29.**	**3**	**30.**	**7**

CHEMISTRY

JEE MAIN PREVIOUS YEARS QUESTIONS – 2018-2023

CHAPTER NAME :- S-Block

(IMPORTANT QUESTIONS ONLY)

1. Match the following items in column I with the corresponding items in column II.

Column-I	**Column-II**
(i) $Na_2CO_3.10H_2O$	(A) Portland cement ingredient
(ii) $Mg(HCO_3)_2$	(B) Castner-Kellner process
(iii) NaOH	(C) Solvay process
(iv) $Ca_3Al_2O_6$	(D) Temporary hardness

[JEE-Main 11-1-19_S2]

(1) (i)(B), (ii)(C), (iii)(A), (iv)(D) (2) (i)(C), (ii)(D), (iii)(B), (iv)(A)

(3) (i)(D), (ii)(A), (iii)(B), (iv)(C) (4) (i)(C), (ii)(B), (iii)(D), (iv)(A)

2. The metal that forms nitride by reacting directly with N_2 of air, is **[JEE-Main 9-1-19_S2]**

(1) Li (2) Rb (3) Cs (4) K

3. Given below are two statements : one is labelled as
Assertion (A) and the other is labelled as Reason (R).
Assertion (A) : Lithium salts are hydrated.
Reason (R) : Lithium has higher polarising power than other alkali metal group members. In the light of the above statements, choose the most appropriate answer from the options given below :

[JEE-Main 31-8-21_S2]

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

(2) (A) is correct but (R) is not correct .

(3) (A) is not correct but (R) is correct.

(4) Both (A) and (R) are correct and (R) is the correct explanation of (A).

4. The major component/ingredient of Portland Cement is : **[JEE-Main 31-8-21_S1]**

(1) tricalcium aluminate (2) tricalcium silicate

(3) dicalcium aluminate (4) dicalcium silicate

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

Assertion (A) : Barium carbonate is insoluble in water and is highly stable. **[JEE-Main 26-8-21_S2]**

Reason (R) : The thermal stability of the carbonates increases with increasing cationic size.

(1) Both (A) and (R) are true but (R) is the true explanation of (A)

(2) (A) is true but (R) is false

(3) Both (A) and (R) are true and (R) is not the true explanation of (A)

(4) (A) is false but (R) is true.

6. The number of water molecules in gypsum, dead burnt plaster and plaster of paris, respectively are:

[JEE-Main 27-8-21_S1]

(1) 2, 0 and 1 (2) 0.5, 0 and 2 (3) 5, 0 and 0.5 (4) 2, 0 and 0.5

7. Given below are two statements : One is labelled as Assertion A and the other labelled as Reason R.

Assertion A : Lithium halides are some what covalent in nature.

Reason R : Lithium possess high polarisation capability. **[JEE-Main 27-7-21_S1]**

In the light of the above statements, choose the most appropriate 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 but R is NOT the correct explanation of A

(4) Both A and R are true and R is the correct explanation of A

8. Match List - I with List - II : **[JEE-Main 27-7-21_S1]**

List - I	List - II
(a) NaOH	(i) Acidic
(b) $Be(OH)_2$	(ii) Basic
(c) $Ca(OH)_2$	(iii) Amphoteric
(d) $B(OH)_3$	
(e) $Al(OH)_3$	

Choose the most appropriate answer from the options given below

(1) (a)-(ii), (b)-(ii), (c)-(iii), (d)-(ii), (e)-(iii) (2) (a)-(ii), (b)-(iii), (c)-(ii), (d)-(i), (e)-(iii)

(3) (a)-(ii), (b)-(ii), (c)-(iii), (d)-(i), (e)-(iii) (4) (a)-(ii), (b)-(i), (c)-(ii), (d)-(iii), (e)-(iii)

9. Given below are two statements : **[JEE-Main 25-7-21_S1]**

Statement I : None of the alkaline earth metal hydroxides dissolve in alkali.

Srtatement II : Solubility of alkaline earth metal hydroxides in water increases down the group.

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) Statement I and Statement II both are incorrect.

(4) Statement I and Statement II both are correct.

10. **Match List-I with List-II**

List-I (Elements)	**List-II (Properties)**
(a) Ba	(i) Organic solvent soluble compounds
(b) Ca	(ii) Outer electronic configuration $6s^2$
(c) Li	(iii) Oxalate insoluble in water
(d) Na	(iv) Formation of very strong monoacidic base

Choose the correct answer from the options given below : **[JEE-Main 22-7-21_S2]**

(1) (a)-(ii), (b)-(iii), (c)-(i) and (d)-(iv) (2) (a)-(iv), (b)-(i), (c)-(ii) and (d)-(iii)

(3) (a)-(iii), (b)-(ii), (c)-(iv) and (d)-(i) (4) (a)-(i), (b)-(iv), (c)-(ii) and (d)-(iii)

11. The correct decreasing order for metallic character is **[JEE-Main 28-7-22_S2]**

(1) Na > Mg > Be > Si > P (2) P > Si > Be > Mg > Na

(3) Si > P > Be > Na > Mg (4) Be > Na > Mg > Si > P

12. **Statement I :** An alloy of lithium and magnesium is used to make aircraft plates.

Statement II : The magnesium ions are important for cell–membrane integrity. In the light the above statements, choose the correct answer from the options given below **[JEE-Main 28-7-22_S2]**

(1) Both Statement I and Statement II are true (2) Both Statement I and Statement II are false

(3) Statement I is true but Statement II is false (4) Statement I is false but Statement II is true

13. Lithium nitrate and sodium nitrate, when heated separately, respectively, give : **[JEE-Main 29-7-22_S1]**

(1) $LiNO_2$ and $NaNO_2$ (2) $Li_2OandNa_2O$ (3) Li_2O and $NaNO_2$ (4) $LiNO_2$ and Na_2O

14. Portland cement contains 'X' to enhance the setting time. What is 'X'? **[JEE-Main 29-7-22_S2]**

(1) $CaSO_4.\ \frac{1}{2}H_2O$ (2) $CaSO_4.2H_2O$ (3) $CaSO_4$ (4) $CaCO_3$

15. Reaction of $BeCl_2$ with Li_AlH_4 gives :

(A) $AlCl_3$ (B) BeH_2 (C) LiH (D) LiCl

(E) $BeAlH_4$

Choose the correct answer from options given below : **[JEE-Main 26-7-22_S1]**

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

16. An element A of group 1 shows similarity to an element B belonging to group 2. If A has maximum hydration enthalpy in group 1 then B is: **[JEE-Main 27-7-22_S2]**

(1) Mg (2) Be (3) Ca (4) Sr

17. Given below are two statements:

Statement I : The chlorides of Be and Al have Cl-bridged structure. Both are soluble in organic solvents and act as Lewis bases. **[JEE-Main 27-7-22_S1]**

Statement II: Hydroxides of Be and Al dissolve in excess alkali to give beryllate and aluminate ions. In the light of the above statements. Choose the correct answer from the options given below.

(1) Both statement I and Statement II are true (2) Both statement I and Statement II are false

(3) Statement I is true but Statement II is false (4) Statement I is false but Statement II is true

18. Which of the following statement is incorrect ? **[JEE-Main 28-7-22_S1]**

(1) Low solubility of LiF in water is due to its small hydration enthalpy.

(2) KO_2 is paramagnetic.

(3) Solution of sodium in liquid ammonia is conducting in nature.

(4) Sodium metal has higher density than potassium metal

19. The correct order of density is **[JEE-Main 25-7-22_S2]**

(1) Be > Mg > Ca > Sr (2) Sr > Ca > Mg > Be (3) Sr > Be > Mg > Ca (4) Be > Sr > Mg > Ca

20. Choose the correct order of density of the alkali metals : **[JEE-Main 25-7-22_S1]**

(1) Li < K < Na < Rb < Cs (2) Li < Na < K < Rb < Cs

(3) Cs < Rb < K < Na < Li (4) Li < Na < K < Cs < Rb

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

Assertion A : LiF is sparingly soluble in water. **[JEE-Main 26-7-22_S2]**

Reason R : The ionic radius of Li+ ion is smallest among its group members, hence has least hydration enthalpy.

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

(1) Both A and R are true and R is the correct explanation of A

(2) Both A and R are true but R is NOT the correct explanation of A

(3) A is true but R is false

(4) A is false but R is true

22. Addition of H_2SO_4 to BaO_2 produces: **[JEE-Main 27-6-22_S1]**

(1) BaO, SO_2 and H_2O (2) $BaHSO_4$ and O_2 (3) $BaSO_4$, H_2 and O_2 (4) $BaSO_4$ and H_2O_2

23. $BeCl_2$ reacts with $LiAlH_4$ to give **[JEE-Main 27-6-22_S1]**

(1) Be + $Li[AlCl_4]$ + H_2 (2) Be + AlH_3 + LiCl + HCl

(3) BeH_2 + LiCl + $AlCl_3$ (4) BeH_2 + $Li[AlCl_4]$

24. Amongst baking soda, caustic soda and washing soda carbonate anion is present in : **[JEE-Main 29-6-22_S2]**

(1) washing soda only. (2) washing soda and caustic soda only.

(3) washing soda and baking soda only. (4) baking soda, caustic soda and washing soda.

25. Which of the following statements are correct ? **[JEE-Main 24-6-22_S1]**

(A) Both LiCl and $MgCl_2$ are soluble in ethanol.

(B) The oxides Li_2O and MgO combine with excess of oxygen to give superoxide.

(C) LiF is less soluble in water than other alkali metal fluorides.

(D) Li_2O is more soluble in water than other alkali metal oxides.

Choose the most appropriate answer from the options given below:

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

26. Which one of the following alkaline earth metal ions has the highest ionic mobility in its aqueous solution? **[JEE-Main 25-6-22_S1]**

(1) Be^{2+} (2) Mg^{2+} (3) Ca^{2+} (4) Sr^{2+}

27. Boiling of hard water is helpful in removing the temporary hardness by converting calcium hydrogen carbonate and magnesium hydrogen carbonate to **[JEE-Main 26-6-22_S2]**

(1) $CaCO_3$ and $Mg(OH)_2$ (2) $CaCO_3$ and $MgCO_3$

(3) $Ca(OH)_2$ and $MgCO_3$ (4) $Ca(OH)_2$ and $Mg(OH)_2$

28. The number of s-electrons present in an ion with 55 protons in its unipositive state is **[JEE-Main 24-1-23_S2]**

(1) 8 (2) 9 (3) 12 (4) 10

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

Assertion A : Beryllium has less negative value of reduction potential compared to the other alkaline earth metals.

Reason R : Beryllium has large hydration energy due to small size of Be^{2+} but relatively large value of atomization enthalpy. **[JEE-Main 24-1-23_S2]**

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

(1) A is correct but R is not correct

(2) Both A and R are correct and R is the correct explanation of A.

(3) A is not correct but R is correct

(4) Both A and R are correct and R is NOT the correct explanation of A.

30. Reaction of BeO with ammonia and hydrogen fluoride gives 'A' which on thermal decomposition gives BeF_2 and NH_4F. What is 'A' ? **[JEE-Main 24-1-23_S1]**

(1) $(NH_4)_2BeF_4$ (2) H_3NBeF_3 (3) $(NH_4)BeF_3$ (4) $(NH_4)Be_2F_5$

ANSWER KEY_S-Block

1.	(2)	**2.**	(1)	**3.**	(1)	**4.**	(2)	**5.**	(1)
6.	(4)	**7.**	(4)	**8.**	(2)	**9.**	(2)	**10.**	(1)
11.	(1)	**12.**	(2)	**13.**	(3)	**14.**	(2)	**15.**	(2)
16.	(1)	**17.**	(4)	**18.**	(1)	**19.**	(3)	**20.**	(1)
21.	(3)	**22.**	(4)	**23.**	(3)	**24.**	(1)	**25.**	(1)
26.	(4)	**27.**	(1)	**28.**	(4)	**29.**	(2)	**30.**	(1)

CHEMISTRY

JEE MAIN PREVIOUS YEARS QUESTIONS – 2018-2023

CHAPTER NAME :- p-Block (B&C)

(IMPORTANT QUESTIONS ONLY)

1. When metal 'M' is treated with NaOH, a white gelatinous precipitate 'X' is obtained, which is soluble in excess of NaOH. Compound 'X' when heated strongly gives an oxide which is used in chromatography as an adsorbent. The metal 'M' is : **[JEE-Main 2018]**

(1) Al (2) Fe (3) Zn (4) Ca

2. The number of 2-centre-2-electron and 3-centre-2-electron bonds in B_2H_6 respectively are: **[JEE-Main 10-1-19_S2]**

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

3. The correct statements among I to III regarding group 13 element oxides are,

(I) Boron trioxide is acidic.

(II) Oxides of aluminium and gallium are amphoteric.

(III) Oxides of indium and thallium are basic. **[JEE-Main 9-4-19_S2]**

(1) (II) and (III) only (2) (I) and (II) only (3) (I), (II) and (III) (4) (I) and (III) only

4. The amorphous form of silica is **[JEE-Main 9-4-19_S2]**

(1) Quartz (2) Tridymite (3) Kieselguhr (4) Cristobalite

5. The hydride that is NOT electron deficient is **[JEE-Main 11-1-19_S2]**

(1) SiH_4 (2) GaH_3 (3) B_2H_6 (4) AlH_3

6. The correct statement among the following is : **[JEE-Main 12-4-19_S1]**

(1) $(SiH_3)_3N$ is planar and less basic than $(CH_3)_3N$

(2) $(SiH_3)_3N$ is pyramidal and more basic than $(CH_3)_3N$

(3) $(SiH_3)_3N$ is pyramidal and less basic than $(CH_3)_3N$

(4) $(SiH_3)_3N$ is planar and more basic than $(CH_3)_3N$

7. The C–C bond length is maximum in : **[JEE-Main 12-4-19_S2]**

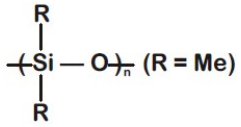
(1) graphite (2) C_{60} (3) diamond (4) C_{70}

8. Diborane (B_2H_6) reacts independently with O_2 and H_2O to produce, respectively: **[JEE-Main 8-4-19_S1]**

(1) H_3BO_3 and B_2O_3 (2) HBO_2 and H_3BO_3 (3) B_2O_3 and H_3BO_3 (4) B_2O_3 and $[BH_4]^-$

9. The basic structural unit of feldspar, zeolites, mica, and asbestos is : **[JEE-Main 12-4-19_S1]**

(1) $(SiO_4)^{4-}$

(2) 

(3) SiO_2

(4) $(SiO_3)^{2-}$

10. The chloride that CANNOT get hydrolysed is: **[JEE-Main 11-1-19_S1]**

(1) $PbCl_4$ (2) CCl_4 (3) $SnCl_4$ (4) $SiCl_4$

11. The reaction of $H_3N_3B_3Cl_3$ (A) with $LiBH_4$ in tetrahydrofuran gives inorganic benzene (B). Further, the reaction of (A) with (C) leads to $H_3N_3B_3(Me)_3$. Compounds (B) and (C) respectively, are **[JEE-Main 9-1-20_S2]**

(1) Borazine and MeBr

(2) Borazine and MeMgBr

(3) Diborane and MeMgBr

(4) Boron nitride and MeBr

12. Boron and silicon of very high purity can be obtained through **[JEE-Main 5-9-20_S2]**

(1) vapour phase refining

(2) electrolytic refining

(3) liquation

(4) zone refining

13. Which one of the following compounds of Group–14 elements is not known? **[JEE-Main 25-7-21_S1]**

(1) $[GeCl_6]^{2-}$ (2) $[Sn(OH)_6]^{2-}$ (3) $[SiCl_6]^{2-}$ (4) $[SiF_6]^{2-}$

14. The correct statement about B_2H_6 is: **[JEE-Main 25-2-21_S1]**

(1) Terminal B–H bonds have less p-character when compared to bridging bonds.

(2) The two B–H–B bonds are not of same length

(3) All B–H–B angles are of 120°

(4) Its fragment, BH_3, behaves as a Lewis base

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

Assertion A : In $T\ell I_3$, isomorphous to CsI_3, the metal is present in +1 oxidation state.

Reason R : $T\ell$ metal has fourteen f electrons in the electronic configuration. **[JEE-Main 26-2-21_S2]**

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

(1) **A** is correct but **R** is not correct

(2) Both **A** and **R** are correct and **R** is the correct explanation of **A**.

(3) **A** is not correct but **R** is correct

(4) Both **A** and **R** are correct but **R** is NOT the correct explanation of **A**.

16. The INCORRECT statement regarding the structure of C_{60} is : **[JEE-Main 16-3-21_S2]**

(1) The six-membered rings are fused to both six and five-membered rings.

(2) Each carbon atom forms three sigma bonds.

(3) The five-membered rings are fused only to six-membered rings.

(4) It contains 12 six-membered rings and 24 five-membered rings.

17. Identify the correct statement for B_2H_6 from those given below.

(A) In B_2H_6, all B-H bonds are equivalent.

(B) In B_2H_6 there are four 3-centre-2-electron bonds.

(C) B_2H_6 is a Lewis acid.

(D) B_2H_6 can be synthesized form both BF_3 and $NaBH_4$.

(E) B_2H_6 is a planar molecule.

Choose the most appropriate answer from the options given below : **[JEE-Main 24-6-22_S1]**

(1) (A) and (E) only (2) (B), (C) and (E) only

(3) (C) and (D) only (4) (C) and (E) only

18. Borazine, also known as inorganic benzene, can be prepared by the reaction of 3-equivalents of "X" with 6-equivalents of "Y". "X" and "Y", respectively are : **[JEE-Main 26-7-22_S1]**

(1) $B(OH)_3$ and NH_3 (2) B_2H_6 and NH_3 (3) B_2H_6 and HN_3 (4) NH_3 and B_2O_3

19. Given below are two statements: one is labeled as **Assertion (A)** and the other is labeled as **Reason (R)**

Assertion (A) : Boron is unable to form BF_6^{3-}

Reason (R) : Size of B is very small. **[JEE-Main 27-7-22_S2]**

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

(1) Both **(A)** and **(R)** are true and **(R)** is the correct explanation of **(A)**

(2) Both **(A)** and **(R)** are true but **(R)** is not the correct explanation of **(A)**

(3) **(A)** is true but **(R)** is false

(4) **(A)** is false but **(R)** is true

20. Given below are two statements.

Statement I : Stannane is an example of a molecular hydride.

Statement II: Stannane is a planar molecule. **[JEE-Main 29-7-22_S2]**

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

(1) Both Statement I and Statement II are true. (2) Both Statement I and Statement II are false.

(3) Statement I is true but Statement II is false. (4) Statement I is false but Statement II is true.

21. When borax is heated with CoO on a platinum loop, blue coloured bead formed is largely due to : **[JEE-Main 29-7-22_S2]**

(1) B_2O_3 (2) $Co(BO_2)_2$ (3) CoB_4O_7 (4) $Co[B_4O_5(OH)_4]$

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

Assertion A : Boric acid is a weak acid

Reason R : Boric acid is not able to release H^+ ion on its own. It receives OH^- ion from water and releases H^+ ion. **[JEE-Main 26-7-22_S2]**

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

(1) Both A and R are correct and R is the correct explanation of A

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

(3) A is correct but R is not correct

(4) A is not correct but R is correct

23. Aqueous solution of which of the following boron compounds will be strongly basic in nature?

[JEE-Main 29-6-22_S2]

(1) $NaBH_4$ (2) $LiBH_4$ (3) B_2H_6 (4) $Na_2B_4O_7$

24. Match the List-I with List- II.

List-I (Metal)	**List-II (Application)**
(A) Cs	(I) High temperature thermometer
(B) Ga	(II) Water repellent sprays
(C) B	(III) Photoelectric cells
(D) Si	(IV) Bullet proof vest

Choose the most appropriate answer from the option given below: **[JEE-Main 29-6-22_S1]**

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

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

25. The geometry around boron in the product 'B' formed from the following reaction is

$BF_3 + NaH \xrightarrow{450K} A + NaF$

$A + NMe_3 \rightarrow B$ **[JEE-Main 25-7-22_S1]**

(1) trigonal planar (2) tetrahedral (3) pyramidal (4) square planar

26. The metal that has very low melting point and its periodic position is closer to a metalloid is :

[JEE-Main 26-7-22_S2]

(1) Al (2) Ga (3) Se (4) In

27. Number of electron deficient molecules among the following

PH_3, B_2H_6, CCl_4, NH_3, LiH and BCl_3 is **[JEE-Main 25-6-22_S1]**

(1) 0 (2) 1 (3) 2 (4) 3

28. Choose the correct stability order of group 13 elements in their +1 oxidation state.

[JEE-Main 26-6-22_S1]

(1) Al < Ga < In < Tl (2) Tl < In < Ga < Al (3) Al < Ga < Tl < In (4) Al < Tl < Ga < In

29. Match List-I with List-II

List-I (Si-Compounds)	**List-II** (Si-Polymeric/other products)
(A) $(CH_3)_4Si$	(I) Chain silicone
(B) $(CH_3)Si(OH)_3$	(II) Dimeric silicone
(C) $(CH_3)_2Si(OH)_2$	(III) Silane
(D) $(CH_3)_3Si(OH)$	(IV) 2D – Silicone

Choose the correct answer from the options given below: **[JEE-Main 27-6-22_S1]**

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

30. The Lewis acid character of boron tri halides follows the order: **[JEE-Main 31-1-23_S2]**

(1) $BBr_3 > BI_3 > BCl_3 > BF_3$
(2) $BCl_3 > BF_3 > BBr_3 > BI_3$
(3) $BF_3 > BCl_3 > BBr_3 > BI_3$
(4) $BI_3 > BBr_3 > BCl_3 > BF_3$

ANSWER KEY_p-Block (B&C)

1.	(1)	**2.**	(1)	**3.**	(3)	**4.**	(3)	**5.**	(1)
6.	(1)	**7.**	(3)	**8.**	(3)	**9.**	(1)	**10.**	(2)
11.	(2)	**12.**	(4)	**13.**	(3)	**14.**	(1)	**15.**	(4)
16.	(4)	**17.**	(3)	**18.**	(2)	**19.**	(2)	**20.**	(3)
21.	(2)	**22.**	(1)	**23.**	(4)	**24.**	(1)	**25.**	(2)
26.	(2)	**27.**	(3)	**28.**	(1)	**29.**	(4)	**30.**	(4)

CHEMISTRY

JEE MAIN PREVIOUS YEARS QUESTIONS – 2018-2023

CHAPTER NAME :- NITROGEN OXYGEN FAMILY

(IMPORTANT QUESTIONS ONLY)

1. The correct order of the oxidation states of nitrogen in NO, N_2O, NO_2, and N_2O_3 is **[JEE-Main 9-4-19_S1]**

(1) $NO_2 < NO < N_2O_3 < N_2O$ (2) $N_2O < NO < N_2O_3 < NO_2$

(3) $NO_2 < N_2O_3 < NO < N_2O$ (4) $N_2O < N_2O_3 < NO < NO_2$

2. The pair that contains two P-H bond in each of the oxoacids is : **[JEE-Main 10-1-19_S2]**

(1) $H_4P_2O_5$ and $H_4P_2O_6$ (2) $H_4P_2O_5$ and H_3PO_3 (3) H_3PO_2 and $H_4P_2O_5$ (4) H_3PO_3 and H_3PO_2

3. Good reducing nature of H_3PO_2 is attributed to the presence of: **[JEE-Main 9-1-19_S2]**

(1) Two P – OH bonds (2) One P – H bond (3) One P – OH bond (4) Two P – H bonds

4. Among statements (a)-(d) the correct ones are:

(a) Decomposition of hydrogen peroxide gives dioxygen.

(b) Like hydrogen peroxide, compounds, such as $KClO_3$, $Pb(NO_3)_2$ and $NaNO_3$ when heated liberate dioxygen.

(c) 2-Ethylanthraquinone is useful for the industrial preparation of hydrogen peroxide.

(d) Hydrogen peroxide is used for the manufacture of sodium perborate.

[JEE-Main 7-1-20_S2]

(1) (a) and (c) only (2) (a), (b) and (c) only (3) (a), (b), (c) and (d) (4) (a), (c) and (d) only

5. White phosphorus on reaction with concentrated NaOH solution in an inert atmosphere of CO_2 gives phosphine and compound (X). (X) on acidification with HCl gives compound (Y). The basicity of compound (Y) is **[JEE-Main 8-1-20_S2]**

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

6. The reaction of NO with N_2O_4 at 250 K gives **[JEE-Main 6-9-20_S2]**

(1) N_2O_3 (2) N_2O_5 (3) N_2O (4) NO_2

7. Given below are two statements : **[JEE-Main 25-2-21_S2]**

Statement-I : α and β forms of sulphur can change reversibly between themselves with slow heating or slow cooling.

Statement-II : At room temperature the stable crystalline form of sulphur is monoclinic sulphur.

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) Both Statement I and Statement II are true.

(3) Statement I is true but Statement II is false.

(4) Both Statement I and Statement II are false.

8. The number of ionisable hydrogens present in the product obtained from a reaction of phosphorus trichloride and phosphonic acid is: **[JEE-Main 18-3-21_S1]**

(1) 3 (2) 0 (3) 2 (4) 1

9. Chemical nature of the nitrogen oxide compound obtained from a reaction of concentrated nitric acid and P_4O_{10} (in 4 : 1 ratio) is : **[JEE-Main 20-7-21_S1]**

(1) acidic (2) basic (3) amphoteric (4) neutral

10. Which one of the following group-15 hydride is the strongest reducing agent ? **[JEE-Main 22-7-21_S2]**

(1) AsH_3 (2) BiH_3 (3) PH_3 (4) SbH_3

11. The number of non-ionisable hydrogen atoms present in the final product obtained from the hydrolysis of PCl_5 is : **[JEE-Main 26-8-21_S2]**

(1) 0 (2) 1 (3) 2 (4) 3

12. Which one of the following is formed (mainly) when red phosphorus is heated in a sealed tube at 803 K ? **[JEE-Main 27-8-21_S2]**

(1) White phosphorus (2) Yellow phosphorus

(3) β-Black phosphorus (4) α-Black phosphorus

13. A group 15 element, which is a metal and forms a hydride with strongest reducing power among group 15 hydrides. The element is : **[JEE-Main 16-3-21_S1]**

(1) Sb (2) P (3) As (4) Bi

14. Dinitrogen is a robust compound, but reacts at high altitude to form oxides. The oxide of nitrogen that can damage plant leaves and retard photosynthesis is : **[JEE-Main 29-7-22_S2]**

(1) NO (2) NO_3^- (3) NO_2 (4) NO_2^-

15. Match List–I with List–II.

	List I (Reaction)		List II (Catalyst)
(1)	$4NH_3(g) + 5O_2(g) \rightarrow 4NO(g) + 6H_2O(g)$	(I)	NO(g)
(2)	$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$	(II)	$H_2SO_4(l)$
(3)	$C_{12}H_{22}O_n(aq) + H_2O(l) \rightarrow C_6H_{12}O_6$ (Glucose) + $C_6H_{12}O_6$ (Fructose)	(III)	Pt(s)
(4)	$2SO_2(g) + O_2(g) \rightarrow 2SO_3(g)$	(IV)	Fe(s)

Choose the correct answer from the options given below : **[JEE-Main 28-7-22_S1]**

(1) (1) – (II), (2) – (III), (3) – (I), (4) – (IV)

(2) (1) – (III), (2) – (II), (3) – (I), (4) – (IV)

(3) (1) – (III), (2) – (IV), (3) – (II), (4) – (I)

(4) (1) – (III), (2) – (II), (3) – (IV), (4) – (I)

16. Match List–I with List–II, match the gas evolved during each reaction.

	List I		List II
(1)	$(NH_4)_2Cr_2O_7 \xrightarrow{\Delta}$	(I)	H_2
(2)	$KMnO_4$+HCl $\longrightarrow$	(II)	N_2
(3)	Al + NaOH + H_2O $\longrightarrow$	(III)	O_2
(4)	$NaNO_3 \xrightarrow{\Delta}$	(IV)	Cl_2

Choose the correct answer from the options given below : **[JEE-Main 28-7-22_S1]**

(1) (1) – (II), (2) – (III), (3) – (I), (4) – (IV)

(2) (1) – (III), (2) – (I), (3) – (IV), (4) – (II)

(3) (1) – (II), (2) – (IV), (3) – (I), (4) – (III)

(4) (1) – (III), (2) – (IV), (3) – (I), (4) – (II)

17. White phosphorus reacts with thionyl chloride to give **[JEE-Main 28-7-22_S2]**

(1) PCl_5, SO_2 and S_2Cl_2

(2) PCl_3, SO_2 and S_2Cl_2

(3) PCl_3, SO_2 and Cl_2

(4) PCl_5, SO_2 and Cl_2

18. Concentrated HNO_3 reacts with Iodine to give **[JEE-Main 28-7-22_S2]**

(1) HI, NO_2 and H_2O

(2) HIO_2, N_2O and H_2O

(3) HIO_3, NO_2 and H_2O

(4) HIO_4, N_2O and H_2O

19. Match List - I with List - II.

List –I (Processes/Reactions)	**List – II (Catalyst)**
(1) $2SO_2(g)+O_2(g)\rightarrow 2SO_3(g)$	(I) Fe(s)
(2) $4NH_3(g)+5O_2(g)\rightarrow 4NO(g)+6H_2O(g)$	(II) Pt(s)-Rh(s)
(3) $N_2(g)+3H_2(g)\rightarrow 2NH_3(g)$	(III) V_2O_5
(4) Vegetable oil(l)+H_2 $\rightarrow$ Vegetable ghee(s)	(IV) Ni(s)

Choose the correct answer from the options given below : **[JEE-Main 26-7-22_S1]**

(1) (1) - (III), (2) - (I), (3) - (II), (4) - (IV)

(2) (1) - (III), (2) - (II), (3) - (I), (4) - (IV)

(3) (1) - (IV), (2) - (III), (3) - (I), (4) - (II)

(4) (1) - (IV), (2) - (II), (3) - (III), (4) - (I)

20. The oxoacid of phosphorus that is easily obtained from a reaction of alkali and white phosphorus and has two P-H bonds, is : **[JEE-Main 29-6-22_S1]**

(1) Phosphonic acid (2) Phosphinic acid

(3) Pyrophosphorus acid (4) Hypophosphoric acid

21. Nitrogen gas is obtained by thermal decomposition of **[JEE-Main 28-6-22_S1]**

(1) $Ba(NO_3)_2$ (2) $Ba(N_3)_2$ (3) $NaNO_2$ (4) $NaNO_3$

22. Heating white phosphorus with conc. NaOH solution gives mainly **[JEE-Main 27-6-22_S1]**

(1) Na_3P and H_2O (2) H_3PO and NaH

(3) $P(OH)_3$ and NaH_2PO_4 (4) PH_3 and NaH_2PO_2

23. The number of bridged oxygen atoms present in compound B formed from the following reactions is

$Pb(NO_3)_2 \xrightarrow{673} A + PbO + O_2$

$A \xrightarrow{\text{Dimerise}} B$ **[JEE-Main 25-6-22_S2]**

(1) 0 (2) 1 (3) 2 (4) 3

24. Consider the following reaction:

$2HSO_4^-(aq) \xrightarrow[(2)\text{Hydrolysis}]{(1)\text{Electrolysis}} 2HSO_4^- + 2H^+ + A$

The dihedral angle in product A in its solid phase at 110 K is : **[JEE-Main 26-6-22_S1]**

(1) 104° (2) 111.5° (3) 90.2° (4) 111.0°

25. Given below are the oxides:

Na_2O, As_2O_3, N_2O, NO and Cl_2O_7

Number of amphoteric oxides is: **[JEE-Main 24-6-22_S1]**

(1) 0 (2) 1 (3) 2 (4) 3

26. Dinitrogen and dioxygen. the main constituents of air do not react with each other in atmosphere to form oxides of nitrogen because **[JEE-Main 28-7-22_S2]**

(1) N_2 is unreactive in the condition of atmosphere.

(2) Oxides of nitrogen are unstable.

(3) Reaction between them can occur in the presence of a catalyst.

(4) The reaction is endothermic and require very high temperature.

27. "A" obtained by Ostwald"s method involving air oxidation of NH_3, upon further air oxidation produces "B". "B" on hydration forms an oxoacid of Nitrogen along with evolution of "A". The oxoacid also produces "A" and gives positive brown ring test **[JEE-Main 29-1-23_S1]**

(1) NO_2, N_2O_5 (2) NO_2, NO_4 (3) NO, NO_2 (4) N_2O_3, NO_2

28. The reaction of white phosphorus on boiling with alkali in inert atmosphere resulted in the formation of product 'A'. The reaction 1 mol of 'A' with excess of $AgNO_3$ in aqueous medium gives _____ mol(s) of Ag. (Round off to the Nearest Integer). **[JEE-Main 17-3-21_S1]**

29. The number of non-ionisable protons present in the product B obtained from the following reaction is_____.

$C_2H_5OH + PCl_3 \rightarrow C_2H_5Cl + A$

$A + PCl_3 \rightarrow B$ **[JEE-Main 26-7-22_S2]**

30. Consider the following reactions :

$PCl_3 + H_2O \longrightarrow A + HCl$

$A + H_2O \longrightarrow B + HCl$

number of ionisable protons present in the product B_____. **[JEE-Main 25-6-22_S2]**

ANSWER KEY_NITROGEN OXYGEN FAMILY

1.	(2)	**2.**	(3)	**3.**	(4)	**4.**	(3)	**5.**	(4)
6.	(1)	**7.**	(3)	**8.**	(3)	**9.**	(1)	**10.**	(2)
11.	(1)	**12.**	(4)	**13.**	(4)	**14.**	(3)	**15.**	(3)
16.	(3)	**17.**	(2)	**18.**	(3)	**19.**	(2)	**20.**	(2)
21.	(2)	**22.**	(4)	**23.**	(1)	**24.**	(3)	**25.**	(2)
26.	(4)	**27.**	(3)	**28.**	**4**	**29.**	**2**	**30.**	**2**

CHEMISTRY

JEE MAIN PREVIOUS YEARS QUESTIONS – 2018-2023

CHAPTER NAME :- d & f Block + QUALITATIVE ANALYSIS (ONLY CATION)

(IMPORTANT QUESTIONS ONLY)

1. $\underline{A} \xrightarrow{4KOH,O_2} \underset{(Green)}{2\underline{B}} + 2H_2O$

$3\underline{B} \xrightarrow{4HCl} \underset{(Purple)}{2\underline{C}} + MnO_2 + 2H_2O$

$2\underline{C} \xrightarrow{H_2O,KI} 2\underline{A} + 2KOH + \underline{D}$

In the above sequence of reactions, A and D, respectively, are : **[JEE-Main 11-1-19_S2]**

(1) KI and K_2MnO_4 (2) $KIO_3$and MnO_2 (3) $MnO_2$and KIO_3 (4) KI and $KMnO_4$

2. Thermal decomposition of a Mn compound (X) at 513 K results in compound Y, MnO_2 and a gaseous product. MnO_2 reacts with NaCl and concentrated H_2SO_4 to give a pungent gas Z. X, Y and Z respectively are: **[JEE-Main 12-4-19_S2]**

(1) K_2MnO_4, $KMnO_4$ and Cl_2 (2) K_3MnO_4, K_2MnO_4 and Cl_2

(3) K_2MnO_4, $KMnO_4$ and SO_2 (4) $KMnO_4$, K_2MnO_4 and Cl_2

3. The pair that has similar atomic radii is : **[JEE-Main 12-4-19_S2]**

(1) Mo and W (2) Ti and Hf (3) Sc and Ni (4) Mn and Re

4. An example of a disproportionation reaction is: **[JEE-Main 12-4-19_S1]**

(1) $2MnO_4^- + 10I^- + 16H^+ \rightarrow 2Mn^{2+} + 5I_2 + 8H_2O$

(2) $2CuBr \rightarrow CuBr_2 + Cu$

(3) $2KMnO_4 \rightarrow K_2MnO_4 + MnO_2 + O_2$

(4) $2NaBr + Cl_2 \rightarrow 2NaCl + Br_2$

5. Match the catalysts (Column I) with products (Column II). **[JEE-Main 9-4-19_S1]**

Column I	**Column II**
Catalyst	**Product**
(A) V_2O_5	(i) Polyethylene
(B) $TiCl_4/Al(Me)_3$	(ii) Ethanal
(C) $PdCl_2$	(iii) H_2SO_4
(D) Iron Oxide	(iv) NH3

(1) (A)-(iv); (B)-(iii); (C)-(ii); (D)-(i) (2) (A)-(iii); (B)-(iv); (C)-(i); (D)-(ii)

(3) (A)-(iii); (B)-(i); (C)-(ii); (D)-(iv) (4) (A)-(ii); (B)-(iii); (C)-(i); (D)-(iv)

6. The lanthanide ion that would show colour is **[JEE-Main 8-4-19_S1]**

(1) Gd^{3+} (2) Lu^{3+} (3) La^{3+} (4) Sm^{3+}

7. The electronic configurations of bivalent europium and trivalent cerium are
(atomic number : Xe = 54, Ce = 58, Eu = 63) **[JEE-Main 9-1-20_S1]**

(1) [Xe] $4f^7$ and [Xe] $4f^1$ (2) [Xe] $4f^7$ $6s^2$ and [Xe] $4f^2$ $6s^2$

(3) [Xe] $4f^2$ and [Xe] $4f^7$ (4) [Xe] $4f^4$ and [Xe] $4f^9$

8. The correct electronic configuration and spinonly magnetic moment (BM) of Gd^{3+} (Z = 64), respectively, are **[JEE-Main 5-9-20_S1]**

(1) [Xe] $5f^7$ and 8.9 (2) [Xe] $4f^7$ and 7.9 (3) [Xe] $5f^7$ and 7.9 (4) [Xe] $4f^7$ and 8.9

9. Mischmetal is an alloy consisting mainly of **[JEE-Main 6-9-20_S2]**

(1) lanthanoid and actinoid metals (2) actinoid and transition metals

(3) lanthanoid metals (4) actinoid metals

10. Aqua regia is used for dissolving noble metals (Au, Pt, etc.). The gas evolved in this process is **[JEE-Main 3-9-20_S1]**

(1) NO (2) N_2 (3) N_2O_5 (4) N_2O_3

11. Potassium permanganate on heating at 513 K gives a product which is : **[JEE-Main 27-8-21_S2]**

(1) paramagnetic and colourless (2) diamagnetic and green

(3) diamagnetic and colourless (4) paramagnetic and green

12. The set having ions which are coloured and paramagnetic both is – **[JEE-Main 22-7-21_S2]**

(1) Cu^{2+}, Cr^{3+}, Sc^{+} (2) Cu^{2+}, Zn^{2+}, Mn^{4+} (3) Sc^{3+}, V^{5+}, Ti^{4+} (4) Ni^{2+}, Mn^{7+}, Hg^{2+}

13. The major components of German Silver are : **[JEE-Main 25-2-21_S2]**

(1) Ge, Cu and Ag (2) Zn, Ni and Ag (3) Cu, Zn and Ni (4) Cu, Zn and Ag

14. Which one of the following when dissolved in water gives coloured solution in nitrogen atmosphere? **[JEE-Main 26-8-21_S1]**

(1) $CuCl_2$ (2) AgCl (3) $ZnCl_2$ (4) Cu_2Cl_2

15. The reaction of zinc with excess of aqueous alkali, evolves hydrogen gas and gives : **[JEE-Main 29-7-22_S1]**

(1) $Zn(OH)_2$ (2) ZnO (3) $[Zn(OH)_4]^{2-}$ (4) $[ZnO_2]^{2-}$

16. The total number of Mn = O bonds in Mn_2O_7 is ___ **[JEE-Main 27-7-22_S1]**

(1) 4 (2) 5 (3) 6 (4) 3

17. The reaction of H_2O_2 with potassium permanganate in acidic medium leads to the formation of mainly:

[JEE-Main 25-7-22_S1]

(1) Mn^{2+} (2) Mn^{4+} (3) Mn^{3+} (4) Mn^{6+}

18. The most common oxidation state of Lanthanoid elements is +3. Which of the following is likely to deviate easily from +3 oxidation state? **[JEE-Main 26-6-22_S2]**

(1) Ce (At. No. 58) (2) La (At. No. 57) (3) Lu (At. No. 71) (4) Gd (At. No. 64)

19. Cerium (IV) has a noble gas configuration. Which of the following is correct statement about it?

(1) It will not prefer to undergo redox reactions. **[JEE-Main 25-6-22_S1]**

(2) It will prefer to gain electron and act as an oxidizing agent

(3) It will prefer to give away an electron and behave as reducing agent

(4) It acts as both, oxidizing and reducing agent

20. In the flame test of a mixture of salts, a green flame with blue centre was observed. Which one of the following cations may be present? **[JEE-Main 24-6-22_S2]**

(1) Cu^{2+} (2) Sr^{2+} (3) Ba^{2+} (4) Ca^{2+}

21. $K_2Cr_2O_7$ paper acidified with dilute H_2SO_4 turns green when exposed to **[JEE-Main 24-1-23_S2]**

(1) Carbon dioxide (2) Sulphur trioxide (3) Hydrogen sulphide (4) Sulphur dioxide

22. $KMnO_4$ oxidises I^- in acidic and neutral/faintly alkaline solution, respectively to

[JEE-Main 30-1-23_S2]

(1) I_2 and IO_3^- (2) IO_3^- and I_2 (3) IO_3^- and IO_3^- (4) I_2 and I_2

23. An ammoniacal metal salt solution gives a brilliant red precipitate on addition of dimethylglyoxime. The metal ion is : **[JEE-Main 24-1-23_S1]**

(1) Cu^{2+} (2) Co^{2+} (3) Fe^{2+} (4) Ni^{2+}

24. During the borax bead test with $CuSO_4$, a blue green colour of the bead was observed in oxidising flame due to the formation of **[JEE-Main 29-1-23_S1]**

(1) Cu_3B_2 (2) Cu (3) $Cu(BO_2)_2$ (4) CuO

25. Consider the following reactions:

$NaCl + K_2Cr_2O_7 + H_2SO_4 \rightarrow (A) +$ side products

(Conc.)

$(A) + NaOH \rightarrow (B) +$ Side products

$(B) + H_2SO_4 + H_2O_2 \rightarrow (C) +$ Side products

(dilute)

The sum of the total number of atoms in one molecule each of (A), (B) and (C) is _____.

[JEE-Main 7-1-20_S2]

26. The number of *f* electrons in the ground state electronic configuration of Np (Z = 93) is _____.
(Nearest integer) **[JEE-Main 27-8-21_S1]**

27. On complete reaction of $FeCl_3$ with oxalic acid in aqueous solution containing KOH, resulted in the formation of product A. The secondary valency of Fe in the product A is ____.
(Round off to the Nearest Integer). **[JEE-Main 17-3-21_S2]**

28. The ratio of number of water molecules in Mohr's salt and potash alum is _____ $\times 10^{-1}$.
(Integer answer) **[JEE-Main 26-8-21_S1]**

29. Consider the sulphides HgS, PbS, CuS, Sb_2S_3, As_2S_3 and CdS. Number of these sulphides soluble in 50% HNO_3 is _____. **[JEE-Main 31-8-21_S1]**

30. The number of terminal oxygen atoms present in the product B obtained from the following reaction is _____.

$FeCr_2O_4 + Na_2CO_3 + O_2 \rightarrow A + Fe_2O_3 + CO_2$

$A + H^+ \rightarrow B + H_2O + Na^+$ **[JEE-Main 29-6-22_S1]**

ANSWER KEY_d & f Block + QUALITATIVE ANALYSIS (ONLY CATION)

1.	(3)	**2.**	(4)	**3.**	(1)	**4.**	(2)	**5.**	(3)
6.	(4)	**7.**	(1)	**8.**	(2)	**9.**	(3)	**10.**	(1)
11.	(4)	**12.**	(1)	**13.**	(3)	**14.**	(1)	**15.**	(4)
16.	(3)	**17.**	(1)	**18.**	(1)	**19.**	(2)	**20.**	(1)
21.	(4)	**22.**	(1)	**23.**	(4)	**24.**	(3)	**25.**	**18**
26.	**18**	**27.**	**6**	**28.**	**5**	**29.**	**4**	**30.**	**6**

CHEMISTRY

JEE MAIN PREVIOUS YEARS QUESTIONS – 2018-2023

CHAPTER NAME :- HALOGEN & NOBLE GAS + QUALITATIVE ANALYSIS (ONLY ANION)

(IMPORTANT QUESTIONS ONLY)

1. Which among the following is the most reactive ? **[JEE-Main 2015]**

(1) Cl_2 (2) Br_2 (3) I_2 (4) ICl

2. The products obtained when chlorine gas reacts with cold and dilute aqueous NaOH are : **[JEE-Main 2017]**

(1) ClO_2^- and ClO_3^- (2) Cl^- and ClO^- (3) Cl^- and ClO_2^- (4) ClO^- and ClO_3^-

3. Among the following reactions of hydrogen with halogens, the one that requires a catalyst is : **[JEE-Main 10-1-19_S2]**

(1) $H_2 + Cl_2 \rightarrow 2HCl$ (2) $H_2 + I_2 \rightarrow 2HI$ (3) $H_2 + Br_2 \rightarrow 2HBr$ (4) $H_2 + F_2 \rightarrow 2HF$

4. Chlorine on reaction with hot and concentrated sodium hydroxide gives **[JEE-Main 12-1-19_S2]**

(1) Cl^- and ClO^- (2) Cl^- and ClO_2^- (3) ClO_3^- and ClO_2^- (4) Cl^- and ClO_3^-

5. HF has highest boiling point among hydrogen halides, because it has **[JEE-Main 9-4-19_S2]**

(1) Strongest hydrogen bonding (2) Lowest dissociation enthalpy

(3) Strongest van der Waals' interactions (4) Lowest ionic character

6. The noble gas that does NOT occur in the atmosphere is : **[JEE-Main 10-4-19_S2]**

(1) Ne (2) Kr (3) He (4) Rn

7. In the following reactions, products (A) and (B), respectively, are

$NaOH + Cl_2 \rightarrow (A) +$ side products

(hot and conc.)

$Ca(OH)_2 + Cl_2 \rightarrow (B) +$ side products

(Dry) **[JEE-Main 7-1-20_S2]**

(1) NaOCl and $Ca(OCl)_2$ (2) $NaClO_3$ and $Ca(ClO_3)_2$

(3) NaOCl and $Ca(ClO_3)_2$ (4) $NaClO_3$ and $Ca(OCl)_2$

8. The species given below that does NOT show disproportionation reaction is : **[JEE-Main 20-7-21_S1]**

(1) BrO_4^- (2) BrO^- (3) BrO_2^- (4) BrO_3^-

9. The incorrect statement is: **[JEE-Main 26-8-21_S1]**

(1) Cl_2 is more reactive than ClF.

(2) F_2 is more reactive than ClF.

(3) On hydrolysis ClF froms HOCl and HF.

(4) F_2 is a stronger oxidizing agent than Cl_2 in aqueous solution

10. Which one of the following is used to remove most of plutonium from spent nuclear fuel?

[JEE-Main 27-8-21_S2]

(1) ClF_3 (2) O_2F_2 (3) I_2O_5 (4) BrO_3

11. Which one of the following correctly represents the order of stability of oxides, X_2O; (X = halogen) ?

[JEE-Main 31-8-21_S2]

(1) Br > Cl > I (2) Br > I > Cl (3) Cl > I > Br (4) I > Cl > Br

12. Hydrogen peroxide reacts with iodine in basic medium to give : **[JEE-Main 1-9-21_S2]**

(1) IO_4^- (2) IO^- (3) I^- (4) IO_3^-

13. Given below are two statements :

Statement I : Colourless cupric metaborate is reduced to cuprous metaborate in a luminous flame.

Statement II : Cuprous metaborate is obtained by heating boric anhydride and copper sulphate in a non-luminous flame. **[JEE-Main 24-2-21_S1]**

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

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

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

14. Which of the following compound is added to the sodium extract before addition of silver nitrate for testing of halogens? **[JEE-Main 25-2-21_S2]**

(1) Nitric acid (2) Ammonia (3) Hydrochloric acid (4) Sodium hydroxide

15. An inorganic Compound 'X' on treatment with concentrated H_2SO_4 produces brown fumes and gives dark brown ring with $FeSO_4$ in presence of concentrated H_2SO_4. Also Compound 'X' gives precipitate 'Y', when its solution in dilute HCl is treated with H_2S gas. The precipitate 'Y' on treatment with concentrated HNO_3 followed by excess of NH_4OH further gives deep blue coloured solution, Compound 'X' is: **[JEE-Main 20-7-21_S1]**

(1) $Co(NO_3)_2$ (2) $Pb(NO_2)_2$ (3) $Cu(NO_3)_2$ (4) $Pb(NO_3)_2$

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

Assertion A : Flourine forms one oxoacid. **[JEE-Main 27-6-22_S2]**

Reason R : Flourine has smallest size amongst all halogens and is highly electronegative

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

(1) Both A and R are correct and R is the correct explanation of A.

(2) Both A and R are correct but R is NOT the correct explanation of A.

(3) A is correct but R is not correct.

(4) A is not correct but R is correct

17. The interhalogen compound formed from the reaction of bromine with excess of fluorine is a : **[JEE-Main 25-7-22_S1]**

(1) hypohalite (2) halite (3) perhalate (4) halite

18. A white precipitate was formed when $BaCl_2$ was added to water extract of an inorganic salt. Further, a gas 'X' with characteristic odour was released when the formed white precipitate was dissolved in dilute HCl. The anion present in the inorganic salt is : **[JEE-Main 29-6-22_S2]**

(1) I^- (2) SO_3^{2-} (3) S^{2-} (4) NO_2^-

19. Which statement is not true with respect to nitrate ion test ? **[JEE-Main 26-6-22_S1]**

(1) A dark brown ring is formed at the junction of two solutions.

(2) Ring is formed due to nitroferrous sulphate complex.

(3) The brown complex is $[Fe(H_2O)_5 (NO)]SO_4$.

(4) Heating the nitrate salt with conc. H_2SO_4, light brown fumes are evolved.

20. Match List I with List II

List I (Anion)	**List II (Gas evolved on reaction with dil. H_2SO_4)**
A. CO_3^{2-}	I. Colourless gas which turns lead acetate paper black
B. S^{2-}	II. Colourless gas which turns acidified potassium dichromate solution green.
C. SO_3^{2-}	III. Brown fumes which turns acidified KI solution containing starch blue.
D. NO_2^-	IV. Colourless gas evolved with brisk effervescence, which turns lime water milky.

Choose the correct answer from the options given below: **[JEE-Main 27-6-22_S2]**

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

21. A chloride salt solution acidified with dil. HNO_3 gives a curdy white precipitate, [A], on addition of $AgNO_3$. [A] on treatment with NH_4OH gives a clear solution, B. **[JEE-Main 25-1-23_S2]**

(1) $H[AgCl_3]$ and $[Ag(NH_3)_2]Cl$ (2) $H[AgCl_3]$ and $(NH_4)[Ag(OH)_2]$

(3) AgCl and $[Ag(NH_3)_2]Cl$ (4) AgCl and $(NH_4)[Ag(OH)_2]$

22. The bond dissociation energy is highest for **[JEE-Main 29-1-23_S1]**

(1) Cl_2 (2) I_2 (3) Br_2 (4) F_2

23. Given below are two statements:

Statement I: Chlorine can easily combine with oxygen to from 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. **[JEE-Main 01-2-23_S1]**

(1) Both the statements I and II are true (2) Statement I is true but Statement II is false

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

24. Inert gases have positive electron gain enthalpy. Its correct order is **[JEE-Main 25-1-23_S1]**

(1) Xe < Kr < Ne < He (2) He < Ne < Kr < Xe (3) He < Xe < Kr < Ne (4) He < Kr < Xe < Ne

25. During the qualitative analysis of SO_3^{2-} using dilute H_2SO_4, SO_2 gas is evolved which turns $K_2Cr_2O_7$ solution (acidified with dilute H_2SO_4): **[JEE-Main 30-1-23_S1]**

(1) Black (2) Red (3) Green (4) Blue

26. In the wet tests for identification of various cations by precipitation, which transition element cation doesn't belong to group IV in qualitative inorganic analysis? **[JEE-Main 30-1-23_S1]**

(1) Fe^{3+} (2) Zn^{2+} (3) Co^{2+} (4) Ni^{2+}

27. Given below are two statements :

Statement I: Upon heating a borax bead dipped in cupric sulphate in a luminous flame, the colour of the bead becomes green.

Statement II : The green colour observed is due to the formation of copper(I) metaborate.

In the light of the above statements, choose the most appropriate answer from the options given below **[JEE-Main 31-1-23_S2]**

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

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

28. Chlorine reacts with hot and concentrated NaOH and produces compounds (X) and (Y). Compound (X) gives white precipitate with silver nitrate solution. The average bond order between Cl and O atoms in (Y) is _____. **[JEE-Main 7-1-20_S1]**

29. A xenon compound 'A' upon partial hydrolysis gives XeO_2F_2. The number of lone pair of electrons present in compound A is _____(Round off to the Nearest integer) **[JEE-Main 18-3-21_S2]**

30. The number of halogen/(s) forming halic (V) acid is _____. **[JEE-Main 31-8-21_S1]**

ANSWER KEY_HALOGEN & NOBLE GAS + QUALITATIVE ANALYSIS (ONLY ANION)

1.	(4)	**2.**	(2)	**3.**	(2)	**4.**	(4)	**5.**	(1)
6.	(3)	**7.**	(4)	**8.**	(1)	**9.**	(1)	**10.**	(2)
11.	(4)	**12.**	(3)	**13.**	(2)	**14.**	(1)	**15.**	(3)
16.	(1)	**17.**	(2)	**18.**	(2)	**19.**	(2)	**20.**	(4)
21.	(3)	**22.**	(1)	**23.**	(1)	**24.**	(3)	**25.**	(3)
26.	(1)	**27.**	(3)	**28.**	**1.67**	**29.**	**19**	**30.**	**3**

CHEMISTRY

JEE MAIN PREVIOUS YEARS QUESTIONS – 2018-2023

CHAPTER NAME :- HYDROGEN

(IMPORTANT QUESTIONS ONLY)

1. The temporary hardness of water is due to **[JEE-Main 9-1-19_S2]**

(1) $CaCl_2$ (2) NaCl (3) Na_2SO_4 (4) $Ca(HCO_3)_2$

2. Hydrogen has three isotopes (A), (B) and (C). If the number of neutron(s) in (A), (B) and (C) respectively, are (x), (y) and (z), the sum of (x), (y) and (z) is **[JEE-Main 8-1-20_S2]**

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

3. The equation that represents the water-gas shift reaction is **[JEE-Main 5-9-20_S1]**

(1) $CH_4(g) + H_2O(g) \xrightarrow[Ni]{1270\ K} CO(g) + 3H_2(g)$

(2) $CO(g) + H_2O(g) \xrightarrow[Catalyst]{673\ K} CO_2(g) + H_2(g)$

(3) $2C(s) + O_2(g) + 4N_2(g) \xrightarrow{1273\ K} 2CO(g) + 4H_2(g)$

(4) $C(s) + H_2O(g) \xrightarrow{1270\ K} CO(g) + H_2(g)$

4. Dihydrogen of high purity (> 99.95%) is obtained through **[JEE-Main 6-9-20_S2]**

(1) the electrolysis of acidified water using Pt electrodes

(2) the electrolysis of warm $Ba(OH)_2$ solution using Ni electrodes

(3) the electrolysis of brine solution

(4) the reaction of Zn with dilute HCl

5. Deuterium resembles hydrogen in properties but : **[JEE-Main 27-8-21_S1]**

(1) reacts slower than hydrogen (2) reacts vigorously than hydrogen

(3) reacts just as hydrogen (4) emits β^+ particles

6. Which one of the following statements is incorrect ? **[JEE-Main 31-8-21_S2]**

(1) Atomic hydrogen is produced when H_2 molecules at a high temperature are irradiated with UV radiation.

(2) At around 2000 K, the dissociation of dihydrogen into its atoms is nearly 8.1%.

(3) Bond dissociation enthalpy of H_2 is highest among diatomic gaseous molecules which contain a single bond .

(4) Dihydrogen is produced on reacting zinc with HCl as well as NaOH(aq).

7. The oxide that gives H_2O_2 most readily on treatment with H_2O is : **[JEE-Main 27-8-21_S2]**

(1) PbO_2 (2) Na_2O_2 (3) SnO_2 (4) $BaO_2 \cdot 8H_2O$

8. Which one of the following chemical agent is not being used for dry–cleaning of clothes? **[JEE-Main 25-7-21_S1]**

(1) H_2O_2 (2) CCl_4 (3) Liquid CO_2 (4) $Cl_2C = CCl_2$

9. Isotope(s) of hydrogen which emits low energy β^- particles with $t_{½}$ value > 12 years is/are **[JEE-Main 22-7-21_S2]**

(1) Protium (2) Tritium (3) Deuterium (4) Deuterium and Tritium

10. At 298.2 K the relationship between enthalpy of bond dissociation (in kJ mol^{-1}) for hydrogen (E_H) and its isotope, deuterium (E_D), is best described by : **[JEE-Main 25-7-21_S1]**

(1) $E_H = \frac{1}{2}E_D$ (2) $E_H = E_D$ (3) $E_H \simeq E_D - 7.5$ (4) $E_H = 2E_D$

11. Given below are two statements : One is labelled as Assertion A and other is labelled as Reason R.
Assertion A : The dihedral angles in H_2O_2 in gaseous phase is 90.2° and in solid phase is 111.5°.
Reason R : The change in dihedral angle in solid and gaseous phase is due to the difference in the intermolecular forces.
Choose the most appropriate answer from the options given below for A and R. **[JEE-Main 20-7-21_S1]**

(1) A is correct but R is not correct.
(2) Both A and R are 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 not correct but R is correct.

12. In basic medium, H_2O_2 exhibits which of the following reactions ?

(A) $Mn^{2+} \rightarrow Mn^{4+}$ (B) $I_2 \rightarrow I^-$ (C) $PbS \rightarrow PbSO_4$

Choose the most appropriate answer from the options given below : **[JEE-Main 18-3-21_S2]**

(1) (A), (C) only (2) (A) only (3) (B) only (4) (A), (B) only

13. Given below are two statements : One is labelled as Assertion A and the other labelled as reason R

Assertion A : During the boiling of water having temporary hardness, $Mg(HCO_3)_2$ is converted to $MgCO_3$. **[JEE-Main 18-3-21_S1]**

Reason R : The solubility product of $Mg(OH)_2$ is greater than that of $MgCO_3$.

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

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

14. The single largest industrial application of dihydrogen is : **[JEE-Main 20-7-21_S2]**

(1) Manufacture of metal hydrides (2) Rocket fuel in space research

(3) In the synthesis of ammonia (4) In the synthesis of nitric acid

15. The INCORRECT statement(s) about heavy water is (are)

(A) used as a moderator in nuclear reactor

(B) obtained as a by-product in fertilizer industry.

(C) used for the study of reaction mechanism

(D) has a higher dielectric constant than water

Choose the correct answer from the options given below : **[JEE-Main 17-3-21_S1]**

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

16. Calgon is used for water treatment. Which of the following statement is NOT true about Calgon? **[JEE-Main 26-2-21_S2]**

(1) Calgon contains the 2nd most abundant element by weight in the Earth's crust.

(2) It is polymeric compound and is water soluble.

(3) It is also known as Graham's salt

(4) It does not remove Ca^{2+} ion by precipitation.

17. Statements about heavy water are given below. **[JEE-Main 26-2-21_S1]**

A. Heavy water is used in exchange reactions for the study of reaction mechanisms.

B. Heavy water is prepared by exhaustive electrolysis of water

C. Heavy water has higher boiling point than ordinary water.

D. Viscosity of H_2O is greater than D_2O

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

18. The correct statements about H_2O_2 are :

(A) used in the treatment of effluents.

(B) used as both oxidising and reducing agents.

(C) the two hydroxyl groups lie in the same plane.

(D) miscible with water.

Choose the correct answer from the options given below : **[JEE-Main 16-3-21_S2]**

(1) (A), (B), (C) and (D) (2) (A), (B) and (D) only

(3) (B), (C) and (D) only (4) (A), (C) and (D) only

19. Water does not produce CO on reacting with: **[JEE-Main 25-2-21_S2]**

(1) CO_2 (2) C (3) CH_4 (4) C_3H_8

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

Assertion A : Hydrogen is the most abundant element in the Universe, but it is not the most abundant gas in the troposphere.

Reason R : Hydrogen is the lightest element. In the light of the above statements, choose the correct answer from the options given below : **[JEE-Main 24-2-21_S2]**

(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**

21. The metal salts formed during softening of hardwater using Clark's method are : **[JEE-Main 28-7-22_S1]**

(1) $Ca(OH)_2$ and $Mg(OH)_2$ (2) $CaCO_3$ and $Mg(OH)_2$

(3) $Ca(OH)_2$ and $MgCO_3$ (4) $CaCO_3$ and $MgCO_3$

22. Which one of the following reactions indicates the reducing ability of hydrogen peroxide in basic medium ? **[JEE-Main 29-6-22_S1]**

(1) $HOCl + H_2O_2 \rightarrow H_3O^+ + Cl^- + O_2$

(2) $PbS + 4H_2O_2 \rightarrow PbSO_4 + 4H_2O$

(3) $2MnO_4^- + 3H_2O \rightarrow 2MnO_2 + 3O_2 + 2H_2O + 2OH^-$

(4) $Mn^{2+} + H_2O_2 \rightarrow Mn^{4+} + 2OH^-$

23. High purity (>99.95%) dihydrogen is obtained by **[JEE-Main 25-7-22_S2]**

(1) reaction of zinc with aqueous alkali.

(2) electrolysis of acidified water using platinum electrodes.

(3) electrolysis of warm aqueous barium hydroxide solution between nickel electrodes.

(4) reaction of zinc with dilute acid.

24. Which of the following can be used to prevent the decomposition of H_2O_2? **[JEE-Main 26-7-22_S1]**

(1) Urea (2) Formaldehyde (3) Formic acid (4) Ethanol

25. Given below are two statements: **[JEE-Main 27-7-22_S1]**

Statement I : Hydrogen peroxide can act as an oxidizing agent in both acidic and basic conditions.

Statement II: Density of hydrogen peroxide at 298 K is lower than that of D_2O.

In the light of the above statements. Choose the correct answer from the options.

(1) Both statement I and Statement II are true

(2) Both statement I and Statement II are false

(3) Statement I is true but Statement II is false

(4) Statement I is false but Statement II is true

26. Hydrogen has three isotopes : protium (^1H), deuterium (^2H or D) and tritium (^3H or T). They have nearly same chemical properties but different physical properties. They differ in **[JEE-Main 28-6-22_S2]**

(1) number of protons
(2) atomic number
(3) electronic configuration
(4) atomic mass

27. In which of the following reactions the hydrogen peroxide acts as a reducing agent?

[JEE-Main_24-1-23_S2]

(1) $PbS + 4H_2O_2 \rightarrow PbSO_4 + 4H_2O$
(2) $2Fe^{2+} + H_2O_2 \rightarrow 2Fe^{3+} + 2OH^-$
(3) $HOCl + H_2O_2 \rightarrow H_3O^{\oplus} + Cl^{\ominus} + O_2$
(4) $Mn^{2+} + H_2O_2 \rightarrow Mn^{4+} + 2OH^-$

28. Given below are two statements :

Statement I: H_2O_2 is used in the synthesis of Cephalosporin

Statement II : H_2O_2 is used for the restoration of aerobic conditions to sewage wastes.

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

[JEE-Main_31-1-23_S2]

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

29. H_2O_2 acts as a reducing agent in **[JEE-Main_31-1-23_S1]**

(1) $2NaOCl + H_2O_2 \rightarrow 2NaCl + H_2O + O_2$
(2) $2Fe^{2+} + 2H^+ + H_2O_2 \rightarrow 2Fe^{3+} + 2H_2O$
(3) $Mn^{2+} + 2H_2O_2 \rightarrow MnO_2 + 2H_2O$
(4) $Na_2S + 4H_2O_2 \rightarrow Na_2SO_4 + 4H_2O$

30. On reaction with stronger oxidizing agent like KIO_4, hydrogen peroxide oxidizes with the evolution of O_2. The oxidation number of I in KIO_4 changes to _____. **[JEE-Main 28-7-22_S2]**

ANSWER KEY_HYDROGEN

1.	(4)	**2.**	(3)	**3.**	(2)	**4.**	(2)	**5.**	(1)
6.	(2)	**7.**	(2)	**8.**	(1)	**9.**	(2)	**10.**	(3)
11.	(4)	**12.**	(4)	**13.**	(4)	**14.**	(3)	**15.**	(3)
16.	(1)	**17.**	(1)	**18.**	(2)	**19.**	(1)	**20.**	(2)
21.	(2)	**22.**	(3)	**23.**	(3)	**24.**	(1)	**25.**	(3)
26.	(4)	**27.**	(3)	**28.**	(1)	**29.**	(1)	**30.**	**5**

CHEMISTRY

JEE MAIN PREVIOUS YEARS QUESTIONS – 2018-2023

CHAPTER NAME :- SURFACE CHEMISTRY

(IMPORTANT QUESTIONS ONLY)

1. Among the following, the false statement is **[JEE-Main 2-1-19_S2]**

(1) Tyndall effect can be used to distinguish between a colloidal solution and a true solution.

(2) Latex is a colloidal solution of rubber particles which are positively charged

(3) Lyophilic sol can be coagulated by adding an electrolyte.

(4) It is possible to cause artificial rain by throwing electrified sand carrying charge opposite to the one on clouds from an aeroplane.

2. Haemoglobin and gold sol are examples of : **[JEE-Main 10-1-19_S2]**

(1) negatively charged sols

(2) positively charged sols

(3) positively and negatively charged sols, respectively

(4) negatively and positively charged sols, respectively

3. Which of the following is not an example of heterogeneous catalytic reaction? **[JEE-Main 10-1-19_S1]**

(1) Combustion of coal (2) Ostwald's process

(3) Hydrogenation of vegetable oils (4) Haber's process

4. Among the colloids cheese (C), milk (M) and smoke (S), the correct combination of the dispersed phase and dispersion medium, respectively is : **[JEE-Main 11-1-19_S2]**

(1) C : solid in liquid; M : liquid in liquid; S : gas in solid

(2) C : liquid in solid; M : liquid in solid; S : solid in gas

(3) C : liquid in solid; M : liquid in liquid; S : solid in gas

(4) C : solid in liquid; M : solid in liquid; S : solid in gas

5. For coagulation of arsenious sulphide sol, which one of the following salt solution will be most effective? **[JEE-Main 9-1-19_S2]**

(1) Na_3PO_4 (2) $AlCl_3$ (3) NaCl (4) $BaCl_2$

6. Peptization is a : **[JEE-Main 12-4-19_S1]**

(1) Process of converting a colloidal solution into precipitate

(2) Process of converting precipitate into colloidal solution

(3) Process of converting soluble particles to form colloidal solution

(4) Process of bringing colloidal molecule into solution

7. Among the following, the INCORRECT statement about colloids is **[JEE-Main 12-4-19_S2]**

(1) They can scatter light.

(2) The range of diameters of colloidal particles is between 1 and 1000 nm.

(3) The osmotic pressure of a colloidal solution is of higher order than the true solution at the same concentration.

(4) They are larger than small molecules and have high molar mass.

8. The aerosol is a kind of colloid in which **[JEE-Main 9-4-19_S1]**

(1) solid is dispersed in gas (2) gas is dispersed in solid

(3) liquid is dispersed in water (4) gas is dispersed in liquid

9. The correct option among the following is : **[JEE-Main 10-4-19_S2]**

(1) Colloidal medicines are more effective because they have small surface area.

(2) Colloidal particles in lyophobic sols can be precipitated by electrophoresis.

(3) Brownian motion in colloidal solution is faster if the viscosity of the solution is very high.

(4) Addition of alum to water makes it unfit for drinking.

10. 10 mL of 1 mM surfactant solution forms a monolayer covering 0.24 cm^2 on a polar substrate. If the polar head is approximated as a cube, what is its edge length? **[JEE-Main 9-4-19_S2]**

(1) 2.0 pm (2) 2.0 nm (3) 0.1 nm (4) 1.0 pm

11. Amongst the following statements regarding adsorption, those that are valid are **[JEE-Main 2-9-20_S2]**

(1) ΔH becomes less negative as adsorption proceeds

(2) On a given adsorbent, ammonia is adsorbed more than nitrogen gas

(3) On adsorption, the residual force acting along the surface of the adsorbent increases

(4) With increase in temperature, the equilibrium concentration of adsorbate increases

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

12. As per Hardy-Schulze formulation, the flocculation values of the following for ferric hydroxide sol are in the order **[JEE-Main 8-1-20_S1]**

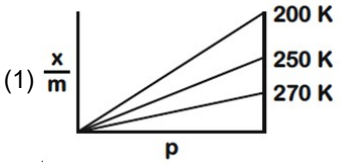
(1) $AlCl_3 > K_3[Fe(CN)_6] > K_2CrO_4 > KBr = KNO_3$

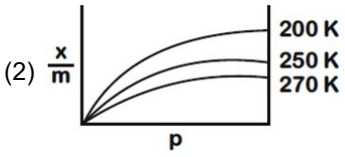
(2) $K_3[Fe(CN)_6] < K_2CrO_4 < KBr = KNO_3 = AlCl_3$

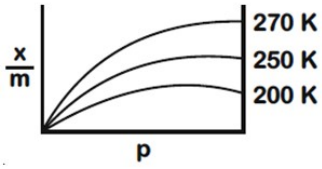
(3) $K_3[Fe(CN)_6] > AlCl_3 > K_2CrO_4 > KBr > KNO_3$

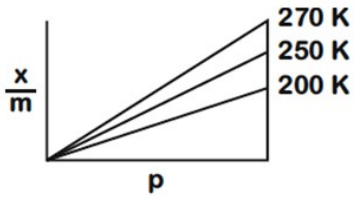
(4) $K_3[Fe(CN)_6] < K_2CrO_4 < AlCl_3 < KBr < KNO_3$

13. Adsorption of a gas follows Freundlich adsorption isotherm. If x is the mass of the gas adsorbed on mass m of the adsorbent, the correct plot of $\frac{x}{m}$ versus p is **[JEE-Main 5-9-20_S2]**

(1) 

(2) 

(3) 

(4) 

14. Kraft temperature is the temperature **[JEE-Main 6-9-20_S1]**

(1) below which the aqueous solution of detergents starts freezing.

(2) above which the formation of micelles takes place.

(3) below which the formation of micelles takes place.

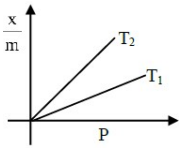
(4) above which the aqueous solution of detergents starts boiling.

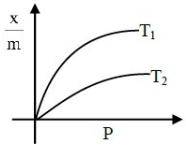
15. Most suitable salt which can be used for efficient clotting of blood will be :- **[JEE-Main 24-2-21_S2]**

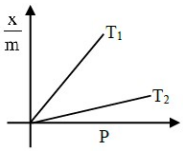
(1) $NaHCO_3$ (2) $FeSO_4$ (3) $Mg(HCO_3)_2$ (4) $FeCl_3$

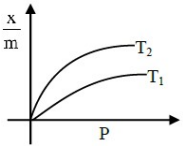
16. Select the graph that correctly describes the adsorption isotherms at two temperatures T_1 and T_2 ($T_1 > T_2$) for a gas : (x – mass of the gas adsorbed ; m – mass of adsorbent ; P – pressure)

[JEE-Main 31-8-21_S1]

(1) 

(2) 

(3) 

(4) 

17. Which one of the following is correct for the adsorption of a gas at a given temperature on a solid surface? **[JEE-Main 26-8-21_S1]**

(1) $\Delta H > 0, \Delta S > 0$ (2) $\Delta H > 0, \Delta S < 0$ (3) $\Delta H < 0, \Delta S < 0$ (4) $\Delta H < 0, \Delta S > 0$

18. The conditions given below are in the context of observing Tyndall effect in colloidal solutions:

(A) The diameter of the colloidal particles is comparable to the wavelength of light used.

(B) The diameter of the colloidal particles is much smaller than the wavelength of light used.

(C) The diameter of the colloidal particles is much larger than the wavelength of light used.

(D) The refractive indices of the dispersed phase and the dispersion medium are comparable.

(E) The dispersed phase has a very different refractive index from the dispersion medium.

Choose the most appropriate conditions from the options given below: **[JEE-Main 20-7-21_S1]**

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

19. When silver nitrate solution is added to potassium iodide solution then the sol produced is : **[JEE-Main 22-7-21_S2]**

(1) AgI / I^- (2) AgI / Ag^+ (3) KI / NO_3^- (4) $AgNO_3 / NO_3^-$

20. The charges on the colloidal CdS sol and TiO_2 sol are, respectively : **[JEE-Main 18-3-21_S2]**

(1) positive and positive (2) positive and negative

(3) negative and negative (4) negative and positive

21. Which one of the following statements is FALSE for hydrophilic sols ? **[JEE-Main 25-2-21_S2]**

(1) Their viscosity is of the order of that of H_2O. (2) The sols cannot be easily coagulated.

(3) They do not require electrolytes for stability. (4) These sols are reversible in nature.

22. Given below are two statements :

Statement I : Emulsions of oil in water are unstable and sometimes they separate into two layers on standing. **[JEE-Main 24-6-22_S1]**

Statement II : For stabilisation of an emulsion, excess of electrolyte is added.

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 correct.

(2) Both Statement I and Statement II are incorrect.

(3) Statement I is correct but Statement II is incorrect.

(4) Statement I is incorrect but Statement II is correct.

23. Which of the following is a correct statement ? **[JEE-Main 29-6-22_S1]**

(1) Brownian motion destabilises sols.

(2) Any amount of dispersed phase can be added to emulsion without destabilising it.

(3) Mixing two oppositely charged sols in equal amount neutralises charges and stabilises colloids.

(4) Presence of equal and similar charges on colloidal particles provides stability to the colloidal solution.

24. The Zeta potential is related to which property of colloids" **[JEE-Main 28-6-22_S1]**

(1) Colour (2) Tyndall effect

(3) Charge on the surface of colloidal particles (4) Brownian movement

25. Using very little soap while washing clothes, does not serve the purpose of cleaning of clothes because **[JEE-Main 25-6-22_S1]**

(1) soap particles remain floating in water as ions

(2) the hydrophobic part of soap is not able to take away grease

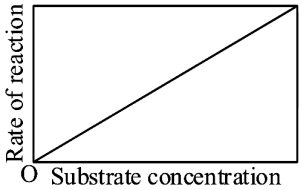
(3) the micelles are not formed due to concentration of soap, below its CMC value

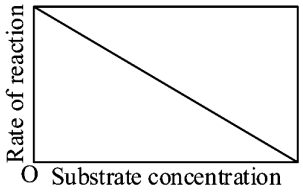
(4) colloidal structure of soap in water is completely disturbed.

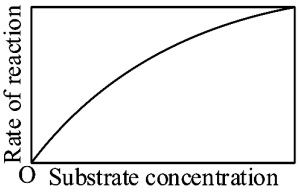
26. 100 mL of 5% (w/v) solution of NaCl in water was prepared in 250 mL beaker. Albumin from the egg was poured into NaCl solution and stirred well. This resulted in a/ an : **[JEE-Main 29-7-22_S1]**

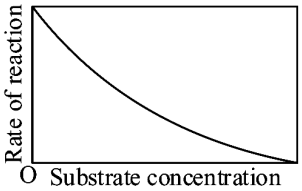
(1) Lyophilic sol (2) Lyophobic sol (3) Emulsion (4) Precipitate

27. The variation of the rate of an enzyme catalyzed reaction with substrate concentration is correctly represented by graph **[JEE-Main 25-1-23_S1]**

(a) 

(b) 

(c) 

(d) 

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

28. CH_4 is adsorbed on 1 g charcoal at 0°C following the Freundlich adsorption isotherm. 10.0 mL of CH_4 is adsorbed at 100 mm of Hg, whereas 15.0 mL is adsorbed at 200 mm of Hg. The volume of CH_4 adsorbed at 300 mm of Hg is 10^x mL. The value of x is _____ × 10^{-2}.
(Nearest integer)
[Use $\log_{10}2 = 0.3010$, $\log_{10}3 = 0.4771$] **[JEE-Main 31-8-21_S2]**

29. CO_2 gas adsorbs on charcoal following Freundlich adsorption isotherm. For a given amount of charcoal, the mass of CO_2 adsorbed becomes 64 times when the pressure of CO_2 is doubled. The value of n in the Freundlich isotherm equation is _____ × 10^{-2}. (Round off to the Nearest Integer)
[JEE-Main 27-7-21_S1]

30. The number of statement/s which are the characteristics of physisorption is _____.

A. It is highly specific in nature
B. Enthalpy of adsorption is high
C. It decreases with increase in temperature
D. It results into unimolecular layer
E. No activation energy is needed **[JEE-Main_24-1-23_S2]**

ANSWER KEY_SURFACE CHEMISTRY

1.	(2)	**2.**	(3)	**3.**	(1)	**4.**	(3)	**5.**	(2)
6.	(2)	**7.**	(3)	**8.**	(1)	**9.**	(2)	**10.**	(1)
11.	(2)	**12.**	(2)	**13.**	(2)	**14.**	(2)	**15.**	(4)
16.	(4)	**17.**	(3)	**18.**	(1)	**19.**	(1)	**20.**	(4)
21.	(1)	**22.**	(3)	**23.**	(4)	**24.**	(3)	**25.**	(3)
26.	(1)	**27.**	(2)	**28.**	**128**	**29.**	**17**	**30.**	**2**

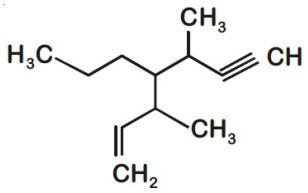
CHEMISTRY

JEE MAIN PREVIOUS YEARS QUESTIONS – 2018-2023

CHAPTER NAME :- IUPAC NOMENCLATURE +ISOMERISM + POLYMER

(IMPORTANT QUESTIONS ONLY)

1. The IUPAC name for the following compound is **[JEE-Main 12-4-19_S2]**



(1) 3-methyl-4-(1-methylprop-2-ynyl)-1-heptene (2) 3-methyl-4-(3-methylprop-1-enyl)-1-heptyne

(3) 3,5-dimethyl-4-propylhept-1-en-6-yne (4) 3,5-dimethyl-4-propylhept-6-en-1-yne

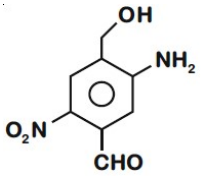
2. The correct match between Item-I and Item-II is: **[JEE-Main 10-4-19_S2]**

	Item – I		Item – II
(a)	High density polythene	(I)	Peroxide catalyst
(b)	Polyacrylonitrile	(II)	Condensation at high temperature and pressure
(c)	Novolac	(III)	Ziegler – Natta Catalyst
(d)	Nylon 6	(IV)	Acid or base catalyst

(1) (a) → (III), (b) → (I), (c) → (IV), (d) → (II) (2) (a) → (III), (b) → (I), (c) → (II), (d) → (IV)

(3) (a) → (IV), (b) → (II), (c) → (I), (d) → (III) (4) (a) → (II), (b) → (IV), (c) → (I), (d) → (III)

3. The IUPAC name of the following compound is **[JEE-Main 6-9-20_S2]**



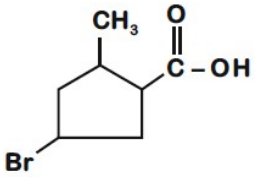
(1) 4-amino-2-formyl-5-hydroxymethyl nitrobenzene

(2) 5-amino-4-hydroxymethyl-2-nitrobenzaldehyde

(3) 3-amino-4-hydroxymethyl-5-nitrobenzaldehyde

(4) 2-nitro-4-hydroxymethyl-5-aminobenzaldehyde

4. The IUPAC name of the following compound is **[JEE-Main 4-9-20_S1]**



(1) 3-Bromo-5-methylcyclopentane carboxylic acid

(2) 3-Bromo-5-methylcyclopentanoic acid

(3) 5-Bromo-3-methylcyclopentanoic acid

(4) 4-Bromo-2-methylcyclopentane carboxylic acid

5. Consider the Assertion and Reason given below. **[JEE-Main 6-9-20_S1]**

Assertion (A) : Ethene polymerized in the presence of Ziegler Natta Catalyst at high temperature and pressure is used to make buckets and dustbins.

Reason (R) : High density polymers are closely packed and are chemically inert.

Choose the correct answer from the following:

(1) Both (A) and (R) are correct and (R) is the correct explanation of (A).

(2) Both (A) and (R) are correct but (R) is not the correct explanation of (A).

(3) (A) is correct but (R) is wrong

(4) (A) and (R) both are wrong

6. Which polymer has 'chiral' monomer(s)? **[JEE-Main 9-1-20_S2]**

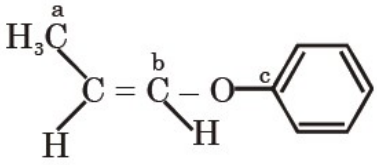
(1) Buna-N (2) PHBV (3) Neoprene (4) Nylon 6, 6

7. The number of compound/s given below which contain/s –COOH group is _____.

[JEE-Main 25-2-21_S2]

(1) Sulphanilic acid (2) Picric acid (3) Aspirin (4) Ascorbic acid

8. In the following molecules,



Hybridisation of carbon a, b and c respectively are : **[JEE-Main 18-3-21_S2]**

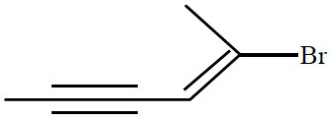
(1) sp^3, sp, sp (2) sp^3, sp^2, sp (3) sp^3, sp^2, sp^2 (4) sp^3, sp, sp^2

9. In $\overset{1}{C}H_2 = \overset{2}{C} = \overset{3}{C}H - \overset{4}{C}H_3$ molecule, the hybridization of carbon 1, 2, 3 and 4 respectively are :

[JEE-Main 26-2-21_S2]

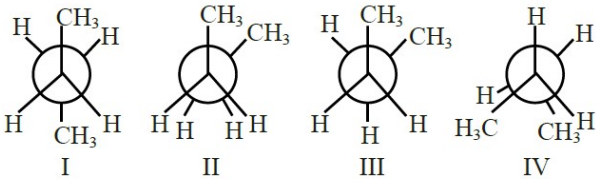
(1) sp^3, sp, sp^3, sp^3 (2) sp^2, sp^2, sp^2, sp^3 (3) sp^2, sp, sp^2, sp^3 (4) sp^2, sp^3, sp^2, sp^3

10. Choose the correct name for compound given below : **[JEE-Main 31-8-21_S1]**



(1) (4E)-5-Bromo-hex-4-en-2-yne
(2) (2E)-2-Bromo-hex-4-yn-2-ene
(3) (2E)-2-Bromo-hex-2-en-4-yne
(4) (4E)-5-Bromo-hex-2-en-4-yne

11. Arrange the following conformational isomers of n-butane in order of their increasing potential energy : **[JEE-Main 31-8-21_S2]**



(1) II < III < IV < I
(2) I < IV < III < II
(3) II < IV < III < I
(4) I < III < IV < II

12. The stereoisomers that are formed by electrophilic addition of bromine to trans-but-2-ene is/are : **[JEE-Main 1-9-21_S2]**

(1) 2 enantiomers and 2 mesomers
(2) 2 identical mesomers
(3) 2 enantiomers
(4) 1 racemic and 2 enantiomers

13. Compound with molecular formula C_3H_6O can show : **[JEE-Main 18-3-21_S1]**

(1) Positional isomerism
(2) Both positional isomerism and metamerism
(3) Metamerism
(4) Functional group isomerism

14. Which among the following is not a polyester ? **[JEE-Main 31-8-21_S2]**

(1) Novolac
(2) PHBV
(3) Dacron
(4) Glyptal

15. Monomer of Novolac is : **[JEE-Main 31-8-21_S1]**

(1) 3-Hydroxybutanoic acid
(2) phenol and melamine
(3) o-Hydroxymethylphenol
(4) 1,3-Butadiene and styrene

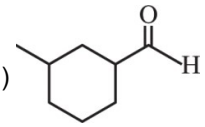
16. Match List I with List II.

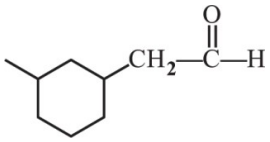
List I (Monomer Unit)	**List II (Polymer)**
(a) Caprolactum	(i) Natural rubber
(b) 2-Chloro-1,3-butadiene	(ii) Buna-N
(c) Isoprene	(iii) Nylon 6
(d) Acrylonitrile	(iv) Neoprene

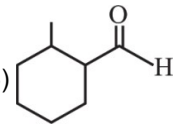
Choose the correct answer from the options given below : **[JEE-Main 24-2-21_S1]**

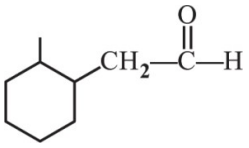
(1) (a) → (iv), (b) → (iii), (c) → (ii), (d) → (i)
(2) (a) → (ii), (b) → (i), (c) → (iv), (d) → (iii)
(3) (a) → (iii), (b) → (iv), (c) → (i), (d) → (ii)
(4) (a) → (i), (b) → (ii), (c) → (iii), (d) → (iv)

17. Correct structure of γ-methylcyclohexane carbaldehyde is : **[JEE-Main 29-7-22_S2]**

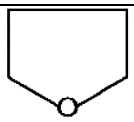
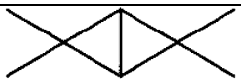
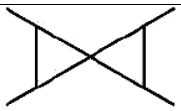
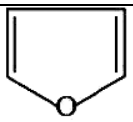
(1) 

(2) 

(3) 

(4) 

18. Match List–I with List–II.

	List I		List II
(A)		(I)	Spiro compound
(B)		(II)	Aromatic compound
(C)		(III)	Non–planar Heterocyclic compound
(D)		(IV)	Bicyclo compound

Choose the correct answer from the options given below : **[JEE-Main 28-7-22_S1]**

(1) (A) – (II), (B) – (I), (C) – (IV), (D) – (III)

(2) (A) – (IV), (B) – (III), (C) – (I), (D) – (II)

(3) (A) – (III), (B) – (IV), (C) – (I), (D) – (II)

(4) (A) – (IV), (B) – (III), (C) – (II), (D) – (I)

19. The correct decreasing order of priority of functional groups in naming an organic compound as per IUPAC system of nomenclature is : **[JEE-Main 26-7-22_S1]**

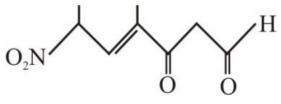
(1) —COOH > —$CONH_2$ > —COCl > —CHO

(2) —SO3H > —COCl > —$CONH_2$ > —CN

(3) —COOR > —COCl > —NH_2 > $\rangle C=O$

(4) —COOH > —COOR > —$CONH_2$ > —COCl

20. The correct IUPAC name of the following compound is : **[JEE-Main 28-6-22_S2]**



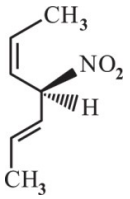
(1) 4-methyl-2-nitro-5-oxohept-3-enal

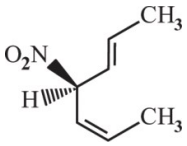
(2) 4-methyl-5-oxo-2-nitrohept-3-enal

(3) 4-methyl-6-nitro-3-oxohept-4-enal

(4) 6-formyl-4-methyl-2-nitrohex-3-enal

21. Given below are two statements.

Statement I : The compound  is optically active.

Statement II :  is mirror image of above compound A. **[JEE-Main 29-7-22_S2]**

In the light of the above statement, choose the most appropriate answer from the options given below.

(1) Both Statement I and Statement II are correct

(2) Both Statement I and Statement II are incorrect.

(3) Statement I is correct but Statement II is incorrect.

(4) Statement I is incorrect but Statement II is correct.

22. Which of the following is not an example of a condensation polymer? **[JEE-Main 24-6-22_S2]**

(1) Nylon 6,6 (2) Decron (3) Buna-N (4) Silicone

23. In the following halogenated organic compounds the one with maximum number of chlorine atoms in its structure is : **[JEE-Main_31-1-23_S2]**

(1) Chloral (2) Gammaxene (3) Chloropicrin (4) Freon-12

24. The isomeric deuterated bromide with molecular formula C_4H_8DBr having two chiral carbon atoms is **[JEE-Main_25-1-23_S2]**

(1) 2-Bromo-1-deuterobutane (2) 2-Bromo-2-deuterobutane

(3) 2-Bromo-3-deuterobutane (4) 2-Bromo-1-deutero-2-methylpropane

25. Match List–I and List–II.

	LIST-I		LIST-II
A	Elastomeric	**I**	Urea formaldehyde polymer resin
B	Fibre polymer	**II**	Polystyrene
C	Thermosetting	**III**	Polyester polymer
D	Thermoplastic	**IV**	Neoprene polymer

Choose the correct answer from the options given below: **[JEE-Main_29-1-23_S2]**

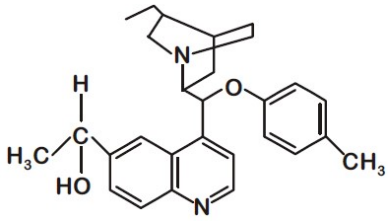
(1) A–II, B–III, C–I, D–IV (2) A–II, B–I, C–IV, D–III

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

26. Caprolactam when heated at high temperature in presence of water, gives **[JEE-Main_30-1-23_S1]**

(1) Teflon (2) Dacron (3) Nylon 6, 6 (4) Nylon 6

27. The number of chiral carbons present in the molecule given below is _____.



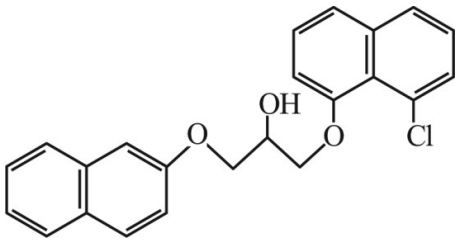
[JEE-Main 2-9-20_S1]

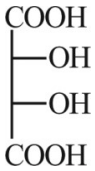
28. The dihedral angle in staggered form of Newman projection of 1, 1, 1-Trichloro ethane is ..... degree. (Round off to the nearest integer)

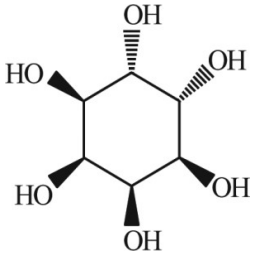
(Round off to the nearest integer) **[JEE-Main 27-7-21_S2]**

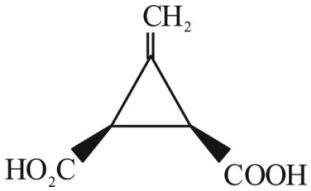
29. Total number of isomers (including stereoisomers) obtained on monochlorination of methylcyclohexane is _____. **[JEE-Main 26-7-22_S2]**

30. The total number of chiral compound/s from the following is _____. **[JEE-Main_01-2-23_S1]**









ANSWER KEY_IUPAC NOMENCLATURE +ISOMERISM + POLYMER

1.	(3)	**2.**	(1)	**3.**	(2)	**4.**	(4)	**5.**	(1)
6.	(2)	**7.**	(3)	**8.**	(3)	**9.**	(3)	**10.**	(3)
11.	(4)	**12.**	(2)	**13.**	(4)	**14.**	(1)	**15.**	(3)
16.	(3)	**17.**	(1)	**18.**	(3)	**19.**	(2)	**20.**	(3)
21.	(3)	**22.**	(3)	**23.**	(2)	**24.**	(3)	**25.**	(3)
26.	(4)	**27.**	**5**	**28.**	**60**	**29.**	**12**	**30.**	**2**

CHEMISTRY

JEE MAIN PREVIOUS YEARS QUESTIONS – 2018-2023

CHAPTER NAME :- GOC-I + GOC-II

(IMPORTANT QUESTIONS ONLY)

1. The increasing order of nucleophilicity of the following nucleophiles is : **[JEE-Main 10-4-19_S2]**

(a) $CH_3CO_2^{\ominus}$ (b) H_2O (c) $CH_3SO_3^{\ominus}$ (d) $\overset{\ominus}{O}H$

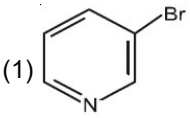
(1) (d) < (a) < (c) < (b)

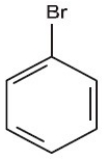
(2) (b) < (c) < (d) < (a)

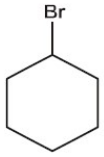
(3) (a) < (d) < (c) < (b)

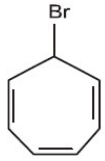
(4) (b) < (c) < (a) < (d)

2. Which of the following compounds will produce a precipitate with $AgNO_3$? **[JEE-Main 11-1-19_S2]**

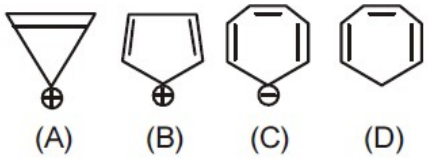
(1) 

(2) 

(3) 

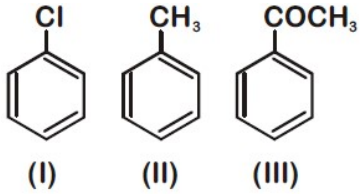
(4) 

3. Which compound(s) out of following is/are not aromatic? **[JEE-Main 11-1-19_S1]**



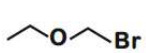
(1) (B), (C) and (D) (2) (A) and (C) (3) (C) and (D) (4) (B)

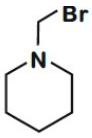
4. The increasing order of the reactivity of the following compounds towards electrophilic aromatic substitution reactions is : **[JEE-Main 10-4-19_S1]**

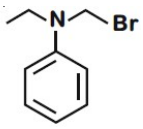


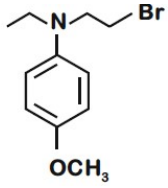
(1) I < III < II (2) III < II < I (3) II < I < III (4) III < I < II

5. Which of the following compounds will form the precipitate with aq. $AgNO_3$ solution most readily? **[JEE-Main 4-9-20_S2]**

(1) 

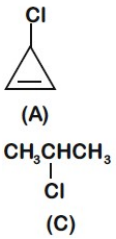
(2) 

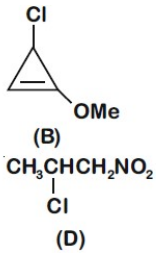
(3) 

(4) 

6. The decreasing order of reactivity of the following organic molecules towards $AgNO_3$ solution is

[JEE-Main 4-9-20_S1]

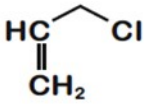


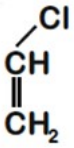


(1) (B) > (A) > (C) > (D)
(2) (A) > (B) > (D) > (C)
(3) (A) > (B) > (C) > (D)
(4) (C) > (D) > (A) > (B)

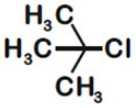
7. Among the following compounds, which one has the shortest C – Cl bond?

[JEE-Main 4-9-20_S2]

(1) 

(2) 

(3) $H_3C - Cl$

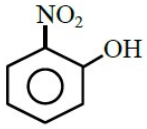
(4) 

8. Which of the following has the shortest C – Cl bond? **[JEE-Main 9-1-20_S2]**

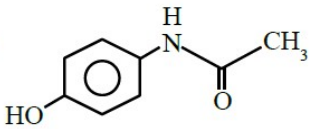
(1) Cl – CH = CH – NO_2
(2) Cl – CH = CH_2
(3) Cl – CH = CH – CH_3
(4) Cl – CH = CH – OCH_3

9. The compound/s which will show significant intermolecular H–bonding is/are :

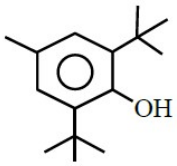
[JEE-Main 27-8-21_S2]



(a)



(b)

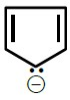


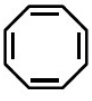
(c)

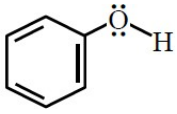
(1) (b) only
(2) (c) only
(3) (a) and (b) only
(4) (a), (b) and (c)

10. Which one of the following compounds is not aromatic ? **[JEE-Main 26-8-21_S2]**

(1) 

(2) 

(3) 

(4) 

11. Given below are two statements : **[JEE-Main 27-7-21_S2]**

Statement I : Hyperconjugation is a permanent effect.

Statement II : Hyperconjugation in ethyl cation $\left(CH_3-\overset{+}{C}H_2\right)$ involves the overlapping of $C_{sp^2}-H_{1s}$ bond with empty 2p orbital of other carbon.

Choose the correct option :

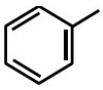
(1) Both statement I and statement II are false

(2) Statement I is incorrect but statement II is true

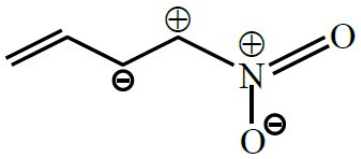
(3) Statement I is correct but statement II is false

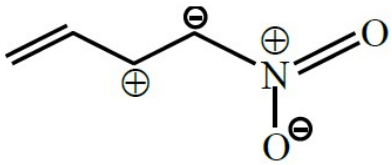
(4) Both Statement I and statement II are true.

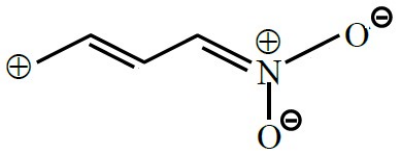
12. Which among the following is the strongest acid ? **[JEE-Main 25-7-21_S2]**

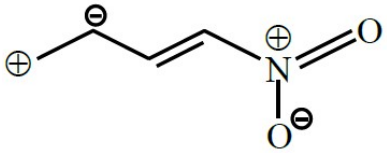
(1) $CH_3CH_2CH_2CH_3$ (2)  (3)  (4) 

13. Which one among the following resonating structures is not correct? **[JEE-Main 25-7-21_S1]**

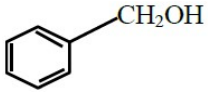
(1) 

(2) 

(3) 

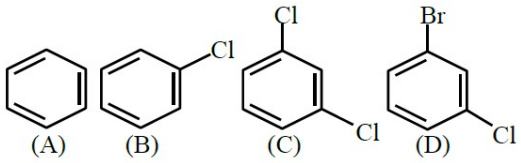
(4) 

14. Which of the following compounds does not exhibit resonance? **[JEE-Main 22-7-21_S2]**

(1) $CH_3CH_2OCH=CH_2$ (2) 

(3) $CH_3CH_2CH_2CONH_2$ (4) $CH_3CH_2CH=CHCH_2NH_2$

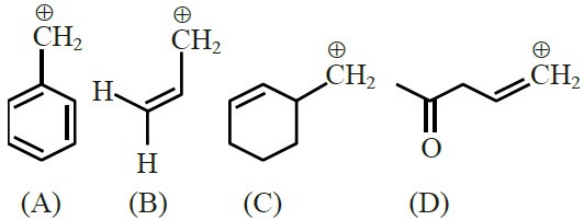
15. The correct decreasing order of densities of the following compounds is : **[JEE-Main 25-7-21_S2]**



(1) (D) > (C) > (B) > (A) (2) (C) > (D) > (A) > (B)

(3) (C) > (B) > (A) > (D) (4) (A) > (B) > (D) > (C)

16.

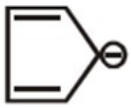
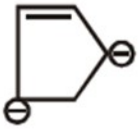


(A) (B) (C) (D)

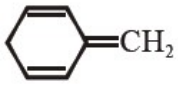
Among the given species the Resonance stabilised carbocations are: **[JEE-Main 20-7-21_S1]**

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

17. Which of the following is an aromatic compound? **[JEE-Main 17-3-21_S1]**

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

18. Among the following, the aromatic compounds are :

(A) 
(B) 
(C) 
(D) 

Choose the correct answer from the following options : **[JEE-Main 16-3-21_S1]**

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

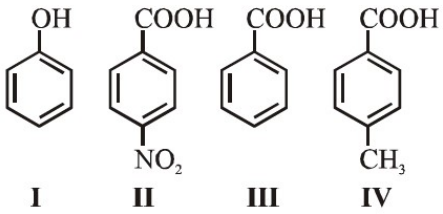
19.

A. Phenyl methanamine
B. N,N-Dimethylaniline
C. N-Methyl aniline
D. Benzenamine

Choose the correct order of basic nature of the above amines. **[JEE-Main 26-2-21_S2]**

(1) A > C > B > D (2) D > C > B > A (3) D > B > C > A (4) A > B > C > D

20. The correct order of acid character of the following compounds is : **[JEE-Main 25-2-21_S2]**



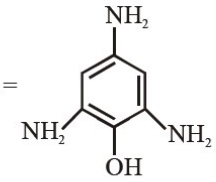
I II III IV

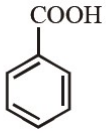
Options:

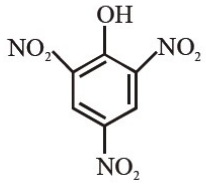
(1) III > II > I > IV (2) IV > III > II > I (3) I > II > III > IV (4) II > III > IV > I

21. Compound(s) which will liberate carbon dioxide with sodium bicarbonate solution is/are:

[JEE-Main 25-2-21_S1]

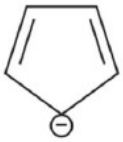
A = 

B = 

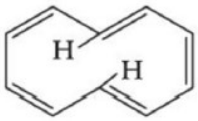
C = 

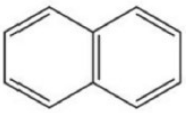
(1) B only (2) C only (3) B and C only (4) A and B only

22. Which of the following compounds is **not** aromatic? **[JEE-Main 26-7-22_S1]**

(1) 

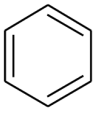
(2) 

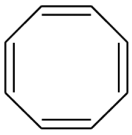
(3) 

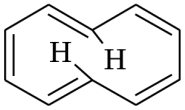
(4) 

23. Given below are two statements. One is labeled as **Assertion A** and the other is labeled as **Reason R**.

Assertion A : [6] Annulene. [8] Annulene and cis-[10] Annulene, are respectively aromatic, not-aromatic and aromatic . **[JEE-Main 27-7-22_S1]**

[6] Annulene 

[8] Annulene 

Cis-[10] Annulene 

Reason R : Planarity is one of the requirements of aromatic systems.

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

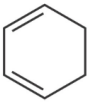
(1) Both **A** and **R** are correct and **R** is the correct explanation of **A**.

(2) Both **A** and **R** are correct but **R** is NOT the correct explanation of **A**.

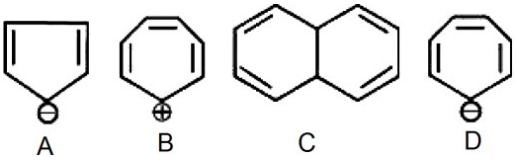
(3) **A** is correct but **R** is not correct.

(4) **A** is not correct but **R** is correct

24. Which of the following is most stable? **[JEE-Main 27-6-22_S2]**

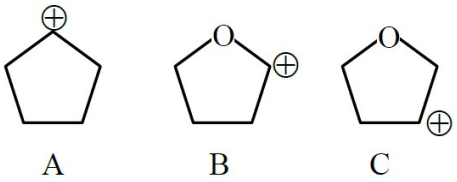
(1)  (2)  (3)  (4) 

25. Which of the following structures are aromatic in nature? **[JEE-Main 28-6-22_S1]**



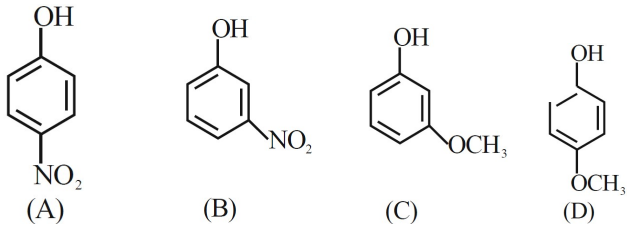
(1) A,B,C and D (2) Only A and B (3) Only A and C (4) Only B, C and D

26. Arrange the following carbocations in decreasing order of stability. **[JEE-Main 24-6-22_S2]**



(1) A > C > B (2) A > B > C (3) B > A > C (4) C > A > B

27. Arrange the following in decreasing acidic strength. **[JEE-Main 25-7-22_S2]**



(1) A > B > C > D (2) B > A > C > D (3) D > C > A > B (4) D > C > B > A

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

Assertion A : Benzene is more stable than hypothetical cyclohexatriene.

Reason R : The delocalized π electron cloud is attracted more strongly by nuclei of carbon atoms.

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

[JEE-Main_24-1-23_S2]

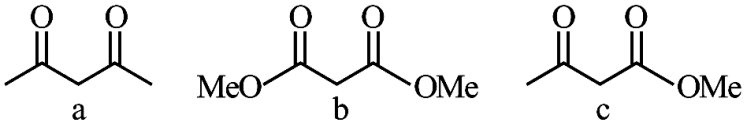
(1) A is true but R is false.

(2) A is false but R is true.

(3) Both A and R are correct and R is the correct explanation of A.

(4) Both A and R are correct but R is NOT the correct explanation of A.

29. Which will undergo deprotonation most readily in basic medium? **[JEE-Main_24-1-23_S2]**



(1) a only (2) c only (3) Both a and c (4) b only

30. The increasing order of pK_a for the following phenols is **[JEE-Main_29-1-23_S1]**

(1) 2, 4-Dinitrophenol (2) 4-Nitrophenol

(3) 2, 4, 5-Trimethylphenol (4) Phenol (5) 3-Chlorophenol

ANSWER KEY_GOC-I + GOC-II

1.	(4)	**2.**	(4)	**3.**	(1)	**4.**	(4)	**5.**	(2)
6.	(1)	**7.**	(2)	**8.**	(1)	**9.**	(1)	**10.**	(3)
11.	(3)	**12.**	(4)	**13.**	(1)	**14.**	(4)	**15.**	(4)
16.	(3)	**17.**	(1)	**18.**	(2)	**19.**	(4)	**20.**	(4)
21.	(3)	**22.**	(3)	**23.**	(4)	**24.**	(1)	**25.**	(2)
26.	(3)	**27.**	(1)	**28.**	(3)	**29.**	(1)	**30.**	**2**

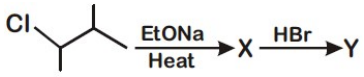
CHEMISTRY

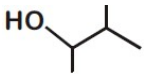
JEE MAIN PREVIOUS YEARS QUESTIONS – 2018-2023

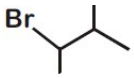
CHAPTER NAME :- HALOALKANES AND HALOARENES

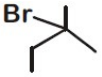
(IMPORTANT QUESTIONS ONLY)

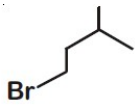
1. The major product 'Y' in the following reaction is : **[JEE-Main 10-4-19_S2]**



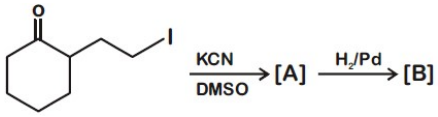
(1) 

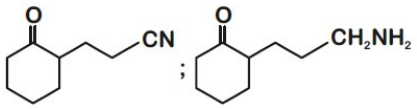
(2) 

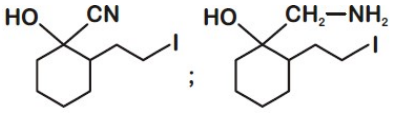
(3) 

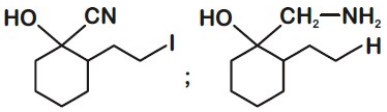
(4) 

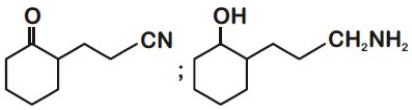
2. The major products A and B for the following reactions are, respectively **[JEE-Main 9-4-19_S2]**



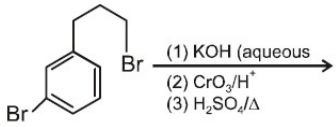
(1) 

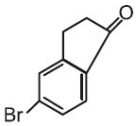
(2) 

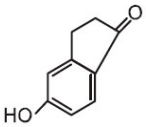
(3) 

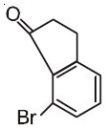
(4) 

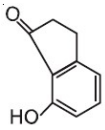
3. The major product of the following reaction is **[JEE-Main 9-1-19_S1]**



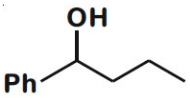
(1) 

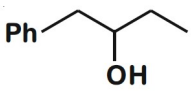
(2) 

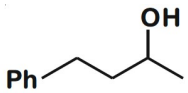
(3) 

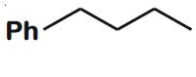
(4) 

4. Heating of 2-chloro-1-phenylbutane with EtOK/ EtOH gives X as the major product. Reaction of X with $Hg(OAc)_2/H_2O$ followed by $NaBH_4$ gives Y as the major product. Y is: **[JEE-Main 12-4-19_S1]**

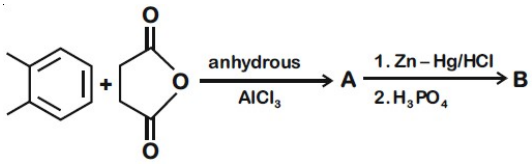
(1) 

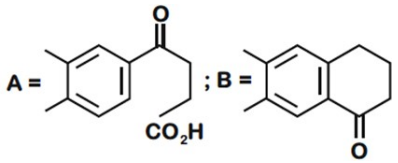
(2) 

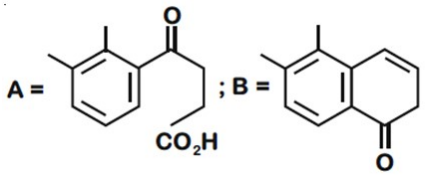
(3) 

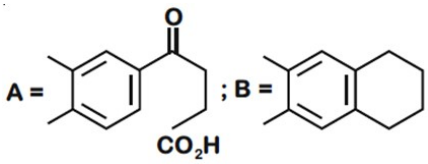
(4) 

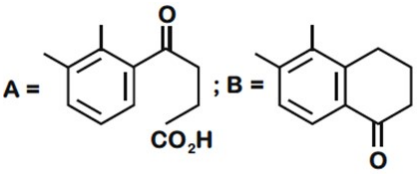
5. In the following reaction sequence the major products A and B are: **[JEE-Main 5-9-20_S1]**



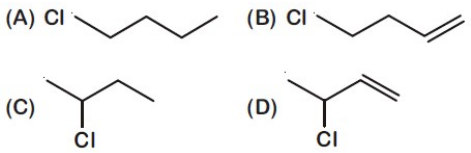
(1) 

(2) 

(3) 

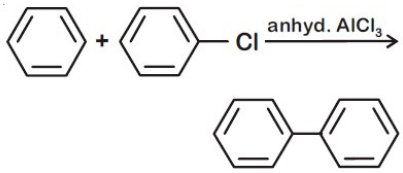
(4) 

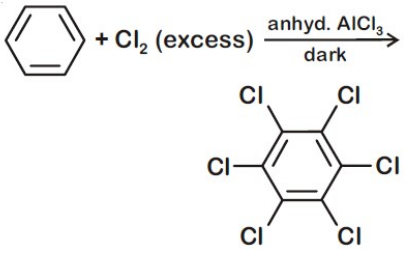
6. The decreasing order of reactivity towards dehydrohalogenation (E_1) reaction of the following compounds is **[JEE-Main 8-1-20_S1]**

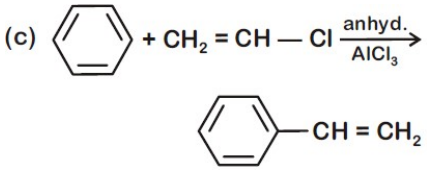


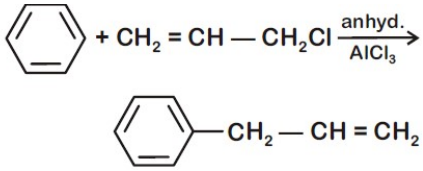
(1) B > A > D > C (2) B > D > A > C (3) B > D > C > A (4) D > B > C > A

7. Consider the following reactions

(a) 

(b) 

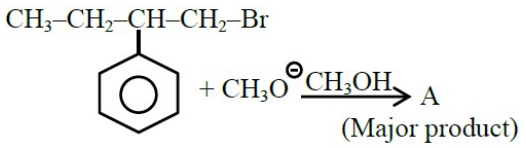
(c) 

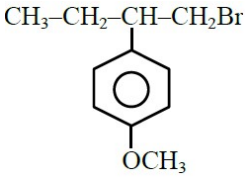
(d) 

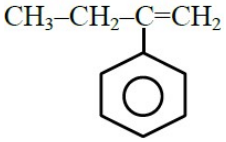
Which of these reactions are possible? **[JEE-Main 7-1-20_S2]**

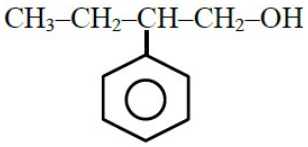
(1) (2) and (4) (2) (1) and (4) (3) (1) and (2) (4) (2), (3) and (4)

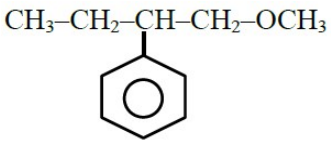
8. The major product (1) formed in the reaction given below is : **[JEE-Main 27-8-21_S2]**



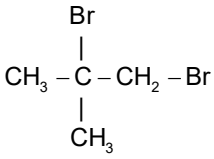
(1) 

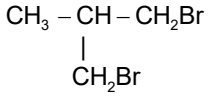
(2) 

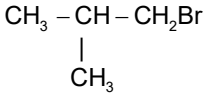
(3) 

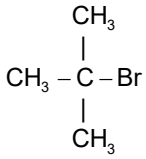
(4) 

9. Excess of isobutane on reaction with Br_2 in presence of light at 125°C gives which one of the following, as the major product? **[JEE-Main 26-8-21_S1]**

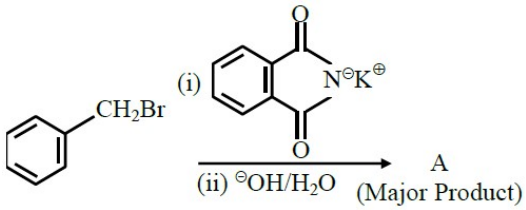
(1) 

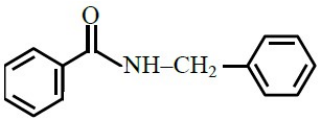
(2) 

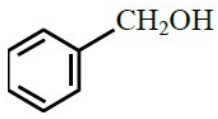
(3) 

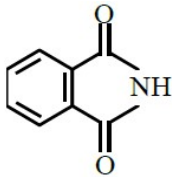
(4) 

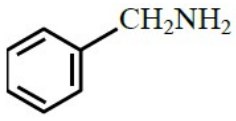
10. What is A in the following reaction ? **[JEE-Main 27-7-21_S2]**



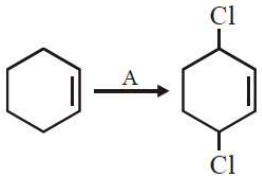
(1) 

(2) 

(3) 

(4) 

11. Identify the reagent(s) 'A' and condition(s) for the reaction : **[JEE-Main 16-3-21_S2]**



(1) A = HCl; Anhydrous $AlCl_3$ (2) A = HCl, $ZnCl_2$

(3) A = Cl_2; UV light (4) A = Cl_2; dark, Anhydrous $AlCl_3$

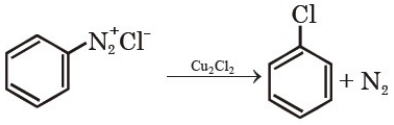
12. Ammonolysis of Alkyl halides followed by the treatment with NaOH solution can be used to prepare primary, secondary and tertiary amines. The purpose of NaOH in the reaction is : **[JEE-Main 16-3-21_S2]**

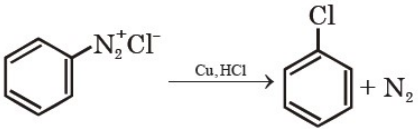
(1) to remove basic impurities (2) to activate NH_3 used in the reaction

(3) to remove acidic impurities (4) to increase the reactivity of alkyl halide

13. Match List - I with List - II

List - I

(1) 

(2) 

(3) $2CH_3CH_2Cl + 2Na \xrightarrow{\text{Ether}} C_2H_5 - C_2H_5 + 2NaCl$

(4) $2C_6H_5Cl + 2Na \xrightarrow{\text{Ether}} C_6H_5 - C_6H_5 + 2NaCl$

List - II

(i) Wurtz reaction

(ii) Sandmeyer reaction

(iii) Fittig reaction

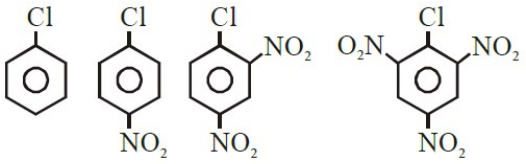
(iv) Gatterman reaction

Choose the correct answer from the options given below : **[JEE-Main 26-2-21_S2]**

(1) (1) → (iii), (2) → (i), (3) → (iv), (4) → (ii) (2) (1) → (ii), (2) → (i), (3) → (iv), (4) → (iii)

(3) (1) → (ii), (2) → (iv), (3) → (i), (4) → (iii) (4) (1) → (iii), (2) → (iv), (3) → (i), (4) → (ii)

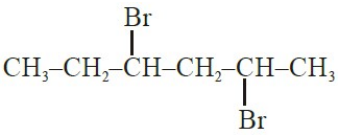
14. The correct order of the following compounds showing increasing tendency towards nucleophilic substitution reaction is :- **[JEE-Main 24-2-21_S2]**



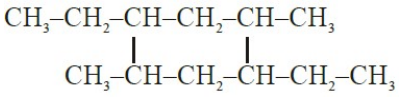
(i) (ii) (iii) (iv)

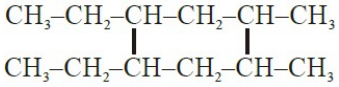
(1) (iv) < (iii) < (ii) < (i)
(2) (iv) < (i) < (ii) < (iii)
(3) (iv) < (i) < (iii) < (ii)
(4) (i) < (ii) < (iii) < (iv)

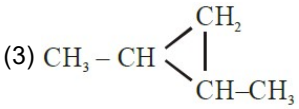
15. The product formed in the first step of the reaction of

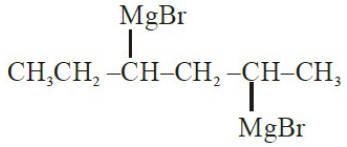


with excess $Mg/Et_2O(Et = C_2H_5)$ is : **[JEE-Main 24-2-21_S1]**

(1) 

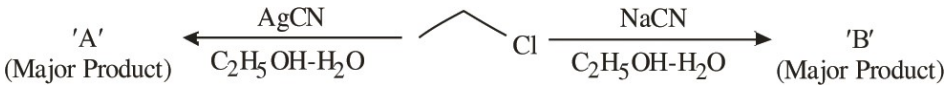
(2) 

(3) 

(4) 

16. Which one of the following reactions will not yield propionic acid? **[JEE-Main 27-8-21_S2]**

(1) $CH_3CH_2COCH_3 + OI^-/H_3O^+$
(2) $CH_3CH_2CH_3 + KMnO_4$ (Heat),OH^-/H_3O^+
(3) $CH_3CH_2CCl_3 + OH^-/H_3O^+$
(4) $CH_3CH_2CH_2Br + Mg$, CO_2 dry ether/H_3O^+

17. 

Considering the above reactions, the compound 'A' and compound 'B' respectively are :

[JEE-Main 29-7-22_S1]

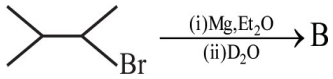
(1) 

(2) 

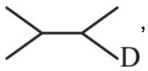
(3) 

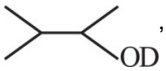
(4) 

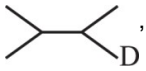
18. Compound 'A' undergoes following sequence of reactions to give compound 'B'. The correct structure and chirality of compound 'B' is: [where Et is $-C_2H_5$] **[JEE-Main 29-7-22_S2]**



Compound 'A'

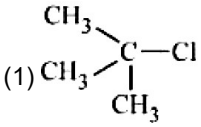
(1)  , Achiral

(2)  , Chiral

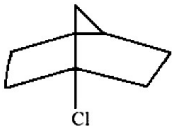
(3)  , Chiral

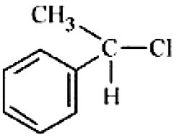
(4)  , Achiral

19. Which one of the following compounds is inactive towards S_N1 reaction? **[JEE-Main 28-6-22_S1]**

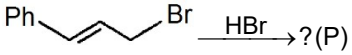
(1) 

(2) 

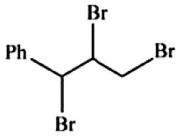
(3) 

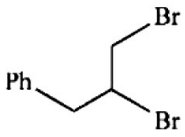
(4) 

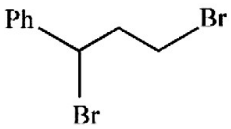
20. The major product (P) in the reaction **[JEE-Main 28-6-22_S1]**

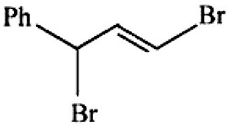


[Ph is $-C_6H_5$] is

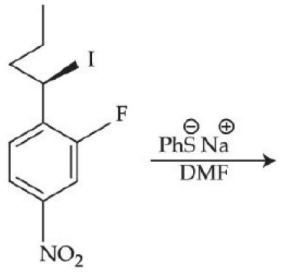
(1) 

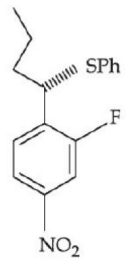
(2) 

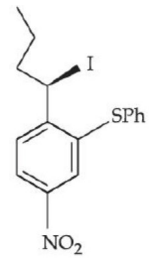
(3) 

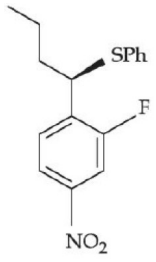
(4) 

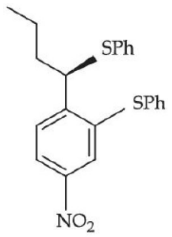
21. The major product of the following reaction is: **[JEE-Main 27-6-22_S1]**



(1) 

(2) 

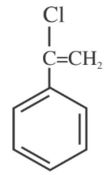
(3) 

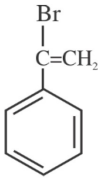
(4) 

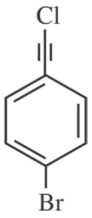
22. Product 'A' of following sequence of reactions is

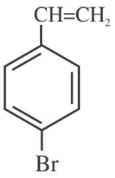
Ethylbenzene $\xrightarrow[(b)Cl_2,\Delta]{(a)Br_2\cdot Fe}$ 'A'(Major product) **[JEE-Main 27-6-22_S2]**

(c) alc·KOH

(1) 

(2) 

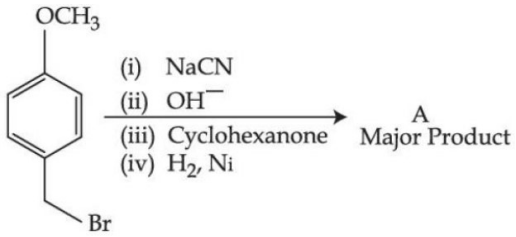
(3) 

(4) 

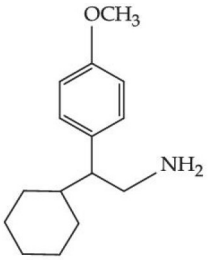
23. The IUPAC name of ethylidene chloride is : **[JEE-Main 25-6-22_S1]**

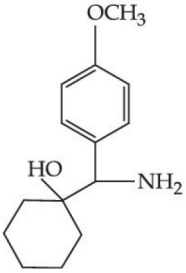
(1) 1-Chloroethene (2) 1-Chloroethyne

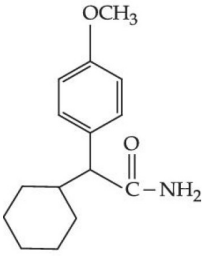
(3) 1,2-Dichloroethane (4) 1,1-Dichloroethane

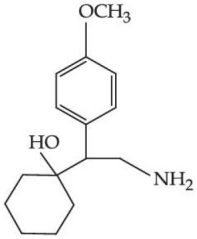
24. 

The major product of the above reaction is **[JEE-Main 24-6-22_S1]**

(1) 

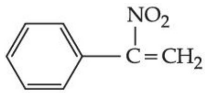
(2) 

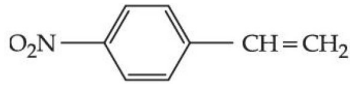
(3) 

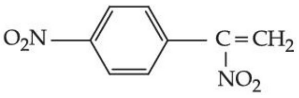
(4) 

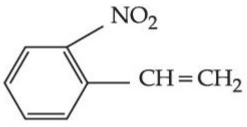
25. In the given reactions sequence, the major product 'C' is : **[JEE-Main 24-6-22_S1]**

$C_8H_{10} \xrightarrow[H_2SO_4]{HNO_3} A \xrightarrow[\Delta]{Br_2} B \xrightarrow[KOH]{\text{alcoholic}} C$

(1) 

(2) 

(3) 

(4) 

26. **Assertion A :** Hydrolysis of an alkyl chloride is a slow reaction but in the presence of NaI, the rate of the hydrolysis increases.

Reason R : I^- is a good nucleophile as well as a good leaving group. **[JEE-Main_24-1-23_S1]**

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

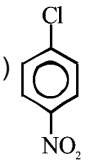
(1) A is false but R is true

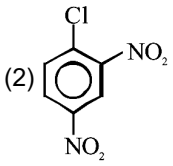
(2) A is true but R is false

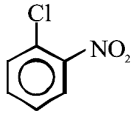
(3) Both A and R are true and R is the correct explanation of A

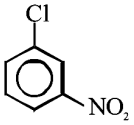
(4) Both A and R are true but R is NOT the correct explanation of A

27. The compound which will have the lowest rate towards nucleophilic aromatic substitution on treatment with OH^- is **[JEE-Main_25-1-23_S1]**

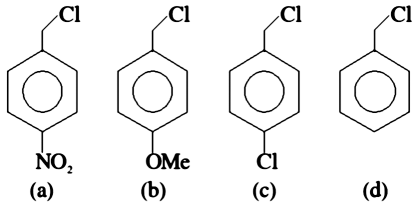
(1) 

(2) 

(3) 

(4) 

28. Decreasing order towards S_N1 reaction for the following compounds is: **[JEE-Main_30-1-23_S2]**



(a) (b) (c) (d)

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

29. A reaction of 0.1 mole of Benzylamine with bromomethane gave 23 g of Benzyl trimethyl ammonium bromide. The number of moles of bromomethane consumed in this reaction are n × 10^{-1}, when n = _____. (Round off to the Nearest Integer).

(Given : Atomic masses : C : 12.0 u, H : 1.0 u,

N : 14.0 u, Br : 80.0 u] **[JEE-Main 18-3-21_S1]**

30. Number of grams of bromine that will completely react with 5.0g of pent-1-ene is _____ × 10^{-2}g. (Atomic mass of Br = 80 g/mol) [Nearest Integer) **[JEE-Main 25-6-22_S1]**

ANSWER KEY_HALOALKANES AND HALOARENES

1.	(3)	**2.**	(4)	**3.**	(1)	**4.**	(1)	**5.**	(1)
6.	(4)	**7.**	(1)	**8.**	(2)	**9.**	(4)	**10.**	(4)
11.	(3)	**12.**	(3)	**13.**	(3)	**14.**	(4)	**15.**	(4)
16.	(4)	**17.**	(3)	**18.**	(3)	**19.**	(3)	**20.**	(3)
21.	(1)	**22.**	(4)	**23.**	(4)	**24.**	(4)	**25.**	(2)
26.	(3)	**27.**	(4)	**28.**	(3)	**29.**	**3**	**30.**	**1143**

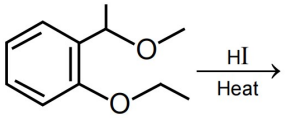
CHEMISTRY

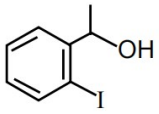
JEE MAIN PREVIOUS YEARS QUESTIONS – 2018-2023

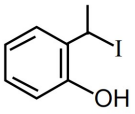
CHAPTER NAME :- ALCOHOLS, PHENOLS AND ETHERS

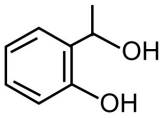
(IMPORTANT QUESTIONS ONLY)

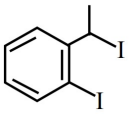
1. The major product formed in the following reaction is : **[JEE-Main 2018_S1]**



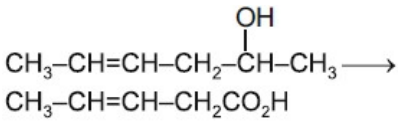
(1) 

(2) 

(3) 

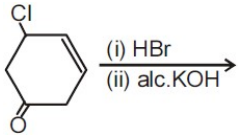
(4) 

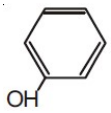
2. Which is the most suitable reagent for the following transformation? **[JEE-Main 10-1-19_S2]**

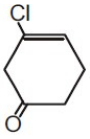


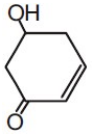
(1) I_2/NaOH (2) Alkaline $KMnO_4$ (3) Tollen's reagent (4) CrO_2Cl_2/CS_2

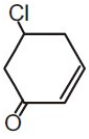
3. The major product of the following reaction is: **[JEE-Main 11-1-19_S1]**



(1) 

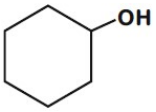
(2) 

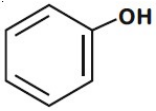
(3) 

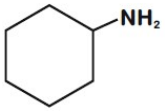
(4) 

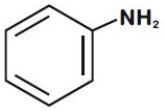
4. The organic compound that gives following qualitative analysis is **[JEE-Main 9-4-19_S]**

Test	Inference
(1) Dil. HCl	Insoluble
(2) NaOH solution	Soluble
(3) Br_2/water	Decolourization

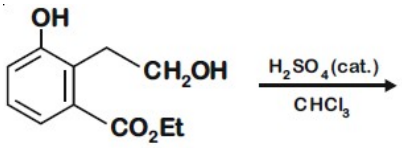
(1) 

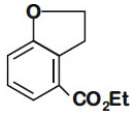
(2) 

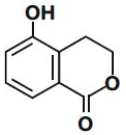
(3) 

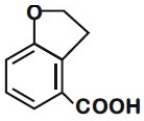
(4) 

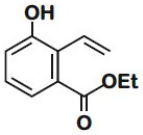
5. The major product of the following reaction is : **[JEE-Main 9-4-19_S2]**



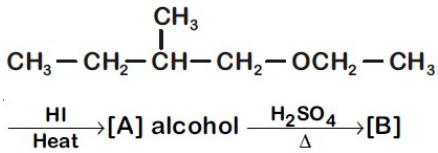
(1) 

(2) 

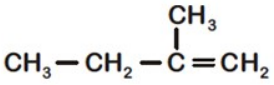
(3) 

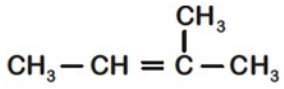
(4) 

6. The major product [B] in the following reactions is **[JEE-Main 4-9-20_S2]**



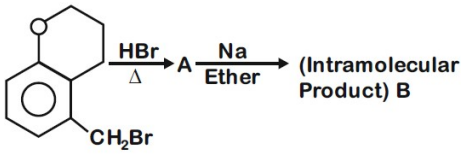
(1) $CH_3 - CH_2 - CH = CH - CH_3$

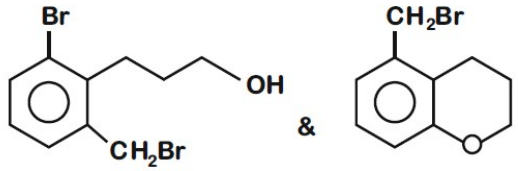
(2) 

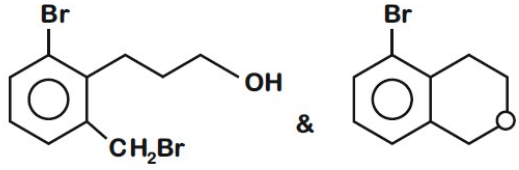
(3) 

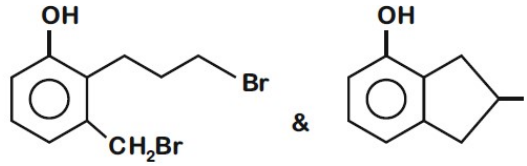
(4) $CH_2 = CH_2$

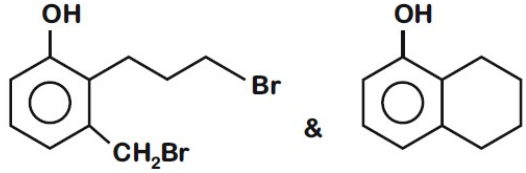
7. In the following reaction sequence, structures of A and B, respectively will be **[JEE-Main 7-1-20_S2]**



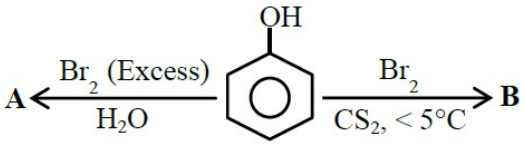
(1) 

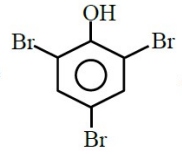
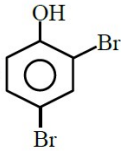
(2) 

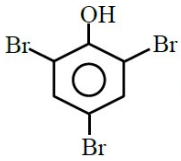
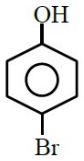
(3) 

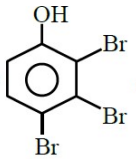
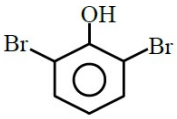
(4) 

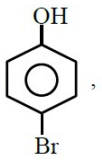
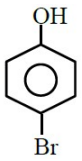
8. The correct options for the products A and B of the following reactions are : **[JEE-Main 26-8-21_S1]**



(1) A=  , B= 

(2) A=  , B= 

(3) A=  , B= 

(4) A=  , B= 

9. Given below are two statements : **[JEE-Main 27-8-21_S2]**

Statement I : Ethyl pent–4–yn–oate on reaction with CH_3MgBr gives a 3°–alcohol.

Statement II : In this reaction one mole of ethyl pent–4–yn–oate utilizes two moles of CH_3MgBr.

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 false.

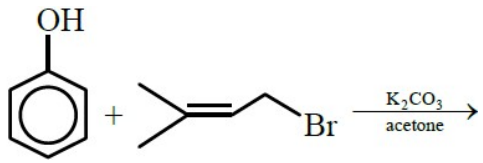
(2) Statement I is false but Statement II is true.

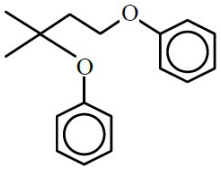
(3) Statement I is true but Statement II is false.

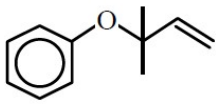
(4) Both Statement I and Statement II are true.

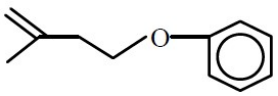
10. The major product of the following reaction, if it occurs by SN_2 mechanism is :

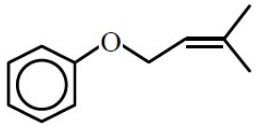
[JEE-Main 27-8-21_S2]



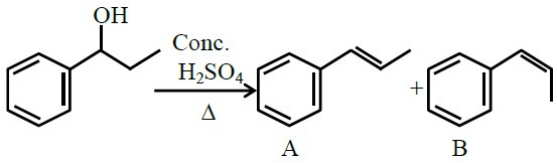
(1) 

(2) 

(3) 

(4) 

11.



consider the above reaction, and choose the correct statement : **[JEE-Main 27-7-21_S2]**

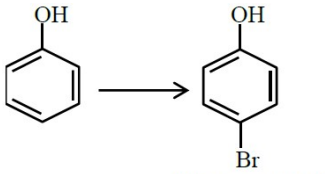
(1) The reaction is not possible in acidic medium

(2) Both compounds A and B are formed equally

(3) Compound A will be the major product

(4) Compound B will be the major product

12.



(Major product)

The given reaction can occur in the presence of : **[JEE-Main 25-7-21_S1]**

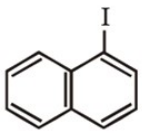
(A) Bromine water (B) Br_2 in CS_2, 273 K (C) $Br_2/FeBr_3$ (D) Br_2 in $CHCl_3$, 273 K

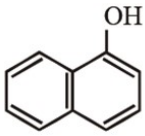
Choose the correct answer from the options given below :

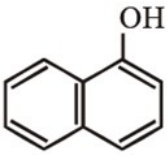
(1) (B) and (D) only (2) (A) and (C) only (3) (B), (C) and (D) only (4) (A), (B) and (D) only

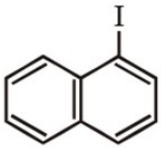
13. Main Products formed during a reaction of 1-methoxy naphthalene with hydroiodic acid are:

[JEE-Main 18-3-21_S2]

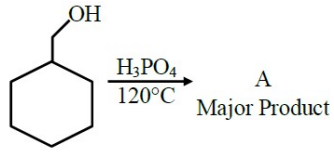
(1)  and CH_3OH

(2)  and CH_3I

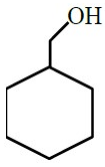
(3)  and CH_3OH

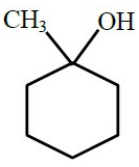
(4)  and CH_3I

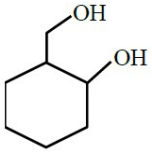
14.

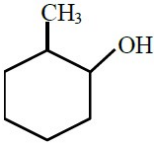


Consider the above reaction and identify the Product P : **[JEE-Main 27-7-21_S1]**

(1) 

(2) 

(3) 

(4) 

15. Given below are two statements : one is labelled as Assertion (A) and the other is labelled as Reason (R). Assertion (A): Synthesis of ethyl phenyl ether may be achieved by Williamson synthesis. Reason (R): Reaction of bromobenzene with sodium ethoxide yields ethyl phenyl ether. In the light of the above statements, choose the most appropriate answer from the options given below:

[JEE-Main 27-8-21_S1]

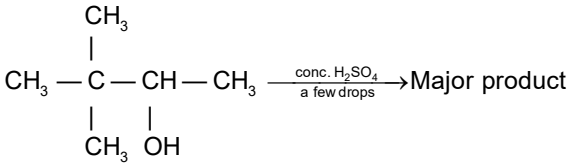
(1) Both (A) and (R) are correct and (R) is the correct explanation of (A)

(2) (A) is correct but (R) is not correct

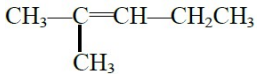
(3) (A) is not correct but (R) is correct

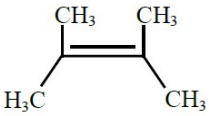
(4) Both (A) and (R) are correct but (R) is NOT the correct explanation of (A)

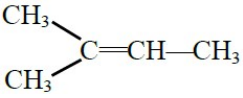
16. The major product formed in the following reaction is :

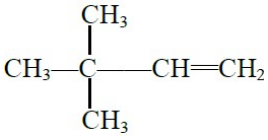


[JEE-Main 31-8-21_S1]

(1) 

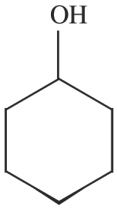
(2) 

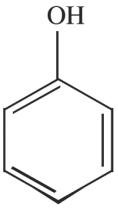
(3) 

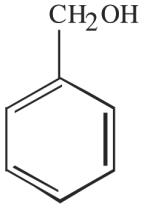
(4) 

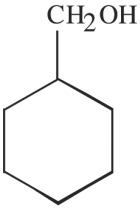
17. A compound 'X' is acidic and it is soluble in NaOH solution, but insoluble in $NaHCO_3$ solution. Compound 'X' also gives violet colour with neutral $FeCl_3$ solution. The compound 'X' is :

[JEE-Main 29-7-22_S1]

(1) 

(2) 

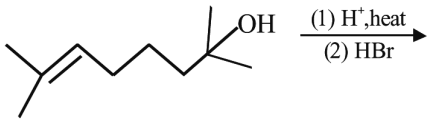
(3) 

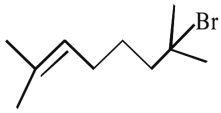
(4) 

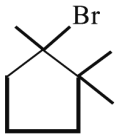
18. When ethanol is heated with conc. H_2SO_4, a gas is produced. The compound formed, when this gas is treated with cold dilute aqueous solution of Baeyer's reagent, is : **[JEE-Main 29-7-22_S2]**

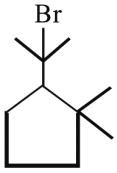
(1) Formaldehyde (2) Formic acid (3) Glycol (4) Ethanoic acid

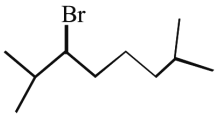
19. The major product in the given reaction is **[JEE-Main 28-7-22_S2]**



(1) 

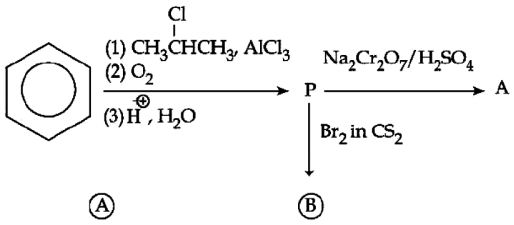
(2) 

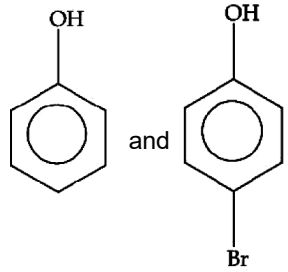
(3) 

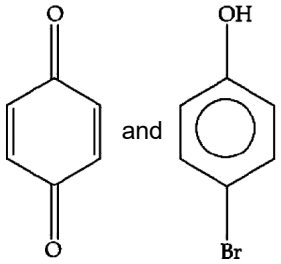
(4) 

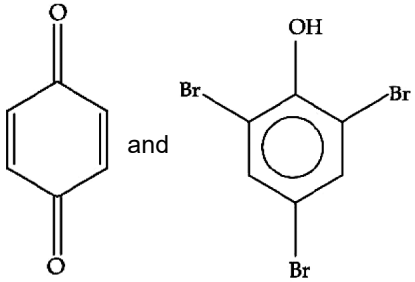
20. Identify the major product A and B for the below given reaction sequence.

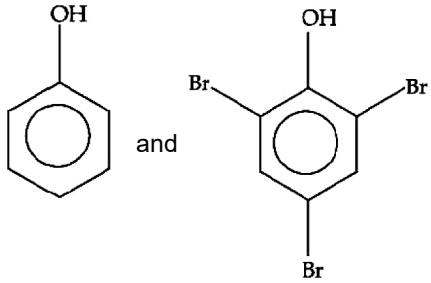
[JEE-Main 28-7-22_S1]



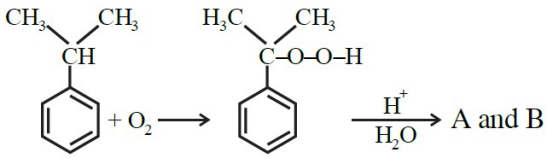
(1) 

(2) 

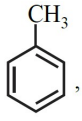
(3) 

(4) 

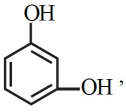
21. In the following reaction :



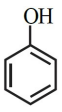
The compounds A and B respectively are :- **[JEE-Main 25-6-22_S1]**

(1) 

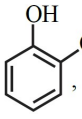
, CH_3COOH

(2) 

, CH_3COOH

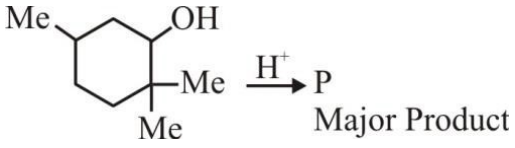
(3) 

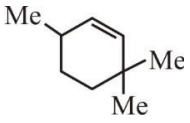
, CH_3COCH_3

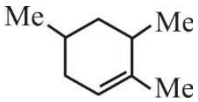
(4) 

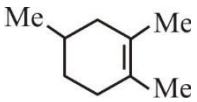
, CH_3COCH_3

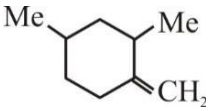
22. The major product (P) of the given reaction is (where, Me is $-CH_3$) **[JEE-Main 28-6-22_S2]**



(1) 

(2) 

(3) 

(4) 

23. The correct order of nucleophilicity is **[JEE-Main 26-6-22_S2]**

(1) $F^- > OH^-$ (2) $H_2\ddot{O} > OH^-$ (3) $R\ddot{O}H > RO^-$ (4) $NH_2^- > NH_3$

24. Hex-4-ene-2-ol on treatment with PCC gives 'A'. 'A' on reaction with sodium hypoiodite gives 'B', which on further heating with soda lime gives 'C'. The compound 'C' is **[JEE-Main 24-6-22_S2]**

(1) 2- pentene (2) propanaldehyde (3) 2-butene (4) 4-methylpent-2-ene

25. The conversion of propan-1-ol to n-butylamine involves the sequential addition of reagents. The correct sequential order of reagents is. **[JEE-Main 24-6-22_S2]**

(1) (i) $SOCl_2$ (ii) KCN (iii) $H_2/Ni,Na(Hg)/C_2H_5OH$ (2) (i) HCl (ii) H_2/Ni, $Na(Hg)/C_2H_5OH$

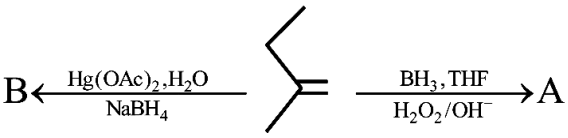
(3) (i) $SOCl_2$ (ii) KCN (iii) CH_3NH_2 (4) (i) HCl (ii) CH_3NH_2

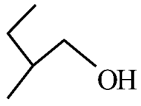
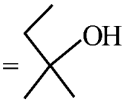
26. The difference in the reaction of phenol with bromine in chloroform and bromine in water medium is due to : **[JEE-Main 26-7-22_S1]**

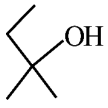
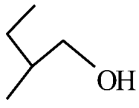
(1) Hyperconjugation in substrate (2) Polarity of solvent

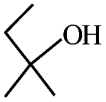
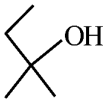
(3) Free radical formation (4) Electromeric effect of the substrate

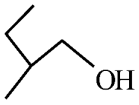
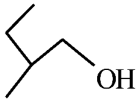
27. Find out the major products from the following reactions. **[JEE-Main_24-1-23_S2]**



(1) A =  , B = 

(2) A =  , B = 

(3) A =  , B = 

(4) A =  , B = 

28. Given below are two statements : one is labelled as **Assertion A** and the other is labelled as **Reason R:**

Assertion A : Acetal/Ketal is stable in basic medium.

Reason R : The high leaving tendency of alkoxide ion gives the stability to acetal/ketal in basic medium.

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

[JEE-Main_25-1-23_S1]

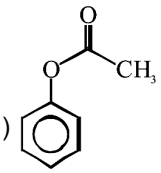
(1) A is true but R is false

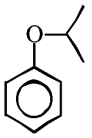
(2) A is false but R is true

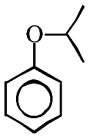
(3) Both A and R are true and R is the correct explanation of A

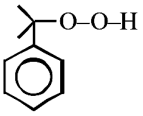
(4) Both A and R are true but R is NOT the correct explanation of A

29. In the cumene to phenol preparation in presence of air, the intermediate is **[JEE-Main_25-1-23_S1]**

(1) 

(2) 

(3) 

(4) 

30. The number of chiral alcohol(s) with molecular formula $C_4H_{10}O$ is_____. **[JEE-Main 29-6-22_S2]**

ANSWER KEY_ALCOHOLS, PHENOLS AND ETHERS

1.	(2)	**2.**	(1)	**3.**	(1)	**4.**	(2)	**5.**	(2)
6.	(3)	**7.**	(4)	**8.**	(2)	**9.**	(3)	**10.**	(4)
11.	(3)	**12.**	(3)	**13.**	(2)	**14.**	(4)	**15.**	(2)
16.	(2)	**17.**	(2)	**18.**	(3)	**19.**	(3)	**20.**	(2)
21.	(3)	**22.**	(3)	**23.**	(4)	**24.**	(3)	**25.**	(1)
26.	(2)	**27.**	(1)	**28.**	(1)	**29.**	(4)	**30.**	**1**

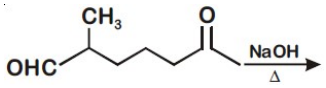
CHEMISTRY

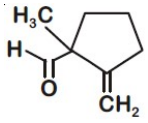
JEE MAIN PREVIOUS YEARS QUESTIONS – 2018-2023

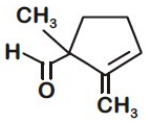
CHAPTER NAME :- CARBONYL COMPOUNDS AND CARBOXYLIC ACID

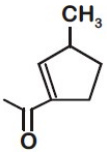
(IMPORTANT QUESTIONS ONLY)

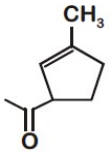
1. The major product obtained in the following reaction is **[JEE-Main 8-4-19_S2]**



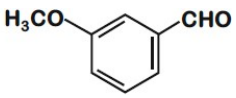
(1) 

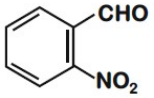
(2) 

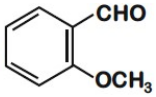
(3) 

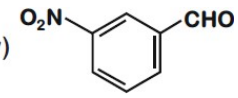
(4) 

2. The increasing order of the following compounds towards HCN addition is **[JEE-Main 2-9-20_S1]**

(i) 

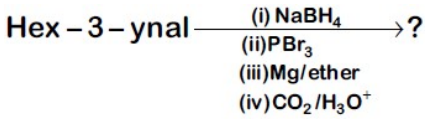
(ii) 

(iii) 

(iv) 

(1) (iii) < (iv) < (ii) < (i) (2) (iii) < (i) < (iv) < (ii) (3) (iii) < (iv) < (i) < (ii) (4) (i) < (iii) < (iv) < (ii)

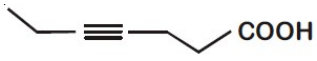
3. What is the product of following reaction? **[JEE-Main 7-1-20_S1]**



(1) 

(2) 

(3) 

(4) 

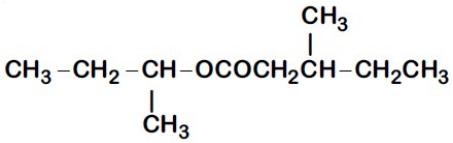
4. The correct match between Item-I (starting material) and Item-II (reagent) for the preparation of benzaldehyde is **[JEE-Main 6-9-20_S2]**

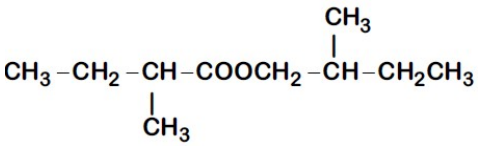
Item-I		**Item-II**
(I) Benzene	(P)	$SnCl_2$ and HCl, H_3O^+
(II) Benzonitrile	(Q)	H_2, Pd-$BaSO_4$, S and quinoline
(III) Benzoyl Chloride	(R)	CO, HCl and $AlCl_3$

(1) (I) - (R), (II) - (P) and (III) - (Q) (2) (I) - (P), (II) - (Q) and (III) - (R)

(3) (I) - (Q), (II) - (R) and (III) - (P) (4) (I) - (R), (II) - (Q) and (III) - (P)

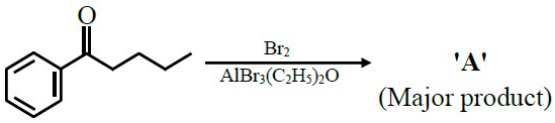
5. An organic compound [A], molecular formula $C_{10}H_{20}O_2$ was hydrolyzed with dilute sulphuric acid to give a carboxylic acid [B] and an alcohol [C]. Oxidation of [C] with $CrO_3 - H_2SO_4$ produced [B]. Which of the following structures are not possible for [A]? **[JEE-Main 3-9-20_S1]**

(1) 

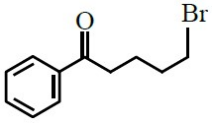
(2) 

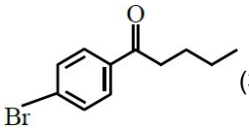
(3) $(CH_3)_3C - COOCH_2C(CH_3)_3$

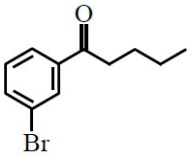
(4) $CH_3CH_2CH_2COOCH_2CH_2CH_2CH_3$

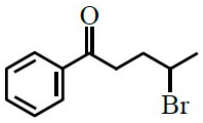
6. 

Consider the given reaction, the product A is : **[JEE-Main 26-8-21_S2]**

(1) 

(2) 

(3) 

(4) 

7. Match List-I with List-II : **[JEE-Main 26-8-21_S2]**

List-I (Chemical Reaction)	**List-II (Reagent used)**
(1) $CH_3COOCH_2CH_3 \rightarrow CH_3CH_2OH$	(i) CH_3MgBr / H_3O^+(1.equivalent)
(2) $CH_3COOCH_3 \rightarrow CH_3CHO$	(ii) H_2SO_4 / H_2O
(3) $CH_3C \equiv N \rightarrow CH_3CHO$	(iii) DIBAL-H/H_2O
(4) $CH_3C \equiv N \rightarrow CH_3COCH_3$	(iv) $SnCl_2$, HCl/H_2O

Choose the most appropriate match :

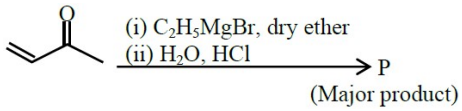
(1) a-ii, b-iv, c-iii, d-i (2) a-iv, b-ii, c-iii, d-i (3) a-ii, b-iii, c-iv, d-i (4) a-iii, b-ii, c-i, d-iv

8. In the following sequence of reactions,

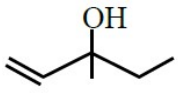
$$C_3H_6 \xrightarrow{H^+/H_2O} A \xrightarrow[\text{dil KOH}]{KIO} B + C$$

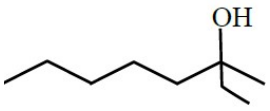
The compounds B and C respectively are : **[JEE-Main 1-9-21_S2]**

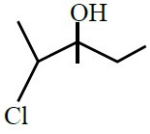
(1) CI_3COOK, HCOOH (2) CI_3COOK, CH_3I (3) CH_3I, HCOOK (4) CHI_3, CH_3COOK

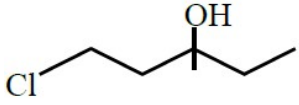
9. 

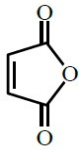
Consider the above reaction, the major product 'P' is: **[JEE-Main 25-7-21_S1]**

(1) 

(2) 

(3) 

(4) 

10. 

Maleic anhydride

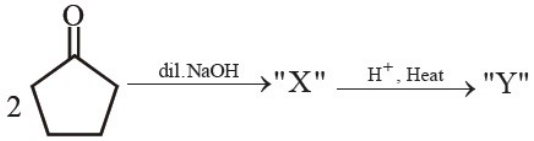
Maleic anhydride can be prepared by : **[JEE-Main 25-7-21_S2]**

(1) Heating trans-but-2-enedioic acid

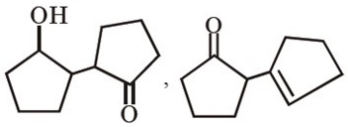
(2) Heating cis-but-2-enedioic acid

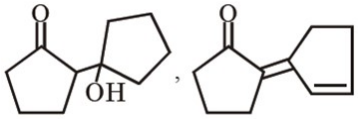
(3) Treating cis-but-2-enedioic acid with alcohol and acid

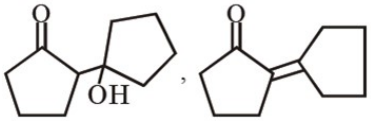
(4) Treating trans-but-2-enedioic acid with alcohol and acid

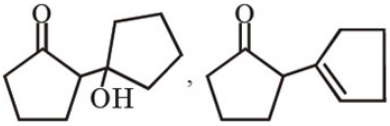
11. 

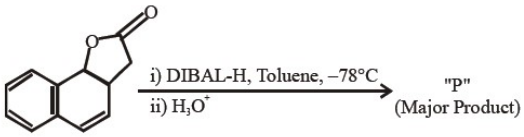
Consider the above reaction, the product 'X' and 'Y' respectively are : **[JEE-Main 18-3-21_S2]**

(1) 

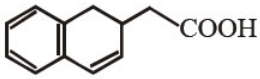
(2) 

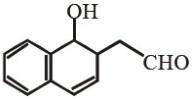
(3) 

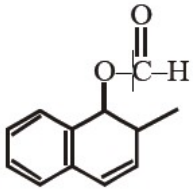
(4) 

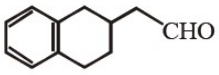
12. 

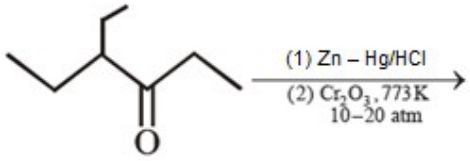
The product 'P' in the above reaction is : **[JEE-Main 16-3-21_S1]**

(1) 

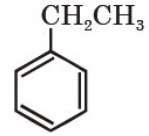
(2) 

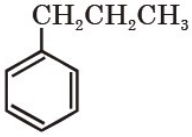
(3) 

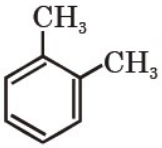
(4) 

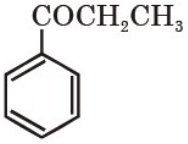
13. 

considering the above reaction, the major product among the following is : **[JEE-Main 26-2-21_S2]**

(1) 

(2) 

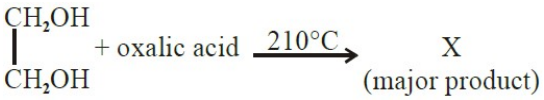
(3) 

(4) 

14. 2,4-DNP test can be used to identify : **[JEE-Main 26-2-21_S2]**

(1) Amine (2) Aldehyde (3) Ether (4) Halogens

15. What is 'X' in the given reaction? **[JEE-Main 25-2-21_S2]**



(1) 

(2) 

(3) 

(4) 

16. The correct sequence of reagents used in the preparation of 4-bromo-2-nitroethyl benzene from benzene is : **[JEE-Main 25-2-21_S2]**

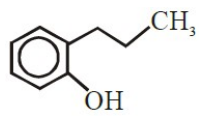
(1) HNO_3/H_2SO_4, $Br_2/AlCl_3$, $CH_3COCl/AlCl_3$, Zn-Hg/HCl

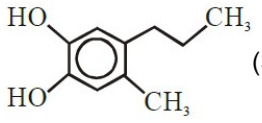
(2) $Br_2/AlBr_3$, $CH_3COCl/AlCl_3$, HNO_3/H_2SO_4, Zn/HCl

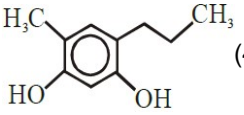
(3) $CH_3COCl/AlCl_3$, $Br_2/AlBr_3$, HNO_3/H_2SO_4, Zn/HCl

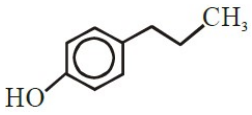
(4) $CH_3COCl/AlCl_3$, Zn-Hg/HCl, $Br_2/AlBr_3$, HNO_3/H_2SO_4

17. Which of the following compound gives pink colour on reaction with phthalic anhydride in conc. H_2SO_4 followed by treatment with NaOH ? **[JEE-Main 24-2-21_S1]**

(1) 

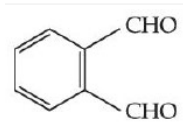
(2) 

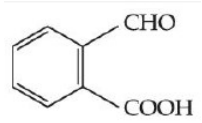
(3) 

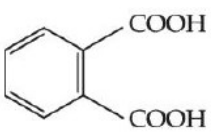
(4) 

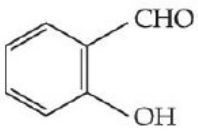
18. An organic compound 'A' on reaction with NH_3 followed by heating gives compound B which on further strong heating gives compound C ($C_8H_5NO_2$). Compound C on sequential reaction with ethanolic KOH, alkyl chloride and hydrolysis with alkali gives a primary amine. The compound A is :

[JEE-Main 25-7-22_S1]

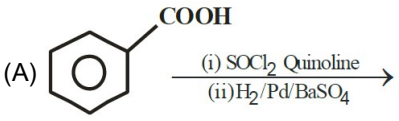
(1) 

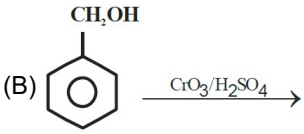
(2) 

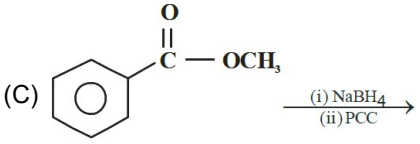
(3) 

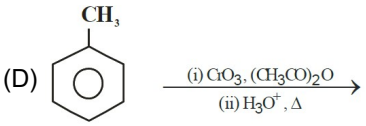
(4) 

19. Which of the following reactions will yield benzaldehyde as a product? **[JEE-Main 27-6-22_S1]**

(A) 

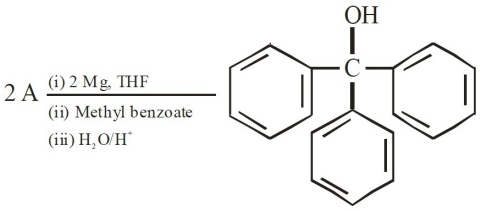
(B) 

(C) 

(D) 

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

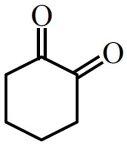
20. In the given reaction

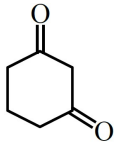


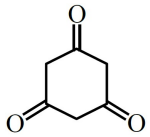
'A' can be **[JEE-Main 25-6-22_S2]**

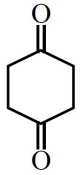
(1) benzyl bromide (2) bromobenzene (3) cyclohexyl bromide (4) methyl bromide

21. Which will have the highest enol content ? **[JEE-Main 26-6-22_S1]**

(1) 

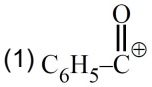
(2) 

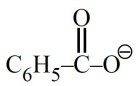
(3) 

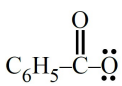
(4) 

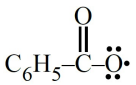
22. $(C_7H_5O_2)_2 \xrightarrow{hv} [X] + 2\dot{C}_6H_5 + 2CO_2$

Consider the above reaction and identify the intermediate 'X' **[JEE-Main 26-6-22_S1]**

(1) 

(2) 

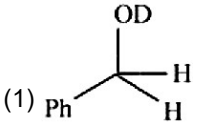
(3) 

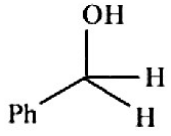
(4) 

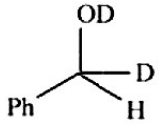
23. The correct structure of product 'A' formed in the following reaction. **[JEE-Main 28-6-22_S1]**

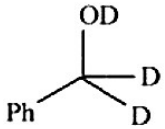
$$PhCHO + Ph\cdot CHO \xrightarrow[in\ D_2O]{NaOD} A + Ph-\overset{O}{\overset{\|}{C}}-O^-$$

$(Ph\ is - C_6H_5)$

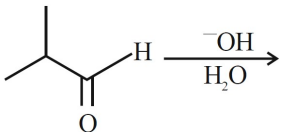
(1) 

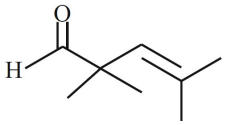
(2) 

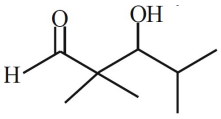
(3) 

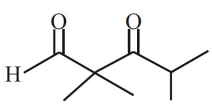
(4) 

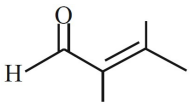
24. What is the major product of the following reaction? **[JEE-Main 25-7-22_S2]**



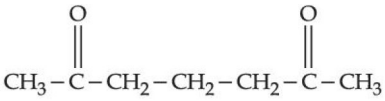
(1) 

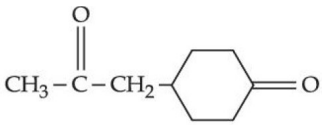
(2) 

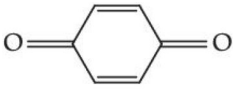
(3) 

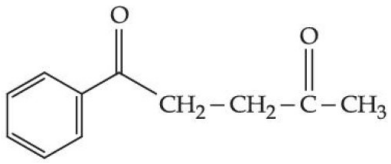
(4) 

25. Which of the following is an example of conjugated diketone? **[JEE-Main 24-6-22_S1]**

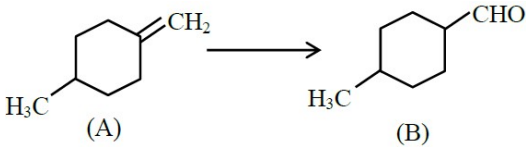
(1) 

(2) 

(3) 

(4) 

26. Which of the following reagents/ reactions will convert 'A' to 'B'? **[JEE-Main 24-6-22_S2]**



(1) PCC oxidation

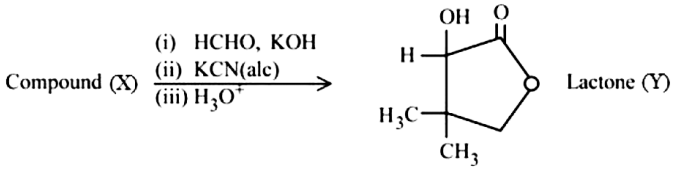
(2) Ozonolysis

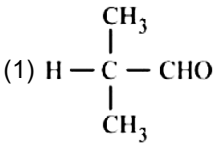
(3) BH_3, H_2O_2 / ^-OH followed by PCC oxidation

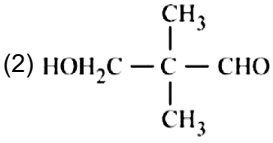
(4) HBr, hydrolysis followed by oxidation by $K_2Cr_2O_7$.

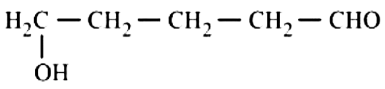
27. Compound (X) undergoes following sequence of reactions to give the Lactone (Y).

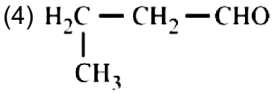
[JEE-Main_24-1-23_S1]



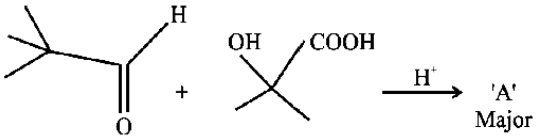
(1) 

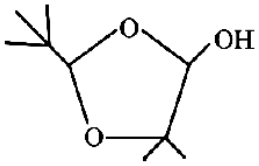
(2) 

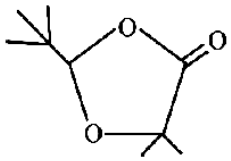
(3) 

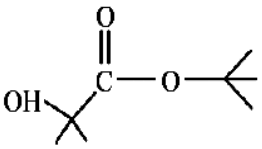
(4) 

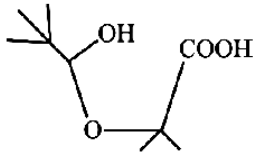
28. 'A' in the given reaction is **[JEE-Main 25-1-23_S2]**



(1) 

(2) 

(3) 

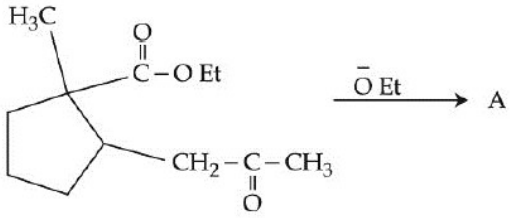
(4) 

29. Consider the following reactions

$$A \xrightarrow[(ii)H_3O^+]{(i)CH_3MgBr} B \xrightarrow[573K]{Cu} 2-\text{methyl}-2-\text{butene}$$

The mass percentage of carbon in A is _____ . **[JEE-Main 9-1-20_S2]**

30. In the given reaction



(Where Et is $-C_2H_5$)

The number of chiral carbon/s in product A is **[JEE-Main 25-7-22_S1]**

ANSWER KEY_CARBONYL COMPOUNDS AND CARBOXYLIC ACID

1.	(3)	**2.**	(2)	**3.**	(4)	**4.**	(1)	**5.**	(1)
6.	(3)	**7.**	(3)	**8.**	(4)	**9.**	(3)	**10.**	(2)
11.	(3)	**12.**	(2)	**13.**	(1)	**14.**	(2)	**15.**	(1)
16.	(4)	**17.**	(1)	**18.**	(3)	**19.**	(3)	**20.**	(2)
21.	(3)	**22.**	(4)	**23.**	(1)	**24.**	(2)	**25.**	(3)
26.	(3)	**27.**	(1)	**28.**	(2)	**29.**	**66.67**	**30.**	**2**

CHEMISTRY

JEE MAIN PREVIOUS YEARS QUESTIONS – 2018-2023

CHAPTER NAME :- AMINES

(IMPORTANT QUESTIONS ONLY)

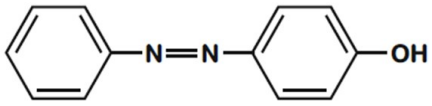
1. Which of the following is NOT a correct method of the preparation of benzylamine from cyanobenzene?

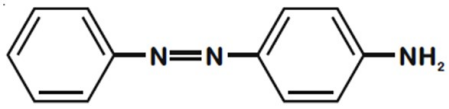
[JEE-Main 10-4-19_S2]

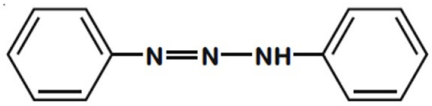
(1) (i) $SnCl_2$ + HCl(gas) (ii) $NaBH_4$ (2) H_2/Ni

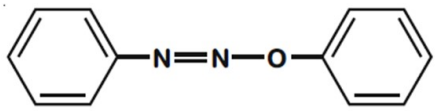
(3) (i) $LiAlH_4$ (ii) H_3O^+ (4) (i) HCl/H_2O (ii) $NaBH_4$

2. Aniline dissolved in dilute HCl is reacted with sodium nitrite at 0ºC. This solution was added dropwise to a solution containing equimolar mixture of aniline and phenol in dil. HCl. The structure of the major product is **[JEE-Main 9-4-19_S1]**

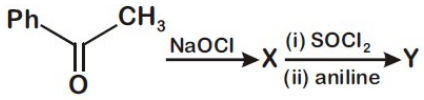
(1) 

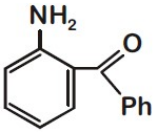
(2) 

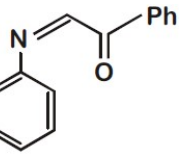
(3) 

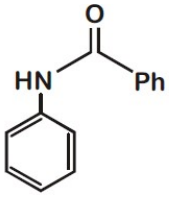
(4) 

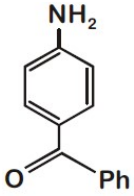
3. The major product 'Y' in the following reaction is : **[JEE-Main 10-4-19_S2]**



(1) 

(2) 

(3) 

(4) 

4. In the following compounds, the decreasing order of basic strength will be **[JEE-Main 8-4-19_S1]**

(1) $NH_3 > C_2H_5NH_2 > (C_2H_5)_2NH$ (2) $C_2H_5NH_2 > NH_3 > (C_2H_5)_2NH$

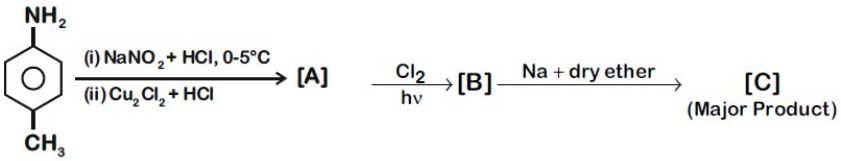
(3) $(C_2H_5)_2NH > NH_3 > C_2H_5NH_2$ (4) $(C_2H_5)_2NH > C_2H_5NH_2 > NH_3$

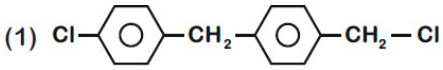
5. The most appropriate reagent for conversion of C_2H_5CN into $CH_3CH_2CH_2NH_2$ is

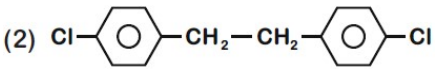
[JEE-Main 5-9-20_S1]

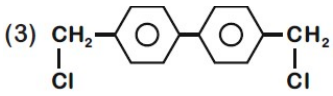
(1) $NaBH_4$ (2) CaH_2 (3) $Na(CN)BH_3$ (4) $LiAlH_4$

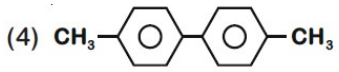
6. In the following reaction sequence, [C] is **[JEE-Main 4-9-20_S2]**



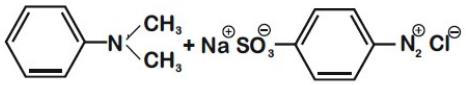
(1) 

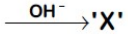
(2) 

(3) 

(4) 

7. Consider the following reaction:





The product 'X' is used **[JEE-Main 7-1-20_S1]**

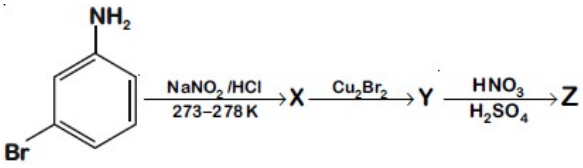
(1) In acid base titration as an indicator

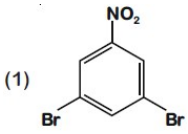
(2) In protein estimation as an alternative to ninhydrin

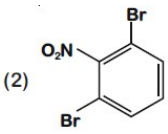
(3) In laboratory test for phenols

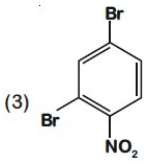
(4) As food grade colourant

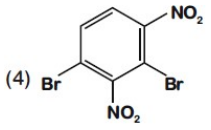
8. The major product Z obtained in the following reaction scheme is **[JEE-Main 9-1-20_S1]**



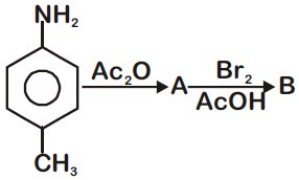
(1) 

(2) 

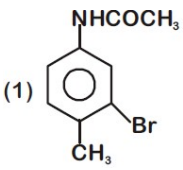
(3) 

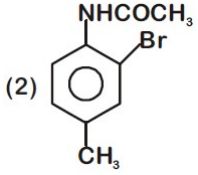
(4) 

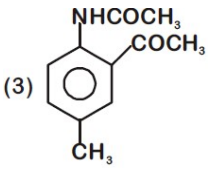
9. In the following reaction sequence: **[JEE-Main 7-1-20_S2]**

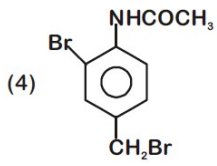


the major product B is:

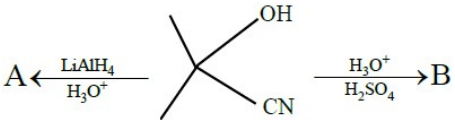
(1) 

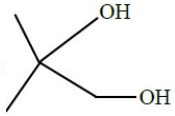
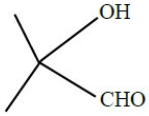
(2) 

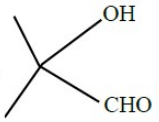
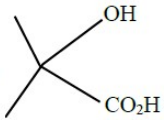
(3) 

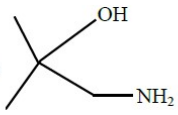
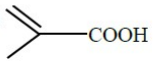
(4) 

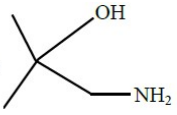
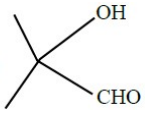
10. The major products A and B in the following set of reactions are : **[JEE-Main 31-8-21_S1]**



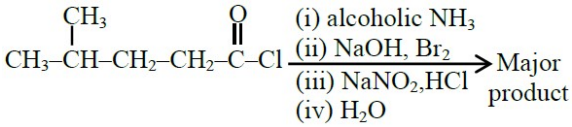
(1) A =  , B = 

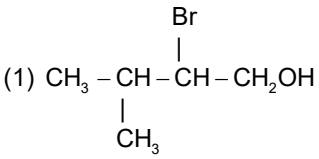
(2) A =  , B = 

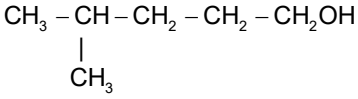
(3) A =  , B = 

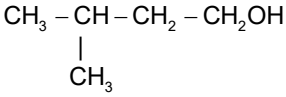
(4) A =  , B = 

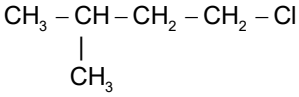
11. The major product of the following reaction is : **[JEE-Main 27-8-21_S1]**



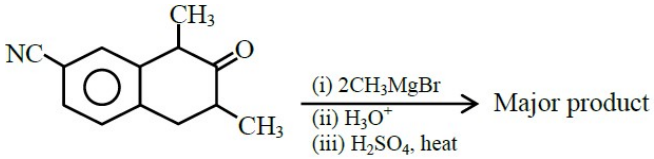
(1) 

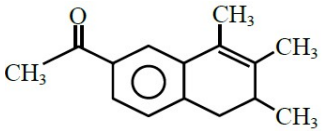
(2) 

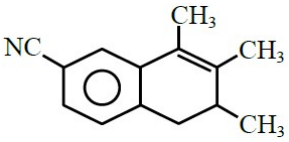
(3) 

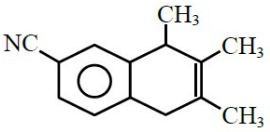
(4) 

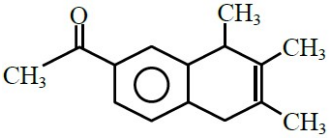
12. Which one of the following is the major product of the given reaction? **[JEE-Main 27-8-21_S2]**



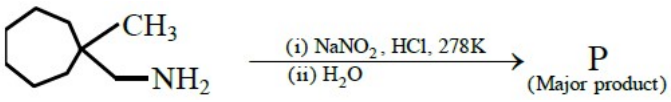
(1) 

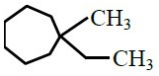
(2) 

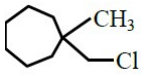
(3) 

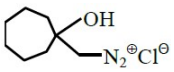
(4) 

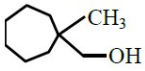
13. What is the major product "P" of the following reaction ? **[JEE-Main 25-7-21_S2]**



(1) 

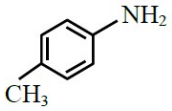
(2) 

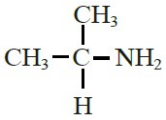
(3) 

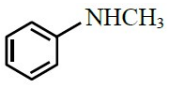
(4) 

14. Which one of the following gives the most stable Diazonium salt ? **[JEE-Main 1-9-21_S2]**

(1) $CH_3 - CH_2 - CH_2 - NH_2$

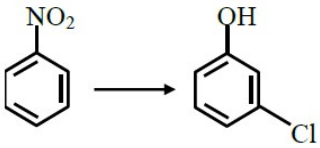
(2) 

(3) 

(4) 

15. The correct sequence of correct reagents for the following transformation is :-

[JEE-Main 27-7-21_S2]



(1) (i) Fe, HCl (ii) Cl_2, HCl, (iii) $NaNO_2$, HCl, 0°C (iv) H_2O/H^+

(2) (i) Fe, HCl (ii) $NaNO_2$, HCl, 0°C (iii) H_2O/H^+ (iv) Cl_2, $FeCl_3$

(3) (i) Cl_2, $FeCl_3$ (ii) Fe, HCl (iii) $NaNO_2$, HCl, 0°C (iv) H_2O/H^+

(4) (i) Cl_2, $FeCl_3$ (ii) $NaNO_2$, HCl, 0°C (iii) Fe, HCl (iv) H_2O/H^+

16. Given below are two statements, one is labelled as Assertion (A) and other is labelled as Reason (R).

Assertion (A) : Gabriel phthalimide synthesis cannot be used to prepare aromatic primary amines.

Reason (R) : Aryl halides do not undergo nucleophilic substitution reaction.

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

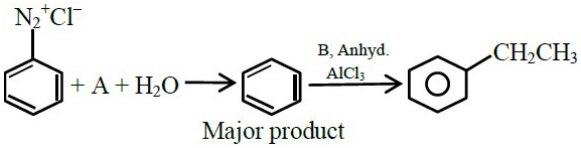
[JEE-Main 25-7-21_S1]

(1) Both (A) and (R) true but (R) is not the correct explanation of (A).

(2) (A) is false but (R) is true.

(3) Both (A) and (R) are true and (R) is correct explanation of (A).

(4) (A) is true but (R) is false.

17. 

In the chemical reactions given above A and B respectively are : **[JEE-Main 22-7-21_S2]**

(1) H_3PO_2 and CH_3CH_2Cl

(2) CH_3CH_2OH and H_3PO_2

(3) H_3PO_2 and CH_3CH_2OH

(4) CH_3CH_2Cl and H_3PO_2

18. Compound A is converted to B on reaction with $CHCl_3$ and KOH. The compound B is toxic and can be decomposed by C. A, B and C respectively are : **[JEE-Main 20-7-21_S1]**

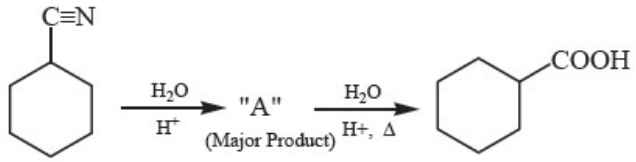
(1) primary amine, nitrile compound, conc. HCl

(2) secondary amine, isonitrile compound, conc. NaOH

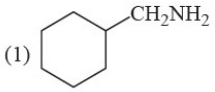
(3) primary amine, isonitrile compound, conc. HCl

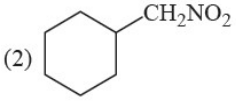
(4) secondary amine, nitrile compound, conc. NaOH

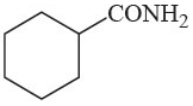
19.

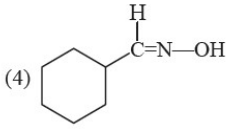


Consider the above chemical reaction and identify product "A" **[JEE-Main 18-3-21_S1]**

(1) 

(2) 

(3) 

(4) 

20. An organic compound "A" on treatment with benzene sulphonyl chloride gives compound B. B is soluble in dil. NaOH solution. Compound A is : **[JEE-Main 18-3-21_S2]**

(1) $C_6H_5–N–(CH_3)_2$ (2) $C_6H_5–NHCH_2CH_3$ (3) $C_6H_5–CH_2\ NHCH_3$ (4) $C_6H_5–\underset{\displaystyle CH_3}{\overset{\displaystyle |}{CH}}–NH_2$

21. Primary, secondary and tertiary amines can be separated using :- **[JEE-Main 17-3-21_S2]**

(1) Para-Toluene sulphonyl chloride (2) Chloroform and KOH

(3) Benzene sulphonic acid (4) Acetyl amide

22. An amine on reaction with benzenesulphonyl chloride produces a compound insoluble in alkaline solution. This amine can be prepared by ammonolysis of ethyl chloride. The correct structure of amine is : **[JEE-Main 26-2-21_S1]**

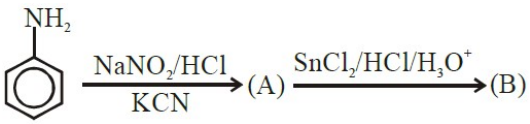
(1) 

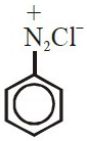
(2) $CH_3CH_2NH_2$

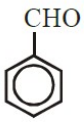
(3) $CH_3CH_2CH_2NHCH_3$

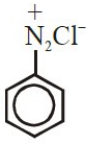
(4) $CH_3CH_2CH_2NHCH_2CH_3$

23. 'A' and 'B' in the following reactions are : **[JEE-Main 24-2-21_S1]**



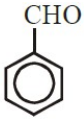
(1) (A) : 

(B) : 

(2) (A) : 

(B) : 

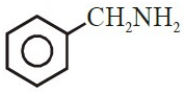
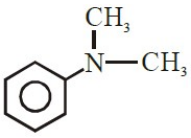
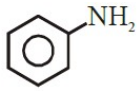
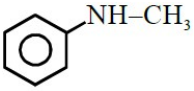
(3) (A) : 

(B) : 

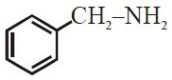
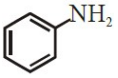
(4) (A) : 

(B) : 

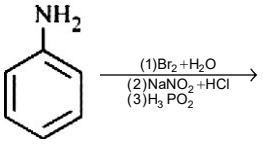
24. The diazonium salt of which of the following compounds will form a coloured dye on reaction with β-Naphthol in NaOH ? **[JEE-Main 24-2-21_S2]**

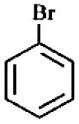
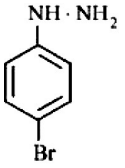
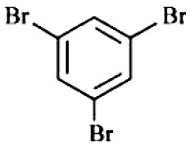
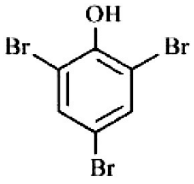
(1) 
(2) 
(3) 
(4) 

25. The total number of amines among the following which can be synthesized by Gabriel synthesis is _____. **[JEE-Main 24-2-21_S2]**

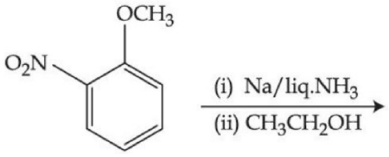
(1)  (2) $CH_3CH_2NH_2$ (3)  (4) 

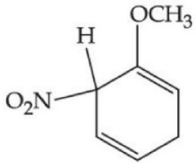
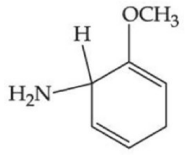
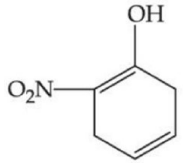
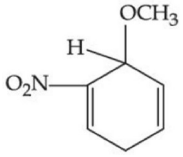
26. Identify the major product formed in the following sequence of reactions : **[JEE-Main 28-6-22_S1]**



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

27. The major product of the following reaction is **[JEE-Main 26-7-22_S1]**



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

28. Given below are two statements :

Statement I : Pure Aniline and other arylamines are usually colourless.

Statement II : Arylamines get coloured on storage due to atmospheric reduction.

In the light of the above statements, choose the most appropriate answer from the options given below **[JEE-Main_24-1-23_S2]**

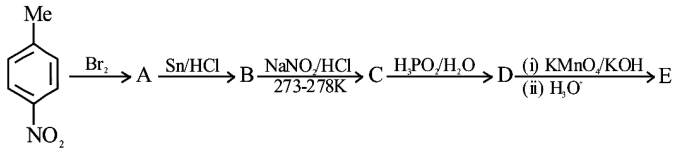
(1) Both Statement I and Statement II are incorrect

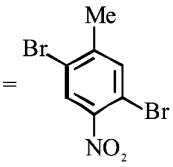
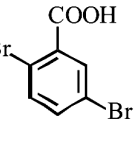
(2) Both Statement I and Statement II are correct

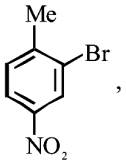
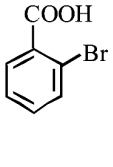
(3) Statement I is correct but Statement II is incorrect

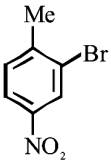
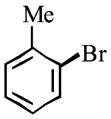
(4) Statement I is incorrect but Statement II is correct

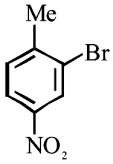
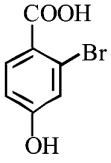
29. Identify the product formed (A and E) **[JEE-Main_25-1-23_S1]**



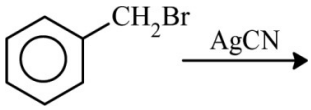
(1) A =  , E = 

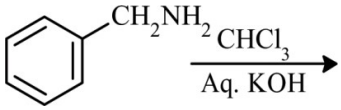
(2) A =  , E = 

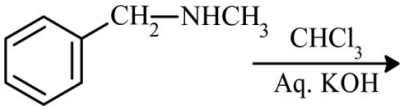
(3) A =  , E = 

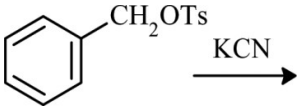
(4) A =  , E = 

30. Benzyl isocyanide can be obtained by : **[JEE-Main 30-1-23_S1]**

(A) 

(B) 

(C) 

(D) 

Choose the correct answer from the options given below :

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

ANSWER KEY_AMINES

1.	(4)	**2.**	(2)	**3.**	(3)	**4.**	(4)	**5.**	(4)
6.	(2)	**7.**	(1)	**8.**	(3)	**9.**	(2)	**10.**	(3)
11.	(3)	**12.**	(1)	**13.**	(4)	**14.**	(2)	**15.**	(3)
16.	(3)	**17.**	(1)	**18.**	(3)	**19.**	(3)	**20.**	(4)
21.	(1)	**22.**	(4)	**23.**	(3)	**24.**	(3)	**25.**	(3)
26.	(3)	**27.**	(1)	**28.**	(3)	**29.**	(2)	**30.**	(3)

CHEMISTRY

JEE MAIN PREVIOUS YEARS QUESTIONS – 2018-2023

CHAPTER NAME :- HYDROCARBON

(IMPORTANT QUESTIONS ONLY)

1. The correct sequential addition of reagents in the preparation of 3-nitrobenzoic acid from benzene is: **[JEE-Main 26-8-21_S1]**

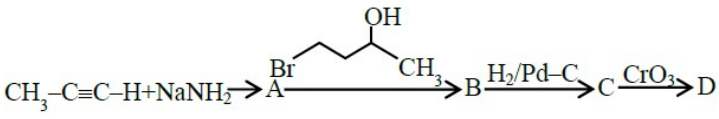
(1) $Br_2/AlBr_3$, HNO_3/H_2SO_4, Mg/ether, CO_2, H_3O^+

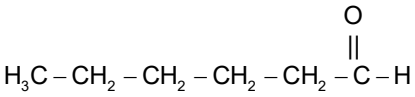
(2) $Br_2/AlBr_3$, NaCN, H_3O^+, HNO_3/H_2SO_4

(3) $Br_2/AlBr_3$, HNO_3/H_2SO_4, NaCN, H_3O^+

(4) HNO_3/H_2SO_4, $Br_2/AlBr_3$, Mg/ether, CO_2, H_3O^+

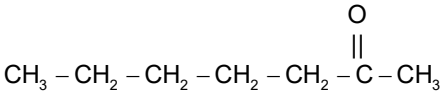
2. In the following sequence of reactions, the final product D is : **[JEE-Main 27-8-21_S1]**



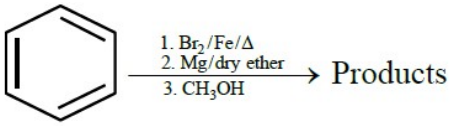
(1) 

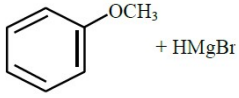
(2) $CH_3–CH=CH–CH_2–CH_2–CH_2–COOH$

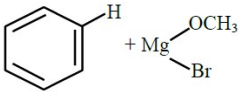
(3) $H_3C–CH=CH–CH(OH)–CH_2–CH_2–CH_3$

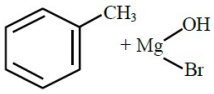
(4) 

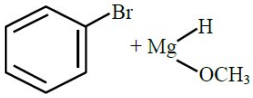
3. For the following : **[JEE-Main 31-8-21_S2]**



(1) 

(2) 

(3) 

(4) 

4. Given below are two statements : one is labelled as Assertion (A) and the other is labelled as Reason (R). Assertion (A) : Treatment of bromine water with propene yields 1-bromopropan-2-ol.

Reason (R) : Attack of water on bromonium ion follows Markovnikov rule and results in 1-bromopropan-2-ol. **[JEE-Main 31-8-21_S1]**

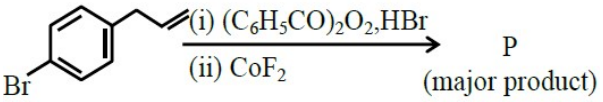
In the light of the above statements, choose the most appropriate answer from the options given below :

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

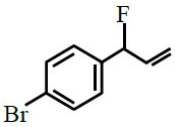
(2) (A) is false but (R) is true.

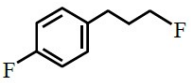
(3) Both (A) and (R) are true and (R) is the correct explanation of (A)

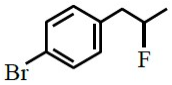
(4) (A) is true but (R) is false

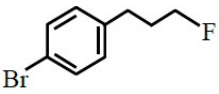
5. 

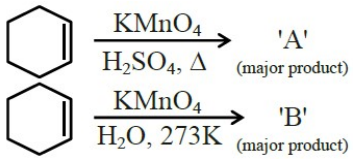
Major product P of above reaction, is : **[JEE-Main 20-7-21_S2]**

(1) 

(2) 

(3) 

(4) 

6. 

For above chemical reactions, identify the correct statement from the following:

[JEE-Main 20-7-21_S1]

(1) Both compound 'A' and compound 'B' are dicarboxylic acids

(2) Both compound 'A' and compound 'B' are diols

(3) Compound 'A' is diol and compound 'B' is dicarboxylic acid

(4) Compound 'A' is dicarboxylic acid and compound 'B' is diol

7. An organic compound 'A' C_4H_8 on treatment with $KMnO_4/H^+$ yields compound 'B' C_3H_6O. Compound 'A' also yields compound 'B' an ozonolysis. Compound 'A' is : **[JEE-Main 25-7-21_S1]**

(1) 2–Methylpropene (2) 1–Methylcyclopropane

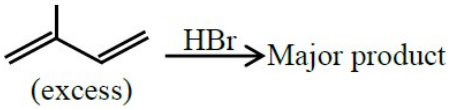
(3) But–2–ene (4) Cyclobutane

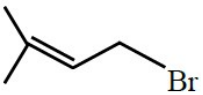
8. Experimentally reducing a functional group cannot be done by which one of the following reagents ?

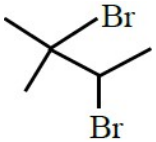
[JEE-Main 1-9-21_S2]

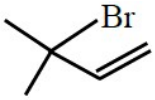
(1) Pt-C/H_2 (2) Na/H_2 (3) Pd-C/H_2 (4) Zn/H_2O

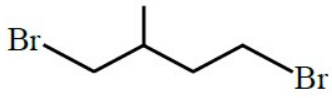
9. The major product formed in the following reaction is : **[JEE-Main 26-8-21_S2]**



(1) 

(2) 

(3) 

(4) 

10. Match List-I with List-II :

List-I (Chemicals)	**List-II (Use / Preparation / Constituent)**
(a) Alcoholic potassium hydroxide	(i) Electrodes in batteries
(b) Pd/ $BaSO_4$	(ii) Obtained by addition reaction
(c) BHC (Benzene hexachloride)	(iii) Used for β- elimination reaction
(d) Polyacetylene	(iv) Lindlar's catalyst

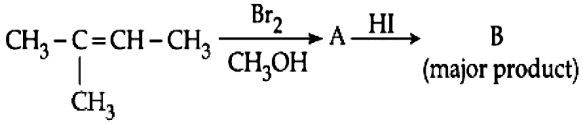
Choose the most appropriate match : **[JEE-Main 18-3-21_S1]**

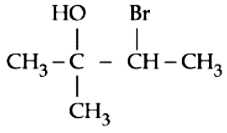
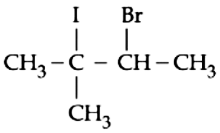
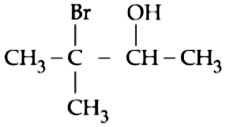
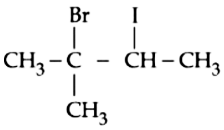
(1) a-ii, b-i, c-iv, d-iii (2) a-iii, b-iv, c-ii, d-i (3) a-iii, b-i, c-iv, d-ii (4) a-ii, b-iv, c-i, d-iii

11. Metallic sodium does not react normally with : **[JEE-Main 20-7-21_S2]**

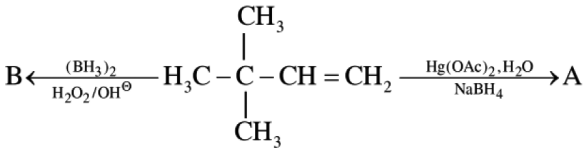
(1) gaseous ammonia (2) But-2-yne (3) Ethyne (4) tert-butyl alcohol

12. Major product 'B' of the following reaction sequence is: **[JEE-Main 27-7-22_S2]**



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

13. Choose the correct option for the following reactions. **[JEE-Main 28-7-22_S1]**



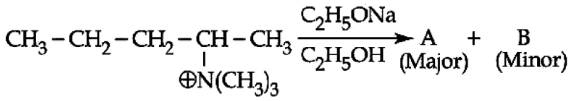
(1) 'A' and 'B' are both Markovnikov addition products.

(2) 'A' is Markovnikov product and 'B' is anti–Markovnikov product.

(3) 'A' and 'B' are both anti–Markovnikov products.

(4) 'B' is Markovnikov and 'A' is anti–Markovnikov product.

14. Identify the correct statement for the below given transformation. **[JEE-Main 28-7-22_S1]**



(1) A – $CH_3CH_2CH = CH – CH_3$, B – $CH_3CH_2CH_2CH = CH_2$, Saytzeff products

(2) A – $CH_3CH_2CH = CH – CH_3$, B – $CH_3CH_2CH_2CH = CH_2$, Hafmann products

(3) A – $CH_3CH_2CH_2CH = CH_2$, B – $CH_3CH_2CH = CHCH_3$, Hofmann products

(4) A – $CH_3CH_2CH_2CH = CH_2$, B – $CH_3CH_2CH = CHCH_3$, Saytzeff products

15. Arrange the following in increasing order of reactivity towards nitration

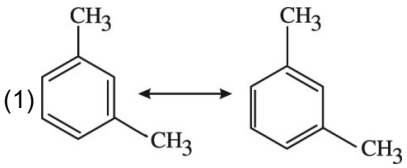
(A) p–xylene (B) bromobenzene (C) mesitylene (D) nitrobenzene

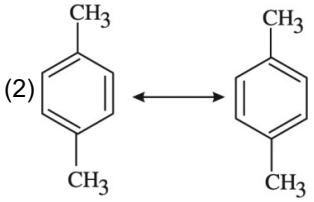
(E) benzene

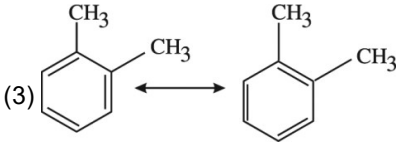
Choose the correct answer from the options given below **[JEE-Main 28-7-22_S2]**

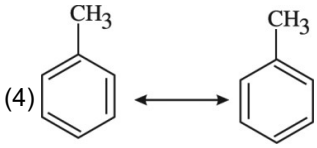
(1) C < D < E < A < B (2) D < B < E < A < C (3) D < C < E < A < B (4) C < D < E < B < A

16. Which among the following pairs of the structures will give different products on ozonolysis? (Consider the double bonds in the structures are rigid and not delocalized.) **[JEE-Main 29-7-22_S1]**

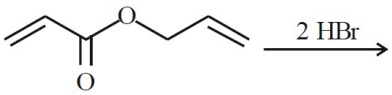
(1) 

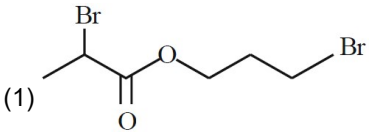
(2) 

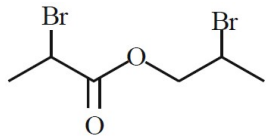
(3) 

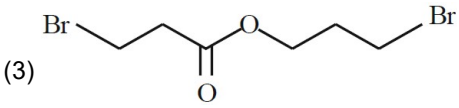
(4) 

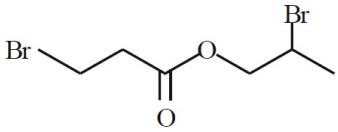
17. Major product of the following reaction is **[JEE-Main 25-7-22_S2]**



(1) 

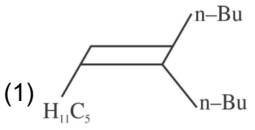
(2) 

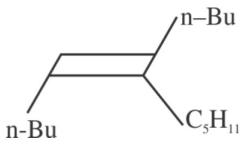
(3) 

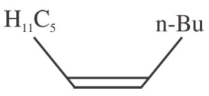
(4) 

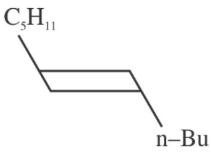
18. What will be the major product of following sequence of reactions? **[JEE-Main 27-6-22_S2]**

$$n-Bu- \equiv \frac{\begin{matrix}(i)\ n-BuLi,\\ n-C_5H_{11}Cl\end{matrix}}{(ii)\ Lindlar\ cat, H_2}$$

(1) 

(2) 

(3) 

(4) 

19. Two isomers 'A' and 'B' with molecular formula C_4H_8 give different products on oxidation with $KMnO_4$ in acidic medium. Isomer 'A' on reaction with $KMnO_4/H^+$ results in effervescence of a gas and gives ketone. The compound 'A' is **[JEE-Main 29-6-22_S1]**

(1) But-1-ene (2) cis-But-2-ene (3) trans-But-2ene (4) 2-methyl propene

20. Given below are two statements.

Statement I : The presence of weaker π- bonds make alkenes less stable than alkanes.

Statement II : The strength of the double bond is greater than that of carbon-carbon single bond.

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

[JEE-Main 24-6-22_S2]

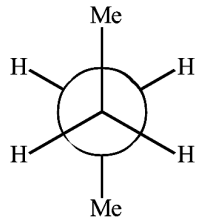
(1) Both Statement I and Statement II are correct.

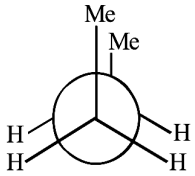
(2) Both Statement I and Statement II are incorrect.

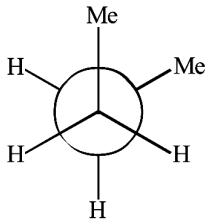
(3) Statement I is correct but Statement II is incorrect.

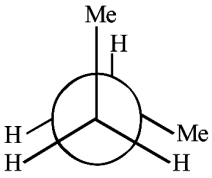
(4) Statement I is incorrect but Statement II is correct.

21. Which of the following conformations will be the most stable ? **[JEE-Main_25-1-23_S1]**

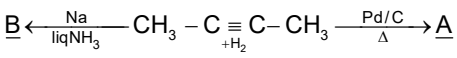
(1) 

(2) 

(3) 

(4) 

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



Identify the incorrect statements from the options given 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. **[JEE-Main_01-2-23_S1]**

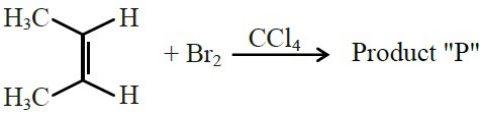
(1) B and C only (2) B, C and D only (3) A, C and D only (4) A and B only

23. A hydrocarbon 'X' with formula C_6H_8 uses two moles of H_2 on catalytic hydrogenation of its one mole. On ozonolysis, 'X' yields two moles of methane dicarbaldehyde. The hydrocarbon 'X' is :

[JEE-Main_31-1-23_S2]

(1) hexa-1, 3, 5-triene (2) 1-methylcyclopenta-1, 4-diene

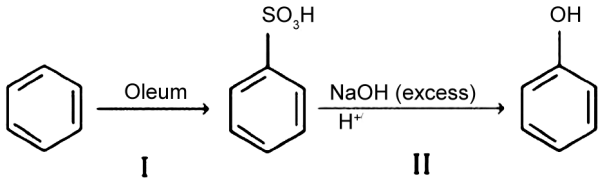
(3) cyclohexa-1, 3-diene (4) cyclohexa-1, 4-diene

24. 

Consider the above chemical reaction. The total number of stereoisomers possible for Product 'P' is _____ . **[JEE-Main 25-7-21_S2]**

25. In the presence of sunlight, benzene reacts with Cl_2 to give product, X. The number of hydrogens in X is_____. **[JEE-Main 26-7-22_S1]**

26. In the following reaction



The % yield for reaction I is 60% and that of reaction II is 50%. The overall yield of the complete reaction is _____% [nearest integer] **[JEE-Main 27-7-22_S1]**

27. In bromination of Propyne, with Bromine 1, 1, 2, 2-tetrabromopropane is obtained in 27% yield. The amount of 1, 1, 2, 2 tetrabromopropane obtained from 1 g of Bromine in this reaction is _____ $\times 10^{-1}$ g. (Nearest integer) (Molar Mass : Bromine = 80 g/mol) **[JEE-Main 29-7-22_S1]**

28. The total number of monobromo derivatives formed by the alkanes with molecular formula C_5H_{12} is (excluding stereo isomers)_____ **[JEE-Main 25-7-22_S2]**

29. The major product 'A' of the following given reaction has _____ sp^2 hybridized carbon atoms.

2,7 – Dimethyl – 2, 6 – octadiene

$\xrightarrow{H^+}$ A (Major Product) **[JEE-Main 24-6-22_S1]**

30. Maximum number of isomeric monochloro derivatives which can be obtained from 2, 2, 5, 5-tetramethylhexane by chlorination is _____ **[JEE-Main 24-1-23_S2]**

ANSWER KEY_HYDROCARBON

1.	(4)	**2.**	(4)	**3.**	(2)	**4.**	(3)	**5.**	(4)
6.	(4)	**7.**	(1)	**8.**	(2)	**9.**	(1)	**10.**	(2)
11.	(2)	**12.**	(2)	**13.**	(2)	**14.**	(3)	**15.**	(2)
16.	(3)	**17.**	(4)	**18.**	(3)	**19.**	(4)	**20.**	(1)
21.	(1)	**22.**	(Bonus)	**23.**	(4)	**24.**	**2**	**25.**	**6**
26.	**30**	**27.**	**3**	**28.**	**8**	**29.**	**2**	**30.**	**3**

CHEMISTRY

JEE MAIN PREVIOUS YEARS QUESTIONS – 2018-2023

CHAPTER NAME :- BIOMOLECULES

(IMPORTANT QUESTIONS ONLY)

1. Glucose on prolonged heating with HI gives : **[JEE-Main 2018_S2]**

(1) Hexanoic acid (2) 6-iodohexanal (3) n-Hexane (4) 1-Hexene

2. Fructose and glucose can be distinguished by: **[JEE-Main 8-4-19_S2]**

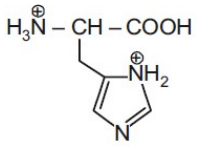
(1) Fehling's test (2) Seliwanoff's test (3) Barfoed's test (4) Benedict's test

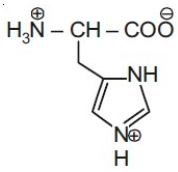
3. Maltose on treatment with dilute HCl gives **[JEE-Main 8-4-19_S1]**

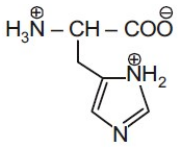
(1) D-Galactose (2) D-Glucose and D-Fructose

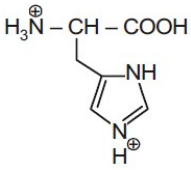
(3) D-Glucose (4) D-Fructose

4. The correct structure of histidine in a strongly acidic solution (pH = 2) is **[JEE-Main 12-1-19_S2]**

(1) 

(2) 

(3) 

(4) 

5. Which of the following tests cannot be used for identifying amino acids? **[JEE-Main 10-1-19_S2]**

(1) Barfoed test (2) Biuret test (3) Xanthoproteic test (4) Ninhydrin test

6. Which of the following statements is not true about RNA? **[JEE-Main 12-4-19_S1]**

(1) It usually does not replicate (2) It is present in the nucleus of the cell

(3) It controls the synthesis of protein (4) It has always double stranded α-helix structure

7. A, B and C are three biomolecules. The results of the tests performed on them are given below

	Molisch's Test	Barfoed Test	Biuret Test
A	Positive	Negative	Negative
B	Positive	Positive	Negative
C	Negative	Negative	Positive

A, B and C are respectively : **[JEE-Main 9-1-20_S2]**

(1) A = Lactose, B = Fructose, C = Alanine (2) A = Lactose, B = Glucose, C = Alanine

(3) A = Glucose, B = Fructose, C = Albumin (4) A = Lactose, B = Glucose, C = Albumin

8. Two monomers in maltose are **[JEE-Main 8-1-20_S2]**

(1) α-D-glucose and α-D-glucose (2) α-D-glucose and β-D-glucose

(3) α-D-glucose and α-D-galactose (4) α-D-glucose and α-D-Fructose

9. Which one of the following statements is not true? **[JEE-Main 6-9-20_S2]**

(1) Lactose contains α-glycosidic linkage between C_1 of galactose and C_4 of glucose

(2) Lactose is a reducing sugar and it gives Fehling's test

(3) On acid hydrolysis, lactose gives one molecule of D(+)-glucose and one molecule of D(+)-galactose

(4) Lactose ($C_{11}H_{22}O_{11}$) is a disaccharide and it contains 8 hydroxyl groups

10. Which of the following is not an essential amino acid? **[JEE-Main 5-9-20_S1]**

(1) Tyrosine (2) Valine (3) Lysine (4) Leucine

11. Which of the following will react with $CHCl_3$ + alc. KOH? **[JEE-Main 4-9-20_S1]**

(1) Adenine and thymine (2) Thymine and proline

(3) Adenine and lysine (4) Adenine and proline

12. Hydrolysis of sucrose gives : **[JEE-Main 27-8-21_S2]**

(1) α-D-(–)-Glucose and β-D-(–)-Fructose (2) α-D-(+)-Glucose and α-D-(–)-Fructose

(3) α-D-(–)-Glucose and α-D-(+)-Fructose (4) α-D-(+)-Glucose and β-D-(–)-Fructose

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

Assertion (A) : Sucrose is a disaccharide and a non-reducing sugar. **[JEE-Main 26-8-21_S2]**

Reason (R) : Sucrose involves glycosidic linkage between CA of β-glucose and CB of α-fructose.

Choose the most appropriate answer from the options given below :

(1) Both (A) and (R) are true but (R) is not the true explanation of (A)

(2) (A) is false but (R) is true.

(3) (A) is true but (R) is false

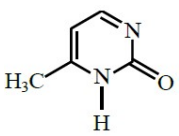
(4) Both (A) and (R) are true and (R) is the true explanation of (A)

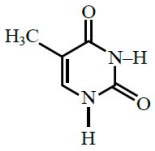
14. Thiamine and pyridoxine are also known respectively as : **[JEE-Main 22-7-21_S2]**

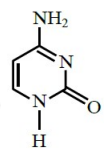
(1) Vitamin B_2 and Vitamin E (2) Vitamin E and Vitamin B_2

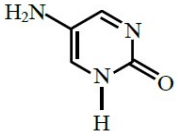
(3) Vitamin B_6 and Vitamin B_2 (4) Vitamin B_1 and Vitamin B_6

15. Which one of the following is correct structure for cytosine ? **[JEE-Main 25-7-21_S2]**

(1) 

(2) 

(3) 

(4) 

16. $\underset{\text{Sucrose}}{C_{12}H_{22}O_{11}} + H_2O \xrightarrow{\text{Enzyme A}} \underset{\text{Glucose}}{C_6H_{12}O_6} + \underset{\text{Fructose}}{C_6H_{12}O_6}$

$\underset{\text{Glucose}}{C_6H_{22}O_6} \xrightarrow{\text{EnzymeB}} 2C_2H_5OH + 2CO_2$

In the above reactions, the enzyme A and enzyme B respectively are : – **[JEE-Main 17-3-21_S2]**

(1) Amylase and Invertase (2) Invertase and Amylase

(3) Invertase and Zymase (4) Zymase and Invertase

17. The water soluble protein is : **[JEE-Main 25-7-21_S1]**

(1) Fibrin (2) Albumin (3) Myosin (4) Collagen

18. Seliwanoff test and Xanthoproteic test are used for the identification of _____and _____ respectively **[JEE-Main 26-2-21_S2]**

(1) Aldoses, ketoses (2) Proteins, ketoses

(3) Ketoses, proteins (4) Ketoses, aldoses

19. Match List-I with List-II

	List-I		**List-I**
(A)	Glucose + HI	(I)	Gluconic acid
(B)	Glucose + Br_2 water	(II)	Glucose pentacetate
(C)	Glucose + acetic anhydride	(III)	Saccharic acid
(D)	Glucose + HNO_3	(IV)	Hexane

Choose the correct answer from the options given below: **[JEE-Main 27-7-22_S2]**

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

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

20. Sugar moiety in DNA and RNA molecules respectively are **[JEE-Main 29-6-22_S1]**

(1) β-D-2-deoxyribose, β -D-deoxyribose (2) β-D-2-deoxyribose, β -D-ribose

(3) β-D-ribose, β -D-2-deoxyribose (4) β-D-deoxyribose, β -D-2-deoxyribose

21. Match List I with List II.

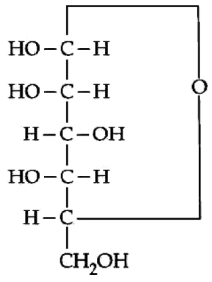
List I	**List II**
Enzyme	**Conversion of**
A. Invertase	I. Starch into maltose
B. Zymase	II. Maltose into glucose
C. Diastase	III. Glucose into ethanol
D. Maltase	IV. Cane sugar into glucose

Choose the most appropriate answer from the options given below : **[JEE-Main 26-6-22_S2]**

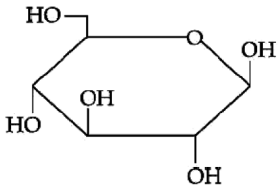
(1) A-III, B-IV. C-II. D-I (2) A-III. B-II. C-I. D-IV

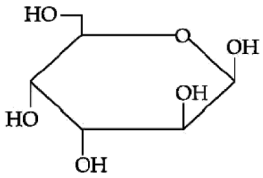
(3) A-IV, B-III C-I. D-II (4) A-IV, B-II. C-III. D-I

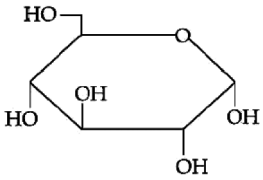
22. For the below given cyclic hemiacetal (X), the correct pyranose structure is :**[JEE-Main 28-7-22_S1]**

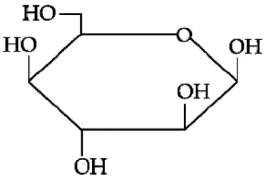


(X)

(1) 

(2) 

(3) 

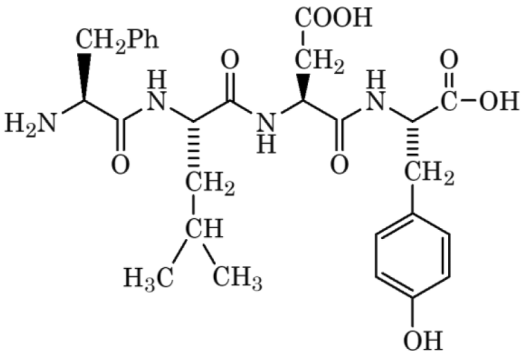
(4) 

23. The structure of protein that is unaffected by heating is : **[JEE-Main 29-6-22_S2]**

(1) secondary structure (2) tertiary structure

(3) primary structure (4) quaternary structure

24. Following tetrapeptide can be represented as



(F, L, D, Y, I, Q, P are one letter codes for amino acids) **[JEE-Main 29-1-23_S2]**

(1) FIQY (2) FLDY (3) YQLF (4) PLDY

25. The number of chiral carbons present in sucrose is _____. **[JEE-Main 5-9-20_S2]**

26. The number of chiral centres present in threonine is _____. **[JEE-Main 4-9-20_S2]**

27. In a linear tetrapeptide (Constituted with different amino acids), (number of amino acids) - (number of peptide bonds) is _____ . **[JEE-Main 29-7-22_S1]**

28. The number of oxygens present in a nucleotide formed from a base, that is present only in RNA is _____. **[JEE-Main 26-6-22_S1]**

29. Total number of tripeptides possible by mixing of valine and proline is _____ **[JEE-Main 24-1-23_S2]**

30. A short peptide on complete hydrolysis produces 3 moles of glycine (G), two moles of leucine (L) and two moles of valine (V) per mole of peptide. The number of peptide linkages in it are_____. **[JEE-Main 30-1-23_S2]**

ANSWER KEY_BIOMOLECULES

1.	(3)	**2.**	(2)	**3.**	(3)	**4.**	(4)	**5.**	(1)
6.	(4)	**7.**	(4)	**8.**	(1)	**9.**	(1)	**10.**	(1)
11.	(3)	**12.**	(4)	**13.**	(3)	**14.**	(4)	**15.**	(3)
16.	(3)	**17.**	(2)	**18.**	(3)	**19.**	(1)	**20.**	(2)
21.	(3)	**22.**	(4)	**23.**	(3)	**24.**	(2)	**25.**	**9**
26.	**2**	**27.**	**1**	**28.**	**9**	**29.**	**8**	**30.**	**6**

CHEMISTRY

JEE MAIN PREVIOUS YEARS QUESTIONS – 2018-2023

CHAPTER NAME :- CHEMISTRY IN EVERYDAY LIFE

(IMPORTANT QUESTIONS ONLY)

1. Noradrenaline is a / an **[JEE-Main 9-4-19_S2]**

(1) Neurotransmitter (2) Antihistamine (3) Antacid (4) Antidepressant

2. The correct match between item (I) and item (II) is: **[JEE-Main 11-1-19_S1]**

Item –I	**Item - II**
(A) Norethindrone	(P) Anti-biotic
(B) Ofloxacin	(Q) Anti-fertility
(C) Equanil	(R) Hypertension
	(S) Analgesics

(1) (A) → (R) ; (B) → (P) ; (C) → (R) (2) (A) → (R) ; (B) → (P) ; (C) → (S)

(3) (A) → (Q) ; (B) → (P) ; (C) → (R) (4) (A) → (Q) ; (B) → (R) ; (C) → (S)

3. The mechanism of action of "Terfenadine" (Seldane) is : **[JEE-Main 4-9-20_S2]**

(1) Activates the histamine receptor (2) Helps in the secretion of histamine

(3) Inhibits the secretion of histamine (4) Inhibits the action of histamine receptor

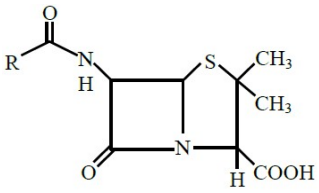
4. If a person is suffering from the deficiency of nor-adrenaline, what kind of drug can be suggested? **[JEE-Main 5-9-20_S1]**

(1) Analgesic (2) Antidepressant (3) Anti-inflammatory (4) Antihistamine

5. Given below are two statements :

Statement I : Penicillin is a bacteriostatic type antibiotic.

Statement II : The general structure of Penicillin is:



Choose the correct option : **[JEE-Main 27-7-21_S2]**

(1) Both statement I and statement II are false (2) Statement I is incorrect but statement II is true

(3) Both statement I and statement II are true (4) Statement I is correct but statement II is false

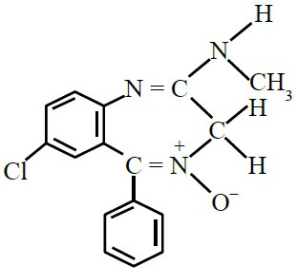
6. Match List-I with List-II :

List-I (Drug)	**List-II (Class of Drug)**
(a) Furacine	(i) Antibiotic
(b) Arsphenamine	(ii) Tranquilizers
(c) Dimetane	(iii) Antiseptic
(d) Valium	(iv) Synthetic antihistamines

Choose the most appropriate match : **[JEE-Main 27-7-21_S1]**

(1) (a)-(i), (b)-(iii), (c)-(iv), (d)-(ii)
(2) (a)-(iii), (b)-(iv), (c)-(ii), (d)-(i)
(3) (a)-(ii), (b)-(i), (c)-(iii), (d)-(iv)
(4) (a)-(iii), (b)-(i), (c)-(iv), (d)-(ii)

7.

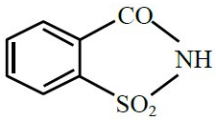


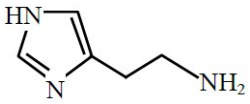
Chlordiazepoxide

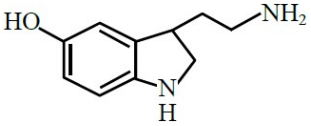
The class of drug to which chlordiazepoxide with above structure belongs is : **[JEE-Main 26-8-21_S2]**

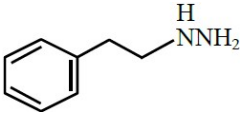
(1) Antacid (2) Analgesic (3) Tranquilizer (4) Antibiotic

8. Which one of the following chemicals is responsible for the production of HCl in the stomach leading to irritation and pain? **[JEE-Main 27-8-21_S2]**

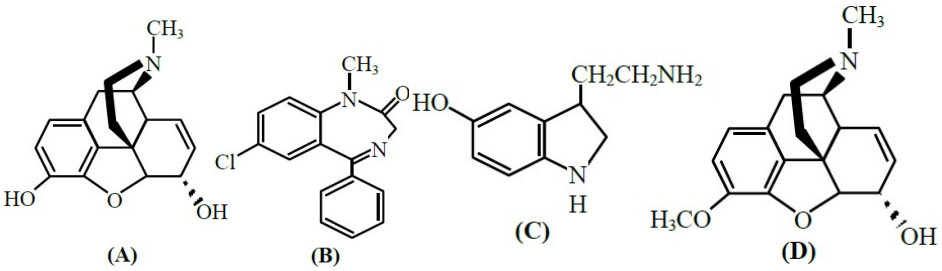
(1) 

(2) 

(3) 

(4) 

9.



(A) (B) (C) (D)

The correct statement about (A), (B), (C) and (D) is : **[JEE-Main 27-8-21_S1]**

(1) (A), (B) and (C) are narcotic analgesics
(2) (B), (C) and (D) are tranquillizers
(3) (A) and (D) are tranquillizers
(4) (B) and (C) are tranquillizers

10. Match List - I with List - II : **[JEE-Main 18-3-21_S2]**

List - I (Class of Chemicals)	**List – II** (Example)
(a) Antifertility drug	(i) Meprobamate
(b) Antibiotic	(ii) Alitame
(c) Tranquilizer	(iii) Norethindrone
(d) Artificial Sweetener	(iv) Salvarsan

(1) (a)-(ii), (b)-(iii), (c)-(iv), (d)-(i) (2) (a)-(iv), (b)-(iii), (c)-(ii), (d)-(i)

(3) (a)-(iii), (b)-(iv), (c)-(i), (d)-(ii) (4) (a)-(ii), (b)-(iv), (c)-(i), (d)-(iii)

11. Match the list -I with list – II **[JEE-Main 18-3-21_S1]**

List-I (Class of Drug)	**List-II (Example)**
(a) Antacid	(i) Novestrol
(b) Artificial sweetener	(ii) Cimetidine
(c) Antifertility	(iii) Valium
(d) Tranquilizers	(iv) Alitame

(1) (a) – (ii), (b) – (iv),(c) – (i), (d) – (iii) (2) (a) – (iv), (b) – (i),(c) – (ii), (d) – (iii)

(3) (a) – (iv), (b) – (iii),(c) – (i), (d) – (ii) (4) (a) – (ii), (b) – (iv),(c) – (iii), (d) – (i)

12. With respect to drug-enzyme interaction, identify the wrong statement: **[JEE-Main 17-3-21_S1]**

(1) Non-Competitive inhibitor binds to the allosteric site

(2) Allosteric inhibitor changes the enzyme's active site

(3) Allosteric inhibitor competes with the enzyme's active site

(4) Competitive inhibitor binds to the enzyme's active site

13. Statements about Enzyme Inhibitor Drugs are given below :

(A) There are Competitive and Non–competitive inhibitor drugs.

(B) These can bind at the active sites and allosteric sites.

(C) Competitive Drugs are allosteric site blocking drugs.

(D) Non–competitive Drugs are active site blocking drugs.

Choose the correct answer from the options given below : **[JEE-Main 28-7-22_S1]**

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

14. Two statements in respect of drug–enzyme interaction are given below

Statement I : Action of an enzyme can be blocked only when an inhibitor blocks the active site of the enzyme. **[JEE-Main 28-7-22_S2]**

Statement II : An inhibitor can form a strong covalent bond with the enzyme.

In the light of the above statements. Choose the correct answer from the options given below

(1) Both Statement I and Statement II are true (2) Both Statement I and Statement II are false

(3) Statement I is true but Statement II is false (4) Statement I is false but Statement II is true

15. Which of the following compounds is an example of hypnotic drug ? **[JEE-Main 29-7-22_S1]**

(1) Seldane (2) Amytal (3) Aspartame (4) Prontosil

16. Stearic acid and polyethylene glycol react to form which one of the following soap/s detergents ?

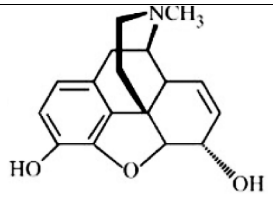
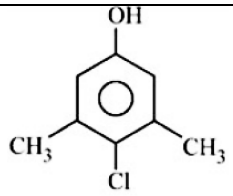
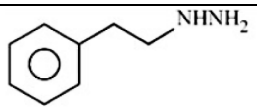
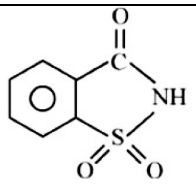
[JEE-Main 26-7-22_S1]

(1) Cationic detergent (2) Soap (3) Anionic detergent (4) Non-ionic detergent

17. Which of the following enhances the lathering property of soap? **[JEE-Main 27-7-22_S2]**

(1) Sodium stearate (2) Sodium carbonate (3) Sodium rosinate (4) Trisodium phosphate

18. Match List I with List II

	List I		List II
(A)		(I)	Anti-depressant
(B)		(II)	550 times sweeter than cane sugar
(C)		(III)	Narcotic analgesic
(D)		(IV)	Antiseptic

Choose the correct answer from the options given below: **[JEE-Main 27-7-22_S1]**

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

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

19. Match List I with List Ii

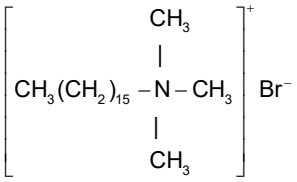
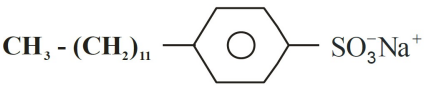
List I	**List II**
A. Antipyretic	I. Reduces pain
B. Analgesic	II. Reduces stress
C. Tranquilizer	III. Reduces fever
D. Antacid	IV. Reduces acidity (Stomach)

Choose the correct answer from the options given below: **[JEE-Main 27-6-22_S2]**

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

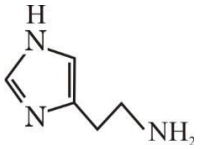
(3) A-I, B-IV, C-II, D-III (4) A-I, B-III, C-II, D-IV

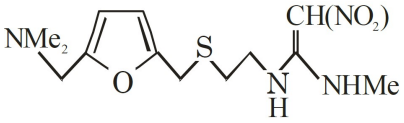
20. Match List-I with List-II **[JEE-Main 27-6-22_S1]**

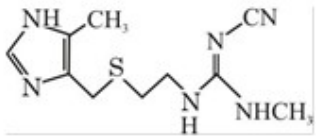
List-I	**List-II**
(A) 	(I) Dishwashing powder
(B) 	(II) Toothpaste
(C) $C_{17}H_{35}COO^-Na^+ + Na_2CO_3 +$ Rosinate	(III) Laundry soap
(D) $CH_3(CH_2)_{16}COO(CH_2CH_2O)_nCH_2CH_2OH$	(IV) Hair conditioner

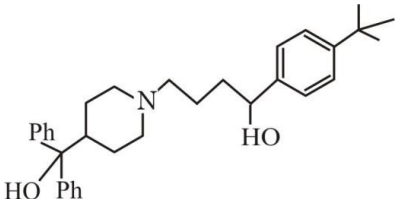
(1) (A) – (III), (B) – (II), (C) – (IV), (D) – (I)
(2) (A) – (IV), (B) – (II), (C) – (III), (D) – (I)
(3) (A) – (IV), (B) – (III), (C) – (II), (D) – (I)
(4) (A) – (III), (B) – (IV), (C) – (I), (D) – (II)

21. The drug tegamet is : **[JEE-Main 28-6-22_S2]**

(1) 

(2) 

(3) 

(4) 

22. The mixture of chloroxylenol and terpineol is an example of : **[JEE-Main 29-6-22_S2]**

(1) antiseptic (2) pesticide (3) disinfectant (4) narcotic analgesic

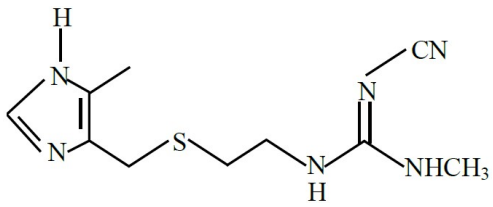
23. Which of the following compound does not contain sulphur atom ? **[JEE-Main 29-6-22_S1]**

(1) Cimetidine (2) Ranitidine (3) Histamine (4) Saccharin

24. An antiseptic dettol is a mixture of two compounds 'A' and 'B' where A has 6π electrons and B has 2π electrons. What is 'B'? **[JEE-Main 25-6-22_S2]**

(1) Bithionol (2) Terpineol (3) Chloroxylenol (4) Chloramphenicol

25. The structure shown below is of which well-known drug molecule? **[JEE-Main 24-6-22_S2]**



(1) Ranitidine (2) Seldane (3) Cimetidine (4) Codeine

26. Amongst the following compounds, which one is an antacid ? **[JEE-Main_30-1-23_S1]**

(1) Ranitidine (2) Meprobamate (3) Terfenadine (4) Brompheniramine

27. The element playing significant role in neuromuscular function and interneuronal transmission is : **[JEE-Main_31-1-23_S2]**

(1) Be (2) Ca (3) Li (4) Mg

28. The number of sp^2 hybridised carbons present in "Aspartame" is _____. **[JEE-Main 7-1-20_S2]**

29. The number of chlorine atoms in bithionol is ____. **[JEE-Main 29-7-22_S2]**

30. How many of the following drugs is/are example(s) of broad spectrum antibiotic ?

Ofloxacin, Penicillin G, Terpineol, Salvarsan **[JEE-Main 26-7-22_S2]**

ANSWER KEY_CHEMISTRY IN EVERYDAY LIFE

1.	(1)	**2.**	(3)	**3.**	(4)	**4.**	(2)	**5.**	(2)
6.	(4)	**7.**	(3)	**8.**	(2)	**9.**	(4)	**10.**	(3)
11.	(1)	**12.**	(3)	**13.**	(3)	**14.**	(4)	**15.**	(2)
16.	(4)	**17.**	(3)	**18.**	(3)	**19.**	(1)	**20.**	(2)
21.	(3)	**22.**	(1)	**23.**	(3)	**24.**	(2)	**25.**	(3)
26.	(1)	**27.**	(2)	**28.**	**9**	**29.**	**4**	**30.**	**1**

CHEMISTRY

JEE MAIN PREVIOUS YEARS QUESTIONS – 2018-2023

CHAPTER NAME :- ENVIRONMENTAL CHEMISTRY

(IMPORTANT QUESTIONS ONLY)

1. The maximum prescribed concentration of copper in drinking water is : **[JEE-Main 8-4-19_S2]**

(1) 3 ppm (2) 0.05 ppm (3) 0.5 ppm (4) 5 ppm

2. Which is wrong with respect to our responsibility as a human being to protect our environment? **[JEE-Main 8-4-19_S1]**

(1) Using plastic bags (2) Restricting the use of vehicles

(3) Avoiding the use of floodlighted facilities (4) Setting up compost tin in gardens

3. Assertion : Ozone is destroyed by CFCs in the upper stratosphere. **[JEE-Main 8-4-19_S1]**

Reason : Ozone holes increase the amount of UV radiation reaching the earth.

(1) Assertion and reason are both correct, and the reason is the correct explanation for the assertion.

(2) Assertion is false, but the reason is correct.

(3) Assertion and reason are correct, but the reason is not the explanation for the assertion.

(4) Assertion and reason are incorrect.

4. The layer of atmosphere between 10 km to 50 km above the sea level is called as **[JEE-Main 9-4-19_S2]**

(1) Stratosphere (2) Mesosphere (3) Thermosphere (4) Troposphere

5. Air pollution that occurs in sunlight is : **[JEE-Main 10-4-19_S2]**

(1) Fog (2) Oxidising smog (3) Acid rain (4) Reducing smog

6. The regions of the atmosphere, where clouds form and where we live, respectively, are : **[JEE-Main 10-4-19_S1]**

(1) Troposphere and Troposphere (2) Stratosphere and Troposphere

(3) Troposphere and Stratosphere (4) Stratosphere and Stratosphere

7. The correct set of species responsible for the photochemical smog is : **[JEE-Main 12-4-19_S1]**

(1) CO_2, NO_2, SO_2 and hydrocarbons (2) N_2, O_2, O_3 and hydrocarbons

(3) NO, NO_2, O_3 and hydrocarbons (4) N_2, NO_2 and hydrocarbons

8. The condition that indicates a polluted environment is **[JEE-Main 5-9-20_S1]**

(1) 0.03% of CO_2 in the atmosphere (2) pH of rain water to be 5.6

(3) eutrophication (4) BOD value of 5 ppm

9. The presence of soluble fluoride ion upto 1 ppm concentration in drinking water, is **[JEE-Main 6-9-20_S1]**

(1) safe for teeth (2) harmful to skin (3) harmful for teeth (4) harmful to bones

10. The green house gas/es is (are) :

(A) Carbon dioxide

(B) Oxygen

(C) Water vapour

(D) Methane

Choose the most appropriate answer from the options given below : **[JEE-Main 16-3-21_S2]**

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

11. The type of pollution that gets increased during the day time and in the presence of O_3 is : **[JEE-Main 16-3-21_S1]**

(1) Reducing smog (2) Oxidising smog (3) Global warming (4) Acid rain

12. Given below are two statements :

Statement I : Non-biodegradable wastes are generated by the thermal power plants.

Statement II : Bio-degradable detergents leads to eutrophication. **[JEE-Main 18-3-21_S2]**

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

(1) Both statement I and statement II are false (2) Statement I is true but statement II is false

(3) Statement I is false but statement II is true (4) Both statement I and statement II are true.

13. The statements that are TRUE :

(A) Methane leads to both global warming and photochemical smog

(B) Methane is generated from paddy fields

(C) Methane is a stronger global warming gas than CO_2

(D) Methane is a part of reducing smog

Choose the most appropriate answer from the options given below : **[JEE-Main 18-3-21_S1]**

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

14. Which one of the following gases is reported to retard photosynthesis ? **[JEE-Main 20-7-21_S2]**

(1) CO (2) CFCs (3) CO_2 (4) NO_2

15. The water having more dissolved O_2 is : **[JEE-Main 22-7-21_S2]**

(1) boiling water (2) water at 80°C (3) polluted water (4) water at 4°C

16. Given below are two statements :

Statement I : Chlorofluoro carbons breakdown by radiation in the visible energy region and release chlorine gas in the atmosphere which then reacts with stratospheric ozone. **[JEE-Main 25-7-21_S2]**

Statement II : Atmospheric ozone reacts with nitric oxide to give nitrogen and oxygen gases, which add to the atmosphere.

For the above statements choose the correct answer from the options given below :

(1) Statement I is incorrect but statement II is true

(2) Both statement I and II are false

(3) Statement I is correct but statement II is false

(4) Both statement I and II are correct

17. Water sample is called cleanest on the basis of which one of the BOD values given below **[JEE-Main 1-9-21_S2]**

(1) 11 ppm (2) 15 ppm (3) 3 ppm (4) 21 ppm

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

Assertion (A) : Photochemical smog causes cracking of rubber.

Reason (R) : Presence of ozone, nitric oxide, acrolein, formaldehyde and peroxyacetyl nitrate in photochemical smog makes it oxidizing.

Choose the most appropriate answer from the options given below : **[JEE-Main 26-8-21_S2]**

(1) Both (A) and (R) are true but (R) is not the true explanation of (A)

(2) (A) is false but (R) is true.

(3) (A) is true but (R) is false

(4) Both (A) and (R) are true and (R) is the true explanation of (A)

19. In stratosphere most of the ozone formation is assisted by : **[JEE-Main 27-8-21_S2]**

(1) cosmic rays. (2) γ–rays. (3) ultraviolet radiation. (4) visible radiations.

20. The gas 'A' is having very low reactivity reaches to stratosphere. It is non–toxic and non–flammable but dissociated by UV—radiations in stratosphere. The intermediates formed initially from the gas 'A' are : **[JEE-Main 27-8-21_S1]**

(1) $\dot{Cl}\dot{O} + \dot{C}F_2Cl$ (2) $\dot{Cl}\dot{O} + \dot{C}H_3$ (3) $\dot{C}H_3 + \dot{C}F_2Cl$ (4) $\dot{Cl} + \dot{C}F_2Cl$

21. BOD values (in ppm) for clean water (A) and polluted water (B) are expected respectively : **[JEE-Main 31-8-21_S1]**

(1) A > 50, B < 27 (2) A > 25, B < 17 (3) A < 5, B > 17 (4) A > 15, B > 47

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

Assertion A: Polluted water may have a value of BOD of the order of 17 ppm.

Reason R: BOD is a measure of oxygen required to oxidise both the biodegradable and nonbiodegradable organic material in water. **[JEE-Main 25-6-22_S2]**

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

(1) Both A and R are correct and R is the correct explanation of A.

(2) Both A and R are correct but R is NOT the correct explanation of A.

(3) A is correct but R is not correct.

(4) A is not correct but R is correct.

23. The measured BOD values for four different water samples (A-D) are as follows:

A = 3 ppm: B=18 ppm: C-21 ppm: D=4 ppm. The water samples which can be called as highly polluted with organic wastes, are **[JEE-Main 26-6-22_S2]**

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

24. Polar stratospheric clouds facilitate the formation of : **[JEE-Main 26-6-22_S1]**

(1) $ClONO_2$ (2) HOCl (3) ClO (4) CH_4

25. Given below are two statements:

Statement I: Classical smog occurs in cool humid climate. It is a reducing mixture of smoke, fog and sulphur dioxide

Statement II: Photochemical smog has components, ozone, nitric oxide, acrolein, formaldehyde, PAN etc. **[JEE-Main 27-6-22_S1]**

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

(1) Both Statement I and Statement II are correct

(2) Both Statement I and Statement II are incorrect

(3) Statement I is correct but statement II is incorrect

(4) Statement I is incorrect but Statement II is correct

26. Correct statement about photo-chemical smog is : **[JEE-Main 28-6-22_S2]**

(1) It occurs in humid climate.

(2) It is a mixture of smoke, fog and SO_2

(3) It is reducing smog.

(4) It results from reaction of unsaturated hydrocarbons.

27. The acid that is believed to be mainly responsible for the damage of Taj Mahal is **[JEE-Main 29-6-22_S1]**

(1) Sulfuric acid (2) Hydrofluoric acid (3) Phosphoric acid (4) Hydrochloric acid

28. Correct statement is : **[JEE-Main_24-1-23_S2]**

(1) An average human being consumes more food than air

(2) An average human being consumes nearly 15 times more air than food

(3) An average human being consumes equal amount of food and air

(4) An average human being consumes 100 times more air than food

29. Some reactions of NO_2 relevant to photochemical smog formation are

$$NO_2 \xrightarrow{\text{Sunlight}} \begin{matrix} X + Y \\ | \\ A \\ | \\ B \end{matrix}$$

Identify A, B, X and Y **[JEE-Main_25-1-23_S1]**

(1) X = [O], Y = NO, A = O_2, B = O_3

(2) X = N_2O, Y = [O], A = O_3, B = NO

(3) X = $\frac{1}{2}O_2$, Y = NO_2, A = O_3, B = O_2

(4) X = NO, Y = [O], A = O_2, B = N_2O_3

30. Correct statement about smog is **[JEE-Main_29-1-23_S1]**

(1) NO_2 is present in classical smog

(2) Both NO_2 and SO_2 are present in classical smog

(3) Photochemical smog has high concentration of oxidizing agents

(4) Classical smog also has high concentration of oxidizing agents

ANSWER KEY_ENVIRONMENTAL CHEMISTRY

1.	(1)	**2.**	(1)	**3.**	(3)	**4.**	(1)	**5.**	(2)
6.	(1)	**7.**	(3)	**8.**	(3)	**9.**	(1)	**10.**	(3)
11.	(2)	**12.**	(4)	**13.**	(1)	**14.**	(4)	**15.**	(4)
16.	(2)	**17.**	(3)	**18.**	(4)	**19.**	(3)	**20.**	(4)
21.	(3)	**22.**	(3)	**23.**	(3)	**24.**	(2)	**25.**	(1)
26.	(4)	**27.**	(1)	**28.**	(2)	**29.**	(1)	**30.**	(3)

MOLE CONCEPT

1. $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$

W_2 = 20g 5g.

$n = \frac{20}{28} \quad \frac{5}{2}$

Stoichiometric Amount:

$N_2 \rightarrow \frac{20/28}{1} = \frac{20}{28}$

$H_2 \rightarrow \frac{5/2}{3} = \frac{5}{6}$

$\therefore$ N_2 is the Limiting Reagent.

$\therefore n(NH_3) = 2 \times n(N_2) = 2 \times \frac{20}{28} = 1.42$

2. $C(S) + O_2(g) \rightarrow CO_2(g) + 400$ kJ

1 g mole

$C(s) + \frac{1}{2} O_2(g) \rightarrow CO(g) + 100$ kJ … (II)

$0.6 \times 1000 = 600$ gm

$600 \times \frac{60}{100}$ (Pure Carbon)

$= 360$ gm $= \frac{360}{12} = 30$mole (Pure Carbon)

Carbon converted into

$CO_2 = \left(30 - 30 \times \frac{60}{100}\right) = 12$ mole

and carbon converted in

$CO = 30 \times \frac{60}{100} = 18$ mole

Energy generated during II equation

$= 18 \times 100 = 1800$ kJ

Energy generated during Ist reaction.

$= 12 \times 400 = 4800$

Total = 1800 + 4800 = 6600 kJ

3. Let $n(SO_2Cl_2) = x$ moles

$\therefore n(H_2SO_4) = x$, $n(HCl) = 2x$

$\Rightarrow n(H^+) = 4x$

For Neutralisation

$\Rightarrow n(H^+) = n(OH^-)$

$\Rightarrow 4x = 16 \quad \Rightarrow x = 4$

4. Moles of $Fe_3O_4 = \frac{4.640 \times 10^3}{232} = 20$

Moles of CO $= \frac{2.52 \times 10^3}{28} = 90$

So limiting Reagent = Fe_3O_4

So moles of Fe formed = 60

Weight of Fe = 60 × 56 = 3360 gms

5. Let total volume = 1000 mL = 1 L

Total mass of solution = 1460 g

Mass of HCl $= \frac{35}{100} \times 1460$

Moles of HCl $= \frac{35 \times 1460}{100 \times 36.5}$

So molarity $= \frac{35 \times 1460}{100 \times 36.5} = 14M$

6. Assume : Mass of solvent ≈ Mass of solution

Case I :- $0.25 = \frac{W_1}{62} \times \frac{1000}{500}$

Case II :- $0.25 = \frac{W_2}{62} \times \frac{1000}{250} \quad \Rightarrow \frac{W_1}{W_2} = \frac{2}{1}$

7. 63% W/W HNO_3 solution having density 1.4 g/ mL i.e. 100 g solution has 63 g HNO_3

Volume of 100 g solution $= \frac{100}{1.4}$mL

$\therefore$ Molarity $= \frac{63 \times 1.4 \times 1000}{63 \times 100} = 14\,mol/L$

8. $N_2(g) + 3H_2(g) \longrightarrow 2NH_3(g)$

Number of moles of $N_2 = \frac{2.8 \times 10^3}{28} = 100$

Number of moles of $H_2 = \frac{1000}{2} = 500$

Number of moles of NH_3 produced = 200

Mass of NH_3 produced = 200 × 17 = 3400 gm

9. 1000 kg solvent has 3.3 moles of KCl

1000 kg solvent $\longrightarrow$ 3.3 × 74.5 gm KCl

$\longrightarrow$ 245.85

Weight of solution = 1245.85 gm

Volume of solution $= \frac{1245.85}{1.2}$ml

So molarity = $\frac{3.3\times1.2}{1245.85}\times1000 = 3.17$

10. $Na_2O + H_2O \rightarrow 2NaOH$

$\frac{20}{62}$moles $\Rightarrow$Moles of NaOH formed = $\frac{20}{62}\times2$

$$[NaOH] = \frac{\frac{40}{62}}{\frac{500}{1000}} = 1.29M = 13\times10^{-1}M$$

(Nearest integer)

11. $[H_2C_2O_4.2H_4O] = \frac{\text{weight}/M_W}{V(L)}$

$x\times10^{-2} = \frac{6.3/126}{250/1000} \Rightarrow x = 20$

12. Consider 1ℓ solution

mass of solution = (1.2 × 1000)g = 1200 gm

Neglecting volume of NaOH

Mass of water = 1000 gm

Mass of NaOH = (1200 – 1000)gm = 200 gm

Moles of NaOH = $\frac{200g}{40} = 5mol$

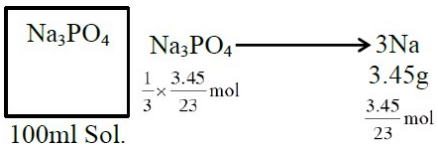
Molality = $\frac{5mol}{1kg} = 5m$

13. Moles of $CuSO_4\cdot5H_2O$ = $\frac{80}{249.54}$

Molarity = $\frac{\frac{80}{249.54}}{5} = 64.117\times10^{-3}$

Nearest integer, x = 64

14.



Therefore molarity of Na_3PO_4

Solution = $\frac{n_{Na_3PO_4}}{\text{volume of solution in L}}$

= $\frac{\frac{1}{3}\times\frac{3.45}{23}mol}{0.1L}$ = 0.5 = 50 × 10^{-2}

15. $M = \frac{4.5/90}{250/1000} = 0.2$ = 2 × 10^{-1}

16. $[Glucose] = \frac{C(gm/\ell)}{M(gm/mol)} = \frac{0.72}{180} = 4\times10^{-3}M$

17. $R(OH)_x \rightarrow H_2$ PoAC on H –

$$x\left(\frac{1.84\times10^{-3}}{92}\right) = \frac{1.344\times10^{-3}}{22.4}\times2$$

$$x = \frac{1.344\times2\times92\times1000}{1.84\times22400} = 6 \Rightarrow x = 6$$

18. $\underset{1mol}{X} + \underset{1mol}{Y} + \underset{0.05mol}{3Z} \rightleftharpoons XYZ_3$

Z is L.R

Mole of XYZ_3 = $\frac{0.05}{3}$

Mass of XYZ_3 = $\frac{0.05}{3}$ × (10+ 20+ 30×3) = 2g

19. Gives 0.7938 g CO_2 = 0.018 moles

0.4428g H_2O = 0.0246 moles

So moles of C = 0.018 $\Rightarrow$ 0.216 g

Moles of H = 0.049 $\Rightarrow$ 0.049g

$\therefore$ wt. of Oxygen = 0.492 – 0.216 – 0.049

= 0.227g

% of Oxygen = $\frac{0.227}{0.492}$ × 100 = 46 (approx.)

20. H_2SO_4 + 2NaOH $\rightarrow$ Na_2SO_4 + $2H_2O$

0.4 mol 0.2 mol –

0.3 mol – 0.1 mol

Molarity of Na_2SO_4 is $\frac{0.1}{4}$ = 0.025

M = 25 mM.

21. n_{HNO3} = 0.5 × 0.8 = 0.4 mole

$(n_{HNO_3})_{remains} = 0.4 - \frac{11.5}{63}$

= 0.4 – 0.1825 = 0.2175

Molarity = $\frac{0.2175}{400}\times1000$

= $\frac{0.2175}{0.4}$ = 0.5437 mole/lit.

$\simeq$ 0.54 mole/lit. = 54 × 10^{-2} mol/lit.

22. O.C $\longrightarrow$ AgBr

0.5g 0.4g

mol of Br = mol of AgBr = $\frac{0.4}{188}$

$$\% \text{ Br} = \%\text{Br} = \frac{\frac{0.4}{188}\times 80}{0.5}\times 100 \quad = 34.04\%$$

23. $C_xHyOz + \left(x + \frac{y}{4} - \frac{z}{2}\right)O_2 \rightarrow xCO_2 + \frac{y}{2}H_2O$

0.3g 0.2g .1g

$$\frac{n_{CO_2}}{n_{H_2O}} = \frac{x}{y/2} = \frac{0.2/44}{.1/18} \Rightarrow \frac{2x}{y} = \frac{36}{44} = \frac{9}{11}$$

$$x = \frac{9y}{22} \Rightarrow \frac{n_{C_xH_yO_z}}{nCO_2} = \frac{1}{x}$$

$$\frac{0.3}{12x + y + 16z}\times\frac{44}{0.2} = \frac{1}{x}$$

66x = 12 x + y + 16 z

54x = y + 16 z

$$\frac{54\times 9y}{22} - y = 16z$$

$$\frac{464y}{22} = 16z \quad \Rightarrow \quad z = \frac{29y}{22}$$

$C_xH_yO_z = C_xH_yO_z$

$C_{\frac{9y}{22}}H_yO_{\frac{29y}{22}} \Rightarrow C_9H_{22}O_{29} \Rightarrow$ % of

$$C = \frac{12\times 9}{(12\times 9 + 22 + 29\times 16)}\times 100 = \frac{108}{594}\times 100$$

18.18%

24. wt. of organic compound = 0.25 g

$$\text{mass of Cl} = \frac{35.5}{143.5}\times 0.4\text{g}$$

= 0.098

mass % of Cl in the organic compound

$$= \frac{0.098}{0.25}\times 100\% = 39.58\%$$

25. Mole of CO_2 = Moles of C = $\frac{0.793}{44}$

$$\text{Weight of 'C'} = \frac{0.793}{44}\times 12 = 0.216\,\text{gm}$$

$$\text{Moles of 'H'} = \frac{0.442}{18}\times 2$$

$$\text{Weight of 'H'} = \frac{0.442}{18}\times 2\times 1 = 0.049\,\text{gm}$$

∴ Weight of 'O' = 0.492–0.216–0.049

= 0.227 gm

$$\% \text{ of 'O'} = \frac{0.227}{0.492}\times 100 = 46.13\%$$

26. 0.30 % glycine is equal to 75

$$1\% \longrightarrow \frac{75}{0.30}$$

$$100\% \longrightarrow \frac{75}{0.30}\times 100 = 25000\text{g}$$

27. M.M of $C_7H_5N_3O_6$ is 84 + 5 + 42 + 96 = 227

$$n_{C_7H_5N_3O_6} = \frac{681}{227} = 3 \Rightarrow \quad n_N = \frac{681}{227}\times 3 = 9 \text{ mol}$$

no. of N atoms = $9 \times 6.02 \times 10^{23}$

= 5418×10^{21}

∴ The answer is 5418

28. $n_{H_2SO_4}$ in Sol^n A = 50% of original solution

= 0.01 m mol.

$n_{H_2SO_4}$ in Final solution = 0.01 + 0.01

= 0.02 mmol

= 0.00002×10^3 mmol

The answer 0

29. Let M is the molar mass of the compound (g/mol)

mass of compound = 0.01 M gm

$$\text{mass of carbon} = 0.01\,\text{M}\times\frac{60}{100}$$

$$\text{moles of carbon} = \frac{0.01\,\text{M}}{12}\times\frac{60}{100}$$

$$\text{moles of } CO_2 \text{ from combustion} = \frac{4.4}{44} = \text{moles}$$

of carbon

$$\frac{0.01\text{M}}{12}\times\frac{60}{100} = \frac{4.4}{44}$$

$$\text{M} = \frac{4.4}{44}\times\frac{100}{60}\times\frac{12}{0.01} = 200\,\text{gm/mol}$$

30.

Element	Percentage	Mole	Mole ratio
C	85.8	$\frac{85.8}{12} = 7.15$	1
H	14.2	$\frac{14.2}{1} = 14.2$	2

Empirical formula (CH_2)

$14 \times n = 84 \quad \Rightarrow n = 6$

∴ Molecular formula C_6H_{12}

SOLID STATE + ATOMIC STRUCTURE

1. Quartz exhibits piezoelectricity. It is fact based.

2. Density = $\frac{z(M_0)}{N_A x a^3}$

Z = 4 (FCC)

M_0 = 63.5 g

$N_A = 6 \times 10^{23}$

a = x × 10–8 cm.

$$\therefore\ d = \frac{4 \times 63.5}{6 \times 10^{23} \times x^3 \times 10^{-24}}; \frac{422}{x^3}\frac{g}{cm^3}$$

3. A_2B_3 can be written as $\Rightarrow A_4B_6$

H.C.P has Six atom so 'B' form

H.C.P lattice and A is present in void.

Total tetrahedral void = 12

Fraction of tetrahedral void occupied by

A = 4/12 = 1/3

4. For BCC

$$\sqrt{3}\,a = 4R \quad \Rightarrow \quad R = \frac{\sqrt{3}a}{4}$$

$\therefore$ Empty space at edge = a – 2R

$$= a - \frac{\sqrt{3}a}{2} = \text{diameter of sphere.}$$

$$\therefore\ r_{sphere} = \frac{a - \frac{\sqrt{3}}{2}a}{2} = \left(\frac{2-\sqrt{3}}{4}\right)a$$

5. Volume occupied by atoms in solid 2

$$= \frac{4}{3}\pi r^3 + \frac{4}{3}\pi(2r)^3 = 12\pi r^3$$

relationship between edge length (a) and radius of atom (r) in solid 2

$$= 6r = \sqrt{3}\,a \Rightarrow a = \frac{6r}{\sqrt{3}}$$

$$\text{Packing efficiency} = \frac{12\pi r^3}{\left(\frac{6r}{\sqrt{3}}\right)^3} \times 100 = 90\%$$

6. AgBr shows both, Frenkel as well as Schottky defects.

7. $M_{12\times\frac{2}{3}}A_6$

M_8A_6

M_4A_3

8. Hence given assertion (A) is correct

But reason (B) is correct

9. $a \neq b \neq c$ and $\alpha = \gamma = 90^\circ \neq \beta$

are parameters of monoclinic unit cell.

10. Theory based.

11. Due to vacancy defect density of the substance will decrease.

12. Shortest wavelength means n2 = ∞

Lyman series $\bar{\nu}_L = \frac{1}{\lambda_L} = -1312 \times \frac{1}{1^2} \times 1^2$

Paschen series $\bar{\nu}_P = \frac{1}{\lambda_P} = -1312 \times \frac{1}{3^2} \times 1^2$

$$\frac{\bar{\nu}_L}{\bar{\nu}_P} = \frac{\lambda_P}{\lambda_L} = 9$$

13. Energy in nth state as per Bohr's model

$$= -13.6 \times \frac{Z^2}{n^2}\text{eV}$$

$\therefore$ 2^{nd} excited state $\Rightarrow$ n = 3

$$\therefore\ E_{3'He} = -13.6 \times \frac{2^2}{3^2}\text{eV} = -6.04\ \text{eV}$$

14. Atomic numbers of N, O, F and Na are 7, 8, 9 and 11 respectively. Therefore, total number of electrons in each of N^{3-}, O^{2-}, F^- and Na^+ is 10 and hence they are isoelectronic.

15. According to Bohr's model

$r_n = \frac{n^2}{Z} \times a_0$ (a_0 = 1st Bohr radius)

$\because$ $2\pi r = n\lambda$ (using de –Broglie relation)

$$\Rightarrow \quad 2\pi \times \frac{4^2}{1} \times a_0 = 4\lambda$$

$$\Rightarrow \quad \boxed{\lambda = 8\pi a_0}$$

16. Cs is used as electrodes in the photoelectric cell.

17. $\mu = \sqrt{n(n+2)}BM$

$Ti^{+3} = [Ar]3d^1$ n = 1 μ = 1.73 BM

$V^{+2} = [Ar]3d^3$ n = 3 μ = 3.87 BM

$Sc^{+3} = [Ar]3d^0 4s^0$ n = 0 μ = 0

18. (A) Cr = $[Ar]3d^5\ 4s^1$

(B) m = $-\ell$ to + ℓ

(C) According to Aufbau principle, orbitals are filled in order of their increasing energies.

(D) Total nodes = n – 1

19. Energy order of subshell decided by

(n + ℓ) rule.

A $\Rightarrow$ 3d $\Rightarrow$ n + *l* = 5

B $\Rightarrow$ 4 p $\Rightarrow$ n + *l* = 5

C $\Rightarrow$ 4d $\Rightarrow$ n + *l* $\Rightarrow$ 6

D $\Rightarrow$ 3p $\Rightarrow$ (n+ *l*) = 4

D < A < B < C

20. According to Henry Moseley $\sqrt{v} \propto z - b$

So $n = \frac{1}{2}$

21. For H : $\frac{1}{\lambda} = R_H \times 1^2\left(\frac{1}{1^2} - \frac{1}{\infty^2}\right)$ .....(1)

$\frac{1}{\lambda_{He^+}} = R_H \times 2^2 \times \left(\frac{1}{4} - \frac{1}{9}\right)$ .....(2)

From (1) & (2) $\frac{\lambda_{He^+}}{\lambda} = \frac{9}{5}$

$\lambda_{He^+} = \lambda \times \frac{9}{5} \Rightarrow \lambda_{He^+} = \frac{9\lambda}{5}$

22. For BCC $\sqrt{3}$ a = 4r

so $r = \frac{\sqrt{3}}{4} \times 27$

or FCC a = $2\sqrt{2}$r

$= 2 \times \sqrt{2} \times \frac{\sqrt{3}}{4} \times 27 = \frac{\sqrt{3}}{\sqrt{2}} \times 27 = 33$

23. HCP Structure : Per atom, there will be one octahedral void (OV) and two tetrahedral voids (TV).

Therefore total three voids per atom are present in HCP structure.

$\rightarrow$ therefore total no of atoms of Ga will be-

$= \frac{\text{Mass}}{\text{Molar Mass}} \times N_A = \frac{0.581g}{70g/mol} \times 6.023 \times 10^{23}$

$\rightarrow$ Now, total Number of voids = 3× total no. of atoms

$= 3 \times \frac{0.581}{70} \times 6.023 \times 10^{23} = 14.99 \times 10^{21}$

$\simeq 15 \times 10^{21}$

24. Anions froms CCP or FCC (A^-) = 4 A^- per unit cell Cations occupy all octahedral voids (B^+) = 4 B^+ per unit cell cell formula $\rightarrow$ A_4B_4 Empirical formula $\rightarrow$ AB $\rightarrow$ (x = 1)

25. n = 4 and $m_\ell = -3$

Now, number of radial nodes = n – l – 1

= 4 – 3 – 1 = 0

26. Total energy per sec. = 50 J

$50 = \frac{n \times 6.63 \times 10^{-34} \times 3 \times 10^8}{795 \times 10^{-9}}$

n = 1998.49 × 10^{17} [n = no. of photons per second]

= 1.998 × 10^{20}

$\simeq 2 \times 10^{20} = x \times 10^{20}$

x = 2

27. $A \rightarrow 4 - \left(2 \times \frac{1}{2}\right) = 3 \Rightarrow B \rightarrow 12 \times \frac{1}{4} + 1 \times 1 = 4$

So, Compound is A_3B_4

The value of x is 3.

28. One unit cell of hcp contains = 18 voids

No. of voids in 0.02 mol of hcp

$= \frac{18}{6} \times 6.02 \times 10^{23} \times 0.02$

$\approx 3.6 \times 10^{22}$

$\approx 36 \times 10^{21}$

29. p_x, p_y, p_z, d_{z^2} & $d_{x^2-y^2}$ are axial orbitals.

30. $r \propto \frac{n^2}{Z} \Rightarrow r_{He^+} = r_H \times \frac{n^2}{Z}$

$r_{He^+} = 0.6 \times \frac{(3)^2}{2}$ = 2.7 Å

$r_{He^+} = 270pm$

PERIODIC TABLE

1. There is a sudden jump after 3rd I.E. due to attainment of noble gas configuration. So, the number of valence electrons in this element are 3.

2. 1st I.E. of Be > B

In case of Be, electron is removed from 2s orbital which has more penetration power, while in case of B electron is removed from 2p orbital which has less penetration power.

2p electron of B is more shielded from nucleus by the inner electrons than 2s electrons of Be

$\therefore$ It is easier to remove 2p electron than 2s electron.

3. Atomic radius decreases on moving left to right in periodic table, while other three properties given increases (in magnitude) on moving left to right across a period.

4. Ionisation energy of elements belonging to period III in general increases as we move from left to right with the exception of Group-2 and Group-15 elements due to their stable configuration. The increasing order of first ionisation energy of the given elements is

Na < Al < Mg < Si

Ionisation energy of the given metals are

Na : 496 kJ/mol ; Al : 577 kJ/mol

Mg : 737 kJ/mol ; Si : 786 kJ/mol

5. From left to right in periodic table :-

Metallic character decreases

Non-metallic character increases

$\Rightarrow$ It is due to increase in ionization enthalpy and increase in electron gain enthalpy.

6. Mg Al P S $\rightarrow$ IE. order

$\Rightarrow$ Al< Mg < S < P

$$\text{Valence } [N_e]: \overset{Mg}{3s^2} \quad \overset{Al}{3s^2 3p^1} \quad \overset{P}{3s^2 3p^3} \quad \overset{S}{3s^2 3p^4}$$

$\uparrow$ Full Filled Stable

$\uparrow$ Half Filled Stable

7. Fe^{3+} [Ar] $3d^5$

8. Group 16/oxygen family is known as Chalcogens the members are O, S, Se, Te, Po

9. $P^{3-} > S^{2-} > Cl^- > K^+ > Ca^{2+}$

(Correct order of ionic radii)

all the given species are isoelectronic species. In isoelectronic species size increases with increase of negative charge and size decreases with increase in positive charge.

10. Al^{3+}, Mg^{2+} and Na^+ are isoelectronic ionic species.

For monoatomic ionic isoelectronic species as positive charge increases ionic size decreases.

The order of size of Na^+ & K^+ is $Na^+ < K^+$,

$\therefore$ order of ionic radii is : $Al^{3+} < Mg^{2+} < Na^+ < K^+$

11. The 1st IE order of 3rd period is

Na < Al < Mg < Si < S < P < Cl < Ar

X & Y are Ar & Cl

Z is sodium (Na)

12. The ionic radii order is

$Na^+ > Mg^{2+} > Al^{3+}$

13. F^-, O^{2-} and N^{3-} all are isoelectronic species in which N^{3-} have least number of protons due to which it's size increases as least nuclear attraction is experienced by the outer shell electrons. Size order $N^{3-} > O^{2-} > F^-$

14. $X = {}_{33}As \rightarrow$ Metalloid

$Y = {}_{53}I \rightarrow$ Nonmetal

$Z = {}_{83}Bi \rightarrow$ Metal

15. Li–Mg, B–Si, Be–Al show diagonal relationship but Li and Na do not show diagonal relationship as both belongs to same group and not placed diagonally.

16. Cr (Z = 24)

[Ar] $4s^1 3d^5$ Cr shows common oxidation states starting from +2 to +6.

17. Order of electron gain enthalpy

(Absolute value)

Cl > F > Br > I

18. (a) $1s^2\ 2s^2 \rightarrow$ Be

(b) $1s^2\ 2s^2\ 2p^4 \rightarrow$ O

(c) $1s^2\ 2s^2\ 2p^3 \rightarrow$ N

(d) $1s^2\ 2s^2\ 2p^1 \rightarrow$ B

The ionization enthalpy order is

B < Be < O < N

Be has more IE compared to B due to extra stability & N has more IE compared to oxygen due to extra stability

Hence, N $\rightarrow$ 1402 kJ/mol

O $\rightarrow$ 1314 kJ/mol

B $\rightarrow$ 801 kJ/mol

Be $\rightarrow$ 899 kJ/mol

19. Ionization enthalpy order :

Li > Na > K

He > Ne > Ar > Kr > Xe > Rn

Sr > Rb

Zn > Ga

20. Rb and Cs have nearly same electron gain enthalpy electron gain enthalpy = –46 kj/ml

Ar and Kr have same ΔH_{eq} Value is + 96 kj/ml

21. I. E : Na < Al < Mg < Si

$\therefore$ 496 < IE (Al) < 737

Option (C), matches the condition,

i.e IE(Al) = 577 kJ mol^{-1}

22. E $\Rightarrow$ [Ar] $3d^{10}\ 4s^2\ 4p^4$

Element above E $\Rightarrow$ [Ne] $3s^2\ 3p^4$

23. 1st I.E. $\underset{(2p^3)}{N} > \underset{(2p^4)}{O} > \underset{(2s^2)}{Be} > \underset{(2p^1)}{B}$

24. Atomic Number 103

25. $3s^2 \rightarrow$ Mg (B) $3s^2 3p^1 \rightarrow$ Al

(C) $3s^2 3p^3 \rightarrow$ P (D) $3s^2 3p^4 \rightarrow$ S

$\underbrace{P > S}_{\text{Half filled stability}} > \underbrace{Mg > Al}_{\text{Penetrating power of s > p}}$

C > D > A > B.

26. Ionic radius of O^{2-} is more than that of Mg^{2+} Both O^{2-} and Mg^{2+} are isoelectronic with 10 electrons

27. The first ionization energies (as in NCERT) are as follows:

B : 801 kJ/mol

Al : 577 kJ/mol

Ga : 579 kJ/mol

Ga : $[Ar]3d^{10}4s^2 4p^1$

28. (i), (ii) and (iv) correct.

Manganese exhibits +7 oxidation state in its oxide.

(Mn_2O_7)

Ru & Os from RuO_4 & OsO_4 oxide in +8 oxidation state

Cr in +6 oxidation act is oxidizing.

Sc does not show +4 oxidation state.

29. Unnilunium

IUPAC symbol = Unu

Atomic no. (Z) = 101

30. The electronic configuration of

${}_{64}Gd$: [Xe] $4f^7\ 5d^1\ 6s^2$

So the electronic configuration of

${}_{64}Gd^{2+}$: [Xe] $4f^7\ 5d^1\ 6s^0$

i.e. the number of 4f electrons in the ground state

electronic configuration of Gd^{2+} is 7.

CHEMICAL BONDING

1. H_2^{2-} have bond order zero

$\therefore$ do not exist

$H_2^{2-} \longrightarrow \sigma 1S^2,\ \sigma^*1S^2$, B.O. = $\frac{2-2}{2} = 0$

2. N_2 Diamagnetic $\rightarrow N_2^+$ (Paramagnetic)

O_2 Paramagnetic $\rightarrow O_2^+$ (Paramagnetic)

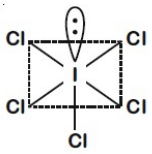
O_2 Paramagnetic $\rightarrow O_2^{2-}$ (Diamagenetics but bond order decreases from 2 to 1)

NO (Paramagnetic $\rightarrow$ NO^+ (Diamagnetic, bond order bond order 2.5) 3)

3. C_2 has s-p mixing and the HOMO is $\pi 2p_x = \pi 2p_y$ and LUMO is $\sigma 2p_z$. So, the extra electron will occupy bonding molecular orbital and this will lead to an increase in bond order.

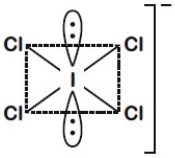
C_2^- has more bond order than C_2.

4. ICl_5 is sp^3d^2 hybridised (5 bond pairs, 1 lone pair)



square pyramidal

ICl_4^- is sp^3d^2 hybridised (4 bond pairs, 2 lone pairs)



square planar

5. $[XeF_5]^-$ is Pentagonal planar

XeO_3F_2 is trigonal Pyramidal.

6. Type of back bonding

BF_3 BCl BBr_3 BI_3

(2pπ–2pπ) (2pπ–3pπ) (2pπ–4pπ) (2pπ–5pπ)

Therefore back bonding strength is as follows

BF_3 > BCl > BBr_3 > BI_3

7. (a) SF_4 – sp^3d hybridisation

(b) IF_5 – sp^3d^2 hybridisation

(c) NO_2^+ – sp hybridisation

(d) NH_4^+ – sp^3 hybridisation

8. Diborane is prepared by the reaction of $NaBH_4$ with I_2.

$2NaBH_4 + I_2 \rightarrow B_2H_6 + 2NaI + H_2$

In diborane, 'B' is sp^3 hybrid, it is Non-planar and two 3c–2e$^-$ bonds are present.

9. O_2 (16 electrons)

$\sigma_{1s}^2, \sigma_{1a}^{*2}, \sigma_{2s}^2, \sigma_{2s}^{*2}, \sigma_{2p_z}^2$

$\pi_{2p_x}^2 = \pi_{2p_y}^2, \pi_{2p_x}^{*1} = \pi_{2p_y}^{*1}, \sigma_{2p_z}^*$

Bond order of $O_2 \Rightarrow 2$

Bond order of $O_2^- \Rightarrow 1.5$

Bond order of $O_2^{2-} \Rightarrow 1$

Bond order of $O_2^+ \Rightarrow 2.5$

10. Species must not contain single unpaired (1)

$O_2^+ \rightarrow \sigma_{1s}^2 < \sigma_{1s}^{*2} < \sigma_{2s}^2 < \sigma_{2s}^{*2} < \sigma_{2pz}^2 < \pi_{2px}^2$

$= \pi_{2py}^2 < \pi_{2px}^{*1} = \pi_{2py}^*$

unpaired $e^- = 1$ $\therefore$ $\mu = 1.73$ BM

(1) $Cu^+I^-\ Cu^+ \rightarrow [Ar]3d^{10}$

$\therefore$ unpaired $e^- = 0$

$I^- \rightarrow$ [Xe] $\therefore$ unpaired $e^- = 0$

Therefore $\mu = 0$

3. $[Cu(NH_3)_4]Cl_2$

$Cu \rightarrow [Ar]\ 3d^3$ $Cu^{+2} = [Ar]3d^1$

$\therefore$ unpaired = 1 $\therefore$ $\mu = 1.73$ BM

4. $O_2^- \rightarrow$ d

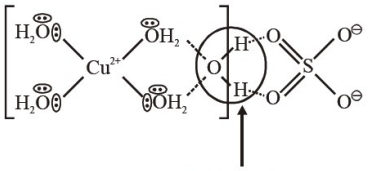
$\sigma_{1s}^2 < \sigma_{1s}^{*2} < \sigma_{2s}^2 < \sigma_{2s}^{*2} < \sigma_{2px}^2 < \pi_{2px}^2$

$= \pi_{2py}^2 < \pi_{2px}^{*2} = \pi_{2py}^{*1}$

(1unpaired e^-)

$\therefore$ unpaired $\therefore$ $\mu = 1.73$ BM

11.



Hydrogen bonded water molecule = 1
Secondary valency = 4

12. The oxidation states of Nitrogen in following molecules are as follows

$NO_3^- \rightarrow +5$

$NO_2 \rightarrow +4$

$NO \rightarrow +2$

$N_2O \rightarrow +1$

13. (a) Hypophosphorus acid : $H_3\underline{P}O_2$

$(+1)\,3 + x + (-2)\,2 = 0$

$x = +1$

(b) Orthophosphoric acid : $H_3\underline{P}O_4$

$(+1)\,3 + x + (-2)4 = 0$

$x = +5$

(c) Hypophosphoric acid : $H_4P_2O_6$

$(+1)\,4 + 2x + (-2)\,6 = 0$

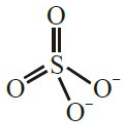
$x = +4$

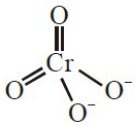
(d) Orthophosphorous acid : H_3PO_3

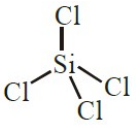
$(+1)\,3 + x + (-2)\,3 = 0$

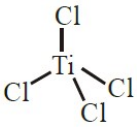
$x = +3$

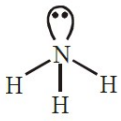
14. Isostructural means same structure

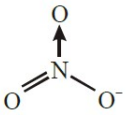
(A) SO_4^{2-}  : Tetrahedral

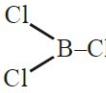
CrO_4^{2-}  : Tetrahedral

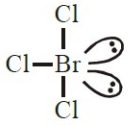
(B) $SiCl_4$  : Tetrahedral

$TiCl_4$  : Tetrahedral

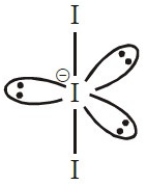
(C) NH_3  : Triagonal pyramidal

NO_3^-  : Triagonal planar

(D) BCl_3  : Triagonal planar

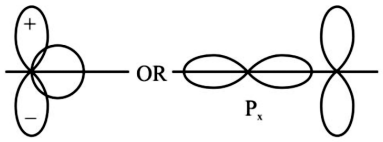
$BrCl_3$  : T-shape

15.



Shape : Linear, I–I–I Bond angle $\Rightarrow$ 180°

16.



Zero overlapping

Zero overlapping due to improper orientation of orbitals

17. **(A)** $BCl_3 \rightarrow$ Even Electron molecule

$SF_6 \rightarrow$ Expanded octet molecule

(B) $NO \rightarrow$ Odd Electron molecule

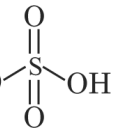
$H_2SO_4 \rightarrow$ Expanded octet.

(C) $SF_6 \rightarrow$ Even Electron molecule

$H_2SO_4 \rightarrow$ Expanded octet.

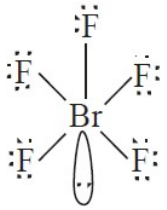
(D) $BCl_3 \rightarrow$ Even Electron molecule

$NO \rightarrow$ Odd Electron molecule

$\ddot{N} = \ddot{O}:$ and 

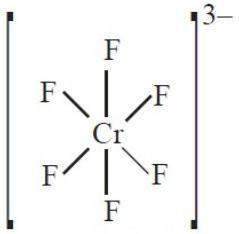
$S \rightarrow 12e^-$ in outer orbit.

18.



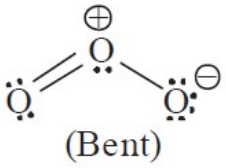
(Square pyramidal)

$[CrF_6]^{3-}$:



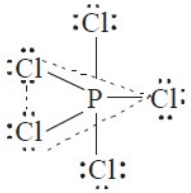
(Octahedral)

O_3 :

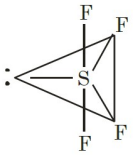


(Bent)

PCl_5 :

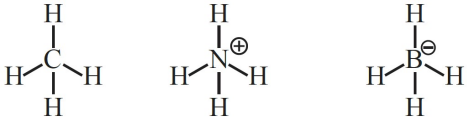


(Trigonal bipyramidal)

19. 

sp^3d, See-Saw

20. In PCl_5, axial bonds are weaker than equatorial.

21. 

All are tetrahedral and each have 10 electrons.

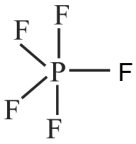
22. Theory based.

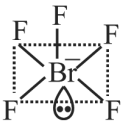
23. $Li_2O \rightarrow O^{2-} \rightarrow$ diamagnetic

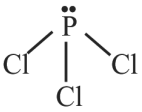
$Na_2O_2 \rightarrow O_2^{2-} \rightarrow$ diamagnetic

$KO_2 \rightarrow O_2^{-} \rightarrow$ paramagnetic

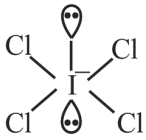
24. Square pyramidal structures are BrF_5, IF_5 and ClF_5.

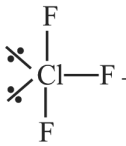
25.  F → sp^3d Hybridisation

 → sp^3d^2 Hybridisation

 → sp^3 Hybridisation

 → sp^3d^2 Hybridisation

 → sp^3d^2 Hybridisation

 → sp^3d Hybridisation

 → sp^3d^2 Hybridisation

26. KO_2, NO_2, ClO_2, NO are paramagnetic.

27. Paramagnetic $B_2, C_2^-, O_2^+, He_2^+$

28.

SO_3	—	sp^2	Planar
BF_3	—	sp^2	Planar
NO_3	—	sp^2	Planar
SF_4	—	sp^3d	Non-planar
H_2O_2	—	sp^3	Non-planar
PCl_3	—	sp^3	Non-planar
$[Al(OH)_4]^-$	—	sp^3	Non-planar
XeF_4	—	sp^3d^2	Planar
XeO_3	—	sp^3	Non-planar
PH_4^+	—	sp^3	Non-planar

29. BeF_2, BF_3 and $CCl_4 \Rightarrow \mu_{net} = 0$

H_2O, NH_3 and $HCl \Rightarrow \mu_{net} \neq 0$

30. Acidic oxides are N_2O_3, NO_2, Cl_2O_7, SO_2

EQUIVALENT CONCEPT + GASEOUS STATE

1. More easily liquefiable a gas is (i.e. having higher critical temperature), the more readily it will be adsorbed.

$\therefore$ Least adsorption is shown by H_2 (least critical temperature)

2. $PM = dRT \quad \Rightarrow \quad d \propto \frac{1}{T} \quad \Rightarrow \quad d \propto P$

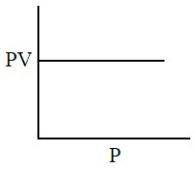
3. The redox reaction is

$$N_2 + O_2 \overset{2000K}{\rightleftharpoons} 2NO$$

Nitrogen is oxidised while oxygen is reduced. Reaction of $[CO(H_2O)_6]Cl_3$ with $AgNO_3$ is not redox reaction. It is a precipitation reaction.

4. PV = nRT (n,T constant)

PV = constant



5. $2KMnO_4 + 16HCl \rightarrow 2MnCl_2 + 2KCl + 8H_2O + Cl_2$

HCl gets oxidised by $KMnO_4$ into Cl_2

6. $\overset{+7}{8}MnO_4^- + 3S_2O_3^{2-} + H_2O \rightarrow \overset{+4}{8}MnO_2 + 6SO_4^{2-} + 2OH^-$

Change in oxidation state of Mn is from +7 to +4 which is 3.

7. $2H_2\overset{-1}{O}_2 \longrightarrow 2H_2\overset{2-}{O} + \overset{0}{O}_2$: Disproportionation

$2\overset{+4}{N}O_2 + H_2O \longrightarrow H\overset{+5}{N}O_3 + H\overset{+3}{N}O_2$:

Disproportionation

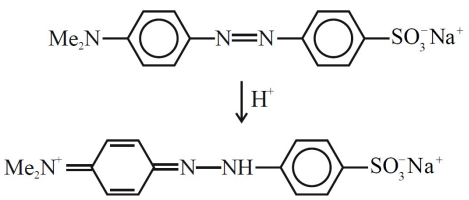
$MNO_4^- + 4H^+ + 3e^- \rightarrow MnO_2 + 2H_2O$

: reduction

$3\overset{+6}{M}nO_4^{2-} + 4H^+ \rightarrow 2\overset{+7}{M}nO_4^- + \overset{+4}{M}nO_2 + 2H_2O$

: Disproportionation

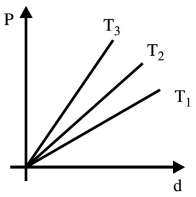
8.



(QUINONOID FORM)

9. P vs d :

$$P = \left(\frac{RT}{M}\right)d$$



$T_3 > T_2 > T_1$

10.

$$I^- + H_2O_2 \longrightarrow \underset{(A)}{I_2} + H_2O$$

$$I_2 + \underset{(Indicator)}{Starch} \longrightarrow Blue$$

11. For 1 mole of real gas

PV = ZRT

from graph PV for real gas is less than PV for ideal gas at point A

Z < 1

$$Z = 1 - \frac{a}{V_m RT}$$

12. Molarity of H_2O_2 solution = 8.9 M

Volume strength of H_2O_2 solution

$= 8.9 \times 11.2 \simeq 100$ V

13. $\text{Normality} = \frac{\text{No. of equivalents of solute}}{\text{Volume of solution(inL)}}$

$$0.1 = \frac{1.43}{\frac{(106+18x)}{2} \times 0.1}$$

$$\Rightarrow \quad \frac{106+18x}{2} = 143$$

$$\Rightarrow \quad 18x = 286 - 106 = 180$$

$$x = 10$$

14. $5H_2O_2 + 2MnO_4^- + 6H^+ \rightarrow 2Mn^{2+} + 5O_2 + 8H_2O$

Moles of $KMnO_4$ = $\frac{0.316}{158} = 2\times10^{-3}$

Equivalents of H_2O_2 = Equivalent of $KMnO_4$

$= 2 \times 10^{-3} \times 5 = 0.01$

Moles of H_2O_2 = $\frac{0.01}{2} = 0.005$

Mass of pure $H_2O_2 = 0.005 \times 34 = 0.170$ gm

Percentage purity = $\frac{0.17}{0.2}\times100 = 85\%$

15. $n_{eq}\, Fe^{2+} = n_{eq}\, Cr_2O_7^{2-}$

or, $\left(\frac{15\times M_{Fe^{2+}}}{1000}\right)\times1 = \left(\frac{20\times0.03}{1000}\right)\times6$

$\therefore\ M_{Fe^{2+}} = 0.24M = 24\times10^{-2}\,M$

16. Most precise volume of HCl = 5 ml

at equivalence point

Meq. of Na_2CO_3 = meq. of HCl

Let molarity of Na_2CO_3

solution = M, then

$M \times 10 \times 2 = 0.2 \times 5 \times 1$

$= 0.05 \times 1000$

= 50 mM

17. milli-equivalents of Fe^{2+}

= milli-equivalents of $K_2Cr_2O_7$

$M \times 10 \times 1$

$= 0.02 \times 15 \times 6$

$M = 0.18$

$= 18 \times 10^{-2}$ M

18. n_{eq} $KMnO_4$ = neq $H_2C_2O_4$. $2H_2O$

or, $\frac{10\times0.05}{1000}\times5 = \frac{10\times M}{1000}\times2$

$\therefore$ Conc. of oxalic acid solution

$= 0.125$ M

$= 0.125 \times 126$ g /L = 15.75 g/L

$= 1575 \times10^{-2}$ g/L

19. Let molarity of $KMnO_4$ = x

$KMnO_4 + FeSO_4 \rightarrow Fe_2(SO_4)_3 + Mn^{2+}$

n = 5 n = 1

(Equivalents of $KMnO_4$ reacted)

= (Equivalents of $FeSO_4$ reacted)

$\Rightarrow$ (5 × x × 10 ml) = 1 × 0.1 × 10 ml

$\Rightarrow$ x = 0.02 M

Molar mass of $KMnO_4$ = 158 gm/mol

$\Rightarrow$ Strength = (x × 158) = 3.16 g/ℓ

20. Applying ; $(n_I + n_{II})_{initial} = (n_I + n_{II})_{final}$

$\Rightarrow$ Assuming the system attains a final temperature of T (such that 300 < T < 60)

$\Rightarrow \begin{pmatrix}\text{Heat lost by}\\ N_2 \text{ of container}\\ I\end{pmatrix} = \begin{pmatrix}\text{Heat gained by}\\ N_2 \text{ of container}\\ II\end{pmatrix}$

$\Rightarrow n_I C_m\,(300–T) = n_{II}\, C_m\,(T–60)$

$\Rightarrow \left(\frac{2.8}{28}\right)(300-T) = \frac{0.2}{28}(T-60)$

$\Rightarrow 14(300–T) = T–60$

$\Rightarrow \frac{(14\times300+60)}{15} = T$

$\Rightarrow$ T = 284 K (final temperature)

$\Rightarrow$ If the final pressure = P

$\Rightarrow (n_I + n_{II})_{final} = \left(\frac{3.0}{28}\right)$

$\Rightarrow \frac{P}{RT}(V_I + V_{II}) = \frac{3.0gm}{28gm/mol}$

$P = \left(\frac{3}{28}mol\right)\times8.31\frac{J}{mol-K}\times\frac{284K}{3\times10^{-3}m^3}\times10^{-5}\frac{bar}{Pa}$

$\Rightarrow$ 0.84287 bar

$\Rightarrow$ 84.28×10^{-2} bar

$\Rightarrow$ 84

21. $\frac{P_1}{T_1} = \frac{P_2}{T_2} \Rightarrow \frac{300\times10^3}{300} = \frac{1.2\times10^6}{T_2}$

$\Rightarrow$ T_2 = 1200 K

T_2 = 927°C

22. $Z + 1 + \frac{Pb}{RT}$

$\left(\frac{\partial Z}{\partial P}\right)_T = 0 + \frac{b}{RT}\times1$

23. Given Mass = 4.75 g $\Rightarrow C_2H_2(g)$

$\Rightarrow$ Moles $= \frac{4.75}{26}$ mol

Temp = 50 + 273 = 323 K

$P = \frac{740}{760}$ atm

$R = 0.0826 \frac{\ell atm}{molK}$

$\Rightarrow V = \frac{nRT}{P} = \frac{4.75}{26} \times \frac{0.0826 \times 323}{\left(\frac{740}{760}\right)}$

$\Rightarrow V = \frac{96314.078}{19240} = 5.0059\,\ell \simeq 5\ell$

24. No. of equivalents of

$H_2SO_4 = 100 \times 0.1 \times 2 = 20$

No. of equivalents of NaOH = 50 × 0.1 = 5

No. of equivalents of H_2SO_4 left = 20 – 5 = 15

$\Rightarrow$ 150 × x = 15

$x = \frac{1}{10} = 0.1N = 1 \times 10^{-1}N$

25. Eq. of $K_2Cr_2O_7$ = Eq. of Fe^{2+}

$\Rightarrow$ (Molarity × volume × n.f) of $K_2Cr_2O_7$

= (molarity × volume × n.f) of Fe^{2+}

$\Rightarrow$ 0.02 × 20 × 6 = M × 10 × 1

$\Rightarrow$ M = 0.24

$\Rightarrow$ Molarity = 24 × 10^{-2}

26. $N_1V_1 = N_2V_2$

$0.01 \times 5 \times V_1 = 0.05 \times 1 \times 20$

V_1 = 20 ml used

$\therefore$ Volume left = 50 – 20 = 30 ml

27. $MnO_2 + HCl \longrightarrow Cl_2 + Mn^{+2}$

6 meq 6 meq

= 3m mol

$Cl_2 + KI \longrightarrow Cl^- + I_2$

6meq 6meq

= 6meq

$\%MnO_2 = \frac{3 \times 10^{-3} \times 87}{2} \times 100$

= 13.05%

28. $n_{eq.}$ of I_2 = n_{eq} of $Na_2S_2O_3$ = 20 × 0.002 × 1

2 × n_{mol} of I_2 = 0.4

n_{mol} of I_2 = 0.2 m mol

n_{mol} of Cu^{+2} = 0.2 × 2 × 10^{-3}

$[Cu^{+2}] = \frac{0.4 \times 10^{-3}}{10 \times 10^{-3}} = 0.04 = 4 \times 10^{-2}$

29. PV = n_{mix} RT

$n_{mix} = \frac{6 \times 12.5}{0.083 \times 300} \approx 3$

Let mole of He = x

Mole of H_2 = 3 – x

4x + 2(3 – x) = 10

$\boxed{x = 2mol}$

Mass of He = 8g

30. Mole of Na $= \frac{0.69}{23} = 3 \times 10^{-2}$

$Na + H_2O \longrightarrow NaOH + \frac{1}{2}H_2$

By using POAC

Moles of NaOH = 3 × 10^{-2}

NaOH reacts with HCl

No. of equivalent of NaOH = No. of equivalent of HCl

$3 \times 10^{-2} \times 1 = \frac{73}{36.5} \times V(\text{In L}) \times 1$

V = 1.5 × 10^{-2} L

Volume of HCl = 15 ml.

THERMODYNAMICS & THERMOCHEMISTRY

1. $C_6H_{6(liq)} + 7.5\ O_{2(g)} \longrightarrow 6CO_{2(g)} + 3H_2O_{(liq)}$

$\Delta n_{(g)} = 6 - 7.5 = -1.5$

$\Delta H = \Delta E + \Delta n_{(g)}\ RT$

$$\Delta H = -3263.9kJ - \frac{1.5\times 8.314\times 298}{1000}kJ$$

$= -3267.6$ kJ

2. $\Delta U = n\ C_{vm}\ \Delta T = 5\times 28\times 100$

$= 14$ kJ

$\Delta(PV) = nR(T_2 - T_1)$

$= 5 \times 8 \times 100$

$= 4$ kJ

3. A reaction is spontaneous if ΔG_{sys} is negative.

$\Delta G_{sys} = \Delta H_{sys} - T\Delta S_{sys}$

A reaction will be spontaneous at all temperatures if ΔH_{sys} is negative and

ΔS_{sys} = +ve

4. $w = -P\Delta V$

$= -(1\ bar) \times (9\ L)$

$= -(10^5\ Pa) \times (9 \times 10^{-3})\ m^3$

$= -9 \times 10^2$ N-m

$= -900$ J

$= -0.9$ kJ

5. (B) and (D) are not correct representation for isothermal expansion of ideal gas.

6. (A) $q + w = \Delta U$, state function

(B) q, path function

(C) w, path function

(D) H – TS = G, state function

7. $\Delta H = 200\ J\ mol^{-1}$

$\Delta S = 40\ JK^{-1}\ mol^{-1}$

For spontaneous reaction,

$$T \geq \frac{\Delta H}{\Delta S}$$

$$T \geq \frac{200}{40} \geq 5K$$

So, minimum temperature is 5 K

8. Both entropy and change in entropy are function of temperature.

9. (A) For a spontaneous process $\Delta G_{T,P} < 0$

(B) $\Delta P = 0 \rightarrow$ Isobaric process

$\Delta T = 0 \rightarrow$ Isothermal process

(C) $\Delta H_{reaction} = \sum$Bond energies of reactants) - ($\sum$bond energies of products)

(D) $\Delta H < 0$ is for exothermic reaction

10. $\Delta H = \sum \Delta H_{Combustion}$ (Reactant) - $\sum \Delta H_{Combustion}$ (Product)

$= 3 \times (-1300) - [-3268]$

$= -632\ kJ\ mol^{-1}$

11. $$C_2H_6(g) + \frac{7}{2}O_2(g) \rightarrow 2CO_2(g) + 3H_2O(\ell)$$

$$\Delta_C H(C_2H_6) = 2\Delta_f HCO_2(g) + 3\Delta_f H(H_2O,\ell) - \Delta_f H(C_2H_6,g)$$

$-1560 = 2(-394) + 3(-286) - \Delta f_H(C_2H_6,g)$

$\Delta f_H(C_2H_6,g) = -86$ kJ/mole

12. (1) $C + O_2 \longrightarrow CO_2$

$\Delta_C H° = -286$ kJ/mol

(2) $H_2 + \frac{1}{2}O_2 \longrightarrow H_2O$

$\Delta_C H° = -393.5$ kJ/mol

(3) $C_2H_6 + \frac{7}{2}O_2 \longrightarrow 2CO_2 + 3H_2O$

$\Delta_C H° = -1560$ kJ/mol

$2 \times (1) + 3 \times (2) - (3)$

$2C + 3H_2 \longrightarrow C_2H_6$

$$\Delta H_f°(C_2H_6) = 2(-286) + 3(-393.5) + 1560$$

$= -192.5$ kJ/mol

13. $A(\ell) \rightleftharpoons 2B\ (g),\ \Delta n_g = 2$

$\Delta H = \Delta U + (\Delta n_g)\ RT$

$= (2.1 + 2 \times 2 \times 300 \times 10^{-3})$ kcal

$= 3.3$ kcal

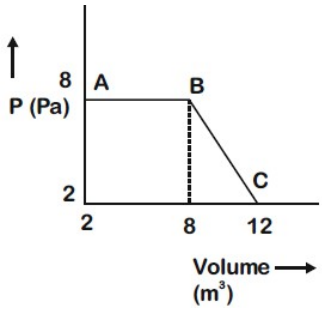
$\therefore \quad \Delta G = \Delta H - T\Delta S$

$= 3.3 - 300 \times 20 \times 10^{-3}$

$= 3.3 - 6$

$= -2.7$ kcal.

14. Work done by a gas that undergoes a reversible expansion along the path ABC is given by



$$W = (6 \times 6) + \left(\frac{1}{2} \times 4 \times 6\right) = 48.00\,J$$

15. $\Delta H_{sub} = \Delta H_{fus.} + \Delta H_{vap.}$

$= 2.8 + 98.2$

$= 101$ kJ/mol

16. $\Rightarrow$ Millimoles of HCl $= 200 \times 0.2 = 40$

$\Rightarrow$ Millimoles of NaOH $= 300 \times 0.1 = 30$

$\Rightarrow$ Heat released

$$= \left(\frac{30}{1000} \times 57.1 \times 1000\right) = 1713\,J$$

$\Rightarrow$ Mass of solution

$= 500$ ml $\times$ 1 gm/ml $= 500$ gm

$$\Rightarrow \Delta T = \frac{q}{m \times C} = \frac{1713\,J}{500g \times 4.18 \frac{J}{g-K}} = 0.8196K$$

$= 81.96 \times 10^{-2}$ K

17. $\Delta_r H = [\in_{C-C} + 2 \in_{C-H}] - [\in_{C=C} + \in_{H-H}]$

$= [347 + 2 \times 414] - [611 + 436] = 128$

18. 1 mol graphite = 12 gm C

$$\text{Ans.} = \frac{248}{12} = 20.67 \text{kJ / gm heat evolved}$$

19. Given reaction :

$3CaO + Al \rightarrow Al_2O_3 + 3Ca$

Now, $\Delta_r H^0 = \sum \Delta_f H^0_{Products} - \sum \Delta_f H^0_{Reactants}$

$= [1 \times (-1675) + 3 \times 0] - [3 \times (-635) + 2 \times 0]$

$= +230$ kJ mol^{-1}

20. $\Delta G = \Delta H - T\Delta S$

$$\Delta G = 57.8 - \frac{298(-176)}{1000}$$

$\Delta G = -5.352$ kJ/mole

|Nearest integer value| = 5

21. $3C_{(gr)} + 4H_{2(g)} \rightarrow C_3H_{8(g)}$

$= -103.7$ kJ mol^{-1}

22. $Mg(s) + \frac{1}{2}O_2(g) \rightarrow MgO(s)$

$\Delta H = \Delta U + \Delta n_g RT$

$$-601.70 \times 10^3 = \Delta U - \frac{1}{2} \times 8.3 \times 300$$

-601.70 kJ $= \Delta U - 1.245$kJ

$\Delta U = -600.455$kJ

Ans. 600

23. Given data is for 1 moles and asked for 5 moles so value is $23.4 \times 5 = 117$ kJ

24. $\Delta H_{ionisation}$ of CH_3COOH = | -57.3 - (-55.3)|

= 2 KJ/mol

25. $\Delta U = -726$ KJ/mol

$$\Delta ng = 1 - 3/2 = \frac{-1}{2}$$

$\Delta H = \Delta U + \Delta ngRT$

$$= -726 - \frac{1}{2} \times \frac{8.3 \times 300}{1000} = -727.245$$

26. Internal energy, volume enthalpy are state variable

27. $H_2O\ (\ell) \rightarrow H_2O(g)$

$$n = \frac{36}{18} = 2 \text{ mol}$$

$\Delta U = \Delta H - \Delta n_g RT$

$$= 41.1 - \frac{1 \times 8.31 \times 373}{1000} \text{ kJ /mol}$$

$= 38$ kJ/mol

28. $1 \rightarrow 2 \Rightarrow$ Isobaric process

$2 \rightarrow 3 \Rightarrow$ Isochoric process

$3 \rightarrow 1 \Rightarrow$ Isothermal process

$$W = W_{1\rightarrow2} + W_{2\rightarrow3} + W_{3\rightarrow1}$$

$$= \left(-P(V_2 - V_1) + 0\left[-P_1V_1\ln\left(\frac{V_2}{V_1}\right)\right]\right)$$

$$= \left[-1\times(40-20) + 0 + \left[-1\times 20\ln\left(\frac{20}{40}\right)\right]\right]$$

$= -20 + 20 \ln 2$

$= -20 + 20 \times 2.3 \times 0.3$

$= -6.2$ bar L

$|W| = 6.2$ bar $1 = 620$ J

29. $\Delta G = \Delta H - T\Delta S$

A : ΔG (J mol^{-1}) $= -25 \times 10^3 + 80 \times 300$: –ve

B : ΔG (J mol^{-1}) $= -22 \times 10^3 - 40 \times 300$: –ve

C : ΔG (J mol^{-1}) $= 25 \times 10^3 + 300 \times 50$: +ve

D : ΔG (J mol^{-1}) $= 22 \times 10^3 - 20 \times 300$: +ve

Processes C and D are non-spontaneous.

30. Let, Volume of C_2H_4 is x litre

$$C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O$$

Initial x

Final – 2x

$$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$$

Initial (16.8 – x)

Final – (16.8 – x)

Total volume of $CO_2 = 2x + 16.8 - x$

$\Rightarrow$ $28 = 16.8 + x$

$x = 11.2$ L

$$n_{CH_4} = \frac{PV}{RT} = \frac{1\times5.6}{0.082\times298} = 0.229\,\text{mole}$$

$$^{n}C_2H_2 = \frac{11.2}{0.082\times298} = 0.458\,\text{mole}$$

$\therefore$ Heat evolved

$= 0.229 \times (-900) + 0.458 \times (-1400)$

$= -847.3$ kJ

CHEMICAL EQUILIBRIUM

1. $A(S) \longrightarrow \underset{P_1}{B(g)} + \underset{P_1+P_2}{C(g)}$ $\quad K_{P_1} = P_1(P_1 + P_2) = x$

$D(S) \longrightarrow \underset{P_2+P_1}{C(g)} + \underset{P_2}{E(g)}$ $\quad K_{P_1} = P_1(P_1 + P_2) = y$

$\therefore P_1(P_1 + P_2) + P_2(P_1 + P_2) = x + y$

$\Rightarrow (P_1 + P_2)^2 = x + y$

$\Rightarrow P_1 + P_2 = \sqrt{x+y}$

$\therefore$ Total pressure

$= 2(P_1 + P_2) = 2\left(\sqrt{x+y}\right)$ atm at equilibrium

2. $\because K_P = K_C \cdot (RT)^{\Delta n}g$

$\therefore$ If $\Delta n_g \neq 0$ then $K_P \neq K_C$

$2C(s) + O_2(g) \rightleftharpoons 2CO(g)$

$\Delta n_g = +1$

$\Rightarrow K_P = K_C \cdot (RT)^1$

3. $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$

$K_c = 1.7 \times 10^{16}$ i.e. reaction goes to completion. Equilibrium constant has no relation with catalyst. Catalyst only affects the rate with which a reaction proceeds.

For the given reaction, catalyst V_2O_5 is used to speed up the reaction (Contact process).

4. $\underset{P_0-2x}{2NH_3(g)} \rightleftharpoons \underset{x}{N_2(g)} + \underset{3x}{3H_2(g)}, K = \frac{1}{K_P}$

$\therefore P = P_0 + 2x$

$\therefore K = \frac{1}{K_P} = \frac{x(3x)^3}{P_{NH_3}{}^2}$

$\Rightarrow P_{NH_3}{}^2 = 3^3 x^4 K_P \Rightarrow P_{NH_3} = 3^{\frac{3}{2}} x^2 K_P^{\frac{1}{2}}$

$= \frac{3^{\frac{3}{2}} \cdot P^2 \cdot K_P^{\frac{1}{2}}}{16}$

5. eq^n 1 $\quad S + O_2 \rightleftharpoons SO_2 \quad K_1 = 10^{52}$

eq^n 2 $\quad 2S + 3O_2 \rightleftharpoons 2SO_3 \quad K_2 = 10^{129}$

eq^n 3 $\quad 2SO_2 + O_2 \rightleftharpoons 2SO_3$

eq^n 3 = eq^n 2 – 2 × (eq^n 1)

$= \frac{10^{129}}{(10^{52})^2} = 10^{25}$

6. $\Delta G° = -RT \ln K$

$\therefore$ If $K > 1$ then $\Delta G° < 0$

If $K < 1$ then $\Delta G° > 0$

If $K = 1$ then $\Delta G° = 0$

7.

	A	+ 2B	$\rightleftharpoons$	2C	+ D
$t = 0$	2	3			
t_{eq}	$2-x$	$3-2x$		$2x$	x

Given, $3 - 2x = 2 - x$

$\Rightarrow x = 1$

$\therefore$ [C] = 2, [D] = 1

[A] = 1, [B] = 1

$\therefore K_c = \frac{2^2 \cdot 1}{1^2 \cdot 1} = 4$

8. $NH_4SH \longrightarrow NH_3(g) + H_2S(g)$

Initial moles $\frac{5.1}{51} = 0.1$ mol

Moles at equilibrium	$NH_4SH \rightarrow$	$NH_3(g)$ +	$H_2S(g)$
	$0.1(1-0.3)$	0.1×0.3	0.1×0.3

$\therefore K_C = [NH_3][H_2S] = \left(\frac{0.03}{3}\right)^2 = 10^{-4}$

$K_P = K_C.(RT)\Delta n_g = 10^{-4} \times (0.082 \times 600)^2$

$= 0.242$ atm^2

9. $\because$ Given reaction is endothermic

$\therefore$ On decreasing temperature backward reaction will be favoured.

On adding N_2, pressure is increased at constant T, and volume would also be constant so no change is observed.

10. At equilibrium,

rate of forward reaction = Rate of backward reaction

11. $K_p = K_C(RT)^{\Delta n_g}$

$= K_C(RT)^{1-3/2}$

$= K_C(RT)^{-1/2}$

$\Rightarrow K_C = K_p(RT)^{1/2}$

12. $A \rightleftharpoons B + C$ ...(i) $K_{eq}^{(1)}$

$B + C \rightleftharpoons P$ ...(ii) $K_{eq}^{(2)}$

(i) + (ii)

$A \rightleftharpoons P$

K_{eq} (overall) = $K_{eq}^{(1)}$ $K_{eq}^{(2)}$

13.

	X	+	Y	$\rightleftharpoons$	2Z
t = 0	1		1.5		0.5
t = eq	1–0.25		1.5–0.25		0.5+0.5

$$\therefore \quad K_{eq} = \frac{(1)^2}{0.75 \times 1.25} = \frac{x}{15}$$

$$\Rightarrow \quad x = \frac{15}{0.75 \times 1.25} = 16$$

14. $Cu^{2+} + NH_3 \overset{K_1}{\rightleftharpoons} [Cu(NH_3)]^{2+}$

$[Cu(NH_3)]^{2+} + NH_3 \overset{K_2}{\rightleftharpoons} [Cu(NH_3)_2]^{2+}$

$[Cu(NH_3)_2]^{2+} + NH_3 \overset{K_3}{\rightleftharpoons} [Cu(NH_3)_3]^{2+}$

$[Cu(NH_3)_3]^{2+} + NH_3 \overset{K_4}{\rightleftharpoons} [Cu(NH_3)_4]^{2+}$

$Cu^{2+} + 4NH_3 \overset{K}{\rightleftharpoons} [Cu(NH_3)_4]^{2+}$

So,

$K = K_1 \times K_2 \times K_3 \times K_4$

$= 10^4 \times 1.58 \times 10^3 \times 5 \times 10^2 \times 10^2$

$K = 7.9 \times 10^{11}$

Where K $\rightarrow$ Equilibrium constant for formation of $[Cu(NH_3)_4]^{2+}$

So equilibrium constant (K') for dissociation of $[Cu(NH_3)_4]^{2+}$ is $\frac{1}{K}$

$$K' = \frac{1}{K}$$

$$K' = \frac{1}{7.9 \times 10^{11}}$$

$= 1.26 \times 10^{-12} = (x \times 10^{-12})$

So the value of x = 1.26

OMR Ans = 1 (After rounded off to the nearest integer)

15. $A + B \rightleftharpoons C + D : K_{eq} = 100$

1M 1M 1M 1M

First check direction of reversible reaction.

Since $Q_C = \frac{[C][D]}{[A][B]} = 1 < K_{eq.} \Rightarrow$ reaction will move in forward direction to attain equilibrium state.

$\Rightarrow A + B \rightleftharpoons C + D : K_{eq} = 100$

to 1 1 1 1

$t_{eq.}$ 1 – x 1 – x 1 + x 1 + x

Now : $K_{eq} = 100 = \frac{(1+x)(1+x)}{(1-x)(1-x)}$

$$\Rightarrow \boxed{100 = \left(\frac{1+x}{1-x}\right)^2}$$

(i) $10 = \left(\frac{1+x}{1-x}\right)$

$\Rightarrow 10 - 10x = 1 + x \qquad \Rightarrow 11x = 9$

$$\Rightarrow \boxed{x = \frac{9}{11}}$$

(ii) $-10 = \frac{1+x}{1-x}$

$\Rightarrow -10 + 10x = 1 + x \qquad \Rightarrow -9x = -11$

$$\Rightarrow \boxed{x = \frac{11}{9}}$$

$\rightarrow$ 'x' cannot be more than one, therefore not valid. therefore equation concretion of (D) = 1 + x

$= 1 + \frac{9}{11} = \frac{20}{11}$

$= 1.8181 = 181.81 \times 10^{-2}$

$\simeq 182 \times 10^{-2}$

16. $N_2O_4(g) \rightleftharpoons 2NO_2(g) ; \Delta n_g = 2 - 1 = 1$

Now, $K_P = K_C.(RT)^{\Delta ng}$

or, $600.1 = 20.4 \times (0.0831 \times T)^1$

$\therefore$ T = 353.99 K = 354 K

17. Using formula

$\Delta_r G^0 = -RT \ln K_p$

$25200 = -2.3 \times 8.3 \times 400 \log (K_p)$

$K_p = 10^{-3} \times 0.501$

$= 5.01 \times 10^{-4}$ Bar^{-1}

$= 5.01 \times 10^{-9}\ Pa^{-1}$

$= \dfrac{K_C}{8.3 \times 400}$

$K_C = 1.66 \times 10^{-5}\ m^3$ / mole

$= 1.66 \times 10^{-2}$ L/mol

18. Let moles added = a

$$Ag^{+}_{(aq.)} + 2NH_{3(aq.)} \rightleftharpoons Ag(NH_3)^{+}_{2(aq.)}$$

$t = 0 \quad 0.8 \quad \left(\frac{a}{2}\right)$

$t = \infty \quad 5 \times 10^{-8} \left(\frac{a}{2} - 1.6\right) \quad 0.8$

$$\frac{0.8}{(5 \times 10^{-8})\left(\frac{a}{2} - 1.6\right)} = 10^8$$

$$\Rightarrow \frac{a}{2} - 1.6 = 0.4 \Rightarrow a = 4$$

19. $k_p = Po_2^{1/2} = 4$

$\therefore \quad Po_2 = 16$ atm

20. $$K_C = \frac{K_P}{RT} = \frac{47.9}{0.083 \times 288} = 2$$

21. $$K'_{eq} = \frac{1}{\sqrt{K_{eq}}} = \frac{1}{\sqrt{2 \times 10^{15}}} = x \times 10^{-8}$$

$$\Rightarrow \frac{1}{\sqrt{20}} \times \frac{1}{10^7} = x \times 10^{-8}$$

$$\Rightarrow \frac{1}{\sqrt{20}} \times 10^{-7} = x \times 10^{-8}$$

$$\frac{10}{\sqrt{20}} = x$$

$$\Rightarrow x = \frac{\sqrt{10}}{\sqrt{2}} = \sqrt{5} = 2.236 \simeq 2.24$$

22.

	N_2O_4	$\rightleftharpoons$	$2NO_2$
$t = 0$	1 mol		
$t = t$	(1-0.5) mol		0.5×2 mol
	= 0.5 mol		1 mol

$$k_p = \frac{\left(\frac{1}{1.5} \times 1\right)^2}{\left(\frac{0.5}{1.5} \times 1\right)} = \frac{1}{0.75} = \frac{100}{75}$$

$= 1.33$

$\Delta G^o = -RT \ell n k_p$

$= -8.31 \times 300 \times \ell n\ (1.33) = -710.45$ J/mol

$= -710$ J/mol

23. $2O_3 \rightleftharpoons 3O_2(g)$

$\frac{2}{5} \qquad \frac{3}{5}$

$$k_p = \frac{P_{O_2}^3}{P_{O_3}^2} \qquad K_p = 1.35$$

$\Delta G^o = -RT \ln k_p$

$= -8.3 \times 300 \times \ln 1.35 \quad = -747$ J/mol

24. Given : 2 mole of N_2 gas was present as inert gas.

Equilibrium pressure = 2.46 atm

$$PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$$

$t = 0 \quad 5 \quad 0 \quad 0$

$t = Eqm \quad 5 - x \quad x \quad x$

from ideal gas equation

$PV = nRT$

$2.46 \times 200 = (5 - x + x + x + 2) \times 0.082 \times 600$

$x = 3$

$$K_p = \frac{n_{PCl_3} \times n_{Cl_2}}{n_{PCl_5}} \times \left[\frac{P_{total}}{n_{total}}\right]$$

$$\frac{3 \times 3}{2} \times \frac{2.46}{10} = 1.107 = 1107 \times 10^{-3}$$

25. $$HI \rightleftharpoons \frac{1}{2}H_2 + \frac{1}{2}I_2$$

$t_i \qquad 1$

$teq \qquad 1-0.4 \qquad \frac{0.4}{2} \qquad \frac{0.4}{2}$

$$K_p = \frac{(0.2)^{\frac{1}{2}}(0.2)^{\frac{1}{2}}}{1 - 0.4} = \frac{0.2}{0.6} = \frac{1}{3}$$

$\Delta G = \Delta G^o + RT \ \ln K = 0$

$\Delta G^o = -RT \ \ln K$

$$\Rightarrow -8.31 \times 300 \times 2.3 \times \log\left(\frac{1}{3}\right)$$

$= 2735$ J/mol

26. $\because \Delta G^\circ = RT \ln K_{eq}$ and $K_{eq} = \frac{K_f}{K_b}$

$\therefore \quad K_{eq} = \frac{10^3}{10^2} = 10$

$\therefore \quad \Delta G = -RT \ln 10$

$\Rightarrow \quad \Delta G = -(8.3 \times 300 \times 2.3)$

$= -5.7 \text{ kJ mole}^{-1} \approx 6 \text{ kJ mole}^{-1}$

(nearest integer)

Ans = 6

27. $H_2O(g) \rightarrow H_2(g) + \frac{1}{2}O_2(g)$

$P_0[1-\alpha] \quad P_0\alpha \quad \frac{P_0\alpha}{2}$

$P_0\left[1+\frac{\alpha}{2}\right] = 1 \ \ldots (i)$

$K_p = \frac{(P_{H_2})(P_{O_2})^{1/2}}{P_{H_2}} \frac{(P_0\alpha)\left(\frac{P_0\alpha}{2}\right)^{1/2}}{P_0[1-\alpha]} = 2\times10^{-3}$

since α is negligible w.r.t 1, $P_0 = 1$

and $1 - \alpha \approx 1$

$\frac{\alpha\sqrt{\alpha}}{\sqrt{2}} = 2\times10^{-3}$

$\alpha^{3/2} = 2^{3/2} \times 10^{-3}$

$\alpha = 2^{3/2 \times 2/3} \times 10^{-3 \times 2/3}$

$\alpha = 2 \times 10^{-2}$

28. $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g), K_1 = 4 \times 10^5$

$N_2(g) + O_2(g) \rightleftharpoons 2NO(g), K_2 = 1.6 \times 10^{12}$

$H_2(g) + \frac{1}{2}O_2(g) \rightleftharpoons H_2O(g), \quad K_3 = 1.0 \times 10^{-13}$

(ii) + 3 × (iii) – (i)

$2NH_3(g) + \frac{5}{2}O_2(g) \rightleftharpoons 2NO(g) + 3H_2O(g)$

$k_{eq} = \frac{k_2 \times k_3^3}{k_1} = \frac{1.6\times10^{12} \times (10^{-13})^3}{4\times10^5}$

$= \frac{1.6}{4} \times 10^{-32} = 4\times10^{-33}$

29. $SO_{2(g)} + \frac{1}{2}O_{2(g)} \rightleftharpoons SO_{3(g)}$

$K_p = 2 \times 10^{12}$ at 300 K

$K_P = K_C \times (RT)^{\Delta n_g}$

$2 \times 10^{12} = K_C \times (0.082 \times 300)^{-1/2}$

$K_C = 9.92 \times 10^{12}$

$K_C = 0.992 \times 10^{13}$

30. $x(g) \rightleftharpoons y(g) + z(g) \quad k_{p_1} = 3$

Initial moles n – –

at equilibrium $n - \alpha n$ αn αn

$k_{p_1} = \frac{\left(\frac{\alpha}{1+\alpha} \times p_1\right)^2}{\frac{\alpha}{1+\alpha} p_1}$

$3 = \frac{\alpha^2 \times p_1}{1-\alpha^2}$

$A(g) \rightleftharpoons 2B(g) \quad k_{p_2} = 1$

Initial mole n –

at equilibrium $x - \alpha n$ $2\alpha n$

$p_{total} = p_2$

$k_{p_2} = \frac{\left(\frac{2\alpha}{1+\alpha} \times p_2\right)^2}{\frac{1-\alpha}{1+\alpha} \times p_2}$

$1 = \frac{4\alpha^2 \times p_2}{1-\alpha}$

$\frac{k_{p_1}}{k_{p_2}} = \frac{p_1}{4p_2}$

$\frac{3}{1} = \frac{p_1}{4p_2}$

$\therefore p_1 : p_2 = 12 : 1$

$x = 12$

$\ldots$ (iii)

IONIC EQUILIBRIUM

1. most basic salt in aq. solution is CH_3COOK it is salt of WASB

and have PH = 7 + $\frac{(P_{ka} + \log c)}{2}$

i.e. pH > 7

2. NH_4OH + HCl $\longrightarrow$ $NH_4Cl + H_2O$

Weak base Strong acid

At end point pH will be less than 7

as strong acid weak base salt have

pH = $7 - \frac{(pK_b + \log c)}{2}$

$\therefore$ Methyl orange will change colour from yellow to pinkish red at the end point.

3. H_2SO_4 + $2NH_4OH$

20 ml 30 ml

0.1 m 0.2 m

$\downarrow$

$(NH_4)_2SO_4$ + NH_4OH

20 ml 10 ml

0.1 m 0.2 m (remain unreacted)

$pOH = pK_b + \log\frac{[Salt]}{[Base]}$

$= 4.7 + \log\left(\frac{2\times 20\times 0.1}{10\times 0.2}\right)$

= 4.7 + log2

= 5

pH = 14 – pOH = 9

4. (a) $H_2SO_4 + NaOH \rightarrow NaHSO_4 + H_2O$

Initial moles 0.04 0.04

0 0 0.04 0.04

$NaHSO_4 \rightarrow Na^+ + H^+ + SO_4^{2-}$

$[H^+] = \frac{0.04}{0.80} = 0.05Ml;\ pH = 1.3$

(b) Ionic product of water increases with increase of temperature because ionisation of water is endothermic.

(c) $HA \rightleftharpoons H^+ + A^-$

$C(1-\alpha)$ $C\alpha$ $C\alpha$ pH = 5 & $K_a = 10^{-5}$

$10^{-5} = \frac{C\alpha^2}{1-\alpha}; C = 2\times 10^{-5}$ and $\alpha = 0.5$

5. $Zr_3(PO_4)_4 \rightleftharpoons \underset{3S}{3Zr^{+4}} + \underset{4S}{4PO_4^{3-}}$

$K_{sp} = \left[Zr^{+4}\right]^3\left[PO_4^{3-}\right]^4 = (3S)^3(4S)^4$

$K_{sp} = 6912\ S^7$

$S = \left(\frac{K_{sp}}{6912}\right)^{1/7}$

6. (A) 0.01 M HCl

$[H^+] = 10^{-2}$, pH = –log 10^{-2} = 2

pOH = 14 – 2 = 12

(B) 0.01 M NaOH

$[OH^-] = 10^{-2}$, pOH = –log [OH]

= 2

(C) 0.01 M CH_3COONa

$ph = 7 + \frac{1}{2}$ [pK_a log0.01]

pH > 7 $\Rightarrow$ pOH < 7

(D) 0.01 M NaCl, pH = 7, pOH = 7

Order of pOH value A > D > C > B

7.

	HCl	+ CH_3COONa	$\rightarrow$ CH_3COOH	+ NaCl
Initial	100×0.1 = 10 mmol	200×0.1 = 20 mmol		
Final moles	0	10 mmol	10 mmol	10 mmol

CH_3COOH and CH_3COONa both are present. Both form acidic buffer.

8. K_{sp} value of CuS is very low $\simeq 10^{-36}$ (3.6×10^{-36}) due to low K_{sp} value Cu^{+2} ion gets precipitated very quickly even with very low concentration of S^{-2} ion

$CuS(s) \rightleftharpoons Cu^{+2} + S^{-2}$

$K_{sp} = [Cu^{+2}]\ [S^{-2}]$

$Cu^{+2} + S^{-2} \underset{K_{eq}}{\rightleftharpoons} CuS(s)$

$K_{eq} = \frac{1}{K_{SP}} = \frac{1}{3.6\times 10^{-36}} = \frac{10^{36}}{3.6}$

Due to high value of K (equilibrium constant) CuS precipitated quickly.

9. For titration between HCl and NaOH, pH at equivalence point is found to be 7.

10. $Cr(OH)_3 \rightleftharpoons Cr^{3+} + 3OH^-$

S 3S [S is solubility]

$\therefore \quad 27S^4 = 6 \times 10^{-31}$

$$S = \left(\frac{6}{27} \times 10^{-31}\right)^{1/4}$$

$\because \quad [OH^-] = 3S = 3\left(\frac{6}{27} \times 10^{-31}\right)^{1/4}$

11. Both assertion and reason are incorrect

12. $\frac{K_{sp}}{Ka} = \frac{s^2}{(H^+)}; \quad s = \sqrt{\frac{K_{sp}}{K_a}(H^+)}$

$$s = \sqrt{\frac{2.2 \times 10^{-16}}{6.2 \times 10^{-10}} \times 10^{-3}}$$

$s = 1.9 \times 10^{-5}$

Hence answer is (2)

13. $Ca(OH)_2 \rightleftharpoons Ca^{2+}(aq) + 2OH^-(aq)$

s 2s

$k_{sp} = s(2s)^2 \Rightarrow 5.5 \times 10^{-6} = 4S^3$

$$\Rightarrow \quad s = \left(\frac{5.5}{4}\right)^{\frac{1}{3}} \times 10^{-2} = 1.11 \times 10^{-2}$$

14. $HCl + H_2SO_4$

$$[H^+] = \frac{(0.01 \times 200) + (0.01 \times 2 \times 400)}{600}$$

$$= \frac{2+8}{600} = \frac{10}{600} = \frac{1}{60}$$

$$pH = -\log\left[\frac{1}{60}\right] = 1.78$$

15. Phenolphthalein dissociate in basic medium

$$HPh(aq) \rightleftharpoons H^+ + Ph^-$$

(colourless) (Pink)

16. In deionized water no common ion effect will take place so maximum solubility

17. $H_2C_2O_4 \rightleftharpoons H^+ + HC_2O_4^- \quad K_{a_1}$

$HC_2O_4^- \rightleftharpoons H^+ + C_2O_4^{2-} \quad K_{a_2}$

$H_2C_2O_4 \rightleftharpoons 2H^+ + C_2O_4^{2-} \quad K_{a_3} = K_{a_1} \times K_{a_2}$

18.

$$\underset{\text{Acid}}{H_2S} + \underset{\text{Base}}{H_2O} \rightleftharpoons H_3O^+ + HS^-$$

$$\underset{\text{Acid}}{H_2O} + \underset{\text{Base}}{NH_3} \rightleftharpoons NH_4OH$$

19. $\Delta[H^+] = 1000$

$\Delta pH = -\log [H^+] = -\log 10^3 = -3$

20. $AB_2 \rightleftharpoons \underset{s}{A^{2+}}(aq) + \underset{2s}{2B^-}(aq)$

$K_{sp} = 4s^3 = 3.2 \times 10^{-11}$

$\Rightarrow \quad s^3 = 8 \times 10^{-12}$

$s = 2 \times 10^{-4}$

21.

	CH_3COOH	HCl
Moles :	$\frac{3}{60}$mol	250 × 0.1 m mol
Concent- ration in 500 ml	0.1 M	0.05 M
Moles in 20 ml	2 m mol	1 m mol

When $\frac{1}{2}$ ml of 5 M NaOH is added then solution contains 0.5 m moles of CH_3COOH and 1.5 m moles of CH_3COONa

$$pH = pK_a + \ln\left(\frac{salt}{acid}\right) = 4.75 + \log(3)$$

= 4.75 + 0.48

= 5.23

22. $A_3B_2(s) \rightleftharpoons 3A^{+2}_{(aq)} + 2B^{-3}_{(aq)}$

3s 2s

$K_{SP} = (3s)^3 (2s)^2$

$K_{SP} = 108\ S^5$ & s = (X/M)

$$K_{SP} = 108\left(\frac{x}{m}\right)^5$$

given $K_{SP} = a\left(\frac{x}{m}\right)^5$

comparing a = 108

23. $pH = pKa + \log\frac{[CB]}{[WA]}$

$5.74 = 4.74 + \log\frac{[CB]}{1} \quad \Rightarrow [CB] = 10\ M$

24. $\left[NH_4^+\right] = 0.0504$ & $\left[NH_3\right] = 0.0210$

$$\text{So } K_b = \frac{\left[NH_4^+\right]\left[HO^-\right]}{\left[NH_3\right]}$$

$$\left[HO^-\right] = \frac{K_b \times \left[NH_3\right]}{\left(NH_4^+\right)} = 1.8 \times 10^{-5} \times \frac{2}{5} \times \frac{210}{504}$$

$= 3 \times 10^{-6}$

25. Solubility of CaF_2 = S mole/L

$$S = \frac{2.34 \times 10^{-3}}{0.1 \times 78} = \frac{2.34}{78} \times 10^{-2} = 3 \times 10^{-4}\ \text{mol/L}$$

$K_{sp}\ (CaF_2) = 4S^3 = 4(3 \times 10^{-4})^3$

$= 108 \times 10^{-12} = 0.0108 \times 10^{-8}\ (\text{mol/L})^3$

26. K_a of Butyric acid

$\Rightarrow 2 \times 10^{-5}$ PKa = 4.7 pH of 0.2 M solution

$$pH = \frac{1}{2}pK_a - \frac{1}{2}\log C = \frac{1}{2}(4.7) - \frac{1}{2}\log(0.2)$$

$= 2.35 + 0.35 = 2.7$

$pH = 27 \times 10^{-1}$

27. Concentration of calcium lactate = 0.005 M, concentration of lactate ion = (2 × 0.005) M. Calcium lactate is a salt of weak acid + strong base

$\therefore$ Salt hydrolysis will take place.

$$pH = 7 + \frac{1}{2}(pKa + \log C)$$

$$= 7 + \frac{1}{2}(5 + \log(2 \times 0.005))$$

$$= 7 + \frac{1}{2}[5 - 2\log 10] = 7 + \frac{1}{2} \times 3$$

$= 8.5 = 85 \times 10^{-1}$

28. Buffer of HOAc and NaOAc

$$pH = pKa + \log\frac{0.1}{0.01}$$

$5 = pKa + 1$

$pKa = 4$

$Ka = 10^{-4}$

$x = 10$

29. In resultant solution

$$n_{NH_3} = 0.1 - 0.02 = 0.08$$

$$n_{NH_4Cl} = n_{NH_4^+} = 0.1 + 0.02 = 0.12$$

$$pOH = pK_b + \log\frac{[NH_4^+]}{[NH_3]}$$

$$= 4.745 + \log\frac{0.12}{0.08}$$

$$= 4.745 + \log\frac{3}{2}$$

$= 4.745 + 0.477 - 0.301$

$pOH = 4.921$

$pH = 14 - pH = 9.079$

30. $\because$ pH = 12

$\therefore$ $[H^+] = 10^{-12}$ M

$\therefore$ $[OH^-] = 10^{-2}$ M

$\therefore$ $[Ca(OH)_2] = 5 \times 10^{-3}$ M

$$5 \times 10^{-3} = \frac{\text{milli moles of Ca (OH)}_2}{100\text{mL}}$$

milli moles of $Ca(OH)_2 = 5 \times 10^{-1}$

Ans. = 5

LIQUID SOLUTION & COLLIGATIVE PROPERTIES

1. The complex having minimum value of vant Hoff's factor (i) will give minimum concentration and highest freezing point.

(1) $[Co(H_2O)_4Cl_2]Cl \cdot 2H_2O \longrightarrow [Co(H_2O)_4Cl_2]^+ + Cl^-$ (i = 2)

(2) $[Co(H_2O)_3Cl_3]3H_2O \longrightarrow$ No dissociation (i = 1)

(3) $[Co(H_2O)_6]Cl_3 \longrightarrow [Co(H_2O)_6]^{+3} + 3Cl^-$ (i = 4)

(4) $[Co(H_2O)_5Cl]Cl_2.H_2O \longrightarrow [Co(H_2O)_5Cl]^{+2} + 2Cl^-$ (i = 3)

2. Solubility decreases with the increase in value of K_H.

3.

	$2C_6H_5COOH \longrightarrow (C_6H_5COOH)_2$	
t = 0	1	0
t	$1 - 2\alpha$	α

Moles at equilibrium = $1 - 2\alpha + \alpha = 1 - \alpha$

$2\alpha = 0.8$, $\alpha = 0.4$

Moles at equilibrium = 0.6

i = 0.6

$$\Delta T_f = ik_fm \Rightarrow 2 = 0.6 \times 5 \times \left(\frac{\frac{w}{122}}{30}\right) \times 1000$$

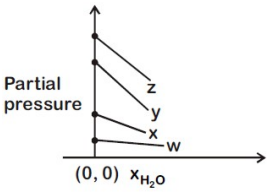
W = 2.4 g

4. According to Henry's law

$P = K_H \cdot X_{gas}$

$\because \quad x_{gas} = 1 - x_{H_2O}$

$\therefore \quad P = K_H - K_H \cdot X_{H_2O} \quad \Rightarrow \quad y = C + mx$



gas	K_H
w	0.5
x	2
y	35
z	50

5. $P_M^\circ = 450\,mmHg, P_N^\circ = 700\ mmHg$

$P_M = P_M^\circ X_M = Y_M P_T$

$$\Rightarrow \quad P_N^\circ = \frac{Y_M}{X_M}(P_T)$$

Similarly, $P_N^\circ = \frac{Y_M}{X_M}(P_T)$

Given, $P_N^\circ = \frac{Y_N}{X_N}(P_T)$

$$\Rightarrow \quad \frac{Y_N}{X_N} < \frac{Y_N}{X_N} \quad \Rightarrow \quad \frac{Y_M}{X_N} < \frac{Y_M}{X_N}$$

6. $\pi_{XY} = 4\pi_{BaCl_2}$

$\therefore \quad 2[XY] = 4 \times (0.01) \times 3$

$[XY] = 0.06$

$$= 6 \times 10^{-2}\ \frac{mol}{L}$$

7. $K_2SO_4 \longrightarrow 2K^+ + SO_4^{2-}$

i (Van't Hoff Factor) = 3

$\therefore \Delta Tf = iK_fm$

$= 3 \times 4 \times 0.03 \qquad = 0.36\ K$

8. Relative lowering of VP is given by

$$\frac{P_B^\circ - P_B}{P_B^\circ} = x_A = \frac{n_A}{n_A + n_B} \simeq \frac{n_A}{n_B}$$

$$\frac{P_B^\circ - P_B}{35} = \frac{0.6 \times 18}{60 \times 360} = \frac{1}{2000}$$

On solving, $\Delta P_B = P_B^\circ - P_B = 0.017$

9. Since the vapour pressure of the solution is greater than individual vapour pressure of both pure components, the solution shows a positive deviation from Raoult's law.

10. There will be lowering in vapour pressure for solution containing non-volatile solute. So, there will be transfer of solvent molecules from pure solvent to solution and hence, volume of beaker containing solvent (pure) will decrease and volume of beaker containing solution will increase.

11. Vapour pressure of a liquid at a given temperature is inversely proportional to intermolecular force of attraction. At the same temperature, vapour pressure of X is higher than that of Y.

Therefore (X) has lower intermolecular interactions compared to Y. Statement (B) is correct.

12. The rate at which water molecules leaves the solution decreases.

13. Osmosis can explain the given process. There are many phenomena which we observed in nature or at home. Raw mango shrivel when pickled in brine.

The solvent molecules will flow through the membrane from pure solvent to the solution. This process of flow of the solvent is called osmosis.

14. With temperature, the value of K_H (Henry's constant) increases and solubility of gas in liquid decreases

Ideally Henry's law is applicable for dilute solutions.

$\therefore$ 55.5 molal solution of δ at 250 bar will not follow Henry's law.

15. $T_f - T'_f = i\ Kf.m$

For minimum T'_f

'i' should be maximum.

$Al_2(SO_4)_3$ i = 5

$C_6H_{12}O_6$ i = 1

KI i = 2

K_2SO_4 i = 3

16. (1) van't Hoff factor, i

$$i = \frac{\text{Normal molar mass}}{\text{Abnormal molar mass}}$$

(2) k_f = Cryoscopic constant

(3) Solutions with same osmotic pressure are known as isotonic solutions.

(4) Solutions with same composition of vapour over them are called Azeotrope.

17. $\Delta T_f = 0.2°C$

$\because \Delta T_f = ikf{\cdot}m$

i = 2 for NaCl

$$\therefore \quad 0.2 = 2 \times 2 \times \frac{W_{NaCl} \times 1000}{58.5 \times 600}$$

$$\Rightarrow \quad W_{NaCl} = \frac{58.5 \times 600 \times 0.2}{4 \times 1000}$$

$$= 1.755$$

$$= 1.76$$

18. For aqueous solution

$\Delta T_f = K_f.m = 2 \times 0.5$

$\therefore$ Temperature of solution = –1°C = 272 K

$$\therefore \text{ Final volume of ideal gas} = \frac{nRT}{P}$$

$$\approx 2.18\ L$$

19. Isotonic solutions have the same osmotic pressure.

$$\pi_A = C_A RT;\ C_A = \frac{0.73 \times 1000}{M_A \times 250}$$

$$\pi_B = C_B RT;\ C_B = \frac{1.65}{M_B}$$

$\pi_A = \pi_B \Rightarrow C_A = C_B$

$$\therefore \quad \frac{0.73 \times 1000}{M_A \times 250} = \frac{1.65}{M_B}$$

$$\frac{M_A}{M_B} = 1.77 = 177 \times 10^{-2}$$

20. If X_1 and P_1^o are the mole fraction and vapour pressure of n-hexane in solution and X_2 and P_2^o are the mole fraction and vapour pressure of n-heptane in solution then

$$550 = X_1 P_1^o + X_2 P_2^o$$

$$= \frac{P_1^o}{4} + \frac{3P_2^o}{4} \Rightarrow P_1^o + 3P_2^o = 2200 \quad ....(1)$$

On addition of 1 more mole of n-heptane

$$560 = X_1' P_1^o + X_2' P_2^o$$

$$= \frac{P_1^o}{5} + \frac{4P_2^o}{5} \Rightarrow P_1^o + 4P_2^o = 2800 \quad ....(2)$$

From (1) and (2), $P_2^o = 600\,mm\ Hg$

21. For NaCl: $\pi_1 = iC_1RT \Rightarrow C_1 = \frac{0.10}{2RT}$

For Glucose: $\pi_2 = C_2RT \Rightarrow C_2 = \frac{0.20}{RT}$

When 1 L of NaCl solution and 2 L glucose solution are mixed.

$$\therefore C_1' = \frac{0.10}{6RT} \text{ and } C_2' = \frac{0.20\times 2}{3RT} = \frac{0.40}{3RT}$$

$$\therefore \pi_{Total} = iC_1' RT + C_2' RT = \frac{0.10}{3} + \frac{0.40}{3} = \frac{0.50}{3}$$

$$\boxed{\pi_{Total} \simeq 167\times 10^{-3} \text{atm}}$$

22. Molality of $CaCl_2$ solution = 0.05 m

$\Delta T_b = i\, K_b\, m = 3 \times K_b \times 0.05 = 0.15\, K_b$

Molality of $CrCl_3.xNH_3$ = 0.10 m

$\Delta T_b' = iK_b \times 0.10;\ \Delta T_b' = 2\Delta T_b$

$iK_b \times 0.10 = 2 \times 0.15\, K_b \Rightarrow i = 3$

Since, co-ordination number of Cr is 6.

$\therefore$ The complex is $[Cr(NH_3)_5Cl]Cl_2$

$\therefore$ x = 5

23. $ClCH_2COOH \rightleftharpoons ClCH_2COO^{\ominus} + H^+$

i = 1 + (2 –1) α

i = 1 + α

$\Delta T_f = ik_f m$

$$0.5 = (1+\alpha)(1.86)\left(\frac{\left(\frac{9.45}{94.5}\right)}{\left(\frac{500}{1000}\right)}\right)$$

$$\frac{5}{3.72} = 1+\alpha \Rightarrow \alpha = \frac{1.28}{3.72}$$

$$\alpha = \frac{32}{93}$$

$ClCH_2COOH \rightleftharpoons ClCH_2COO^{\ominus} + H^+$

$C - C\alpha \qquad C\alpha \qquad C\alpha$

$$K_a = \frac{(C\alpha)^2}{C - C\alpha} = \frac{C\alpha^2}{1-\alpha}$$

$$C = \frac{0.1}{500/1000} = 0.2$$

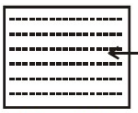
= 0.036

$K_a = 36 \times 10^{-3}$

24. Pure Solvent : C_6H_6 (l)

Given : $T_f^\circ = 5.5^\circ C$

$K_f = 5.12^\circ C / m$



: Solute is non dissociative

$\because \quad \Delta T_f = k_f \times m$

$$\Rightarrow \quad \left(T_f^0 - T_f'\right) = 5.12 \times \frac{\left(\frac{10}{58}\right)}{\left(\frac{2000}{1000}\right)} \text{mol}$$

$$\Rightarrow \quad 5.5 - T_f' = \frac{5.12\times 5\times 10}{58}$$

$T_f' = 1.086^\circ C \simeq 1^\circ C$

25. $SO_2 \quad + \quad 2NaOH \rightarrow Na_2SO_3 + H_2O$

$\frac{224}{0.0821\times 298} \quad 10\,\text{mmol} \quad 5\,\text{mmol}$

$\qquad\qquad\quad$ (L.R.) $\quad$ (i = 3)

= 9.2 m mol

$P^s = P^0.X_{solvent}$

$$= 24 \times \frac{2}{(2+15\times 10^{-3})}$$

$\Delta P = 0.18$ torr $= 18 \times 10^{-2}$ torr.

26. $P = K_H . X$

or, $20 \times 10_3 = (8 \times 10^4 \times 10^3) \times \frac{n_{O_2}}{n_{O_2} + n_{water}}$

or, $\frac{1}{4000} = \frac{n_{O_2}}{n_{O_2} + n_{water}} = \frac{n_{O_2}}{n_{water}}$

means 1 mole water

(18 gm = 18 ml) dissolves

$\frac{1}{4000}$ moles O_2. Hence, molar solubility

$$= \frac{\left(\frac{1}{4000}\right)}{18} \times 1000 = \frac{1}{72} \text{mol dm}^{-3}$$

$= 1388.89 \times 10^{-5}$ mold dm^{-3}

$\approx 1389\,\text{mol dm}^{-3}$

27. $K_4Fe(CN)_6 \rightleftharpoons 4K^+ + Fe(CN)_6^{4-}$

Initial conc.	1m	0	0
Final conc.	(1–0.4)m	4×0.4	0.4m
	= 0.6 m	= 1.6 m	

Effective molality = 0.6 + 1.6 + 0.4 = 2.6 m

For same boiling point, the molality of another solution should also be 2.6 m.

Now, 18.1 weight percent solution means 18.1 gm solute is present in 100 gm solution and hence, (100 – 18.1 =) 81.9 gm water.

Now, $2.6 = \dfrac{18.1/M}{81.9/1000}$

$\therefore$ Molar mass of solute, M = 85

28. π = CRT ; π = osmotic pressure

C = molarity

T = Temperature of solution

let the molar mass be M gm / mol

2.42×10^{-3} bar

$$= \frac{\left(\frac{1.46g}{Mgm/mol}\right)}{0.1\ell} \times \left(\frac{0.083\ell - bar}{mol - K}\right) \times (300K)$$

$\Rightarrow$ M = 15.02×10^4 g/mol

29. Let V.P. of pure A be P_A^0

Let V.P of pure B be P_B^0

When X_A = 0.7 and X_B = 0.3

P_s = 350

$\Rightarrow$ $P_A^0 \times 0.7 + P_B^0 \times 0.3 = 350$ … (i)

When X_A = 0.2 and X_B = 0.8

P_s = 410

$\Rightarrow$ $P_A^0 \times 0.2 + P_B^0 \times 0.8 = 410$ … (ii)

Solving (i) and (ii)

P_A^0 = 314mm Hg

P_B^0 = 434mm Hg

= (314)

30. π = iCRT

$\pi \propto$ iC

A, B, D and E have same value of osmotic pressure.

ELECTROCHEMISTRY

1. $B_2H_6 + 3O_2 \longrightarrow B_2O_3 + 3H_2O$

1 mol 3mol

3 mol O_2 is required for Burning 1 mol B_2H_6

$$H_2O \xrightarrow{Electrolysis} H_2 + \frac{1}{2}O_2$$

(V.F.of O_2 = 4)

$$\frac{Equivalent\ of\ O_2}{V.F.of\ O_2} = \text{mol of } O_2 = 3$$

$$\left[\frac{(100A)\times t\,\text{sec.}}{96500}\right]\times\frac{1}{4}=3$$

$$\therefore t = \frac{3\times 96500}{100\times 3600}hr. = 3.22\text{hrs.}$$

2. $PbSO_4 \longrightarrow Pb^{+4} + 2e^-$

$W = Z \times i \times t$

$$= \frac{303}{2\times F}\times 0.05F = 7.575$$

$\approx$ 7.6g

3. As $E^\circ_{m/m^{2+}}$ increases, reducing power increases.

$E^\circ_{Zn/Zn^{2+}} = 0.76V$

$E^\circ_{Ca/Ca^{2+}} = 2.87V$

$E^\circ_{Mg/Mg^{2+}} = 2.36V$

$E^\circ_{Ni/Ni^{2+}} = 0.25V$

Ca > Mg > Zn > Ni

4. $E^\circ_{cell} = (E^\circ_{R.P.})_{Cathode} - (E^\circ_{R.P.})_{Anode}$

All electrodes act as cathode w.r.t. Zn so the ion which has highest reduction potential will give maximum value of E°_{cell} so Au^{3+}/Au produce highest E°_{cell}.

5. $$E^0_{cell} = \frac{0.059}{n}\log K_C$$

$$= \frac{0.059}{2}\log 10^{16}$$

= 0.472 V

6. $$\Delta_rH^\circ = -nFE^\circ + nFT\frac{dE^\circ}{dT}$$

Cell reaction: $Zn(s)+Cu^{2+}(aq) \longrightarrow Zn^{2+}(aq) + Cu(s)$

$\therefore \Delta_rH^\circ = -2 \times 96000\ (2 + 300 \times 5 \times 10^{-4})$

$= -2 \times 96000\ (2 + 0.15)$

$= -412.8 \times 10^3$ J/mol

$\Delta_rH^\circ = -412.8$ kJ/mol

7. $\Lambda^\circ_m(NaCl) = 126.4\ S\ cm^2\ mol^{-1}$

$\Lambda^\circ_m(HCl) = 425.9\ S\ cm^2\ mol^{-1}$

$\Lambda^\circ_m(NaA) = 100.5\ S\ cm^2\ mol^{-1}$

$\Lambda^\circ_m(HA) = 425.9 - 126.4 + 100.5$

$= 400\ S\ cm^2\ mol^{-1}$

$K(HA) = 5 \times 10^{-5}\ S\ cm^{-1}$

$$\Lambda^c_m = \frac{K\times 1000}{\text{Molarity}} = \frac{5\times 10^{-5}\times 1000}{0.001} = 50$$

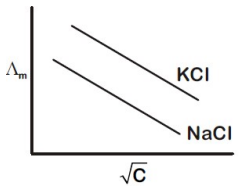
$$\alpha = \frac{\Lambda^c_m}{\Lambda^\circ_m} = \frac{50}{400} = 0.125$$

8. 0.1 F of electricity is passed through $Ni(NO_3)_2$ solution

$\therefore$ Amount of Ni deposited = 0.1 eq

$$\therefore \text{Moles} = \frac{0.1}{2} = 0.05$$

9. KCl is more conducting than NaCl



10. $$E^0_{cell} = E^0_{Cu^{2+}/Cu} - E^0_{Zn^{2+}/Zn}$$

$= 0.34 - (-0.76)$

$= 1.10$ V

if E_{ext} < 1.1 V then Zn dissolves at anode and copper deposits

if E_{ext} > 1.1V then Zn deposited at zinc electrodes and copper dissolves

11. The electrolyte (X) must be weak electrolyte. So X is CH_3COOH.

12. The E° value for Ce^{4+}/Ce^{3+} is 1.74 V because the most stable oxidation state of lanthanide series elements is +3

It means Ce^{3+} is more stable than Ce^{4+}.

13.

Ion	H^+	K^+	Cl^-	CH_3COO^-
$\Lambda^{\infty}_{m\ Scm^2/mole}$	349.8	73.5	76.3	40.9

So, $\Lambda^{\infty}_m CH_3COOH = \Lambda^{\infty}_{m(H^+)} + \Lambda^{\infty}_{m\ CH_3COO^-}$

= 349.8 + 40.9

= 390.7 Scm^2/mole

$\Lambda^{\infty}_{mKCl} = \Lambda^{\infty}_{m(K^+)} + \Lambda^{\infty}_{m(Cl^-)}$

= 73.5 + 76.3

= 149.3 Scm^2/mole

So statement-I is wrong or False. As the concentration decreases, the dilution increases which increases the degree of dissociation, thus increasing the no. of ions, which increases the molar conductance. So statement-II is false.

14. Metal cation with (–) value of reduction potential (M^{+3}/M^{+2}) or with (+) value of oxidation potential (M^{+2}/M^{+3}) will liberate H_2.

Therefore they will reduce H^+

i.e. V^{+2} and Cr^{+2}

15. At equilibrium state $E_{cell} = 0$ $\quad E^{\circ}_{cell} = 0.01\ V$

$$Sn(s) + Pb^{+2}(aq.) \longrightarrow Sn^{+2}(aq.) + Pb(s)$$

$$E = E^{\circ}_{cell} - \frac{0.06}{n}\log\frac{[P]}{[R]}$$

$$0 = 0.01 - \frac{0.06}{2}\log\frac{[Sn^{+2}]}{[Pb^{+2}]}$$

$$0.01 = \frac{0.06}{2}\log\frac{[Sn^{+2}]}{[Pb^{+2}]}$$

$$\frac{1}{3} = \log\frac{[Sn^{+2}]}{[Pb^{+2}]}$$

$$\frac{[Sn^{+2}]}{[Pb^{+2}]} = 10^{\frac{1}{3}} = 2.1544 = 2.15$$

16. $Ag^+ + e^- \longrightarrow Ag$

Moles of Ag deposited = $\frac{108}{108} = 1$mole

$\therefore$ 1 mole e^- or 1 F charge is required to deposite 1 mole of Ag.

$$H_2O \longrightarrow \frac{1}{2}O_2 + 2H^+ + 2e^-$$

$\because$ 2 moles of e^- liberate $\frac{1}{2}$ moles of O_2

$\therefore$ 1 mole or 1 F charge will liberate $\frac{1}{4}$ mole of O_2

$\therefore$ Volume of O_2 at 1 bar and 273

K = $\frac{1}{4} \times 22.7$

= 5.675 L

= 5.68 L

17. $Cu(s) + Sn^{2+}(aq) \rightarrow Cu^{2+}(aq) + Sn(s)$

$E^{\circ}_{cell} = E^{\circ}_{Sn^{2+}/Sn} - E^{\circ}_{Cu^{2+}/Cu}$

= –0.16 – 0.34 = –0.50 V

$\Delta G^{\circ} = -nF\ E^{\circ}_{cell}$

= –2 × 96500 (–0.50)

= 96500 J

18. $Pt|H_2(1\ bar)|HCl(pH = 1)|AgCl|Ag$

$$\frac{1}{2}H_2 + AgCl \longrightarrow H^+ + Ag + Cl^-$$

$$E_{cell} = E^0_{cell} - \frac{0.06}{1}\log\,[H^+][Cl^-]$$

= 0.22 – 0.06 log 10^{-2} = 0.34 V

Work function of Na metal = 2.3 eV

KE of photoelectron = 0.34 eV

Energy of incident radiation

= 2.3 + 0.34 = 2.64 eV

Also energy of incident radiation for K metal = 2.64 eV

Work function of K metal = 2.25 eV

KE of photoelectrons = 2.64 – 2.25 = 0.39 eV

$\therefore$ E_{cell} = 0.39 V = 0.22 – 0.06 log $[H^+]^2$

= 0.22 + 0.12 × pH

$pH \simeq 1.42 = 142 \times 10^{-2}$

19. $Cr_2O_7^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{3+} + 7H_2O$

I = 2 A, t = 8 min

$$Q = \frac{2\times 8\times 60}{96000}F$$

Moles of $Cr_2O_7^{2-}$ ions reduced

$$= \frac{960}{96000\times 6} = \frac{1}{600}$$

Moles of Cr^{3+} ions obtained = $\frac{1\times 2}{600}$

Mass of Cr^{3+} ions obtained = $\frac{2\times 52}{600} = \frac{104}{600}$

Mass of Cr^{3+} ions actually obtained

= 0.104 gm Efficiency

$$= \frac{6\times 0.104\times 100}{104} = 60\%$$

20. $6OH^- + Cl^- \rightarrow ClO_3^- + 3H_2O + 6e^-$

For synthesis of 1 mole of ClO_3^-, 6F of charge is required

current efficiency = 60%.

$\therefore$ To synthesis 1 mole of ClO_3^-,10F of charge is required.

To synthesis $\frac{10}{122}$ moles of $KClO_3$,

charge = $\frac{10\times 10}{122}F$

$$\therefore \frac{2\times t(hr)\times 3600}{96500} = \frac{100}{122}$$

$t \simeq 11$

21. Eqn is-

$MnO_4^- + H^{\oplus} + 5e^- \rightarrow Mn^{+2} + 4H_2O$

Nernst equation:

$$E_{cell} = E^0_{Cell} - \frac{0.059}{5}\log\frac{[Mn^{+2}]}{[MnO_4^-]}\left[\frac{1}{H^+}\right]^8$$

(I) Given $[H^{\oplus}]$ = 1M

$$E_1 = E^0 - \frac{0.059}{5}\log\frac{[Mn^{+2}]}{[MnO_4^-]}$$

(II) Now : $[H^{\oplus}] = 10^{-4}$M

$$E_2 = E^0 - \frac{0.059}{5}\log\frac{[Mn^{+2}]}{[MnO_4^-]}\times\frac{1}{(10^{-4})^8}$$

$$= E^0 - \frac{0.059}{5}\log\frac{Mn^{+2}}{[MnO_4^-]} + \frac{0.059}{5}\log 10^{-32}$$

therefore : $|E_1 - E_2| = \frac{0.059}{5}\times 32$

= 0.3776 V = 3776 × 10^{-4}

x = 3776

22. $Zn_{(s)} \rightarrow Zn^{2+}_{(aq.)} + 2e^-$

$2Ag^+_{(aq.)} + 2e^- \rightarrow 2Ag_{(s)}$

$Zn(s) + 2Ag^+_{(aq)} \rightarrow Zn^{2+}_{(aq.)} + 2Ag_{(s)}$

$E^0_{cell} = E^0_{Ag^+/Ag} - E^0_{Zn^{2+}/Zn}$

= 0.80 – (–0.76)

= 1.56 V

$$E_{cell} = 1.56\frac{-0.059}{2}\log\frac{[Zn^{2+}]}{[Ag^+]^2}$$

$$= 1.56 - \frac{0.059}{2}\log\frac{0.1}{(0.01)^2}$$

$$= 1.56 - \frac{0.059}{2}\times 3$$

= 1.56 – 0.0885

= 1.4715

= 147.15 × 10^{-2}

23. Given conc^n of KCl = $\frac{m.mol}{L}$

: Conductance (G) = 0.55 mS

: Cell constant $\left(\frac{\ell}{A}\right)$ =1.3cm^{-1}

To Calculate : Molar conductivity (λ_m) of sol.

→ Since $\boxed{\lambda_m = \frac{1}{1000}\times\frac{k}{m}}$.....(1)

→ Molarity = 5× 10^{-3} $\frac{mol}{L}$

→ Conductivity

$$= G\times\left(\frac{\ell}{A}\right) = 0.55mS\times\frac{1.3}{\frac{1}{100}}m^{-1}$$

= 55 ×1.3

eq^n(1) $\lambda_m = \frac{1}{1000} \times \frac{55 \times 1.3}{\left(\frac{5}{1000}\right)} \frac{mSm^2}{mol}$

$\Rightarrow \lambda_m = 14.3 \frac{mSm^2}{mol}$

24. From Kohlrausch's law

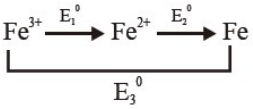
$\Lambda_m^\infty(BaSO_4) = \lambda_m^\infty(Ba^{2+}) + \lambda_m^\infty(SO_4^{2-})$

$\Lambda_m^\infty(BaSO_4) = \Lambda_m^\infty(BaCl_2) + \Lambda_m^\infty(H_2SO_4) - 2\Lambda_m^\infty(HCl)$

= 280 + 860 – 2(426)

= 288 $Scm^2\ mol^{-1}$

25.



$E_1^0 + 2E_2^0 = 3E_3^0$

$E_1^0 = 3E_3^0 - 2E_2^0$

= 3 (–0.036) – 2 (–0.44)

= + 0.772 V

$E_{cell}^0 = E_{Fe^{3+}/Fe^{2+}}^0 + E_{I^-/I_2}^0 = 0.233$

$\Delta_r G^0 = -2 \times 96.5 \times 0.233 = -45$ kJ

26. Given balanced equation is

$6\overset{\ominus}{O}H + \overset{\ominus}{Cl} \longrightarrow ClO_3^- + 3H_2O + 6e^- \rightarrow$

10g $KClO_3 \Rightarrow \frac{10}{122.6}$ mol $KClO_3$ is obtained

→ from the above reaction, it is concluded that by 6F charge 1 mol $KClO_3$ is obtained.

→ By the passage of 6F charge = 1 mol $KClO_3$

∴ By the passage of

$\frac{x \times 10 \times 60 \times 60}{96500}$ F charge

$= \frac{1}{6} \times \frac{x \times 10 \times 60 \times 60}{96500}$

Now, $\frac{x \times 10 \times 60 \times 60}{6 \times 96500} = \frac{10}{122.6}$

$\Rightarrow \quad x = \frac{10 \times 965}{60 \times 122.6} = \frac{965}{735.6} = 1.311 \simeq 1$

Or

$W = \frac{E}{F} \times I \times t \Rightarrow 10 = \frac{122.6}{96500 \times 6} \times x \times 10 \times 3600$

X = 1.311

27. $E = E^\circ - \frac{0.059}{2} \log \frac{[Cu^{+2}]}{[Ag^+]^2}$

$= 2.97 - \frac{0.059}{2} \log \frac{0.25}{(10^{-3})^2} = 2.81V$

28. $\Lambda_m = 1000 \times \frac{\kappa}{M}$

$= 1000 \times \frac{2 \times 10^{-5}}{0.001} = 20\ S\ cm^2\ mol^{-1}$

$\Rightarrow \alpha = \frac{\Lambda_m}{\Lambda_m^\infty} = \frac{20}{190} = \left(\frac{2}{19}\right)$ $HA \rightleftharpoons H^+ + A^-$

0.001 (1– α) 0.001α 0.001 α

$\Rightarrow K_a = 0.001\left(\frac{\alpha^2}{1-\alpha}\right) = \frac{0.001 \times \left(\frac{2}{19}\right)^2}{1 - \left(\frac{2}{19}\right)}$

$= 12.3 \times 10^{-6}$

29. $\frac{1}{2} H_2(g) + Fe^{3+}(aq.) \longrightarrow H^+(aq) + Fe^{2+}(aq.)$

$E = E^\circ - \frac{0.059}{1} \log \frac{[Fe^{2+}]}{[Fe^{3+}]}$

$\Rightarrow 0.712 = (0.771 - 0) - \frac{0.059}{1} \log \frac{[Fe^{2+}]}{[Fe^{3+}]}$

$\log \frac{[Fe^{2+}]}{[Fe^{3+}]} = \frac{(0.771 - 0712)}{0.059} = 1 \Rightarrow \frac{[Fe^{2+}]}{[Fe^{3+}]} = 10$

30. $Zn(s) + Sn^{2+}(aq) \rightleftharpoons Zn^{2+}(aq) + Sn(s)$

$\Delta G^\circ = -2.303\ RT \log_{10} Keq$

$-nF(E_{cell}^\circ) = -2.303 RT \log_{10} Keq$

$E_{Zn/Zn^{2+}}^\circ + E_{Sn^{2+}/Sn}^\circ = \frac{0.059}{2} \log_{10} Keq$

$0.76 + E_{Sn^{2+}/Sn}^\circ = \frac{0.059}{2} \log_{10} 10^{20}$

$0.76 + E_{Sn^{2+}/Sn}^\circ = \frac{0.059 \times 20}{2}$

$E_{Sn^{2+}/Sn}^\circ = 0.59 - 0.76 = -0.17$

$E_{Sn/Sn^{2+}}^\circ = 17 \times 10^{-2} V$

CHEMICAL KINETICS

1. Zero order reaction has complex mechanism.

Zero order reaction is a multistep reaction.

2. The rate constant of a reaction is given by

$k = Ae^{-E_a/RT}$

The rate constant in presence of catalyst is given by

$k' = Ae^{-E_a'/RT}$

$\frac{k'}{k} = e^{-(E_a' - E_a)/RT}$

$10^6 = e^{-(E_a' - E_a)/RT}$

$\ln 10^6 = \frac{(E_a' - E_a)}{RT}$

$E_a' - E_a = -6(2.303)RT$

3. Rate = $k[A]^n$

$\log[\text{Rate}] = \log k + n \log [A]$

slope = n [n is order of the reaction]

$\therefore$ Correct sequence for the order of the reaction is

d > b > a > c

4. $\because$ $A = A_0e^{-kt}$ $\quad k = \frac{\ln 2}{t_{1/2}}$

$\therefore$ $\frac{4B = A_0e^{-\frac{\ln 2}{300}\times t}}{B = B_0e^{-\frac{\ln 2}{180}\times t}}$

[given $A_0 = B_0$, $A = 4B$]

$4 = e^{\ln 2\left(\frac{1}{180} - \frac{1}{300}\right)t}$

T = 900 sec.

5. Rate = $k[A]^a [B]^b$

$6 \times 10^{-3} = k(0.1)^a (0.1)^b$ ...(1)

$2.4 \times 10^{-2} = k(0.1)^a (0.2)^b$ ...(2)

$1.2 \times 10^{-2} = k(0.2)^a (0.1)^b$ ...(3)

Solving eq (1), (2) and (3), we get

a = 1, b = 2

$6 \times 10^{-3} = k(0.1)^1 (0.1)^2$ from (1)

k = 6

$7.2 \times 10^{-2} = 6(x)^1 (0.2)^2 \Rightarrow x = 0.3$

$2.88 \times 10^{-2} = 6(0.3)^1 (y)^2 \Rightarrow y = 0.4$

6. $T_{1/2}$ = 200 s and 1st order reaction

$K = \frac{2.303 \log 2}{200} = \frac{2.303}{t} \log \frac{A_0}{0.2A_0}$

$\frac{\log 2}{200} = \frac{1}{t} \log 5$

$t = \frac{7}{3} \times 200 = 466.67 s = 467 s$

7. Given $t_{0.90} = xt_{1/2}$

First order rate constant

$K = \frac{\ln 2}{t_{1/2}} = \frac{1}{xt_{1/2}} \ln \frac{A_0}{A_0 - A_0 \times \frac{90}{100}}$

$\frac{\ln 2}{t_{1/2}} = \frac{\ln 10}{xt_{1/2}}$

$x = \frac{\ln 10}{\ln 2} = \frac{2.303}{2.303 \times 0.3010} = 3.32$

8. $t_{1/2} \propto (P_0)^{1-n}$

$\frac{(t_{1/2})_1}{(t_{1/2})_2} = \frac{(P_0)_1^{1-n}}{(P_{0_2})_2^{1-n}}$

$\Rightarrow \quad \left(\frac{4}{2}\right) = \left(\frac{50}{100}\right)^{1-n}$

$\Rightarrow \quad 2 = \left(\frac{1}{2}\right)^{1-n}$

$\Rightarrow \quad 2 = (2)^{n-1}$

$\Rightarrow \quad n - 1 = 1$

$\Rightarrow \quad n = 2$

9. Decay constant

$(\lambda) = \frac{\ell n 2}{(\text{half life})} = \frac{0.693}{6.93} = 0.1 \text{ yr}^{-1}$

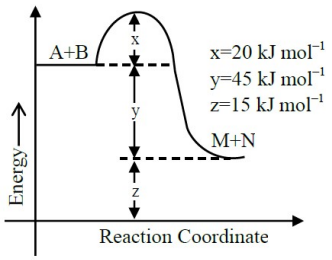
Now λ $(t_{90\%}) = \ln \left(\frac{100}{10}\right)$

$t_{90\%}$ = 10 ln 10

= 10 × 2.303

= 23.03 yr

10.



$\Delta H = E_{a_f} - E_{a_b}$

= 20 – 65

= – 45 KJ/ mol

$|\Delta H|$ = 45 KJ/mol

11. Given $\log K = 20.35 - \frac{2.47\times10^3}{T}$

We know $\log K = \log A - \frac{E_a}{2.303RT}$

$\Rightarrow \quad \frac{E_a}{2.303R} = 2.47\times10^3$

$E_a = 2.47 \times 10^3 \times 2.303 \times \frac{8.314}{1000}$ KJ/mole

= 47.29 = 47 (Nearest integer)

12. $K_{700} = 6.36\times10^{-3}s^{-1}$;

$K_{600} = x \times 10^{-6}s^{-1}$

E_a = 209 kJ/mol

Applying ;

$$\log\left(\frac{K_{T_2}}{K_{T_1}}\right) = \frac{-E_a}{2.303R}\left(\frac{1}{T_2}-\frac{1}{T_1}\right)$$

$$\log\left(\frac{K_{700}}{K_{600}}\right) = \frac{-E_a}{2.303R}\left(\frac{1}{700}-\frac{1}{600}\right)$$

$$\log\left(\frac{6.36\times10^{-3}}{K_{600}}\right) = \frac{+209\times1000}{2.303\times8.31}\left(\frac{100}{700\times600}\right)$$

$\log(6.36 \times 10^{-3}) - \log K_{600} = 2.6$

$\Rightarrow \quad \log K_{600} = -2.19 - 2.6 = -4.79$

$\Rightarrow \quad K_{600} = 10^{-4.79} = 1.62 \times 10^{-5}$

$= 16.2 \times 10^{-6}$

$= x \times 10^{-6}$

$\Rightarrow \quad x = 16$

13. $7 \times 10^{-9} = K \times (8 \times 10^{-5})^x (8 \times 10^{-5})^y$ .....(1)

$2.1 \times 10^{-8} = K \times (24 \times 10^{-5})^x$

$(8 \times 10^{-5})^y$ .....(2)

$\frac{1}{3} = \left(\frac{1}{3}\right)^x \Rightarrow x = 1$

14. As the unit of rate constant is min^{-1} so it must be a first order reaction

$K \times t = 2.303 \log A_0/A_t$

in 1 min 10% is in activated

$A_0 = 100$ $A_t = 90$ in 1 min

So $\quad K\times1 = 2.303\times\log\frac{100}{90}$

= 2.303 × (log 10 – 2log3)

= 2.303 × (1 – 2 × 0.477)

= 0.10593

= 105.93 × 10^{-3}

≈ 106

15. $PCl_{5(g)} \xrightarrow[300K]{\text{I order}} PCl_{3(g)} + Cl_{2(g)}$

t = 0 50 M

t = 120 min 10 M

$\Rightarrow \quad K = \frac{2.303}{t}\log\frac{[A_0]}{[A_t]}$

$\Rightarrow \quad K = \frac{2.303}{120}\log\frac{50}{10}$

$\Rightarrow \quad K = \frac{2.303}{120}\times0.6989 = 0.013413\,min^{-1}$

= 1.3413 × 10^{-2} min^{-1}

1.34 $\Rightarrow$ Nearest integer = 1

16. T_1 = 300K, T_2 = 325K, K_2 = 5K,

$$\ln\frac{K_2}{K_1} = \frac{Ea}{R}\left[\frac{1}{T_1}-\frac{1}{T_2}\right]$$

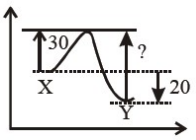
or, $\quad \ln5 = \frac{Ea}{8.314}\left[\frac{1}{300}-\frac{1}{325}\right]$

or, Ea = 0.7 × 2.303 × 8.314 × 12 × 325

= 52194 J = 52.194 kJ

Nearest integer answer will be 52 kJ

17. $X \rightarrow Y$



$\Delta H = E_{Af} - E_{Ab}$

$-20 = 30 - E_{Ab}$

$E_{Ab} = 50\ kJ\ mol^{-1}$

18. $A \rightarrow B$ $t_{1/2} = 0.3010$ min

A_0/A_t at time 2 min = ?

$$K = \frac{2.303}{t}\log\left(\frac{A_0}{A_t}\right)$$

$$\Rightarrow \quad \frac{0.693}{t_{\frac{1}{2}}} = \frac{2.303}{2}\log\left(\frac{A_0}{A_t}\right)$$

or $$\frac{2.303\times 0.3010}{0.3010} = \frac{2.303}{2}\log\frac{A_0}{A_t}$$

$$\log\frac{A_0}{A_t} = 2 \qquad \therefore \quad \frac{A_0}{A_t} = 10^2 = 100$$

19. $r = k\,[x]\,[y]^0 = k\,[x]$

Using I and II

$$\frac{4\times 10^{-3}}{2\times 10^{-3}} = \left(\frac{L}{0.1}\right) \Rightarrow L = 0.2$$

Using I and III

$$\frac{M\times 10^{-3}}{2\times 10^{-3}} = \frac{0.4}{0.1} \Rightarrow M = 8$$

$$\frac{M}{L} = \frac{8}{0.2} = 40$$

20. $$t = \frac{1}{\lambda}\ell n\left(\frac{a}{a-x}\right)$$

$$100 = \frac{30}{\ell n 2}\ell n\left(\frac{1}{w}\right)$$

$$\frac{1}{w} = 10$$

$W = 0.1\ \mu g$

Ans. $1 \times 10^{-1}\ \mu g$

21. For first order reaction

$$k = \frac{1}{t}\ln\left(\frac{P_0}{P}\right)$$

$$\ln\left(\frac{P_0}{P}\right) = kt$$

$$t_{1/2} = \frac{\ln 2}{k} = \frac{0.693}{3.465\times 10^4} = 2\times 10^{-5}$$

22. $$t_{\frac{1}{2}} \propto \frac{1}{[A_0]^{n-1}} \quad \Rightarrow \quad 100 \propto \frac{1}{(0.5)^{n-1}}$$

$$50 \propto \frac{1}{(1)^{n-1}}$$

$$[2]^1 = \left[\frac{1}{0.5}\right]^{n-1} \quad \Rightarrow \quad [2]^1 = [2]^{n-1}$$

$n - 1 = 1$

$n = 2$

order = 2

23. $$\ell n\left(\frac{K_2}{K_1}\right) = \frac{E_a}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$

$$\ell n\left(\frac{K_2}{K_1}\right) = \frac{532611}{8.3}\times\left(\frac{10}{310\times 300}\right)$$

Where K_2 is at 310 K & K_1 is at 300 K

$$\ell n\left(\frac{K_2}{K_1}\right) = 6.9 \quad = 3\times\ell n 10$$

$$\ell n\frac{K_2}{K_1} = \ell n 10^3$$

$$K_2 = K_1\times 10^3$$

$$K_1 = K_2\times 10^{-3}$$

So K = 1

24. $$\ln k = \ln A - \frac{E_A}{RT}$$

Given: $$\ln k = 33.24 - \frac{2.0\times 10^4}{T}$$

$\therefore$ on comparing $$\frac{E_A}{R} = 2.0\times 10^4$$

$\therefore\ E_A = 2.0 \times 10^4 \times R$

$\therefore\ E_A = 2.0 \times 10^4 \times 8.3\ J$

$\therefore\ E_A = 16.6 \times 10^4 J = 166\ kJ$

25. $\log_{10}\frac{K_2}{K_1}=\frac{E_a}{2.303R}\left(\frac{1}{300}-\frac{1}{309}\right)$

$0.3=\frac{E_a}{2.303\times 8.3}\left(\frac{9}{300\times 309}\right)$

$E_a=\frac{0.3\times 2.303\times 8.3\times 300\times 309}{9}$

= 59065.04 J

E_a = 59.06 kJ

26. $k_A=\frac{\ln 2}{100};\ k_B=\frac{\ln 2}{50}$

$A_t=A_0\times e^{-k_A t}$

$A_t=A_0\times e^{\left(\frac{-\ln 2}{100}\times t\right)}$

$B_t=B_0\times e^{\left(\frac{-\ln 2}{50}\times t\right)}$

$A_0=B_0$

& $A_t=4B_t$

$e^{-\frac{\ln 2}{100}\times t}=4\times e^{-\frac{\ln 2}{50}\times t}$

$e^{\frac{\ln 2}{100}\times t}=4$

$\frac{\ln 2}{100}\times t=\ln 4=2\ln 2$

t = 200 sec

27. ln k = I

$n\ A-\frac{Ea}{10^3RT}\times 10^3=\ell nA+\frac{10^3}{T}\left[-\frac{Ea}{10^3RT}\right]$

From the graph

$\frac{-Ea}{10^3\times R}=-18.5$

Ea = 153.735 kJ/mol

Ea ~154 kJ/mol

28. $t_{1/2}\times\frac{1}{[P_0]^{n-1}}$

$\frac{t_1}{t_2}\times\frac{(P_2)^{n-1}}{[P_1]^{n-1}}$

$\frac{340}{170}=\left(\frac{27.8}{55.5}\right)^{n-1}$

$\Rightarrow 2=\frac{1}{(2)^{n-1}}$

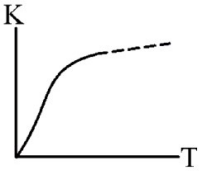
n = 0

29. **A:** $k=Ae^{-\frac{Ea}{RT}}$

As Ea increases k decreases

B: Temperature coefficient = $\frac{k_{T+10}}{k_T}$

C:



Option (C) is wrong. Δk may be greater or lesser depending on temperature.

D: $\ln k=\ln A-\frac{Ea}{RT}$

30. $t_{10\%}=\frac{1}{K}\ln\left(\frac{a}{a-x}\right)=\frac{1}{K}\ln\left(\frac{100}{90}\right)$

$t_{10\%}=\frac{2.303}{K}(\log 10-\log 9)$

$t_{10\%}=\frac{2.303}{K}\times(0.04)$

Similarly

$t_{90\%}=\frac{1}{K}\ln\left(\frac{100}{10}\right)$

$t_{90\%}=\frac{2.303}{K}$

$\frac{t_{90\%}}{t_{10\%}}=\frac{1}{0.04}=25$

$e^{kt}=\frac{a}{a-x}$

$\frac{a-x}{a}=e^{-kt}$

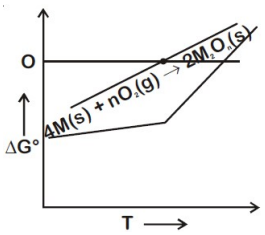
$1-\frac{x}{a}=e^{-kt}$

$x=a(1-e^{-kt})$

$\alpha=\frac{x}{a}=(1-e^{-kt})$

METALLURGY

1. From Ellingham Diagram



From graph it is evident, that the temperature below which the oxide is stable, is the point at which free energy change shows a change from negative to positive.

2. An Ellingham diagram provides information about, the temperature dependence of the standard gibbs energies of formation of some metal oxides.

3. Cast iron is used for the manufacture of wrought iron and steel.

4. $CaCO_3 \xrightarrow{500-800\,K} CaO + CO_2$

In extraction of silver, silver is extracted as an anionic complex $[Ag(CN)_2]^-$.

Ni is purified by Mond's process

$Ni + 4CO \xrightarrow{330-350K} Ni(CO)_4$

$Ni(CO)_4 \xrightarrow{450-470K} Ni + 4CO$

Zr and Ti are purified by Van Arkel method.

5. (A) Aluminium is reactive metal so Aluminium is extracted by electrolysis of Alumina with molten mixture of Cryolite

(B) Cryolite, Na_3AlF_6 Here Al is in +3 O.S.

So Answer is 4

6. Liquation method is used to purify those impure metals which has lower melting point than the melting point of impurities associated.

$\therefore$ This method is used for metal having low melting point.

7. Sphalerite-ZnS, copper glance - Cu_2S two sulphide ores can be separated by adjusting proportions of oil to water or by using ' Depressants '

8. (a) Concentration of Ag is performed by leaching with dilute NaCN solution

(b) Pig iron is formed in blast furnace

(c) Blister Cu is produced in Bessemer converter

(d) Froth floatation method is used for sulphide ores.

Note : During extraction of Cu reverberatory furnace is involved.

9. Ellingham diagram is a plot between $\Delta G°$ and T and does not give any information regarding rate of reaction

10. (A) $ZnCO_3(S) \xrightarrow{\Delta} ZnO(s) + CO_2(g)$

Heating in absence of oxygen in calcination.

(B) $2Zns(s) + 3O_2(g) \rightarrow 2ZnO(g) + 2SO_2(g)$

heating in presence of oxygen in roasting

Hence (A) is calcination while (B) in roasting.

11. Reduction of $Al_2O_3 \rightarrow Al$ is carried out by electrolytic reduction of its fused salts. ZnO, Fe_2O_3 & Cu_2O can be reduce by carbon.

12. At intersection point $\Delta G = 0$ and sudden increase in slope is due to melting or boiling point of the metal.

13. (a) Siderite = $FeCO_3$ = Fe-metal

(b) Calamine = $ZnCO_3$ = Zn-metal

(c) Malachite = $Cu(OH)_2.CuCO_3$ = Cu-metal

(d) Cryolite = Na_3AlF_6 = Aℓ-metal

14. Kernite = $Na_2B_4O_7.4H_2O$

Cassiterite = SnO_2 Calamine = $ZnCO_3$

Cryolite = $Na_3A\ell\ F_6$

15. Sphalerite ore : ZnS

Calamine ore : $ZnCO_3$

Siderite ore : $FeCO_3$

Malachite ore : $Cu(OH)_2.CuCO_3$

It is possible to separate two sulphide ores by adjusting proportion of oil to water or by using 'depressants'. In case of an ore containing ZnS and PbS, the depressant used is NaCN.

16. $Al_2O_{3(s)} + 2NaOH_{(aq.)} + 3H_2O_{(\ell)}$

$\downarrow$

$2Na[Al(OH)_4]_{(aq.)}$ (X)

$\downarrow$ CO_2 (Y)

$Al_2O_3.xH_2O_{(s)} + 2NaHCO_{3(aq.)}$

(Z)

So, X : $Na[Al(OH)_4]$

Y : CO_2

Z : $Al_2O_3.xH_2O$

17. $Al_2O_3 + 2NaOH + 3H_2O \rightarrow 2Na[Al(OH)_4]$ Leaching.

18. Liquation is used to purify metals having lower melting point than impurities present in them.

19. $FeO + SiO_2 \rightarrow FeSiO_3$

20. Statement I is incorrect because cast iron is obtained by heating pig iron with scrap iron

Statement II is also incorrect because pig iron has more carbon content (~ 4%) than cast iron (~3%)

21. From Ellingham diagram given in NCERT, it can be seen that Mg, MgO line crosses Al, Al_2O_3 line after 1350°C hence assertion is true.

Yes, Mg have lower MP and BP than aluminium but it does not explain the above fact.

22. In the electro-refining, impure metal (here blister copper) is used as an anode while precious metal like Au, Pt get deposited as anode mud.

23. Metal oxide with lower ΔG° is more stable

24.

List – I	**List - II**	
(A) Sphalerite	(IV)	ZnS
(B) Calamine	(III)	$ZnCO_3$
(C) Galena	(II)	PbS
(D) Siderite	(I)	$FeCO_3$

25. Ag. $4Ag + 8CN^- + O_2 + 2H_2O \rightarrow 4[Ag(CN)_2]^- + 4OH^-$

$2[Ag(CN)_2]^{-1} + Zn \rightarrow 2Ag\downarrow + [Zn(CN)_4]^{-2}$

26. Reverberatory furnace: Used for roasting of Copper.

Electrolytic cell : For reactive metal : Al

Blast furnace : Hematite to Pig Iron

Zone Refining furnace: For semiconductors : Si

27. In froth floatation method a rotating paddle draws in air and stirs the pulp.

28. Anode mud contains Sb, Se, Te, Ag, Au and Pt

29.

Bauxite	—	$AlO_x(OH)_{3-2x}$ (where $0 < x < 1$)
✓Siderite	—	$FeCO_3$
Cuprite	—	Cu_2O
Calamine	—	$ZnCO_3$
✓Haematite	—	Fe_2O_3
Kaolinite	—	$Al_2(0H)_4Si_20_5$
Malachite	—	$CuCO_3 . Cu(OH)_2$
✓Magnetite	—	Fe_3O_4
Sphalerite	—	ZnS
✓Limonite	—	$Fe_2O_3.3H_2O$
Cryolite	—	Na_3AlF_6

30.

(1) Baryte : $BaSO_4$

(2) Galena : PbS

(3) Zinc blende : ZnS

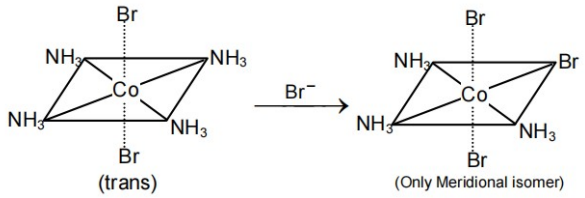
(4) Copper pyrite : $CuFeS_2$

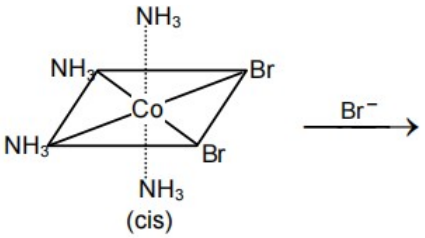
] sulphide (S^{2-}) ores

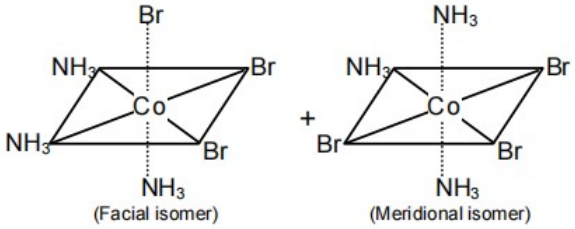
COORDINATION COMPOUND

1. (I & III)

$[Co(NH_3)_4Br_2]^+ + Br^- \rightarrow [Co(NH_3)_3Br_3] + NH_3$







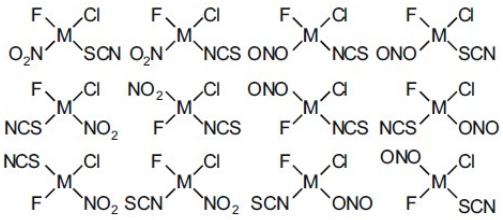
2. $[CoCl_6]^{3-} + 2(en) \longrightarrow [CoCl2(en)_2]^+$

(1 : 2 mole ratio) (cis-trans isomer)

A - optically active (cis-isomer)

B - optically inactive (trans isomer)

3.



$\therefore$ Answer is 12.

4. $K_4[Th(C_2O_4)_4(OH_2)_2]$

$C_2O_4^{2-}$ is bidentate ligand and H_2O is monodentate ligand.

$\therefore$ Co-ordination no. of Th = 2 × 4 + 2 = 10

5. μ = 3.9 BM

So, the central metal ion has 3 unpaired electrons.

$\therefore$ Configuration is either d^3 or d^7 as H_2O is a weak field ligand.

V^{2+} has d^3 configuration.

Co^{2+} has d^7 configuration.

6.

$[Fe(H_2O)_6]_2$	$[Fe(CN)_6]$
$[Fe(H_2O)_6]^{2+}$	$[Fe(CN)_6]^{4-}$
4 unpaired electrons	no unpaired electron
$\mu = 4.9$	$\mu = 0$

7.

		No. of unpaired electrons
$[V(CN)_6]^{4-}$	V^{+2}	3
$[Ru(NH_3)_6]^{3+}$	Ru^{+3}	1
$[Fe(CN)_6]^{4-}$	Fe^{+2}	0
$[Cr(NH_3)_6]^{2+}$	Cr^{+2}	2

$\therefore$ Order of spin magnetic moment

$V^{2+} > Cr^{2+} > Ru^{3+} > Fe^{2+}$

8. It has four lone pairs but maximum it will be able to donate three lone pairs.

Maximum denticity is 3.

9. Cr^{3+} has d^3 configuration and forms an octahedral inner orbitals complex.

The set of degenerate orintals are (d_{xy}, d_{yz} and d_{xz}) and ($d_{x^2-y^2}$ and d_{z^2}).

10. Ruby is aluminium oxide (Al_2O_3) containing about 0.5 – 1% Cr^{3+} ions which are randomly distributed in the position normally occupied by Al^{3+} ions.

11.

$[Fe(H_2O)_6]^{2+}$	$t_{2g}^4 e_g^2$	CFSE = $-0.4\Delta_0$
$[NiCl_4]^{2-} e^4$	t_2^4	CFSE = $-0.8\Delta_t$

12. The transition metal atom/ion in a complex may have unpaired electrons ranging from zero to 5. So, maximum number of unpaired electrons that may be present in a complex is 5. Magnetic moment is given as

$\mu = \sqrt{n(n+2)}$ BM (no. of unpaired electrons = n) Maximum value of magnetic moment

$= \sqrt{5(5+2)} = \sqrt{35} = 5.92$ BM

13. For the same metal ion, greater the co-ordination number and greater the strength of the ligands, greater is the value of crystal field splitting energy

$^{-}CN > NH_3 > H_2O > Cl^{-}$

14. (a) Co^{3+} with strong field complex forms low magnetic moment complex

(b) If $\Delta_0 < P$ configuration of Co^{3+} will be $t_{2g}^4 e_g^2$

(c) CFSE of $[Co(en)_3]^{3+}$ is more than $[CoF_6]^{3-}$

$\Rightarrow \lambda_{absorbed}$ of $[Co(en)_3]^{3+}$ is less than $[CoF_6]^{3-}$

(d) $\Delta_t = \frac{4}{9}\Delta_0 = \frac{4}{9} \times 18000 = 8000\,cm^{-1}$

Hence, (a) and (d) are incorrect

15. The IUPAC name is Diamminechlorido (methanamine)platinum(II) chloride

16.

		Number of unpaired electrons	μ
(A) $Ni(CO)_4$	$Ni = 3d^8 4s^2$(SFL)	0	0
(B) $[Ni(H_2O)_6]Cl_2$	$Ni^{+2} = 3d^8$(WFL)	2	$\sqrt{8}$ BM
(C) $Na_2[Ni(CN)_4]$	$Ni^{+2} = 3d^8$(SFL)	0	0
(D) $PdCl_2(PPh_3)_2$	$Pd^{+2} = 4d^8$	0	0

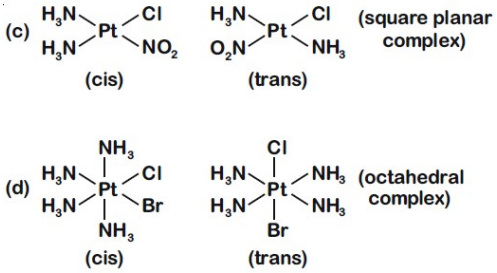
Correct order of the calculated spin only magnetic moments of complexes A to D is

$(A) \simeq (C) \simeq (D) < B$

17.

$[Pt(NH_3)_2Cl(NO_2)]$ and $[Pt(NH_3)_4ClBr]^{+2}$
(c) (d)

can display geometrical isomerism



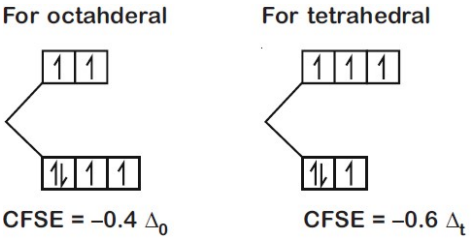
18. $[Co(NH_3)_3(NO_2)_3]$ will show fac and mer isomers

19. Spin only magnetic moment = 4.9 =

From this, n = 4 (unpaired electrons)

In case of d^6 having 4 unpaired electrons.

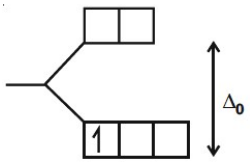
We have 2 possibilities.



So, option (3) is correct.

20.

$[Ti(H_2O)_6]^{3+}$ $\quad Ti^{3+} \rightarrow d^1$



$\Delta_0 = 20300\ cm^{-1}$

For octahedral

CFSE = $-0.4\ \Delta_0 = -0.4 \times 20300 = -8120\ cm^{-1}$

CFSE (in kJ) = $\frac{8120}{83.7} = 97\,kJ/mol$

21. $[CoF_3(H_2O)_3] \Rightarrow Co^{3+} \Rightarrow d^6$ or $t_{2g}^4 \rho_g^2$

CFSE = $[-4 \times 0.4 + 2 \times 0.6]\Delta_0 + 0$

$= -0.4\ \Delta_0$

22. **(A)** Sc^{3+}, Zn^{2+} ; $3d^0$ $3d^{10}$ **(B)** Ti^{4+}, Cu^{2+} ; $3d^0$ $3d^9$

(C) V^{2+}, Ti^{3+} ; $3d^3$ $3d^1$ **(D)** Zn^{2+}, Mn^{2+} ; $3d^{10}$ $3d^5$

No d-d transitions in ions with d° and d^{10} configuration. Therefore they are colourless.

23. Crystal field theory introduce spectrochemical series based upon the experimental values of Δ but can't explain it's order. While other three points are explained by CFT. Specially when the CFSE increases thermodynamic stability of the complex increases.

24. $[Co(NH_3)_5Cl]Cl_2$

Oxidation number of Co is +3.

So primary valency is 3.

It is an octahedral complex so secondary valency 6 or Co-ordination number 6.

25. $Na_4[Fe(CN)_5(NOS)]^{4-}$

Let the O.S. of Fe be x

OS of CN = –1

OS of NOS = –1

$\therefore$ $x + 5(-1) + (-1) = -4 \Rightarrow x = +2$

$Na_4[FeO_4]^{4-}$

Let O.S. of Fe be y

$\therefore$ $y + 4(-2) = -4 \Rightarrow y = +4$

$[Fe_2(CO)_9]$

Let O.S. of Fe be z

$2(z) + 9(0) = 0 \Rightarrow z = 0$

$x + y + z = 2 + 4 + 0 = 6$

26. A,B,C are correct and D is incorrect because Fehling solution has Cu(II)

27. Fehling solution is a complex of Cu^{++}

$Cu^{++} = 3d^9$

No. of unpaired $e^- = 1$

M.M = $\sqrt{1(1+2)} = \sqrt{3} = 1.73BM$

28.

MnF_4 (+4) MnF_3 (+3) MnF_2 (+2)

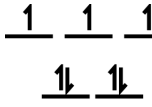
E.C = $[Ar]3d^3$ $[Ar]3d^4$ $[Ar]3d^5$

Hence $MnF_3 \Rightarrow$ strongest O.A

$\mu = \sqrt{4(4+2)} = \sqrt{24} = 4.89 = 5$

29. Carbonyl complex compounds have tendency to show synergic bonding.

30. Co^{2+} : $3d^7$ $4s^0$, Cl^- : WFL



Configuration $e^4t_2^3$: m = 4

Number of unpaired electrons = 3

So, answer = 7

S-Block

1. (i) $Na_2CO_3.10H_2O$ is prepared by Solvay process

(ii) $Mg(HCO_3)_2$is the reason of temporary hardness

(iii) NaOH is prepared by Castner-Kellener process

(iv) $Ca_3Al_2O_6$is the ingredient of Portland cement

2. Only lithium react with N_2 among alkali metals

3. Lithium salts are hydrated due to high hydration energy of Li^+

Li^+ due to smallest size in IA group has highest polarizing power.

4. Major component of portland cement is "Tricalcium silicate ($Ca_3\ SiO_5$) 51%

5. In IIA group on moving down the group size of cation increases and show thermal stability of carbonate increases.

6. Gypsum $CaSO_4.2H_2O$

Plaster of Paris $CaSO_4.\frac{1}{2}H_2O$

Dead burnt plaster $CaSO_4$

7. Lithium due to small size has very high polarization capability and thus increases covalent nature in Halides.

8. $NaOH \rightarrow$ Basic

$Be(OH)_2 \rightarrow$ Amphoteric

$Ca(OH)_2 \rightarrow$ Basic

$B(OH)_3 \rightarrow$ Acidic

$Al(OH)_3 \rightarrow$ Amphoteric

9. Statement-I is incorrect

$Be(OH)_2$ dissolve in alkali due to it's amphoteric nature.

Statement-II is correct Solubility of alkaline earth metal hydroxide in water increases down the group due to rapid decreases in lattice energy as compared to hydration energy.

10. (a) 'Ba' having outer electronic configuration $6s^2$.

(b) CaC_2O_4 is water insoluble

(c) 'Li' is soluble in organic solvents

(d) NaOH is strong Monoacidic base among given.

11. Across a period metallic character decreases

12. Alloy of Li and Mg is used to make armour plates and not aircraft plates.

Calcium plays important roles in neuromuscular function, interneuronal transmission and cell membrane integrity

13. Li_2O, $NaNO_2$

As per NCERT Lithium nitrate when heated gives lithium oxide, Li_2O, whereas other alkali metal nitrates decompose to give the corresponding nitrite.

$$4LiNO_3 \longrightarrow 2Li_2O + 4NO_2 + O_2$$

$$2NaNO_3 \longrightarrow 2NaNO_2 + O_2$$

However, the decomposition product of $NaNO_3$ are temperature dependent process as shown in the below reaction.

$$NaNO_3 \xrightarrow[500°C]{\Delta} NaNO_2\,(s) + \frac{1}{2}O_2\,(g)$$

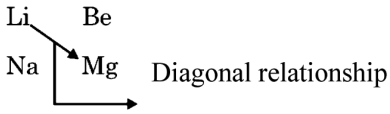
$$\xrightarrow[800°C]{\Delta} Na_2O(s) + N_2(g) + O_2(g)$$

As temperature is not mentioned, we can go by

14. Gypsum ($CaSO_4.2H_2O$) is used to enhance setting time in portland cement.

15. $2BeCl_2 + LiAlH_4 \rightarrow 2BeH_2 + LiCl + AlCl_3$

16.



$Li^+ \rightarrow$ Maximum hydration enthalpy in group 1 due to small size.

So 'B' is Mg.

17. Be_2Cl_4 is lewis acid and Al_2Cl_6 has complete octet. Be and Al are amphoteric metals therefore dissolve in acid as well as alkaline solution and form beryllate and aluminate ions in excess alkali.

18. Low solubility of LiF in water is due to high lattice enthalpy

19. In II'A' group density decreases down the group till Ca and after that it increases.
Correct order of density is Sr > Be > Mg > Ca

20. Factual

21. Due to high lattice energy LiF is sparingly soluble in water. Li^+ has high hydration energy among its group members due to smallest size.

22. $BaO_2 + H_2SO_4 \rightarrow BaSO_4 + H_2O_2$
This is a common method to prepare hydrogen peroxide

23. $2BeCl_2 + LiAlH_4 \rightarrow 2\ BeH_2 + LiCl + AlCl_3$
This is the method to prepare BeH_2

24. Baking soda $\rightarrow NaHCO_3$
Washing soda $\rightarrow Na_2CO_3.10H_2O$
Caustic soda $\rightarrow$ NaOH

25. (A) Both LiCl and $MgCl_2$ are soluble in ethanol
(B) Li and Mg do not form superoxide
(C) LiF has high lattice energy
(D) Li_2O is least soluble in water than other alkali metal oxides

26. Highest ionic mobility corresponds to lowest extent of hydration and highest size of gaseous ion.
Hence Sr^{2+} has the highest ionic mobility in its aqueous solution.

27. $Mg(HCO_3)_2 \xrightarrow{\text{Boil}} Mg(OH)_2 + 2CO_2\uparrow$
$Ca(HCO_3)_2 \xrightarrow{\text{Boil}} CaCO_3 + H_2O + CO_2\uparrow$

28. Z = 55
Cs = [Xe] $6s^1$
Cs^+ = [Xe] $\Rightarrow$ i.e. upto 5s count e^- of s-subshell i.e. 1s, 2s, 3s, 4s, 5s $\Rightarrow$ 10 electrons

29. Be has less negative value compared to other alkaline earth metal. However it's reducing nature is due to large hydration energy associated with the small size of Be^{2+} ion and relatively large value of the atomization enthalpy of metal.

30. $BeO + 2NH_3 + 4HF \rightarrow (NH_4)_2BeF_4 + H_2O$
$(NH_4)_2BeF_4 \xrightarrow{\Delta} BeF_2 + NH_4F$

p-Block (B&C)

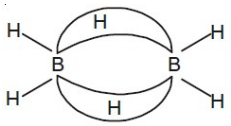
1.

$(A\ell)M + NaOH \longrightarrow (X)A\ell(OH)_3\downarrow \xrightarrow{\Delta} A\ell_2O_{3(s)}$

Gelatinous white ppt — Silica Gel. used as adsorbent in chromatography

$\xrightarrow[\text{Excess}]{NaOH} Na[Al(OH)_4]_{aq}$ soluble in water

2.



No. of 2-C-2-e^- bond = 4

No. of 3-C-2-e^- bond = 2

3. B_2O_3 is an acidic oxide

Al_2O_3 and Ga_2O_3 are amphoteric oxide

In_2O_3 and Tl_2O are basic oxide

4. Quartz, tridymite and cristobalite are crystalline forms of silica.

Kieselguhr is an amorphous form of silica.

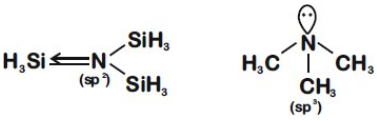
5. SiH_4– Electron precise hydride

GaH_3– Electron deficient hydride

$B2H_6$– Electron deficient hydride

AlH_3– Electron deficient hydride

6.



Trisilylamine is planar, due to backbonding of lone pairs of nitrogen into vacant d-orbitals of Si. In trimethylamine, there is no such delocalisation and hence it is more basic.

7. Carbon-carbon bond length is maximum in diamond

Species	C – C bond length
Diamond	154 pm
Graphite	141.5 pm
C_{60}	138.3 pm and 143.5 pm (double bond) (single bond)

8. $B_2H_6 + 3O_2 \longrightarrow B_2O_3 + 3H_2O$

$B_2H_6 + 6H_2O \longrightarrow 2H_3BO_3 + 6H_2$

9. These are examples of silicates, the basic unit being SiO_4^{4-} in each of them.

10. CCl_4 cannot be hydrolysed due to absence of d orbitals. Carbon cannot extend its coordination number beyond four.

11.

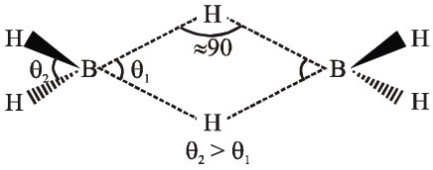
$B_3N_3H_3Cl_3$ (A) $\xrightarrow[THF]{LiBH_4}$ $B_3N_3H_6$ (B) (inorganic benzene)

(A) $\xrightarrow{MeMgBr\ (C)}$ $B_3N_3H_3(Me)_3$

12. For boron and silicon zone refining is used

13. $[SiCl_6]^{2-}$ does not exist due to steric crowding of surrounding atoms.

14.



- $\theta_2 > \theta_1$, $\therefore$ B–H (terminal) having less p-character as compare to bridge bond.
- Both B–H–B bridge bond having same bond length.
- B–H–B bond angle is $\approx 90°$
- BH_3 is e^- deficient species and therefore act as lewis acid

15. $T\ell I_3 \Rightarrow (T\ell^{\oplus}\ \&\ I_3^{\ominus})$

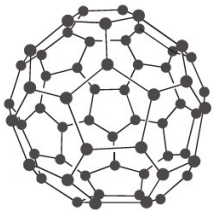
$CsI_3 \Rightarrow (Cs^{\oplus}\ \&\ I_3^{\ominus})$

[Both have same crystalline structure is called isomorphous]

$T\ell^{\oplus}_{(81)} = [xe_{54}]4f^{14}, 5d^{10}, 6s^2$

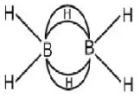
(It is correct due to present 14 f electrons in $T\ell^{\oplus}$ ion)

16. Structure of C_{60}



It contain 20 hexagons  and

12 pentagons  so option 4 is incorrect.

17. (A) (B) 

Two 3 centre – 2 – electron bonds

(C) B_2H_6 is e– deficient species

(E) B_2H_6 is non – Planar molecule

(D) $BF_3 + LiAlH_4 \rightarrow 2B_2H_6 + 3LiF + 3AlF_3$

$NaBH_4 + I_2 \rightarrow B_2H_6 + 2NaI + H_2$

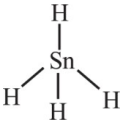
18. $3B_2H_6 + 6NH_3 \xrightarrow{\Delta} 2B_3N_3H_6 + 12\ H_2$

19. **Assertion (A):** True

Reason (R): True but not correct explanation.

Correct explanation: Expansion of octet not possible for 'B'.

20. SnH_4 is non planar molecular hydride

 Tetrahedral shape,

sp^3 hybridisation

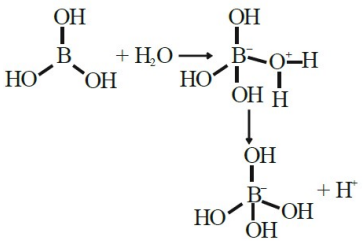
21. $Na_2B_4O_7 10H_2O \xrightarrow{\Delta} Na_2B_4O_7 + 10H_2O$

$Na_2B_4O_7 \xrightarrow{\Delta} 2NaBO_2$ (sodium metaborate) $+ B_2O_3$

$B_2O_3 + CoO \rightarrow Co(BO_2)_2$ (cobalt (II) meta borate)

Blue Bead

22.



23. $Na_2B_4O_7$ gives H_3BO_3 and NaOH (strong base) in water.

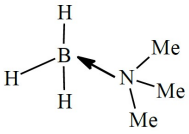
24. Caesium is used in devising photoelectric cells. Boron fibres are used in making bullet–proof vest.

Silicones being surrounded by non–polar alkyl groups are water repelling in nature. Gallium is less toxic and has a very high boiling point, so it is used in high temperature thermometers.

25.

$$BF_3 + NaH \xrightarrow{450K} \underset{\text{(diborane)}}{B_2H_6} + NaF$$

$$B_2H_6 + NMe_3 \longrightarrow \underset{\text{symmetrical cleavage}}{2[BH_3 \leftarrow NMe_3]}$$



26. **Melting point**

Al → 933 K

Ga → 303 K

In → 430 K

Se → 490 K

27. Electron deficient species have less than 8 electrons (or two electrons for H) in their valence (incomplete octet)

B_2H_6, BCl_3 have incomplete octet.

28. Moving down the group stability of lower oxidation state increase

Al < Ga < In < Tl

29. $(CH_3)_4Si$ is a silane

$(CH_3)Si(OH)_3$ polymerise to form 2D silicone

$(CH_3)_2Si(OH)_2$ polymerise to form chain silicone

$(CH_3)_3Si(OH)$ form dimer $(CH_3)_3Si\text{-}O\text{-}Si(CH_3)_3$

30. Extent of back bonding, reduces down the group leading to more Lewis acidic strength

BF_3 > BCl_3 > BBr_3 > BI_3

(extent of back bonding)

(2p–2p) (2p–3p) (2p–4p) (2p–5p)

$BF_3 < BCl_3 < BBr_3 < BI_3$ (lewis acidic nature)

NITROGEN OXYGEN FAMILY

1.

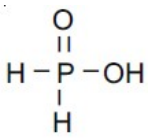
(oxide)	(oxidation state)
N_2O	+ 1
NO	+ 2
N_2O_3	+ 3
NO_2	+ 4

So, $N_2O < NO < N_2O_3 < NO_2$

2.

Acid	No of P-H bond
$H_4P_2O_5$	2
$H_4P_2O_6$	0
H_3PO_3	1
H_3PO_2	2

3.



Greater the number of P–H bonds in acids of phosphorous, greater is the reducing property.

4.

$$H_2O_2 \xrightarrow{\Delta} H_2O + \frac{1}{2}O_2$$

$KClO_3$, $Pb(NO_3)_2$, $NaNO_3$ on heating will release O_2 gas.

$$2NaBO_2 + 2H_2O_2 + 6H_2O \longrightarrow \underset{\text{Sodium metaborate}}{}$$

$$Na_2\left[(OH)_2B(O-O)_2B(OH)_2\right].6H_2O$$

Sodium Peroxoborate

5.

$$P_4 + 3NaOH + 3H_2O \rightarrow PH_3 + 3NaH_2PO_2\ (X)$$

$$\downarrow \text{acidification with HCl}$$

$$H_3PO_2\ (Y)$$

Basicity of H_3PO_2 (Y) $= 1$

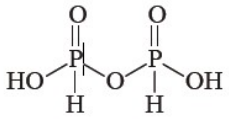
6. $2NO + N_2O_4 \xrightarrow{250K} N_2O_3$

7. $\alpha - \text{sulphur} \underset{<369}{\overset{>369K}{\rightleftharpoons}} \beta - \text{sulphur}$

at room temperature a-sulphur (Rhombic) is most stable form.

8.

$$PCl_3 + H_3PO_3 \rightarrow H_4P_2O_5$$



(Two ionisable H)

9. $4HNO_3 + P_4O_{10}$

$\downarrow$

$2N_2O_5 + (HPO_3)_4$

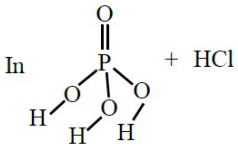
Ans. N_2O_5 is acidic in nature.

10. Among 15th group hydrides, BiH_3 is strongest reducing agent.

11. $PCl_5 + H_2O \rightarrow POCl_3 + 2HCl$

$\downarrow + 3H_2O$

$H_3PO_4 + 3HCl$



all hydrogens are ionisable

$\therefore$ Ans is zero.

12. When red phosphorus is heated in a sealed tube at 803 K, α-black phosphorus is formed.

13. In group 15

$\left.\begin{matrix}N\\P\end{matrix}\right] \rightarrow$ Non metal

$\left.\begin{matrix}As\\Sb\end{matrix}\right] \rightarrow$ Metalloid

$\left.\begin{matrix}Bi\end{matrix}\right] \rightarrow$ Metal

Hydrides of group 15 elements are

NH_3

PH_3

AsH_3

SbH_3

BiH_3

In NH_3, hydrogen atom gets partial positive charge due to less electronegativity.

But in BiH_3, hydrogen atom gets partial negative charge because hydrogen is more electronegative than bismuth.

i.e. BiH_3 is a strong reducing agent than others because we know that H^- is a strong reducing agent.

14. $N_2(g) + O_2(g) \rightarrow 2NO(g)$

$2N0(g) + O_2(g) \rightarrow 2NO_2(g)$

NO_2 damage plant leaves

15. (1) $4NH_3(g) + 5O_2(g) \xrightarrow{Pt(s)} 4NO(g) + 6H_2O(g)$

Ostwald process 500 K

(2) $N_2 + 3H_2 \xrightarrow{Fe(s)} 2NH_3(g)$

Haber's process

(3) $C_{12}H_{22}O_n(aq.) + H_2O(l) \xrightarrow{H^+} \underset{(glucose)}{C_6H_{12}O_6} + \underset{(fructose)}{C_6H_{12}O_6}$

Inversion of sugar cane

(4) $2SO_2(g) + O_2(g) \xrightarrow{NO(g)} 2SO_3(g)$

16. $(NH_4)_2Cr_2O_7 \xrightarrow{\Delta} N_2 + Cr_2O_3 + 4H_2O$

$KMnO_4 + HCl \longrightarrow MnCl_2 + KCl + Cl_2 + H_2O$

$Al + NaOH + H_2O \longrightarrow H_2 + Na[Al(OH)_4]$

$NaNO_3 \xrightarrow{\Delta} NaNO_2 + O_2$

17. $P_4 + 8SOCl_2 \rightarrow 4PCl_3 + 4SO_2 + 2S_2Cl_2$

18. $I_2 + 10HNO_{3(conc)} \Rightarrow 2HIO_3 + 10NO_2 + 4H_2O$

19. $2SO_2(g) + O_2\,g \xrightarrow{V_2O_5} 2SO_3\,g$:

contact process

$4NH_3\,(g) + 5O_2\,g \xrightarrow{Pt(s)-Rh(s)} 4NO(g) + 6H_2O(g)$:

Ostwald 's process

$N_2\,(g) + 3H_2\,g \xrightarrow{Fe(s)} 2NH_3\,g$;

Haber 's process

Vegetable oil $(l) + H_2\,g \xrightarrow{Ni(s)}$ vegetable ghee

: Hydrogenation

20. $P_4 + 3NaOH + 3H_2O \rightarrow PH_3 + 3NaH_2PO_2$

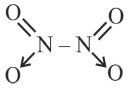
oxoacid = H_3PO_2 (hypo phosphorus acid) or (phosphinic acid)

21. $Ba(N_3)_2 \rightarrow Ba + 3N_2$

22. $P_4 + 3NaOH + 3H_2O \rightarrow 3NaH_2PO_2 + PH_3$

23. $Pb(NO_3)_2 \xrightarrow[673K]{\Delta} PbO + NO_2 + O_2$

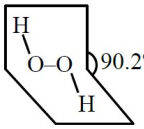
$\underset{A}{NO_2} \xrightarrow{Dimerise} \underset{B}{N_2O_4}$



(no bridged oxygen)

24. $2HSO_4^-(aq) \xrightarrow[(2)Hydrolysis]{(1)Electrolysis} 2HSO_4^- + 2H^+ + H_2O_2$

(A)



Solid phase.

25. Na_2O = Basic As_2O_3 = Amphoteric

N_2O = Neutral NO = Neutral

Cl_2O_7 = Acidic

26. $N_2 + O_2 \underset{}{\overset{(1483-2000\ K)}{\rightleftharpoons}} 2NO$

(Endothermic and feasible at high temperature)

27. $4NH_3 + 5O_2 \xrightarrow{\Delta} \underset{(A)}{4NO} + 6H_2O$

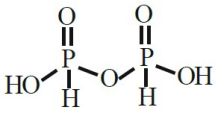
$2NO + O_2 \longrightarrow \underset{(B)}{2NO_2}$

28. $P_4 + 3OH^- + 3H_2O \rightarrow PH_3 + \underset{(A)}{3H_2PO_2^-}$

$\underset{1\,mole}{H_2PO_2^-} + \underset{excess}{4Ag^+} + 2H_2O \rightarrow \underset{4\,mole}{4Ag} + H_3PO_4 + 3H^+$

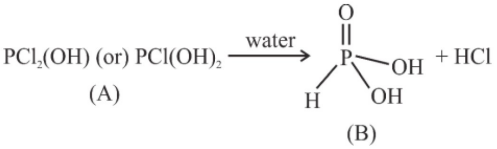
29. $C_2H_5OH + PCl_3 \longrightarrow C_2H_5Cl + H_3PO_3$

$H_3PO_3 + PCl_3 \longrightarrow H_4P_2O_5 + HCl$



30. $PCl_3 + H_2O$ Partial $\xrightarrow[hydrolysis]{Partial}$

$PCl_2(OH)$ (or) $PCl(OH)_2 + HCl$



no. of ionisable protons in B = 2

d & f Block + QUALITATIVE ANALYSIS (ONLY CATION)

1. $\underset{(A)}{2MnO_2} + 4KOH + O_2 \longrightarrow \underset{\substack{(Green)\\(B)}}{2K_2MnO_4} + 2H_2O$

$K_2MnO_4 + 4HCl \longrightarrow \underset{\substack{(Green)\\(C)}}{2KMnO_4} + MnO_2 + 2H_2O$

$2KMnO_4 + H_2O + KI \longrightarrow 2MnO_2 + 2KOH + \underset{(D)}{KIO_3}$

A – MnO_2

D – KIO_3

2. $\underset{(X)}{2KMnO_4} \xrightarrow{513K} \underset{(Y)}{K_2MnO_4} + MnO_2 + \underset{gas}{O_2}$

$MnO_2 + 4NaCl + \underset{Conc.}{4H_2SO_4} \rightarrow MnCl_2 + 4NaHSO_4 + \underset{\substack{(Z)\\pungent\ gas}}{Cl_2} + 2H_2O$

3. Mo and W belong to group-6 and period 5 (4d series) and 6 (5d series) respectively.

Due to lanthanoid contraction, radius of Mo and W are almost same.

4. $\underset{Cu^+}{CuBr} \longrightarrow \underset{Cu^0}{Cu} + \underset{Cu^{2+}}{CuBr_2}$

It is an example of disproportionation reaction.

5. (A) V_2O_5 → Preparation of H_2SO_4 in contacts process

(B) $TiCl_4$ + $Al(Me)_3$ → Polyethylene (Ziegler- Natta catalyst)

(C) $PdCl_2$ → Ethanal (Wacker's process)

(D) Iron oxide → NH_3 in Haber's process

6. Sm^{+3} = Partially filled f orbital = $4f^5$

Sm = $4f^6 6s^2$

Sm^{+3} = Yellow.

Lu^{+3} = $4f^{14}$ colourless.

7. Ce^{3+} (Z = 58) – [Xe] $4f^1$

Eu^{2+} (Z = 63) – [Xe]$4f^7$

8. Gd^{3+} (Z = 64) = [Xe] $4f^7$

$\mu = \sqrt{n(n+2)} = \sqrt{7(7+2)} = 7.9$ B.M.

9. Misch metal is an alloy consisting mainly of lanthanoid metals.

10.

$Au + 4H^+ + NO_3^- + 4Cl^- \rightarrow AuCl_4^- + NO + 2H_2O$

$3Pt + 16H^+ + 4NO_3^- + 18Cl^- \rightarrow 3PtCl_6^{2-} + 4NO + 8H_2O$

11. $2KMnO_4 \xrightarrow[200°C]{\Delta} \underset{Green}{K_2MnO_4} + \underset{Black}{MnO_2} + O_2$

In K_2MnO_4, manganese oxidation state is +6 and hence it has one unpaired e^-.

12. $Cu^{2+} : [Ar]3d^9 4s^0$
$Cr^{3+} : [Ar]3d^3 4s^0$
$Sc^{+} : [Ar]3d^1 4s^1$
] All are coloured and paramagnetic due to presence of unpaired electrons

13. Major components of German silver are:

Cu, Zn, Ni

(50%) (30%) (20%)

14. (1) $CuCl_2 + nH_2O \rightarrow Cu^{+2}_{(aq.)}$ blue colour

(2) AgCl + nH_2O → Insoluble

(3) $ZnCl_2 + nH_2O \rightarrow Zn^{+2}_{(aq.)}$ Colourless

(4) $Cu_2Cl_2 + nH_2O$ → Insoluble

15. Zinc dissolves in excess of aqueous alkali

$Zn + 2OH^- + 2H_2O \rightarrow \underset{\substack{Tetrahydroxozincate(II)ion}}{[Zn(OH)_4]^{2-}} + H_2 \uparrow$

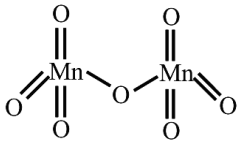
However, this reaction in NCERT is given as

$Zn + 2NaOH \rightarrow Na_2ZnO_2 + H_2 \uparrow$

ZnO_2^{2-} is anhydrous form of $[Zn(OH)_4]^{2-}$

So in aqueous medium best answer of this question is $[Zn(OH)_4]^{2-}$

16.



17. $H_2O_2 + MnO_4^- \rightarrow Mn^{2+} + O_2$ (unbalanced)

18. Ce = [Xe] $4f^1 5d^1 6s^2$

Ce^{3+} = [Xe] $4f^1 5d^0$

Ce^{+4} = [Xe] $4f^0 5d^0$ (Noble gas configuration)

19. Cerium exists in two different oxidation state +3, +4

$Ce^{+4} + e^- \rightarrow Ce^{3+}$

$E^0 = +1.61V$

$Ce^{+3} + 3e^- \rightarrow Ce$

$E^0 = -2.336\,V$

It shows Ce^{+4} acts as a strong oxidizing agent & accepts electron.

20.

Ion	Colour of the flame
(A) Cu^{+2}	green flame with blue centre
(B) Sr^{2+}	Crimson Red
(C) Ba^{2+}	Apple green

21. $3SO_2 + Cr_2O_7^{2-} + 2H^+ \rightarrow 3SO_4^{2-} + \underset{\text{green}}{2Cr^{+3}} + H_2O$

22. In acidic medium

$2MnO_4^- + 10I^- + 16H^+ \rightarrow 2Mn^{2+} + 5I_2 + 8H_2O$

In neutral/faintly alkaline solution

$2MnO_4^- + I^- + H_2O \rightarrow 2MnO_2 + 2OH^- + IO_3^-$

23. $Ni^{+2} + 2DMG \xrightarrow{NH_3(aq)} \underset{\text{(Rosy Red complex)}}{[Ni(DMG)_2]}$

24. Blue green colour is due to formation of $Cu(BO_2)_2$

$CuSO_4 \xrightarrow{\Delta} CuO + SO_3$

$CuO + B_2O_3 \longrightarrow Cu(BO_2)_2$

25. $NaCl \xrightarrow[\text{conc.}H_2SO_4]{K_2Cr_2O_7} \underset{(A)}{CrO_2Cl_2} \xrightarrow{NaOH} \underset{(B)}{Na_2CrO_4}$

$\underset{(B)}{Na_2CrO_4} \xrightarrow[H_2O_2]{\text{dil } H_2SO_4} \underset{(C)}{CrO_5}$

Total number of atoms in A, B and C are 18.

26. Np = $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^6\ 5s^2\ 4d^{10}\ 5p^6\ 6s^2\ 4^{14f}\ 5d^{10}\ 6p^6\ 7s^2\ 5f^4\ 6d^1$

Total no. of 'f' electron = $14\ e^- + 4e^- = 18$

27. $Fe^{3+} + 3K^+ + 3C_2O_4^{2-} \rightarrow \underset{(A)}{K_3[Fe(C_2O_4)_3]}$

Secondary valency of Fe in 'A' is 6.

28. Mohr's salt : $(NH_4)_2\,Fe(SO_4)_2.6H_2O$

The number of water molecules in Mohr's salt = 6

Potash alum : $KAl(SO_4)_2.12H_2O$

The number of water molecules in potash alum = 12

So ratio of number of water molecules in Mohr's salt and potash alum = $\frac{6}{12}$

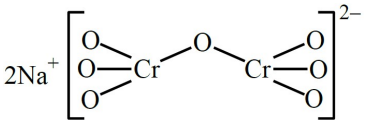
$= \frac{1}{2} = 0.5 = 5 \times 10^{-1}$

29. Pbs, CuS, As_2S_3, CdS are soluble in 50% HNO_3 HgS, Sb_2S_3 are insoluble in 50% HNO_3

So Answer is 4.

30. $4FeCr_2O_4 + 8Na_2CO_3 + 7O_2 \rightarrow 8Na_2CrO_4 + 2Fe_2O_3 + 8CO_2$

$2Na_2CrO_4 + 2H^+ \rightarrow \underbrace{Na_2Cr_2O_7}_{B} + 2Na^+ + H_2O$



HALOGEN & NOBLE GAS + QUALITATIVE ANALYSIS (ONLY ANION)

1. In general, interhalogen compounds are more reactive than halogens except fluorine (as per NCERT)

2. $Cl_2 + 2NaOH \longrightarrow Cl^- + ClO^- + Na^+ + H_2O$

(Disproportionation reaction.)

Cold & dil.

3. Reaction of I_2 with H_2 requires catalyst.

While all other halogens reacts with H_2 without catalyst.

4. $3Cl_2 + 6NaOH \longrightarrow 5NaCl + NaClO_3 + 3H_2O$

5. HF has highest boiling point among the hydrogen halides due to strong H-bonding between HF molecules.

6. Radon is not present in atmosphere.

7. $NaOH + Cl_2 \rightarrow \underset{(A)}{NaCl} + NaClO_3 + H_2O$

$Ca(OH)_2 + Cl_2 \rightarrow \underset{(B)}{CaCl_2} + Ca(OCl)_2 + H_2O$

8. In $BrO_4^{\ominus}$, Br is in highest oxidation state (+7), So it cannot oxidise further hence it cannot show disproportionation reaction.

9. (i) Reactivity order :

$F_2 > ClF$ (inter halogen) $> Cl_2$

(ii) $ClF + H_2O \rightarrow HOCl + HF$

(iii) Oxidizing power in aqueous solution

$F_2 > Cl_2 > Br_2 > I_2$

10. O_2F_2 oxidises plutonium to PuF_6 and the reaction is used in removing plutonium as PuF_6 from spent nuclear fuel.

11. Stability of oxides of Halogens is I > Cl > Br

12. $I_2 + H_2O_2 + 2OH^- \longrightarrow 2I^- + 2H_2O + O_2$

13. (i) Blue cupric metaborate is reduced to colourless cuprous metaborate in a luminous flame

$2Cu(BO_2)_2 + 2NaBO_2 + C$

$\downarrow$ Luminous flame

$2CuBO_2 + Na_2B4O_7 + CO$

(ii) Cupric metaborate is obtained by heating boric anhydride and copper sulphate in a non luminous flame.

$$CuSO_4 + B_2O_3 \xrightarrow[\text{Flame}]{\text{Non-luminous}} \underset{\text{Cupric metaborate (Blue-green)}}{Cu(BO_2)_2 + SO_3}$$

14. For testing of halogens, Nitric acid is added to the sodium extract because if CN^- or S^{2-} are present then they will be oxidised and removed before the test of halides.

15. $\underset{\text{(Anion)}}{\underset{X}{NO_3^-}} + \underset{\text{(Conc.)}}{H_2SO_4} \rightarrow \underset{\text{Brown fumes}}{NO_2} \uparrow + H_2O$

$\underset{Sol^n}{FeSO_4} + \underset{conc.}{H_2SO_4} + \underset{X}{NO_3^-}$

$\downarrow$

$[Fe(H_2O)_5(NO)]SO_4$

(Dark brown ring)

Cu^{2+} + (dil HCl + H_2S)

$\underset{\text{(cation)}}{X}$ (Group – II reagent)

$\downarrow$

$CuS \downarrow$

(Black ppt)

(Y)

$$\underset{(Y)}{Cus} \xrightarrow[HNO_3]{Conc^n} \overset{Solube}{Cu(NO_3)_2} + NO_2 + S + H_2O$$

$\downarrow$ Excess NH_4OH Sol^n.

$[Cu(NH_3)_4]^{2+}$

Deep blue colour solution.

$\therefore$ $X \rightarrow Cu(NO_3)_2$

16. Both A and R are correct and R is the correct explanation of A.

17.

$$Br_2 + 5\underset{\text{(excess)}}{F_2} \longrightarrow 2\overset{+5}{BrF_5} \xrightarrow{H_2O} HBrO_3 \text{ (Forms bromate)}$$

18. $BaCl_2 + SO_3^{2-} \rightarrow \underset{\text{white}}{BaSO_3} \downarrow \xrightarrow{dil.HCl} \underset{\text{burning sulphur like smell}}{SO_2} \uparrow$

19. Ring is formed due to formation of nitrosoferrous sulphate

20. CO_3^{2-} will give CO_2(g) which will turns lime water milky.

S^{2-} will give H_2S (g), will turns lead acetate paper black

SO_3^{2-} will give SO_2 (g), which will turns acidified potassium dichromate solution green.

NO_2^- will give brown NO_2(g) will turn KI solution blue.

21. $Cl^- + AgNO_3 \longrightarrow \underset{\substack{[A]\\ \text{Curdy white}\\ \text{precipitate}}}{AgCl}$

$AgCl + NH_4OH \longrightarrow \underset{\substack{[B]\\ \text{(soluble Complex)}}}{[Ag(NH_3)_2]Cl}$

22. Bond energy of F_2 less than Cl_2 due to lone pair-lone pair repulsions.

Bond energy order $Cl_2 > Br_2 > F_2 > I_2$

23. Chlorine oxides, Cl_2O, ClO_2, Cl_2O_6 and Cl_2O_7 are highly reactive oxidising agents and tend to explode.

24.

Element	ΔegH[KJ/mol]
He	+48
Ne	+116
Kr	+96
Xe	+77

From NCERT

So, order is Ne > Kr >Xe > He

25. $Cr_2O_7^{2-} + SO_3^{2-} \xrightarrow{H^+} \underset{\text{Green}}{Cr^{3+}} + SO_4^{2-}$

26. Zn^{2+}, Co^{2+}, Ni^{2+} = IVth Group

Fe^{3+} = IIIrd Group

27. (Borax Bead Test)

On treatment with metal salt, boric anhydride forms metaborate of the metal which gives different colours in oxidising and reducing flame. For example, in the case of copper sulphate, following reactions occur.

$CuSO_4 + B_2O_3 \xrightarrow[\text{(Oxidising)}]{\text{Non-luminous flame}}$

$\underset{\substack{\text{Cupric metaborate}\\ \text{blue-green}}}{Cu(BO_2)_2} + SO_3$

Two reactions may take place in reducing flame (Luminous flame)

(i) The blue-green $Cu(BO_2)_2$ is reduced to colourless cuprous metaborate as :

$2Cu(BO_2)_2 + 2NaBO_2 + C \xrightarrow[\text{flame}]{\text{Luminous}}$

$2CuBO_2 + Na_2B_4O_7 + CO$

(ii) Cupric metaborate may be reduced to metallic copper and bead appears red opaque.

$2Cu(BO_2)_2 + 4NaBO_2 + 2C \xrightarrow[\text{flame}]{\text{Luminous}}$

$2Cu + 2Na_2B_4O_7 + 2CO$

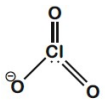
28. $3Cl_2 + 6NaOH \xrightarrow{\text{Conc.}} 5NaCl + NaClO_3 + 3H_2O$

Ag+ forms precipitate with Cl– i.e. AgCl.

$AgClO_3$ is soluble.

$\therefore$ X is NaCl

Y is $NaClO_3$

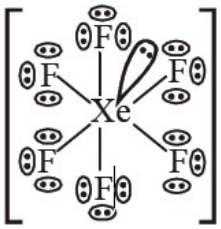
Now, structure of ClO_3^- is 

$\therefore$ Bond order is $\frac{5}{3}$ i.e. 1.67

29. $XeF_6 + 2H_2O \longrightarrow XeO_2F_2 + 4HF$

(A) (Limited water)

Structure of 'A'



Total l.p. on (A) = 19

30. The number of halogen forming halic (V) acid

$HClO_3$

$HBrO_3$

HIO_3

So Answer is 3

HYDROGEN

1. Bicarbonates cause temporary hardness. Chlorides and sulphates cause permanent hardness.

2. Isotopes of hydrogen and the number of neutrons present in them are

	$_1H^1$	$_1H^2$(D)	$_1H^3$(T)
Number of neutrons	0 (x)	1 (y)	2 (z)

Total number of neutrons in three isotopes of hydrogen = 0 + 1 + 2 = 3

3. In water gas shift reaction, Hydrogen gas is produced economically by the reaction of carbon monoxide with water vapour at 673 K in presence of iron, cromium and copper zinc catalyst

$$CO + H_2O(g) \xrightarrow[\Delta]{\text{Catalyst}} CO_2 + H_2(g)$$

4. To obtain H_2 of high purity (> 99.95 %) electrolysis of $Ba(OH)_2$ solution is done using Ni electrodes

5. The bond dissociation energy of D_2 is greater than H_2 and therefore D_2 reacts slower than H_2.

6. Atomic hydrogen is produced at high temperature in an electric arc under ultraviolet radiations The dissociation of dihydrogen at 2000 K is only 0.081%

H–H bond dissociation enthalpy is highest for a single bond for any diatomic molecule. Dihydrogen can be produced on reacting Zn with dil. HCl as well as NaOH (aq.)

7. 1. $PbO_2 + 2H_2O \rightarrow Pb(OH)_4$

2. $Na_2O_2 + 2H_2O \rightarrow 2NaOH + H_2O_2$ this reaction is possible at room temperature

3. $SnO_2 + 2H_2O \rightarrow Sn(OH)_4$

4. Acidified $BaO_2.8H_2O$ gives H_2O_2 after evaporation.

8. CO_2, CCl_4 and $Cl_2C = CCl_2$ are used as dry cleaning agents for clothes.

H_2O_2 is used as bleaching agent in laundry.

9. $_1^1H$ and $_2^1H$ are stable while $_1^3H$ is radioactive.

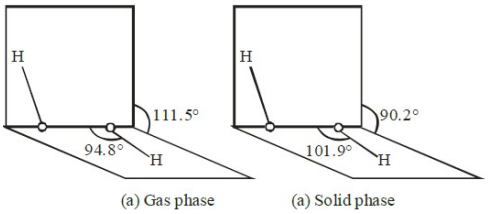
10. Enthalpy of bond dissociation (kJ/mole) at 298.2K

For , hydrogen = 435.88

For , Deuterium = 443.35

$\therefore \quad E_H \simeq E_D - 7.5$

11.



(a) Gas phase (a) Solid phase

(a) H_2O_2 structure in gas phase, dihedral angle is 111.5°. (b) H_2O_2 structure in solid phase at 110K, dihedral angle is 90.2°. Hence given statement (A) is not correct But statement (B) is correct.

12. In basic medium oxidising action of H_2O_2,

$Mn^{2+} + H_2O_2 \rightarrow Mn^{+4} + 2OH^-$

In basic medium, reducing action of H_2O_2

$$I_2 + H_2O_2 + 2OH^- \rightarrow 2I^- + 2H_2O + O_2$$

In acidic medium, oxidising action of H_2O_2

$$PbS(s) + 4H_2O(aq) \rightarrow PbSO_4(s) + 4H_2O(l)$$

Hence correct option (4)

13. For temporary hardness,

$$Mg(HCO_3)_2 \xrightarrow{\text{heating}} Mg(OH)_2\downarrow + 2CO_2\uparrow$$

Assertion is false.

$MgCO_3$ has high solubility product than $Mg(OH)_2$.

According to data of NCERT table 7.9 (Equilibrium chapter), the solubility product of magnesium carbonate is 3.5×10^{-8} and solubility product of $Mg(OH)_2$ is 1.8×10^{-11}.

Hence Reason is incorrect.

14. Informative, according to ncert uses of di hydrogen.

In fact NH_3 largest production in used to manufacture nitrogenous fertilisers.

15. The dielectric constant of H_2O is greater than heavy water.

16. $\rightarrow$ 2nd most abundant element is "Si" and it is not present in calgon

$Na_6P_6O_{18}$ = (Graham's salt) (Sodium hexametaphosphate)

$\rightarrow$ It exist in polymeric form as $(NaPO_3)_6$ and water soluble compound

$\rightarrow$ It removes Ca^{2+} in soluble ion but not by precipitation

17. Heavy water is used in exchange reactions for study of reaction mechanisms

Heavy water is prepared by exhaustive electrolysis of water.

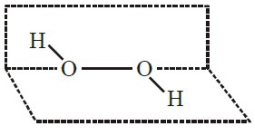
B.P. of D_2O = 374.4 K

B.P. of H_2O = 373 K

Viscosity of H_2O = 0.89 centipoise

Viscosity of D_2O = 1.107 centipoise

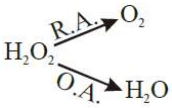
18.



Structure of H_2O_2

(Open book type) $\longrightarrow$ Non planar

H_2O_2 is used in the treatment of effluents.



act as both O.A. & R.A.

H_2O_2 is miscible in water due to hydrogen bonding.

19. $CO_2 + H_2O \rightarrow H_2CO_3$

$C + H_2O(steam) \rightarrow CO + H_2$

$CH_4 + H_2O \rightarrow CO + 3H_2$
$C_3H_8 + H_2O \rightarrow 3CO + H_2$
] both reactions are carried out at 1270K temp. with Ni catalyst

Thus CO_2 does not produce CO.

20. Most abundant gas in the troposphere is nitrogen.

21. Clark's Method Reaction

$Ca(HCO_3)_2 + Ca(OH)_2 \rightarrow 2CaCO_3 + 2H_2O$

$Mg(HCO_3)_2 + 2Ca(OH)_2 \rightarrow 2CaCO_3 + Mg(OH)_2 + 2H_2O$

22. For reducing ability H_2O_2 changes to O_2, i.e. oxidize , so in option '1' & '3' O_2 is formed but '1' is in acidic medium so option - 3 correct.

23. High purity (>99.95%) dihydrogen is obtained by electrolysis of warm aqueous $Ba(OH)_2$ solution between Ni-electrodes

24. Urea acts as stabiliser for H_2O_2.

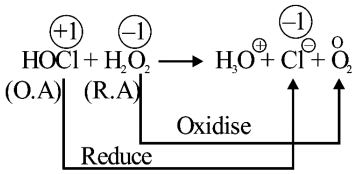
25. Depending on the nature of reducing agent H_2O_2 can act as an oxidising agent in both acidic as well as basic medium.

Density of D_2O = 1.1 g/cc

Density of H_2O_2 = 1.45 g/cc

26. They have different neutrons and mass number

27.



28. It is used in the synthesis of hydroquinone, tartaric acid and certain food products and pharmaceuticals (cephalosporin) etc. Restoration of aerobic conditions to sewage wastes etc.

29.

30. $IO_4^- + H_2O_2 \rightarrow IO_3^- + O_2$

SURFACE CHEMISTRY

1. Latex is colloidal solution of rubber particles which are negatively charged.

2. Haemoglobin $\rightarrow$ Positive sol

Metal $\rightarrow$ Negative sol

3. $C + O_2 \longrightarrow CO_2$ (No catalyst)

vegetable oil + $H_2 \xrightarrow{Pt}$ Ghee

Ostwald process :

$$4NH_3 + 5O_2 \xrightarrow{Pt/Rh} 4NO + 6H_2O$$

Haber's process

$$N_2 + 3H_2 \xrightarrow{Fe} 2NH_3$$

4.

	Dispersed phase	**Dispersion medium**
(C) Cheese	liquid	solid
(M) Milk	liquid	liquid
(S) Smoke	solid	gas

5. Arsenious sulphide sol is negatively charged, so according to Hardy-Schulze rule the cation which is in more oxidation state will be most effective

6. Peptisation is the process of converting a precipitate into a colloidal sol by shaking it with dispersion medium in the presence of small amount of electrolyte.

7. The osmotic pressure of a colloidal solution is of lower order than that of true solution at the same concentration due to association of solute molecule till they acquire colloidal dimensions.

π = iCRT

i is less in colloidal solution than true solution

8. In aerosol, the dispersion medium is gas while the dispersed phase can be both solid or liquid.

9. Electrophoresis is used to coagulate lyophobic colloids.

10. No. of surfactant molecule

$$= 6\times10^{23}\times\frac{10}{1000}\times10^{-3} \Rightarrow 6 \times 10^{18} \text{ molecule}$$

Let edge length = a cm

Total surface area of surfactant

$= 6 \times 10^{18}\ a^2 = 0.24$

$a = 2 \times 10^{-10}$ cm = 2 pm

11. Because of polar nature of NH_3, it can be easily liquified as well as easily adsorbed as compared with non-polar N_2 gas.

ΔH becomes less negative as the adsorption proceeds.

12. $Fe(OH)_3$ is a positive sol. Its coagulation will be caused by the anion of the electrolyte. The flocculation value is inversely proportional to coagulation power or valency of the anion. The correct order of flocculation value is

$K_3[Fe(CN)_6] < K_2CrO_4 < KBr = KNO_3 = AlCl_3$

13. Freundlich adsorption isotherm

$$\frac{x}{m} = K \cdot p^{1/n}$$

With increase in temperature, decrease in physical adsorption is observed.

14. Above Kraft temperature the formation of micelles takes place.

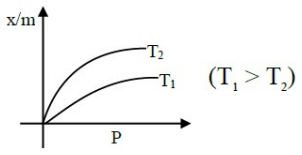
15. Blood : negatively charged sol

According to Hardly-schulz rule, for the negatively charged sol, highest charge containing cation is needed for its efficient coagulation.

16. $\frac{x}{m} \alpha p^{1/n}\left(0 < \frac{1}{n} < 1\right)$

On Increasing temperature $\frac{x}{m}$ decreases.

$\because$ adsorption is generally exothermic



17. (i) Adsorption of gas at metal surface is an exothermic process so $\Delta H < 0$

(ii) As the adsorption of gas on metal surface reduces the free movement of gas molecules thus restricting its randomness hences $\Delta S < 0$

18. The diameter of the colloidal particles is comparable to the wavelength of light used. The dispersed phase has a very different refractive index from the dispersion medium.

19. $\underset{\text{(drop by drop)}}{AgNO_3(aq.)} + \underset{\text{excess}}{KI(aq.)} \longrightarrow \underset{\text{Sol}}{AgI/I^-}$

20. CdS sol $\rightarrow$ –ve sol

TiO_2 sol $\rightarrow$ +ve sol

21. $\rightarrow$ Viscosity of hydrophilic sol > viscosity of H_2O

$\rightarrow$ Hydrophilic sol is more stable so can't be easily coagulated.

$\rightarrow$ Hydrophilic sols are reversible sols.

$\rightarrow$ No electrolytes are required to stabilise hydrophilic sol.

22. Statement I : Fact

Statement II: The emulsifying agents for O/W emulsions are proteins, gums, natural and synthetic soaps etc.

23. As equal & similar charge particle will repel each other, hence stabilises colloids.

24. The potential difference between the fixed and diffused layer of charges in a colloidal particle is called zeta potential

25. Micelle formation only takes place above CMC.

26. Standard method for the preparation of lyophilic sol. (Discussed in lab Manual)

27. Fact base.

28. $\frac{x}{m} = KP^{1/n}; \text{using}(x \propto V)$

$$\Rightarrow \quad \frac{10}{1} = K \times (100)^{1/n} \qquad ....(1)$$

$$\frac{15}{1} = K \times (200)^{1/n} \qquad ....(2)$$

$$\frac{V}{1} = K \times (300)^{1/n} \qquad ....(3)$$

Divide (2) by (1)

$$\frac{15}{10} = 2^{1/n}$$

$$\log\left(\frac{3}{2}\right) = \frac{1}{n}\log 2$$

$$\frac{1}{n} = \frac{\log 3 - \log 2}{\log 2} = \frac{0.4771 - 0.3010}{0.3010}$$

Divide (3) by (1)

$$\frac{V}{10} = 3^{1/n}$$

$$\log\left(\frac{V}{10}\right) = \frac{1}{n}\log 3$$

$$\log\left(\frac{V}{10}\right) = 0.585 \times 0.4771 = 0.2791$$

$$\frac{V}{10} = 10^{0.279} \Rightarrow V = 10 \times 10^{0.279}$$

$\Rightarrow V = 10^{1.279} = 10^x$

$\Rightarrow x = 1.279$

$\Rightarrow x = 128 \times 10^{-2}$ (Nearest integer)

29. Freundlich isotherm. ;

$$\frac{x}{m} = k.p^{\frac{1}{n}}$$

Substituting values ;

$$\left(\frac{64}{1}\right) = (2)^{\frac{1}{n}} \Rightarrow n = \frac{1}{6} = 0.166$$

$$\cong 17 \times 10^{-2}$$

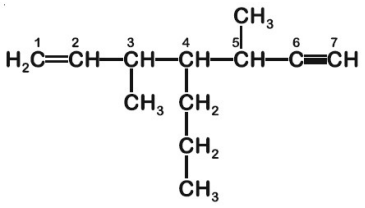
30. For physisorptions

(a) Decreases with increase in temperature

(b) No appreciable activation energy is required

IUPAC NOMENCLATURE + ISOMERISM + POLYMER

1.



3, 5-dimethyl-4-propylhept-1-en-6-yne

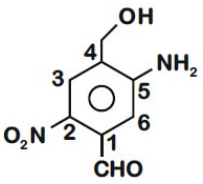
2. a. HDPE – Ziegler-Natta Catalyst

b. Polyacrylonitrile – Peroxide Catalyst

c. Novolac – Catalysed by acid or base

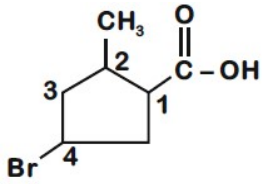
d. Nylon-6 – Condensation at High T and P

3.



5-amino-4-hydroxymethyl-2-nitrobenzaldehyde

4.



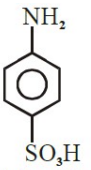
4-Bromo-2-methylcyclopentane carboxylic acid.

5. High density polyethene is hard and chemically inert thats why used to make buckets and dustbins.

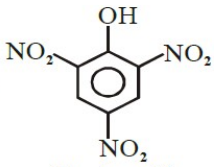
6.

Polymer	Monomers
Buna-N	$CH_2 = CH - CH = CH_2$ and $CH_2 = CH - CN$
Neoprene	$CH_2 = CH - C(Cl) = CH_2$
Nylon- 6, 6	$HO-C(=O)-(CH_2)_4-C(=O)-OH$ and $NH_2-(CH_2)_6-NH_2$
PHBV	$CH_3-CH(OH)-CH_2-COOH$ and $CH_3-CH_2-CH(OH)-CH_2-COOH$

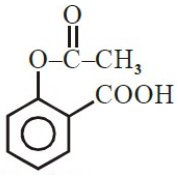
7. ⟶ COOH group present in

(A) 

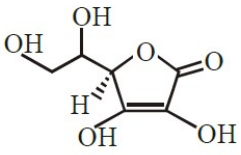
Sulphanilic acid

(B) 

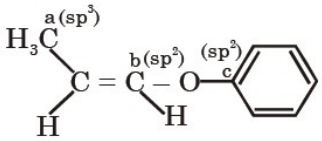
Picric acid

(C) 

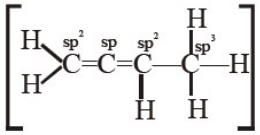
Asprine

(D) 

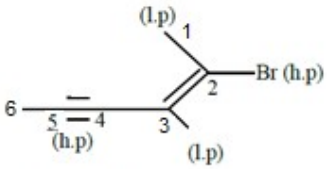
Ascorbic acid

8. 

9. $[\overset{1}{C}H_2 = \overset{2}{C} = \overset{3}{C}H - \overset{4}{C}H_3]$



10.



h.p. ⇒ higher priority
l.p. ⇒ lower priority

(2E) –2- bromo hex –2- en–4-yne

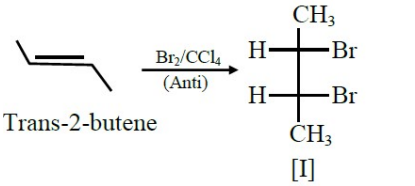
11. More stable less potential energy.

Stability order : I > III > IV > II

So

Potential energy : II > IV > III > I

12.



Trans-2-butene

[I]

meso product

13. $C_3H_6O \Rightarrow CH_3–CH_2–CH=O$ & $CH_3–\underset{\underset{O}{\|}}{C}–CH_3$

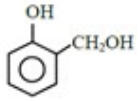
They are functional group isomerism.

14. Novalac is a linear polymer of

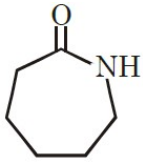
[Ph–OH + HCHO].

So ester linkage not present.

So novalac is not a polyester.

15. Monomer of Novalac is 

O-hydroxy methyl phenol

16. (a) 

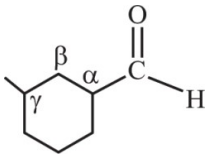
Caprolactum is the monomeric unit of polymer Nylon-6

$$\left[HN-(CH_2)_5-\underset{\underset{O}{\|}}{C}\right]_n$$

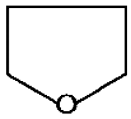
(b) 2-Chlorobuta-1, 3-diene is the monomeric unit of polymer neoprene.

(c) 2-Methylbuta-1, 3-diene is the monomeric unit of polymer natural rubber.

(d) $CH_2 = CH – CN$ (Acrylonitrile) is the one of the monomeric unit of polymer Buna-N

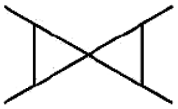
17. 

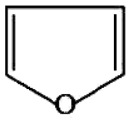
γ-methyl cyclohexane carbaldehyde

18. 

: Non–planar heterocyclic Compound

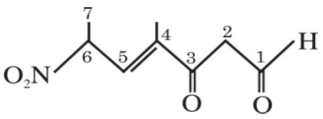

: Bicyclo Compound


: Spiro Compound

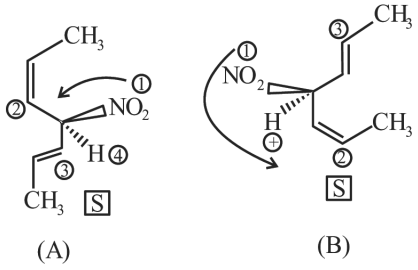


: Aromatic Compound

19. $—SO_3H > —COCl > —CONH_2 > —CN$

20. 

4-Methyl-6-nitro-3-oxohept-4-enal

21. 

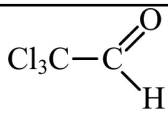
Having same configuration.

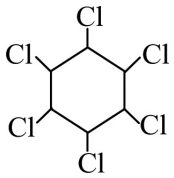
22. Buna-N is an addition copolymer of 1,3-butadiene and acrylonitrile.

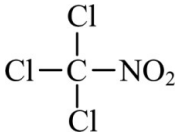
$$CH_2=CH–CH=CH_2 + CH_2=\underset{\underset{CN}{|}}{CH}$$

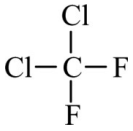
$$[–CH_2–CH=CH–CH_2–CH_2–\underset{\underset{CN}{|}}{CH}–]_n$$

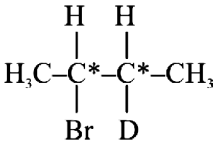
Buna-N

23. (1) Chloral 

(2) Gammaxene 

(3) Chloropicrin 

(4) Freon-12 

24. 

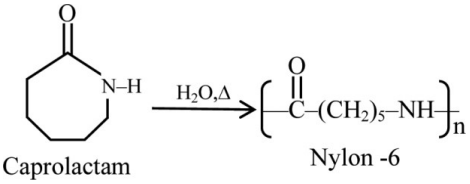
25. Neoprene : Elastomer

Polyester: Fibre

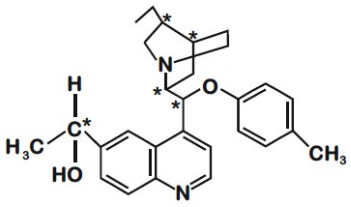
Polystyrene : Thermoplastic

Urea-Formaldehyde Resin:

Thermosetting polymer

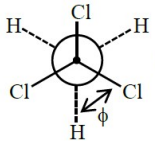
26. 

Caprolactam Nylon -6

27. 

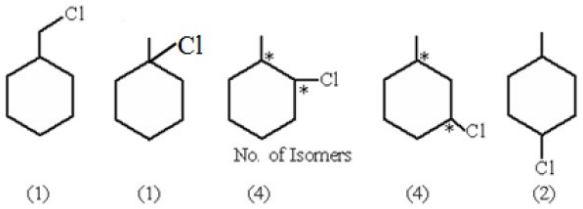
Chiral carbon atom is bonded to 4 different atoms or group of atoms. The given structure has 5 chiral carbon-atoms.

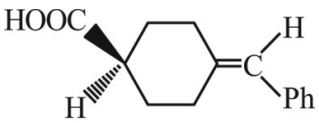
28. 1,1,1–Trichloro ethane [$CCl_3 - CH_3$]



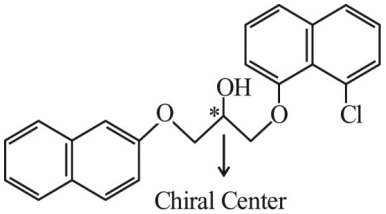
Dihedral angle(ϕ) = 60°

(Newmonns stqqared form)

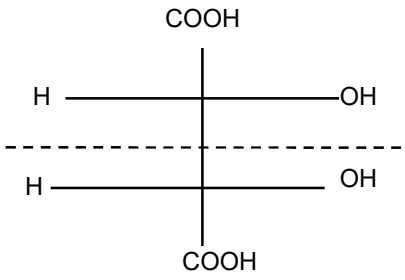
29. 

30. 

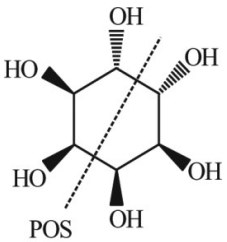
No POS, COS
(Chiral)



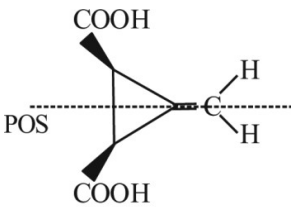
Chiral Center
No POS, COS
(Chiral)



COOH
(achiral)



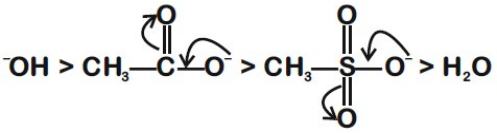
(Achiral)



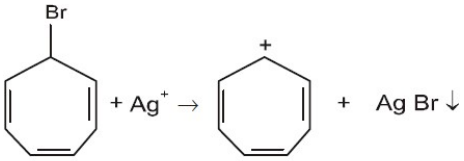
(Achiral)

GOC-I + GOC-II

1. Greater the negative charge Present on a nucleophilic centre greater would be its nucleophilicity.



2.



aromatic

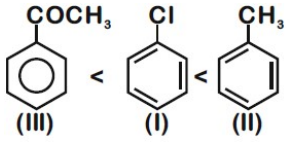
3.

 is aromatic as it has $2\pi e^-$ in complete conjugation

 and  are antiaromatic.

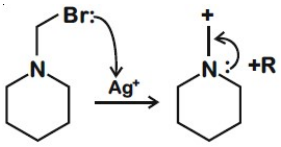
 is non aromatic

4. CH_3 group when bonded to benzene increases the electron density of benzene by +I and hyper conjugation effects and hence makes the compound more reactive towards EAS. Cl group decreases the electron density of benzene by –I effect, and CH_3CO group strongly decreases the electron density of benzene by –I and –R effects. Therefore, correct increasing order the given compounds towards EAS is



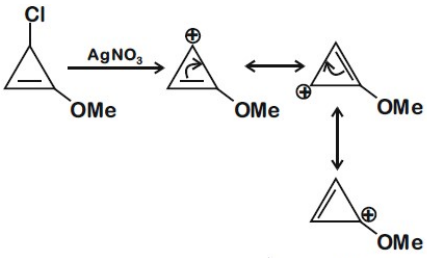
(III) (I) (II)

5. Ease of precipitation of AgBr depends upon the rate of formation of carbocation



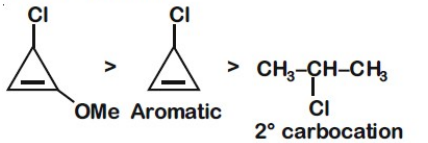
Most stable carbocation due to +R effect of N.

6.



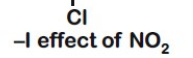
aromatic as well as stabilized by lone pair of -OMe

So the order is

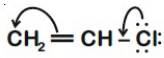


2° carbocation

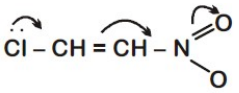
v



–I effect of NO_2

7. In  due to resonance, C – Cl bond acquires partial double bond character and has shortest bond length among given species.

8.

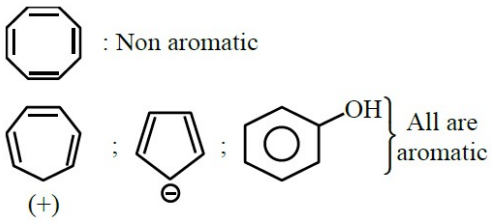


due to strong – R effect of – NO_2 group, partial double bond character between C and Cl increases.

9. (a) Shows intra molecular H-bonding

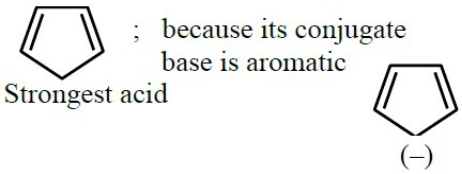
(b) Shows significant intermolecular H-bonding

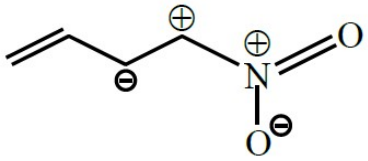
(c) It do not show intermolecular H-bonding due to steric hindrance.

10. 

11. Statement I : It is correct statement

Statement II : $CH_3 - \overset{\oplus}{C}H_2$ involve $C_{sp^3} - H_{1s}$ bond with empty 2p orbital hence given statement is false.

12. 

13. 

It is unstable RS (due to similar charge on adjacent atom)

14. $CH_3–CH_2–CH = CH–CH_2–NH_2$

No conjugation thus resonance is not possible.

15. When chlorine is attached to benzene group, it shows both

−I and + R effect but

+ R < − I, and it decreases electron density

Since, (A) has no group attached to it, so that benzene ring has the highest electron density.

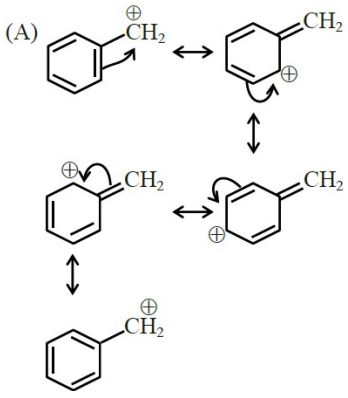
More the number of halogens attached, lower is the electron density

So,

Between (C) and (D), since electronegativity decreases down the group as the size increases, so

− I effect also decreases. So, (D) will have more electron density in comparison to (C)

16. (A) and (B) only in Resonance

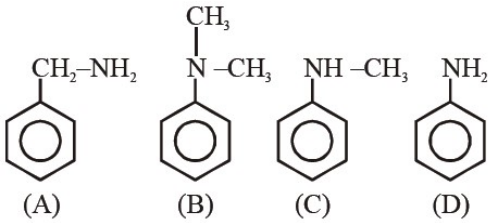


17. 

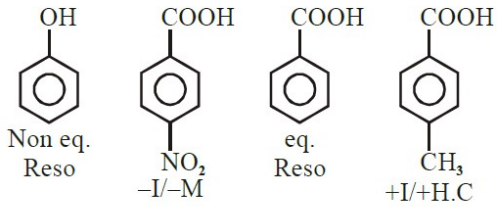
$6\ \pi e^-$

18. (A) Non-Aromatic (B) Aromatic

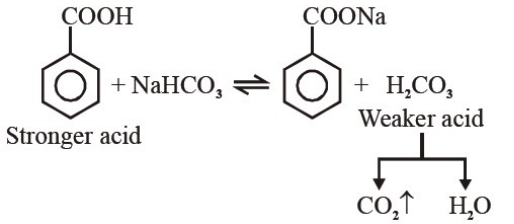
(C) Aromatic (D) Anti-Aromatic

19. 

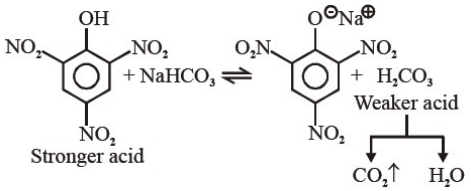
B.S. order (A) > (B) > (C) > (D)

20. 

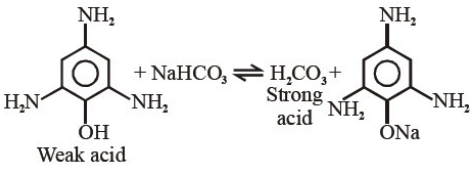
2 > 3 > 4 > 1

21. 

equilibrium favours forward direction and CO_2 ↑ is librated.



Equilibrium favours forward direction and CO_2 ↑ is librated.

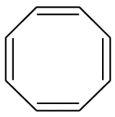


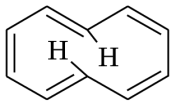
Equilibrium favours back word direction and CO_2 ↑ is not librated.

22. [10] Annulene, although follow $(4n + 2)\pi$ electron rule, but it is non-aromatic due to its non planar nature. It is nonplanar due to repulsion of C – H bonds present inside the ring.

23. **Assertion A :** Not correct, Reason R : correct

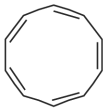
 **Aromatic acid** [6] – annulene

 - Not aromatic [8] - annulene



- Not aromatic[10] - annulene

In [10]-Annulene - the hydrogen atoms in the 1 and 6 position interfere with each other and force the molecule out of planarity



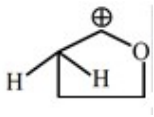
all-cis(10) annulene

If this annulene with five cis double bonds were planar, each internal angle would be 144°. Since a normal double bond has bond angle of 120°, this would be from ideal. This compound can be made but it does not adopt a planar conformation and therefore is not aromatic even though it has ten π electrons.

24.  is most stable as it is aromatic.

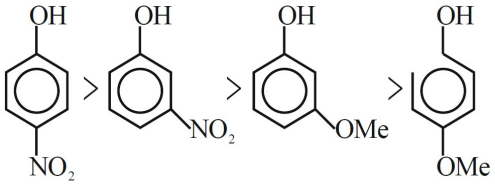
25. A, B aromatic

C,D is nonaromatic

26. Carbocation is stabilised by resonance with lone pairs on oxygen atom and +H effect of 2α hydrogens 

B > A > C

27. The correct order of acid strength is

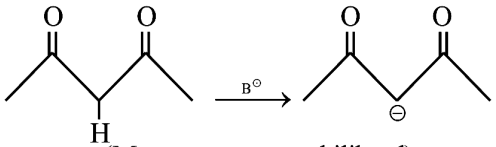


28. **Assertion A :** Benzene is more stable than cyclohexatriene **(True)**

Reason R : Delocalised π–e cloud lies B.M.O so more attracted by nuclei of carbon atom.

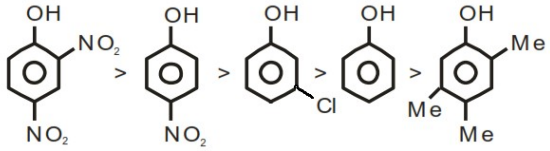
(True and Correct Explanation)

29. Most easily deprotonation



(More resonance stabilibsed)

30. Order of acidity for following phenol is

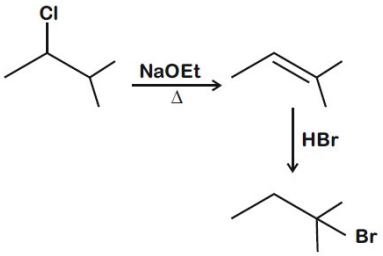


– M and – I increases acidity

+ M and + I decreases acidity

HALOALKANES AND HALOARENES

1.



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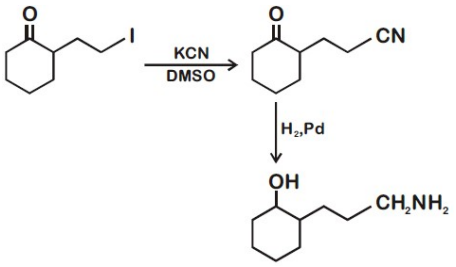

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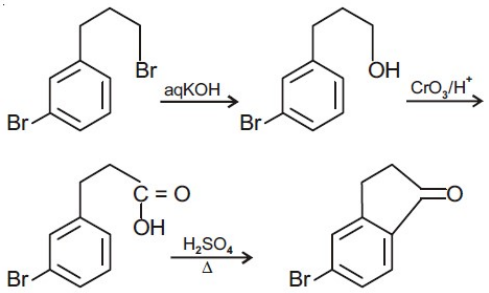

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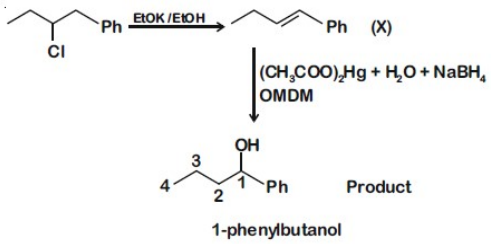
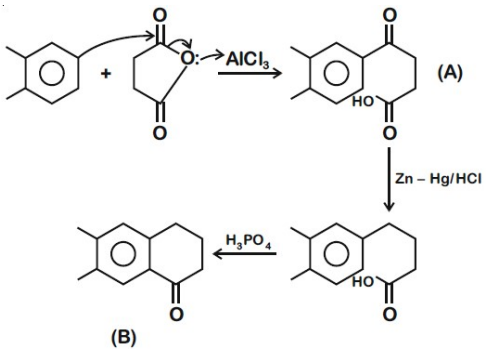
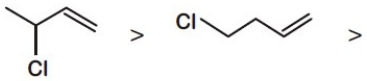


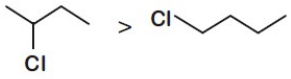
5.



6. Dehydrohalogenation of the given halides by E_1 mechanism is decided by the stability of carbocation formed in the first step. The correct decreasing order of the given halides towards dehydrohalogenation by E_1 mechanism is



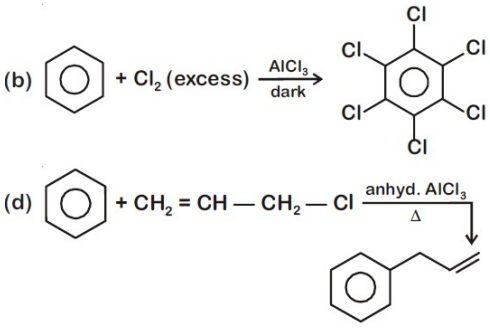
(D) (B)



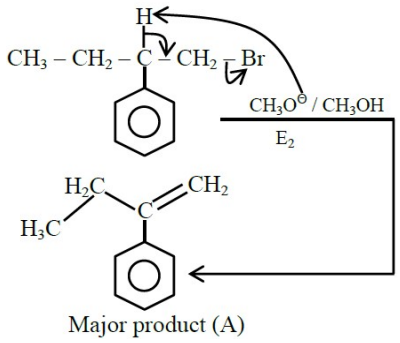
(C) (A)

7. Vinyl halide and aryl halide do not give Friedel Craft's reaction.

The reactions which are possible are :

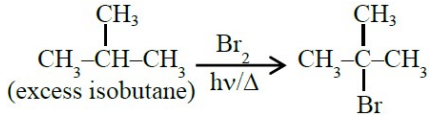


8.

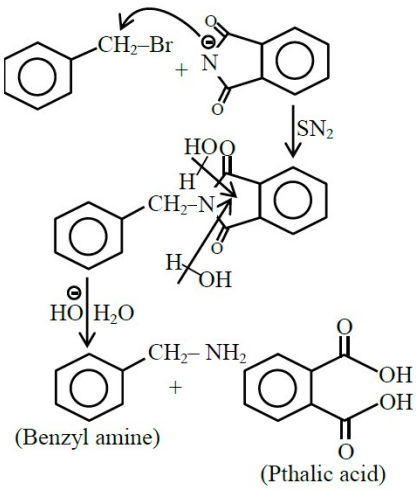


Major product (A)

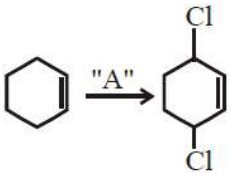
9.



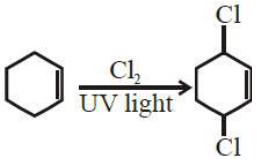
10.



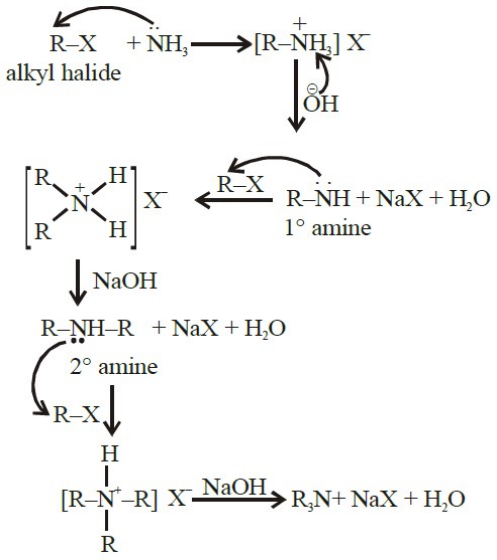
11.



For substitution at allylic position in the given compound, the reagent used is Cl_2/uv light. The reaction is free radical halogenation.



12.



So the purpose of NaOH in the above reactions in to remove acidic impurities.

13. (1) → (ii) Sand Meyer reaction

(2) → (iv) Gatterman reaction

(3) → (i) Wurtz reaction

(4) → (iii) Fittig reaction

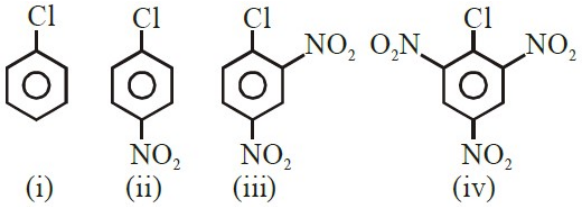
(1) → (ii),

(2) → (iv),

(3) → (i),

(4) → (iii)

14. For nucleophile substitution in aromatic halides

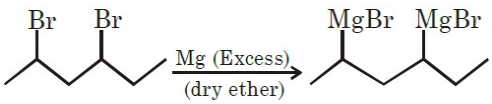


Correct order is :

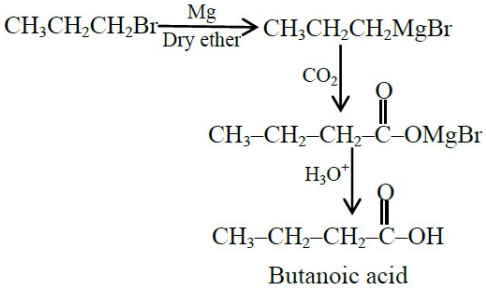
(i) < (ii) < (iii) < (iv)

More No. of NO_2 substituted aromatic halide, increase the rate of nucleophile substitution reaction in aromatic halides.

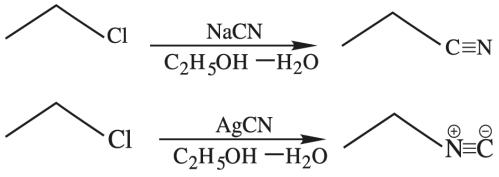
15.



16. All gives propanoic acid as product but option 4 gives butanoic as product

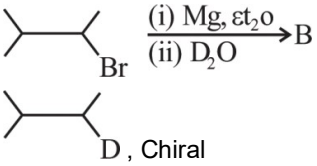


17.



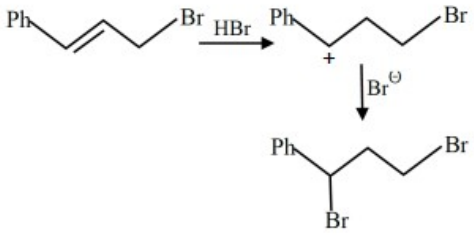
In NaCN; carbon is more nucleophilic atom. Whereas in AgCN; Ag - C has covalent bond.

18.

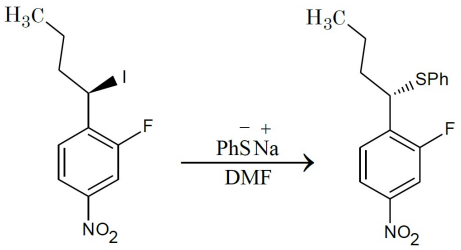


19. The carbocation fromed is very unstable. So it is inactive towards S_N1

20.

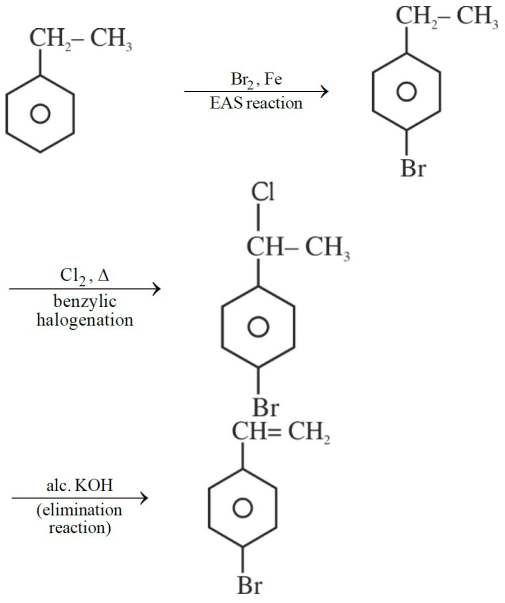


21.

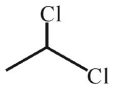


It is bimolecular nucleophilic substitution (SN^2) which occur at benzylic carbon by inversion in contiguration. This reaction cannot undergo substitution at benzene ring

22.

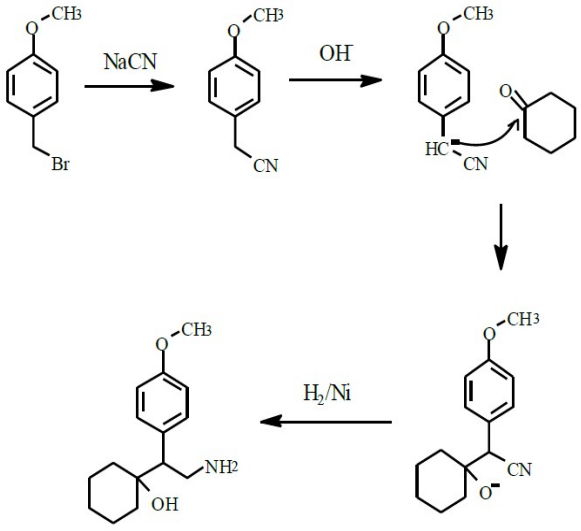


23.

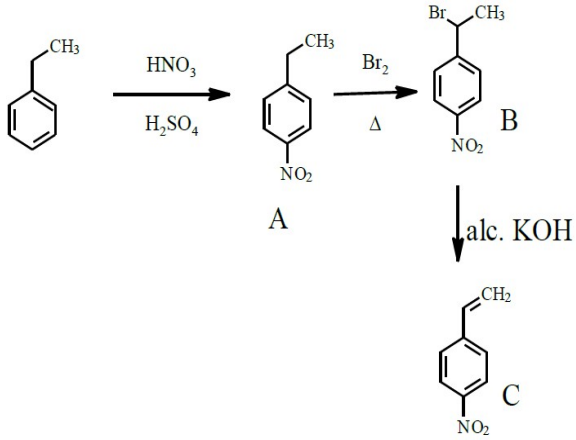


"1,1-Dichloroethane is ethylidene chloride"

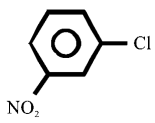
24.



25. C_8H_{10} DU = 9 –5 = 4

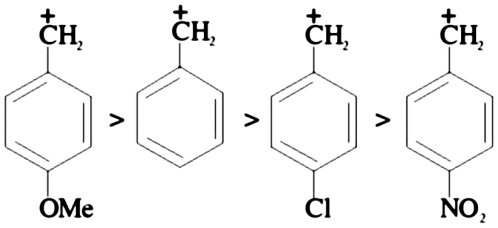


26. The rate of hydrolysis of alkyl chloride improves because of better Nucleophilicity of I^-.

27. Electron withdrawing groups are highly ineffective at meta position in nucleophilic aromatic substitution reactions. Hence compound 

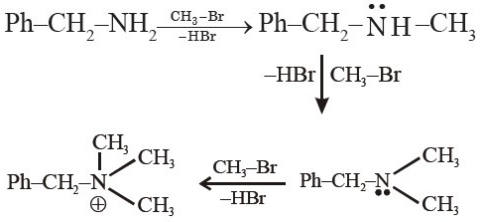
will have lowest rate in nucleophilic aromatic substitution.

28. The rate of S_N1 reaction depends upon stability of carbocation which follows the order



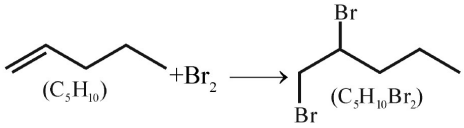
$\therefore$ Reactivity order (b) > (d) > (c) > (a)

29.



no of moles = 3

30.



Moles of Br_2 = moles of C_5H_{10}

$$\Rightarrow \frac{w}{160} = \frac{5}{70}$$

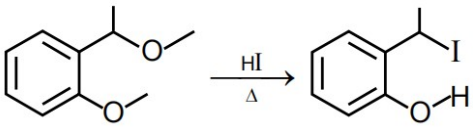
$$\Rightarrow w = \frac{5 \times 160}{70} g$$

= 11.428g

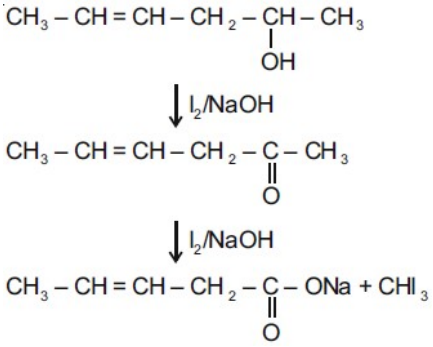
= 1142.8×10^{-2} g $\approx 1143 \times 10^{-2}$g

ALCOHOLS, PHENOLS AND ETHERS

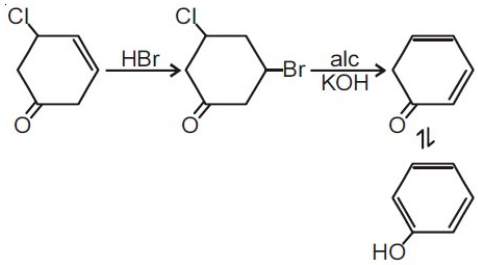
1.



2.



3.



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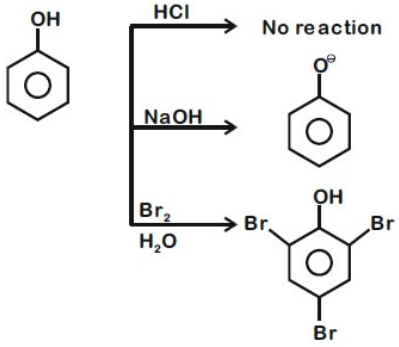
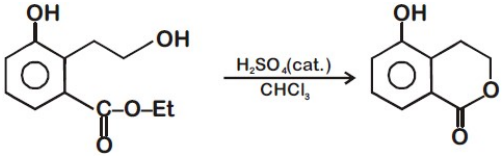
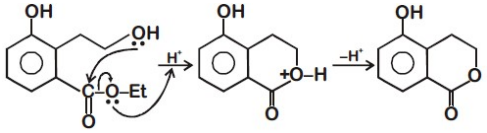


5.



Acid catalysed intramolecular esterification



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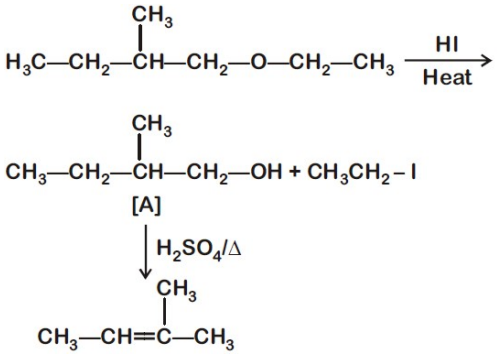
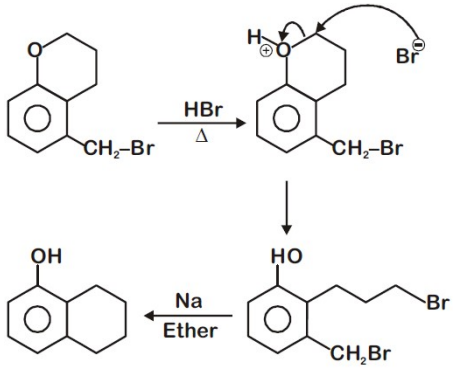
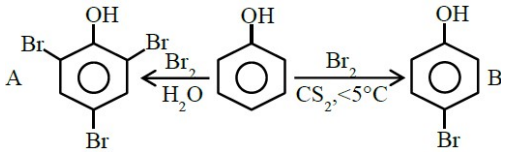


7.



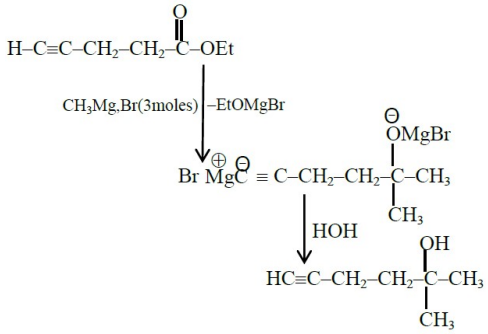
8.



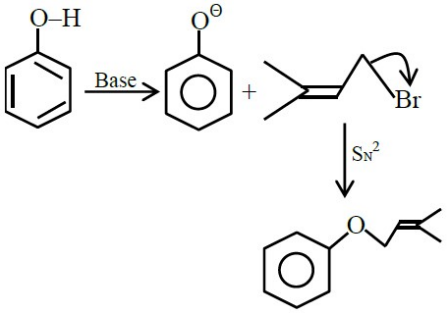
9. Statement 1 is true

But it consume 3 moles of G R

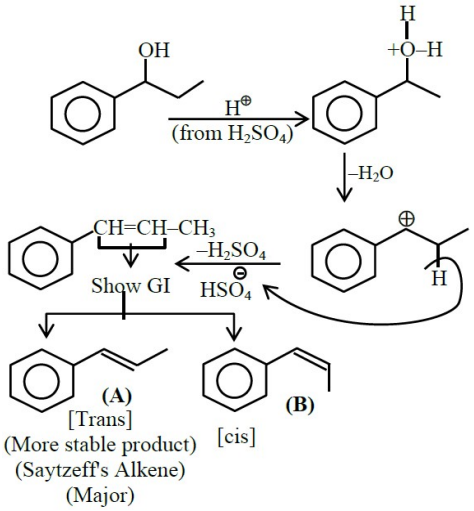
So statement 2 is false.



10.

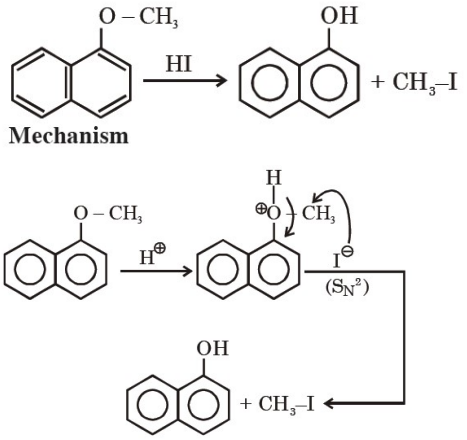


11.



12. Bromine water gives tribromo products, other gives monobromo products in which para is major product.

13.



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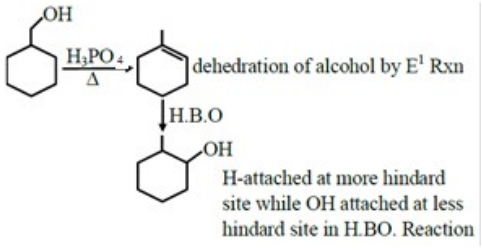
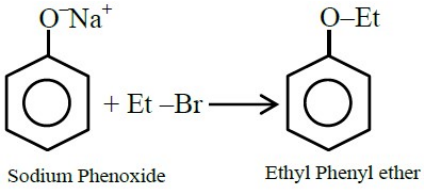
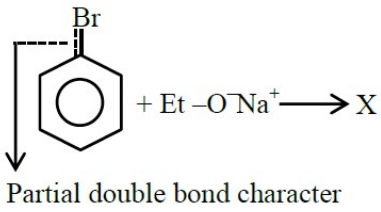
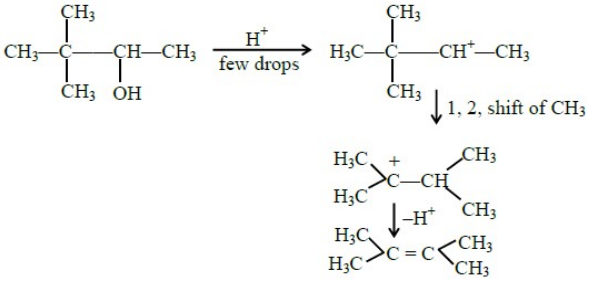


15.

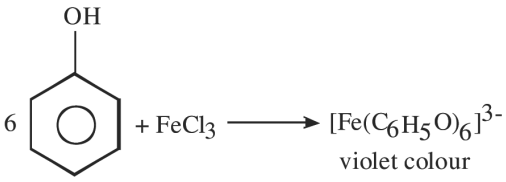




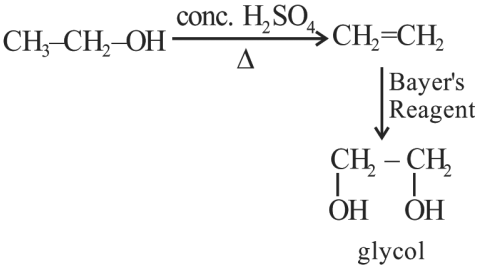
16.



17.



18.



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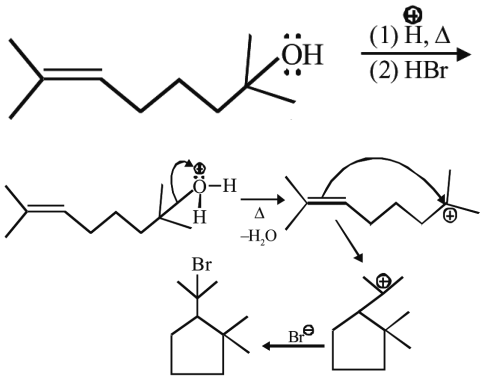

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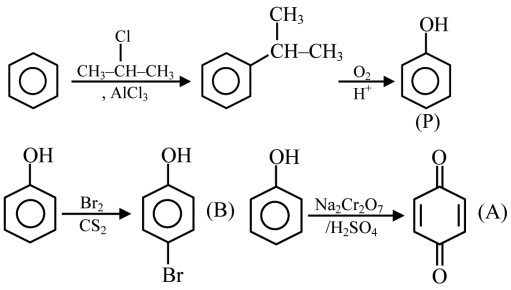
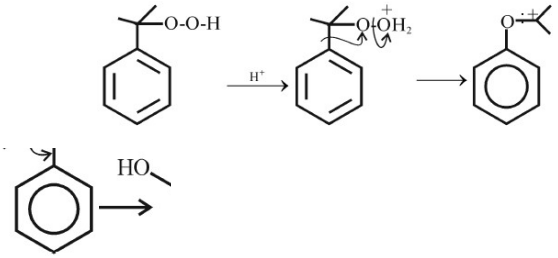


21. Given reaction is cumene-Peroxide method for the preparation of phenol. In this reaction



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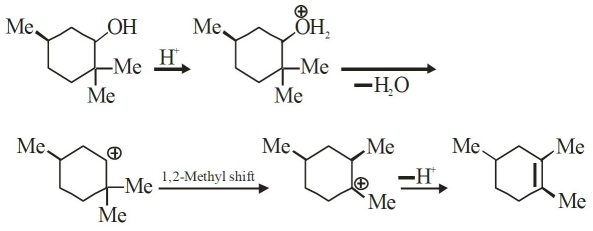
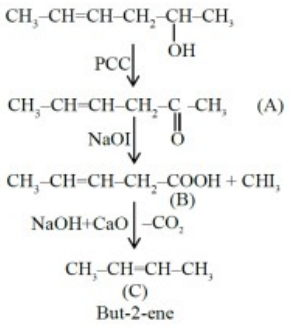


23. Nucleophilicity $\propto$ electro density on donor atom

$\propto$ size of donor atom (in gas)

$\propto \frac{1}{\text{EN of atom}}$ (for period)

24.



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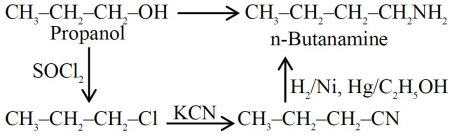

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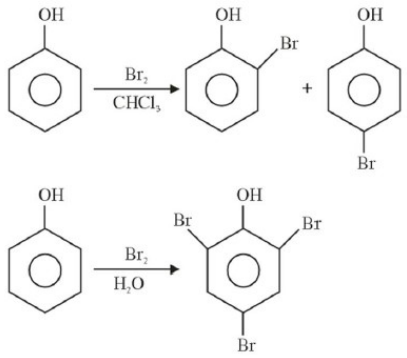
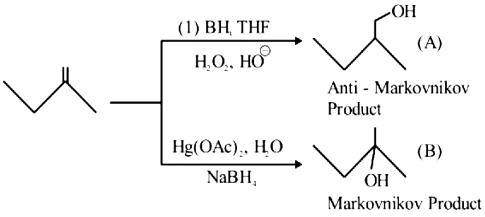


Difference in reactions is observed due to solvent polarity, which

(i) Ionizes phenol to make more reactive phenoxide ion

(ii) Increases electrophilicity of bromine.

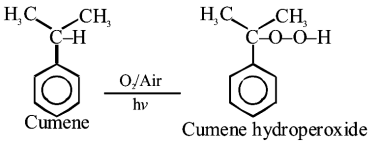
27.



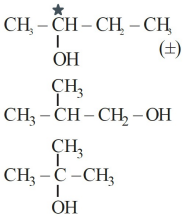
28. For Assertion :Acetal and ketals are basically ethers hence they must be stable in basic medium but should break down in acidic medium.

Hence assertion is correct. For reason: Alkoxide ion (RO^-) is not considered a good leaving group hence reason must be false.

29.



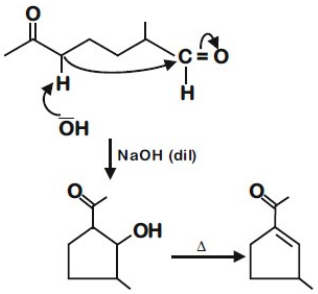
30. $CH_3 - CH_2 - CH_2 - CH_2 - OH$



Out of which only one are chiral

CARBONYL COMPOUNDS AND CARBOXYLIC ACID

1.



2. Attack of nucleophile on carbonyl centres depends upon

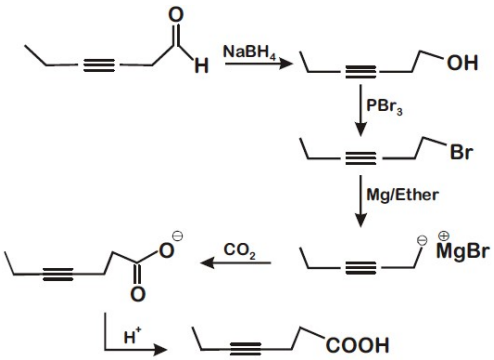
(i) Steric factor

(ii) Electronic factor

∴ Rate of reaction should follow the order

(ii) > (iv) > (i) > (iii)

3.



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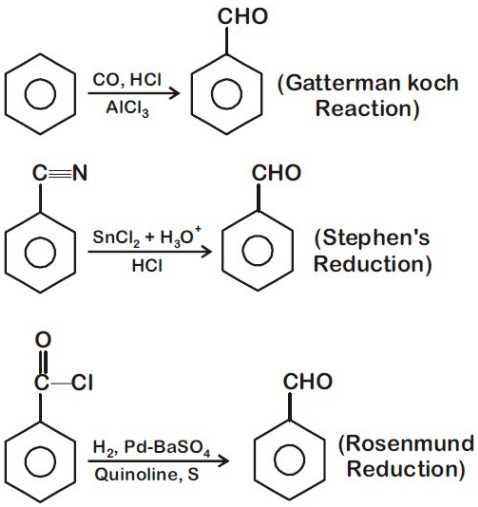

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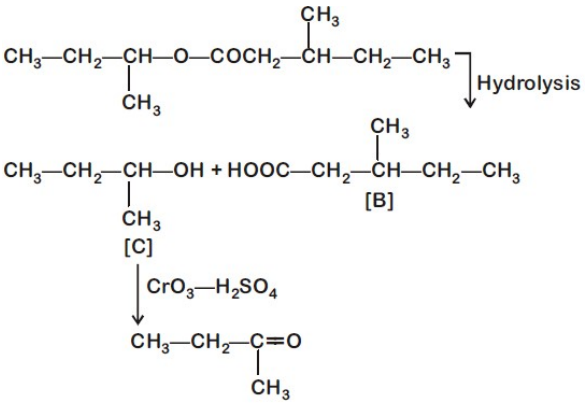

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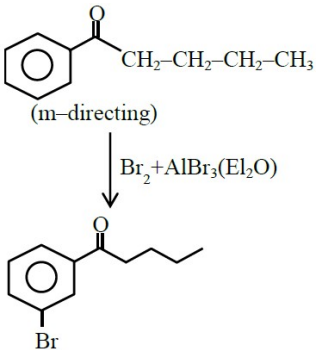

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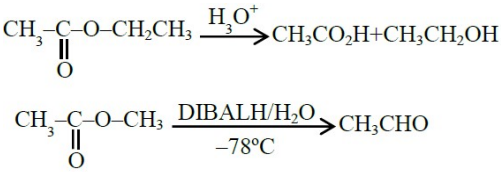

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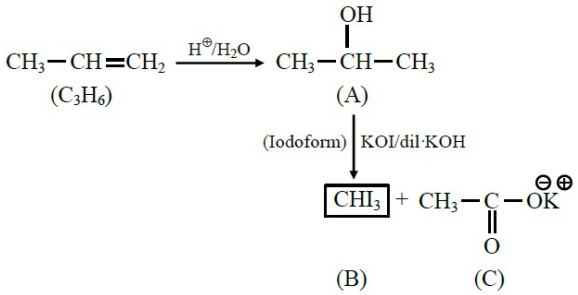

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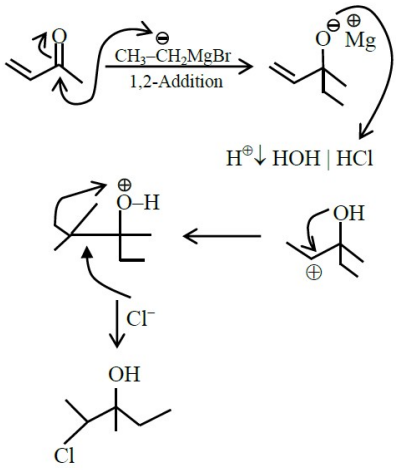
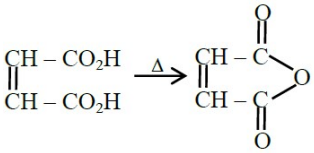


10. Cis but 2-enoic acid



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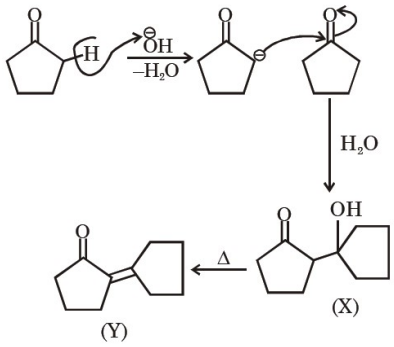

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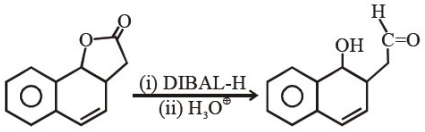
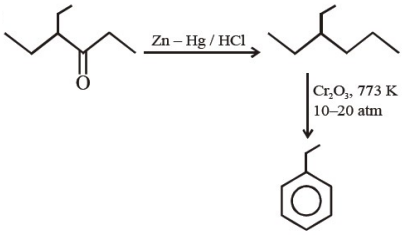


DIBAL can not reduce double bond

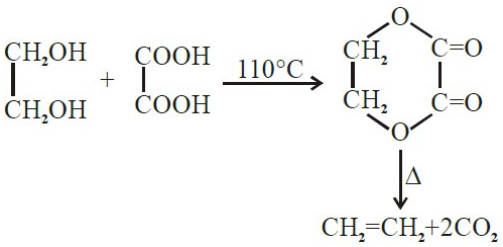
It can reduce cyclic ester.

13.

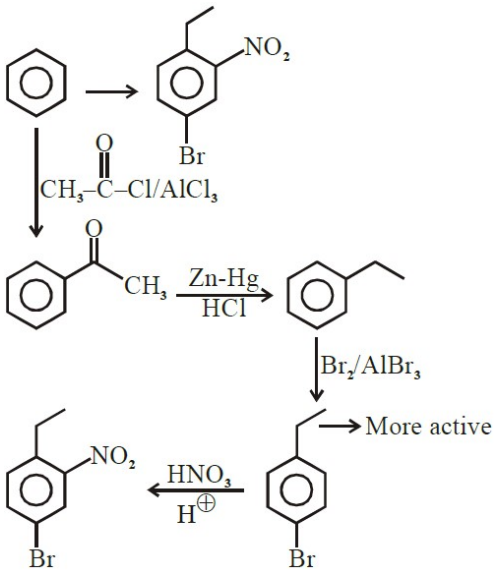


14. 2,4-DNP test is useful for the identification of carbonyl compounds.

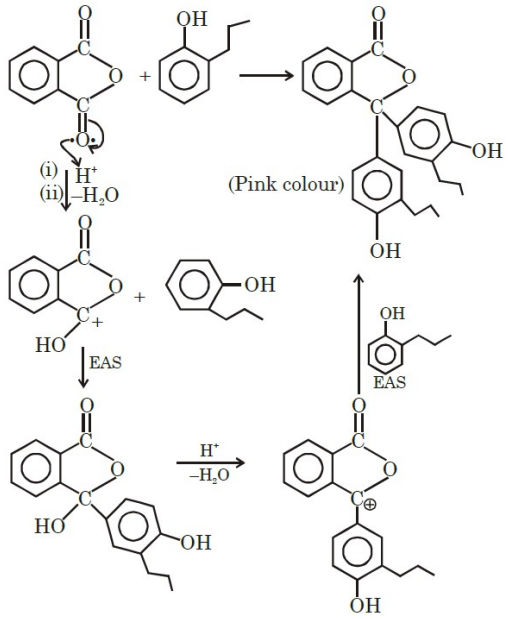
15.



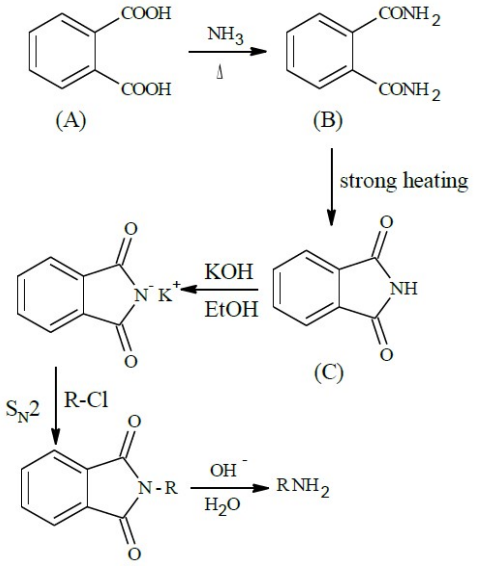
16.



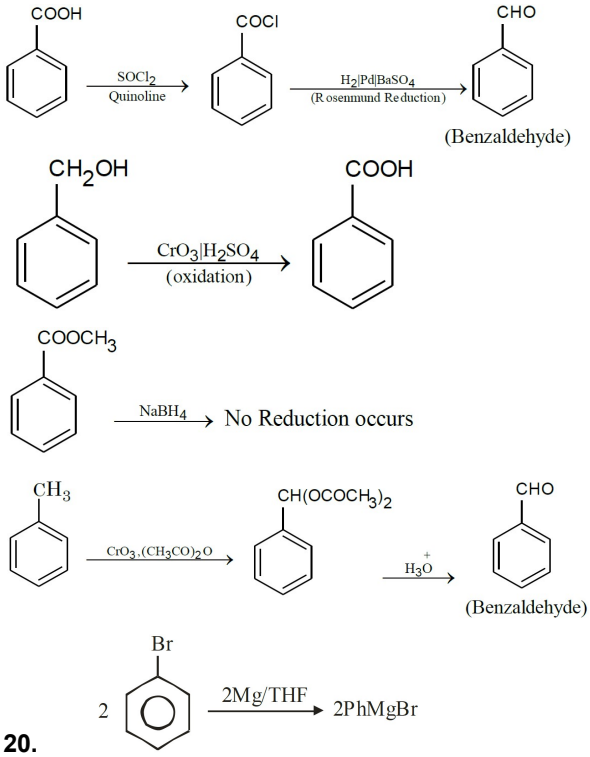
17.



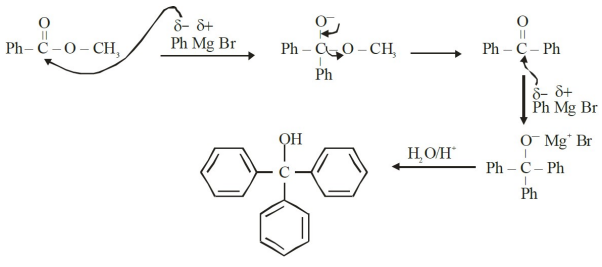
18. Gabriel Pthalimide reaction

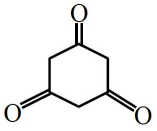


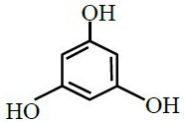
19.



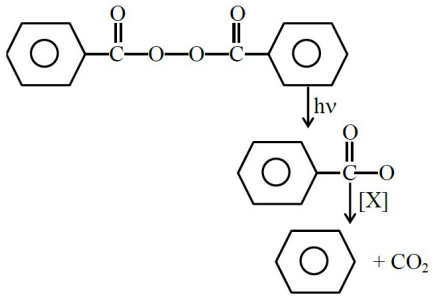
20. Now



21.  is tautomer of

 , Which is aromatic in nature.

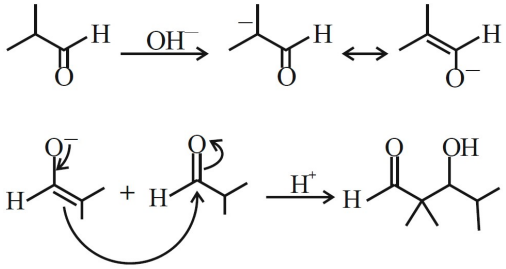
22.



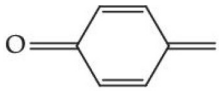
23. PhCH = O + PhCH = O

$\xrightarrow{OD/D_2O}$ $PhCH_2OD + PhCO_2^-$

24.

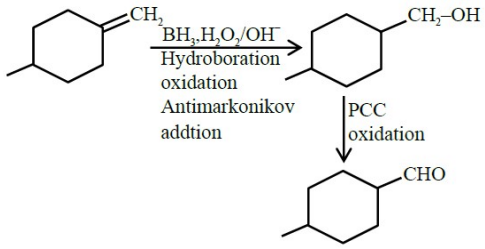


Aldol formation takes place.

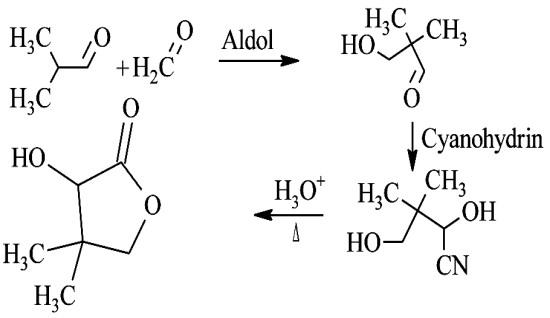
25.  is a conjugated

diketone

26. BH_3, H_2O_2/–OH followed by PCC oxidation.



27.



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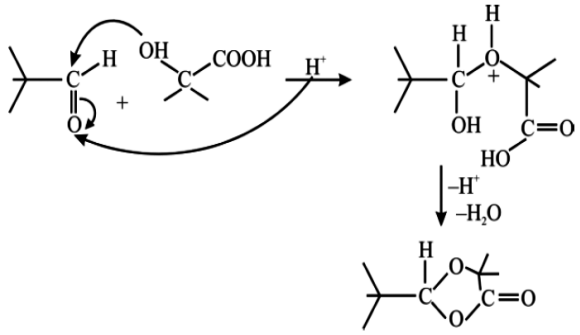
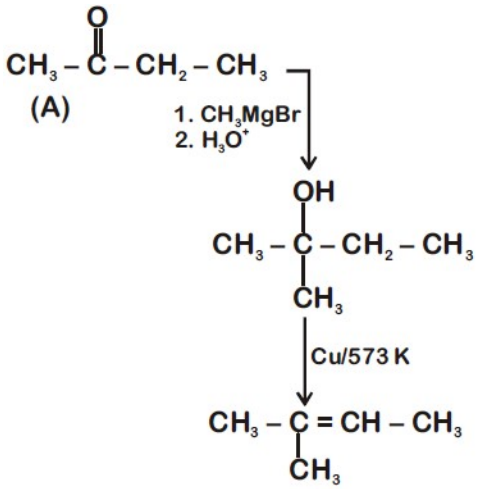


29.

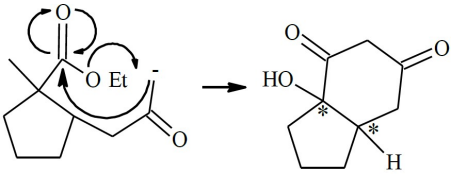


A is C_4H_8O

$$\% \text{ of C} = \frac{48}{72} \times 100$$

$$= 66.67$$

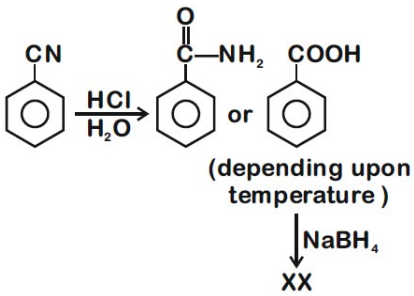
30.



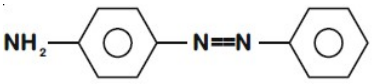
2 chiral carbons

AMINES

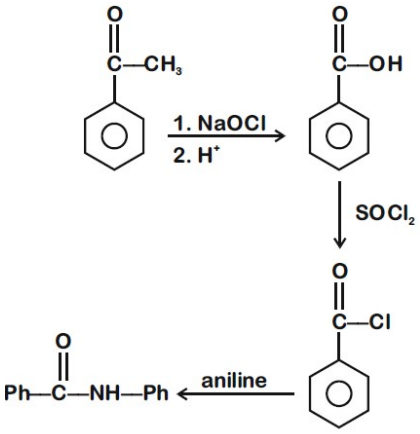
1.



2. In acidic medium aniline is more reactive than phenol that's why electrophilic aromatic substitution of $Ph-\overset{+}{N}_2$ takes place with aniline



3.



4. Correct order of K_b value

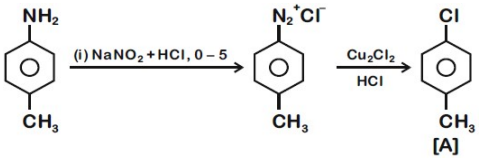
$(C_2H_5)_2\ddot{N} > (C_2H_5)_3N > NH_3$

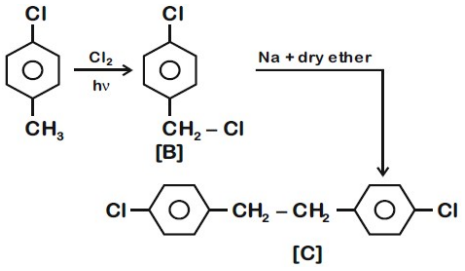
In aqueous medium sec. amines are most basic.

3°amines are more basic than NH_3 as +I factor dominate over steric factor.

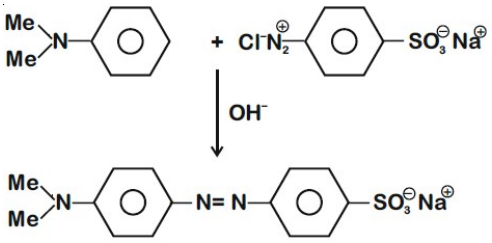
5. $C_2H_5CN \xrightarrow{LiAlH_4} C_2H_5CH_2NH_2$

6.



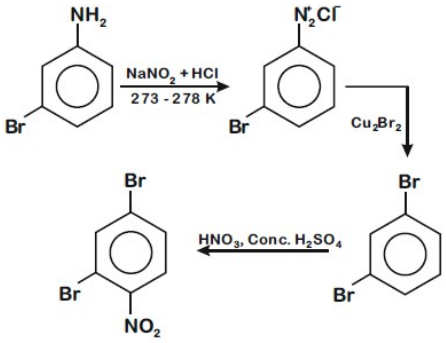


7.



Formed product is methyl orange and it is used as an indicator in acid base titrations.

8.



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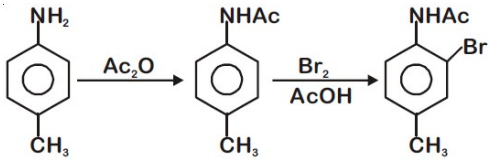

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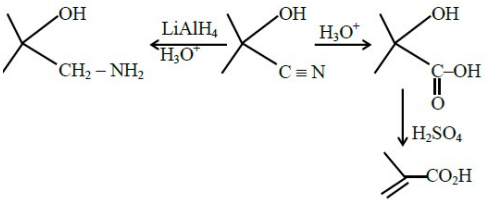

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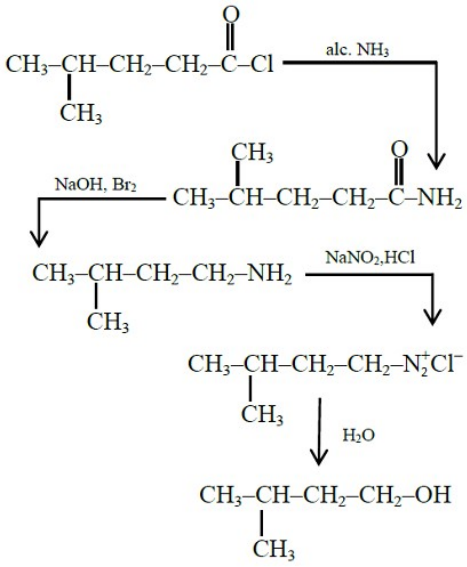

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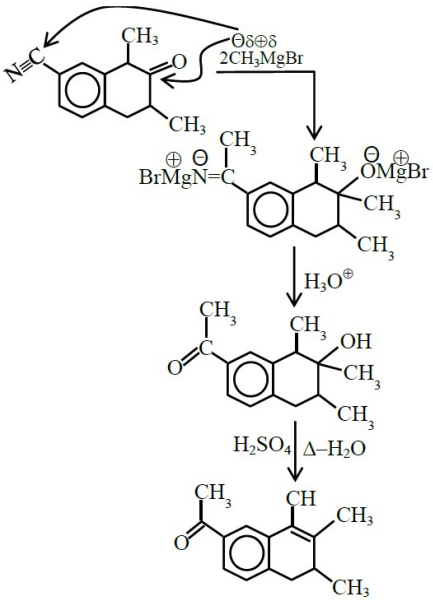

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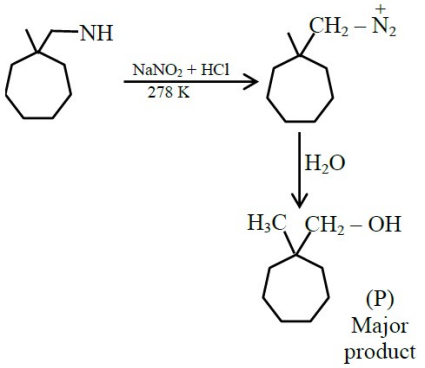

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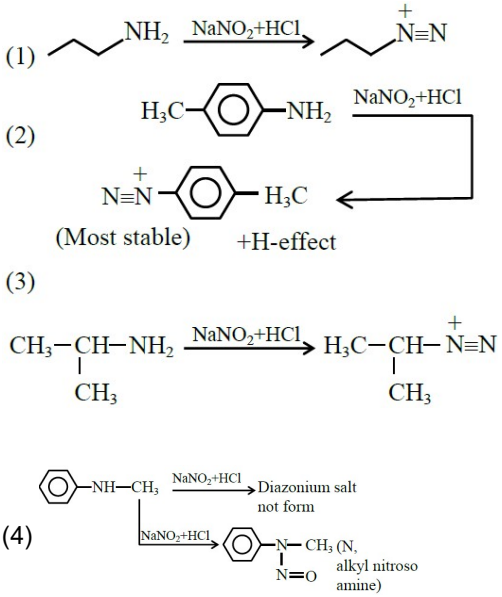

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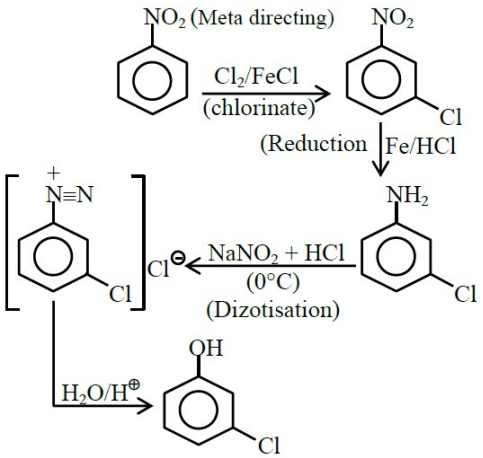
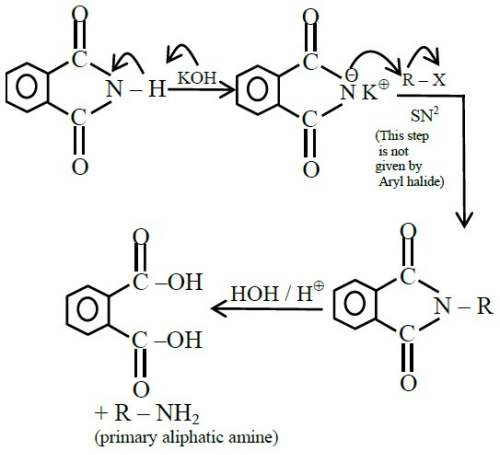
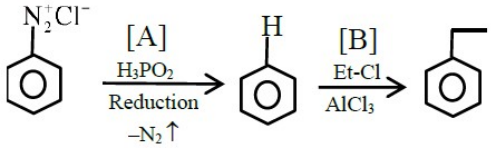


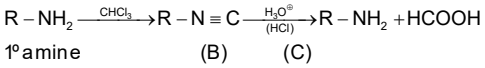
16. Gabriel pthalimide synthesis



17.

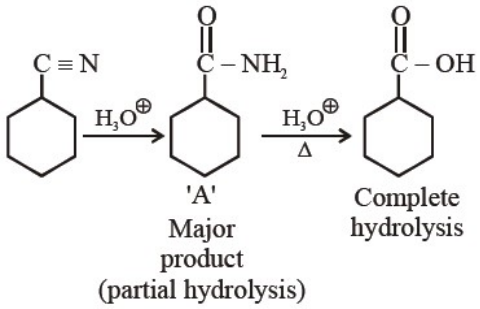


18.

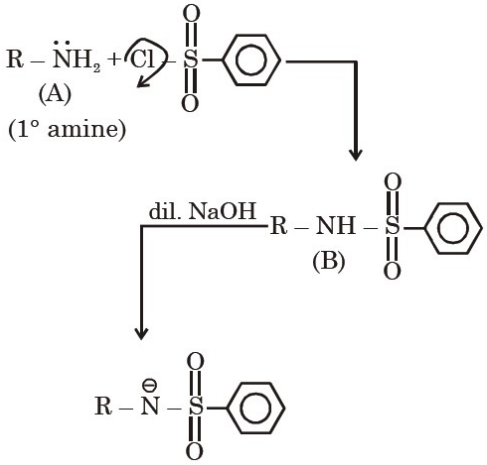


(A) (Isonitrile)

19.



20. Hinsberg reagent (Benzene sulphonyl chloride) gives reaction product with 1° amine and it is soluble in dil. NaOH.

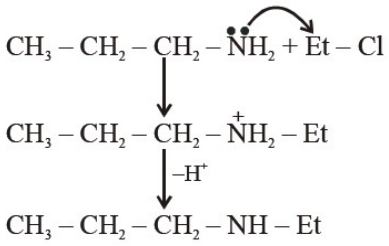


21. Primary amines react with Para Toluene sulfonyl chloride to form a precipitate that is soluble in NaOH.

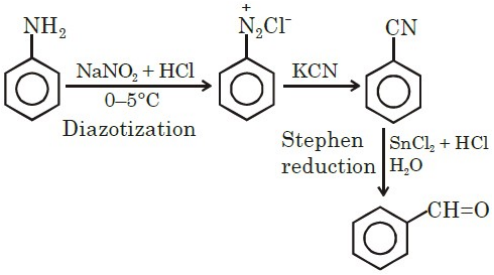
Secondary amines reacts with para toluene sulfonyl chloride to give a precipitate that is insoluble in NaOH.

Tertiary amines do not react with para toluene sulfonyl chloride.

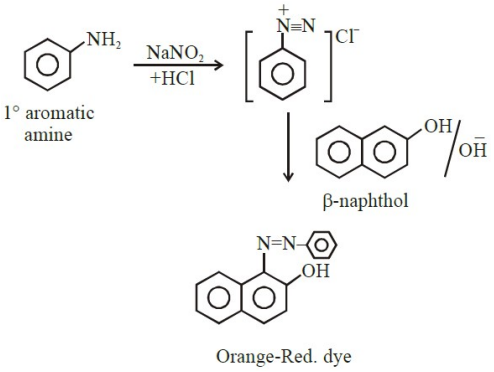
22. It has to be 2° amine because on reaction with benzene sulphonylchloride it gives water in soluble product. As it is formed by ammonolysis of ethylchloride, so it has to be R–NH–Et type.



23.



24.



25. Gabriel phthalimide synthesis is used to prepare 1° aliphatic/alicyclic amine in common.

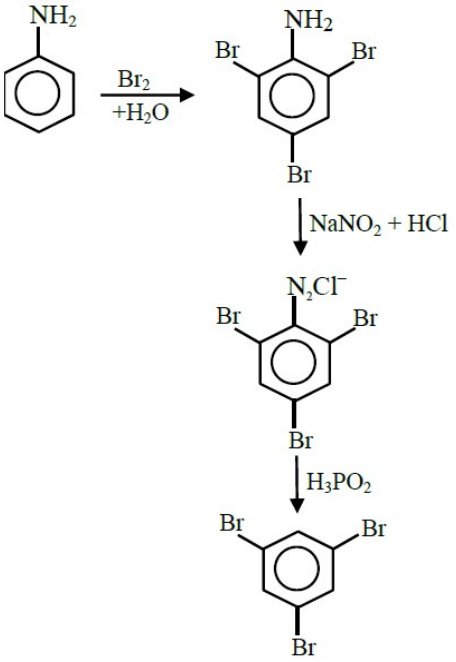
Hence amine which can synthesised by Gabriel phthalimide synthesis method is :

(1) $Me_2CH-CH_2-NH_2$

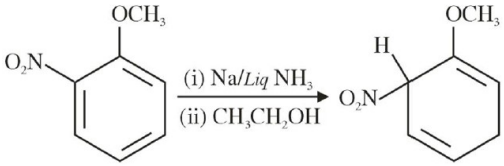
(2) $CH_3CH_2NH_2$

(3) $Ph-CH_2-NH_2$

26.



27.



Given reaction is an example of birch reduction.

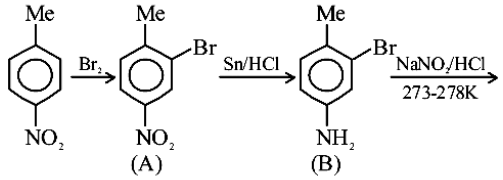
28. **Statement - 1 is (True)**

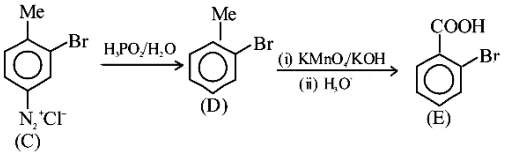
Pure aniline is colourless liquid

Statement - 2 is (False)

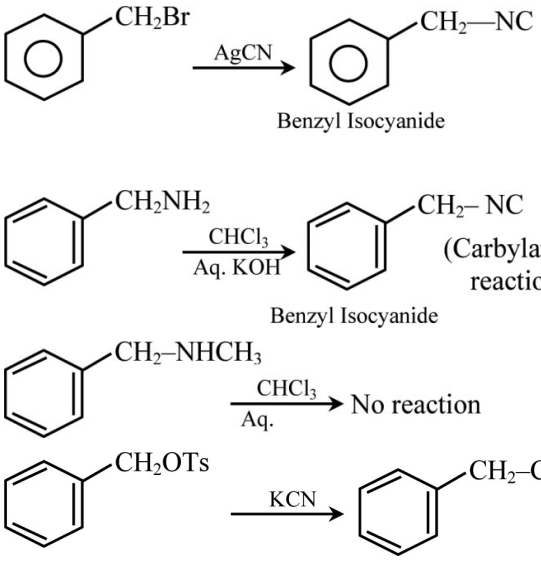
Aniline becomes dark brown due to action of air and light [oxidation]

29.



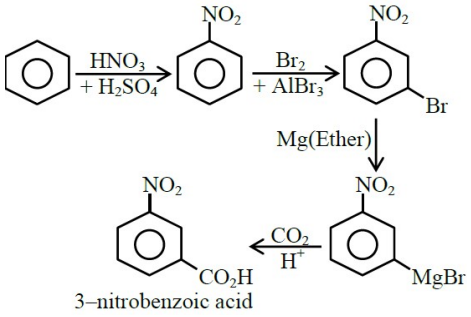


30.

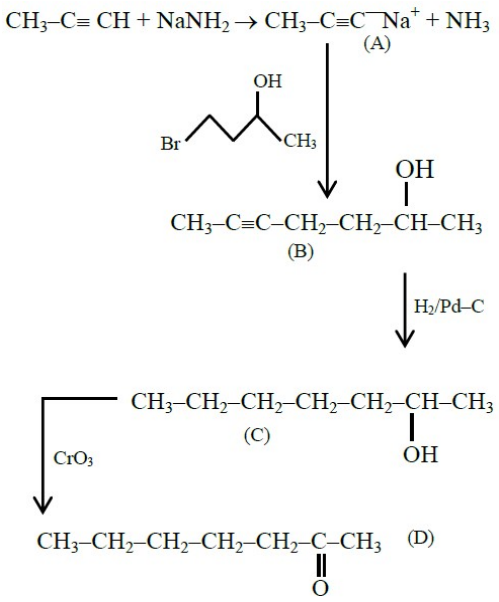


HYDROCARBON

1.



2.



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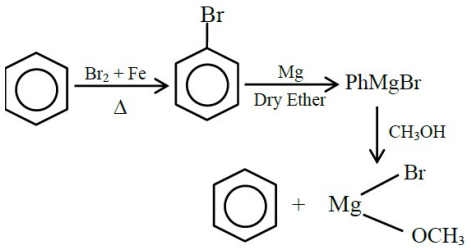
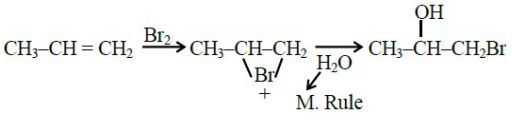
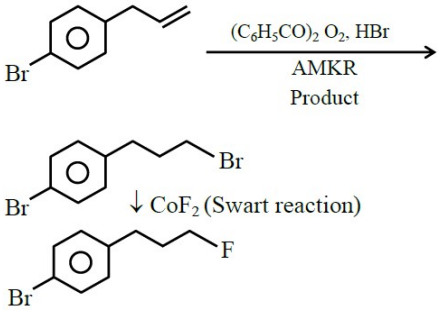


4.

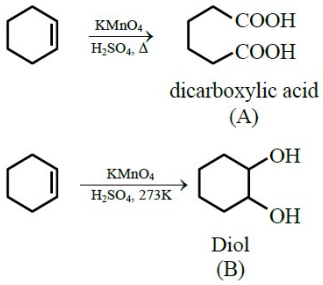


Its IUPAC name 1-bromopropan–2-ol A and R are true and (R) is the correct explanation of (A)

5.



6.



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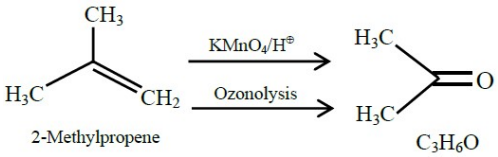
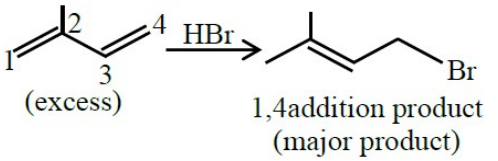


8. Solution Na/H_2 is not reducing agent

9.



10. (a) Alcoholic potassium hydroxide ⟶ Used for β- elimination reaction

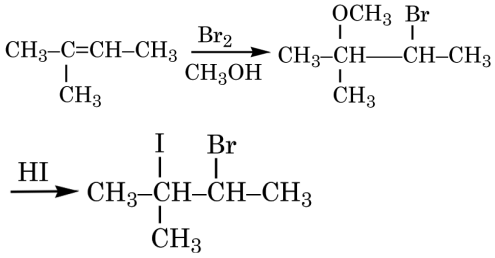
(b) Pd/ $BaSO_4$ ⟶ Lindlar's catalyst

(c) BHC (Benzene hexachloride) ⟶ Obtained by addition reactions

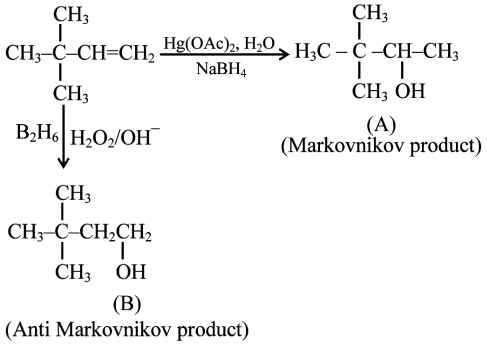
(d) Polyacetylene ⟶ Electrodes in batteries

11. Metallic sodium does not react with 2-butyne because 2-butyne does not have acidic hydrogen.

12.



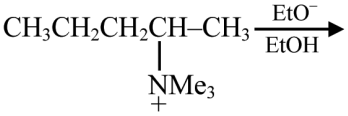
13.



(A)
(Markovnikov product)

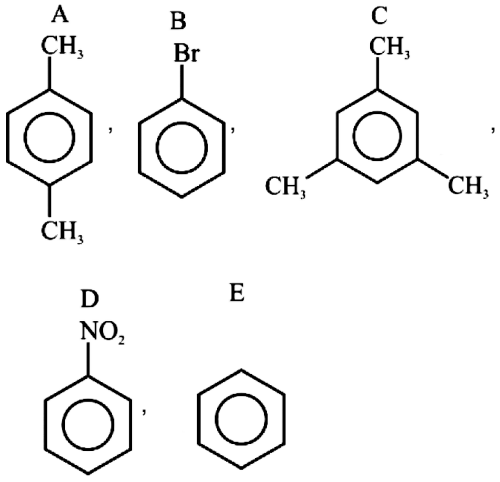
(B)
(Anti Markovnikov product)

14.



$CH_3CH_2CH_2CH{=}CH_2$ + $CH_3CH_2CH{=}CH{-}CH_3$
(major) (A) (minor)

15.



D E

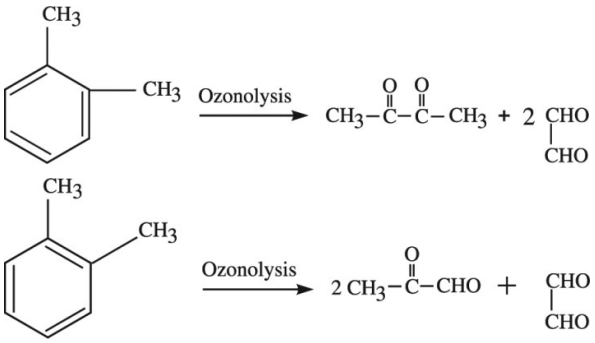
$-NO_2$ is strongly deactivating

–Br – deactivating

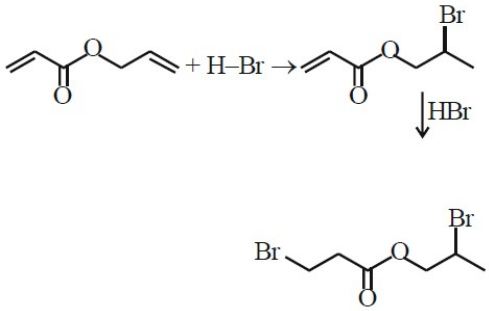
$-CH_3$–activating group

D < B < E < A < C

16.



17.



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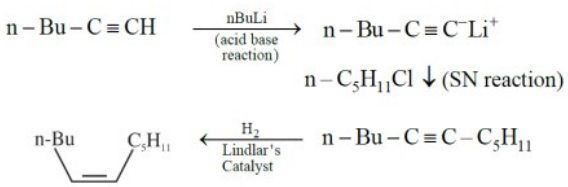

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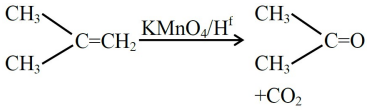
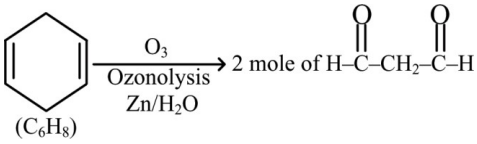


20. Both Statement I and Statement II are correct.

21. Conformation has lowest vanderwaal and torsional strain. Hence it must be most stable.

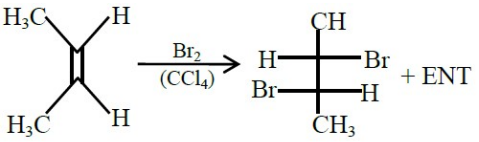
22. Incorrect statements are C and D only, correct choice is not available.

23.



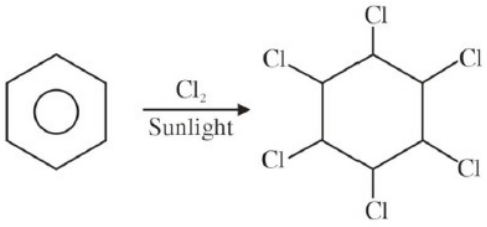
(Cyclohexa–1, 4–diene)

24.

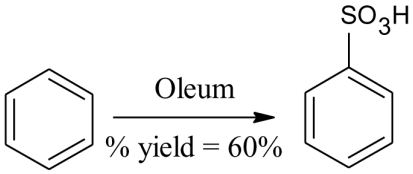


The total number of products possible = 2

25.



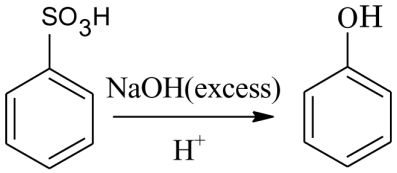
26. **(I)**



Let initial moles of reactant taken = n

Total moles obtained for benzene sulphonic acid (with % yield = 60%) = 0.6n

(II)



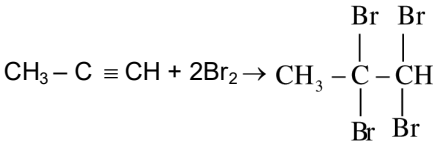
Moles of benzene sulphonic acid before reaction II = 0.6n

Moles obtained for phenol (with % yield = 50%) = 0.6 × 0.5n = 0.3n

So over all % yield of complete reaction

$= \frac{0.3n}{n} \times 100 = 30$

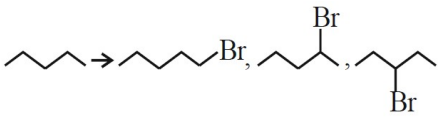
27.

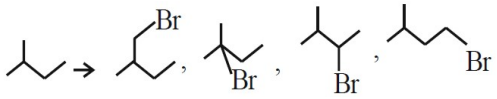


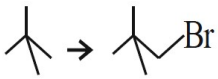
$= \frac{1}{160} \times \frac{1}{2} \times 360 \times 0.27 = 0.30375$

$= 3.0375 \times 10^{-1}$

28. The Alkanes and their monobromodervative are

1. 

2. 

3. 

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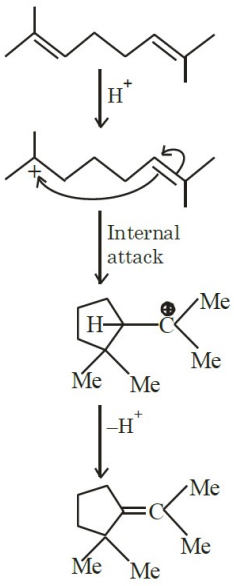
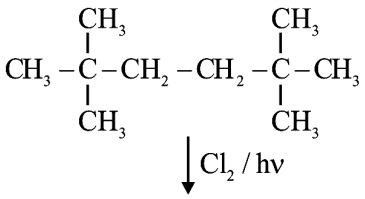
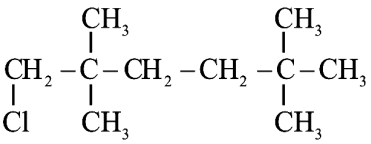


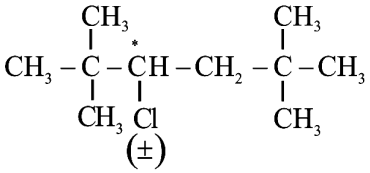
30.



(1)



(2)



Total numbers of isomer = 03

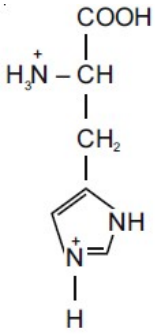
BIOMOLECULES

1. n-Hexane

2. Seliwanoff's test is used to distinguish aldose and ketose

3. Hydrolysis of maltose give glucose as maltose is composed of two α-D glucose units.

4. Histidine (in strongly acidic solution)



5. Barfoed test is used for carbohydrate to cheak reducing nature of sugar.

6. RNA has a single helix structure.

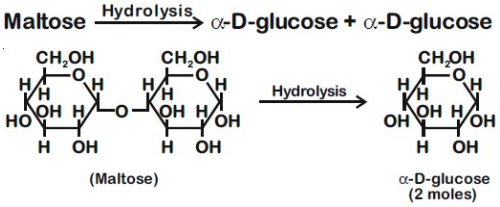
DNA has a double helix structure.

7. - All carbohydrates give, Molisch's test

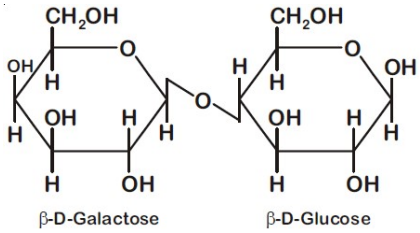
- Barfoed test is specific for monosaccharide

- Biuret test is used for detecting the presence of peptide bonds

8.



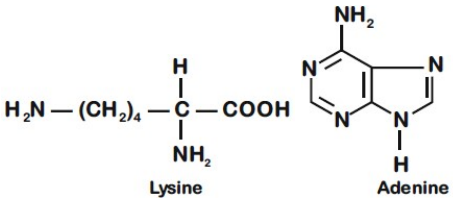
9. Lactose contains β-glycosidic linkage between C_1 of galactose and C_4 of glucose.

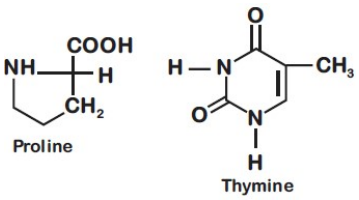


10. Tyrosine is not an essential amino acid.

11. Primary amine react with $CHCl_3$ + KOH to give isocyanide

Adenine and lysine can react with $CHCl_3$ + KOH as they contain $-NH_2$ group.





12. Sucrose is formed by α–D(+) . Glucose + β–D (–) Fructose.

we obtain these monomers on hydrolysis.

13. Surcrose is example of disaccharide & non reducing sugar

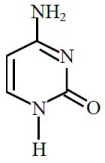
Assertion : correct

Sucrose involves glycosidic linkage between C_1 of α-D-glucose C_2 of β-D-fructose

Reason : Incorrect

14. Vitamine-B_1 is also known as Thiamine while vitamin B-6 is known as Pyridoxine

15. The correct structure of cytosine



16. Informative

OR

$$C_{12}H_{22}O_{11} + H_2O \xrightarrow{\text{Zymase}} 2C_6H_5OH + 2CO_2$$

17. Albumin is water soluble.

18. Seliwanoff test for ketose and Xenthoprotic test for proteins.

19. (1) Glucose $\xrightarrow{HI}$ n-hexane

(2) Glucose $\xrightarrow[H_2O]{Br_2}$ $(CHOH)_4$ with COOH and CH_2OH — Gluconic acid

(3) Glucose $\xrightarrow[\text{anhydride}]{5\text{acetic}}$ Glucose pentacetate

(4) Glucose $\xrightarrow{HNO_3}$ $(CHOH)_4$ with COOH and COOH — Saccharic acid

20. DNA contains $\Rightarrow$ β – D – 2 – deoxyribose

RNA contains $\Rightarrow$ β – D – ribose

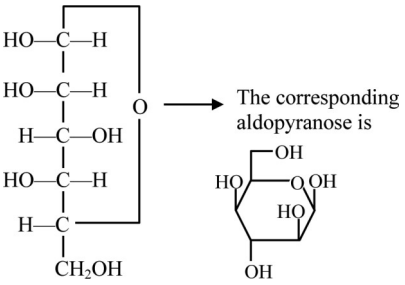
21. Invertase : Cane sugar $\rightarrow$ Glucose and fructose

Zymase : Glucose $\rightarrow$ Ethanol and CO_2

Diastase : Starch $\rightarrow$ Maltose

Maltase : Maltose $\rightarrow$ Glucose

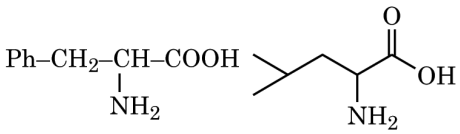
22. **Correct pyranose structure is**



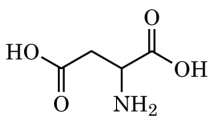
X(Hemiacetal)

23. Primary structure of protein is unaffected by physical 'or' chemical changes.

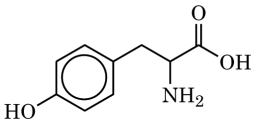
24. Hydrolysis of the given tetrapeptide will give the following:



(F) (Phenylalanine) (L) (Leucine)

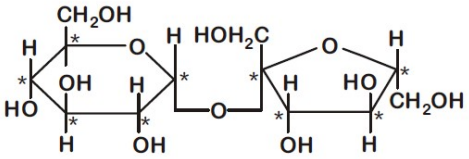


(D) (Aspartic acid)



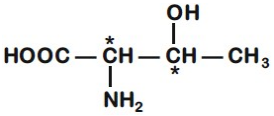
(Y) (Tyrosine)

25.



No. of chiral centres = 9

26. The structure of threonine is



No. of chiral centres present in it = 2

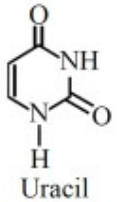
27. In Tetrapeptide,

No. of Amino Acids = 4

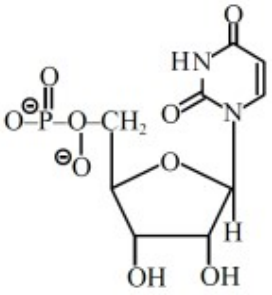
No. of Peptide bonds = 3

Hence Ans. = 1

28. Uracil is the base which only present is RNA.



Uracil



Structure of nucleotides number of 0-9.

29. No. of possible tripeptide :

Val and Pro is 2^3

(1) val – val – val (2) pro – pro – pro

(3) val – pro – pro (4) pro – val – pro

(5) val – val – pro (6) val – pro – val

(7) pro – pro – val (8) pro – val – val

30. Number of peptide linkage = (amino acid – 1)

= 7 – 1 = 6

CHEMISTRY IN EVERYDAY LIFE

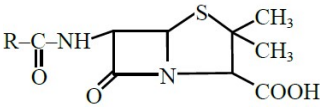
1. Noradrenaline is neurotransmitter.

2. (A) Norethindrone - Antifertility (Q)
(B) Ofloxacin - Anti-biotics (P)
(C) Equanil - Tranquilizer (R)

3. Seldane is an anti-histamine drug that has inhibitory action on histamine receptor.

4. Noradrenaline is an organic chemical that functions in brain and body as hormone and neurotransmitter.
Antidepressant drugs can be suggested for the deficiency of noradrenaline.

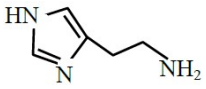
5. Statement I : Pencillin is bactericidal not bacteriostatic hence given statement is false.
Statement II : Structure of pencilline given is correct



6. → furacine acts as Antiseptic
→ Arsphenamine also known as salvarsan acts as antibiotic
→ Dimetane is synthetic histamine
→ valium is a Tranquilizer

7. The drug named chlordiate poxide is example of tranquilizer.

8. Histamine stimulate the secretion of HCl



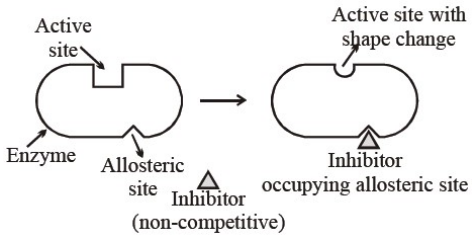
Histamine structure

9. B and C are tranquilizers

10. (A) Antifertility drug → (iii) Nor ethindrone
(B) Antibiotic → (iv) Salvarsan
(C) Tranquilizer → (i) Meprobamate
(D) Artificial sweetener → (ii) Alitame

11. (a) Antacid : Cimetidine
(b) Artifical Sweetener : Alitame
(c) Antifertility : Novestrol
(d) Tranquilizers : Valium

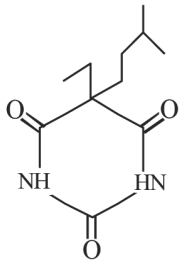
12. Some durg do not bind to the Enzyme's active site. These bind to a different site of enzyme which called **allosteric site**. This binding of inhibitor at allosteric site changes the shape of the active site in such a way that substrate can not recognise it. Such inhibitor is known as **Non-competitive inhibitor**.



13. Enzyme inhibitors can be competitive inhibitors (inhibit the attachment of substrate on active site of enzyme) and non–competitive inhibitor (changes the active site of enzyme after binding at allosteric site.)

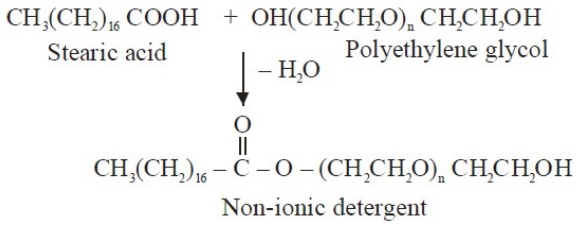
14. Some drugs do not bind to active sites. These bind to different site of enzyme called allosteric sites.

15. Amytal is hypnotic drug used to treat sleeping disorder.



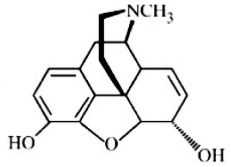
Amytal

16.



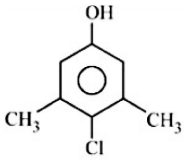
17. Rosin is added to soaps which forms sodium rosinate which lathers well.

18. (A)



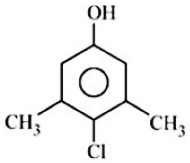
It is morphine use for relief for pain, known for narcotic analgesic

(B)



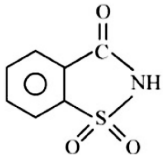
Chloroxylenol used as an antiseptic

(C)



Phenelzine (Nardil) use as Antidepressant

(D)

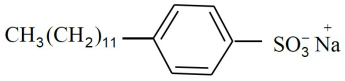


Saccharin 550 times sweeter than cane sugar

19.

A. Antipyretic	Reduces fever
B. Analgesic	Reduces pain
C. Tranquilizer	Reduces stress
D. Antacid	Reduces acidity (Stomach)

20. (A) $[CH_3(CH_2)_{15} - N(CH_3)_3\ Br^-$ is cationic detergents used in hair conditioner

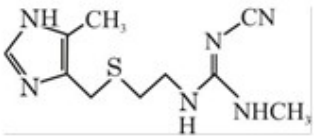
(B) 

Is anionic detergent used in tooth pastes

(C) $C_{17}H_{35}COO^-Na^+ + Na_2CO_3$ + Rosinate is used as laundary soap

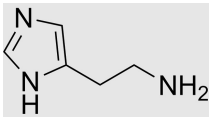
(D) $CH_3(CH_2)_{16}\ COO(CH_2CH_2O)_N\ CH_2CH_2OH$ is non-ionic detergents formed from stearic acid and poly ethylene glycol used as liquid dishwashing detergents.

21. Tegamet is the brand name of Cimetidine



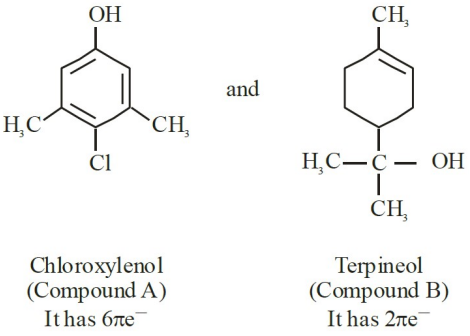
22. Antiseptic Dettol is mixture of chloroxylenol and terpineol.

23.



Histamine is nitrogenous compound it does not contain sulpher.

24. Dettol is mixture of



Chloroxylenol (Compound A) It has $6\pi e^-$

Terpineol (Compound B) It has $2\pi e^-$

Hence compound 'B' is Terpineol.

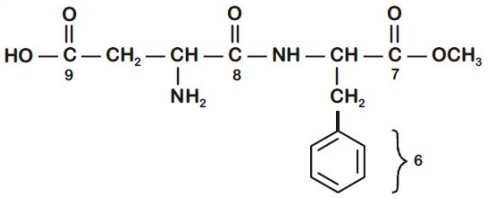
25. Cimetidine

26.

1. **Ranitidine:** Antacid
2. **Meprobamate:** Tranquilizer
3. **Terfenadine:** Antihistamine
4. **Brompheniramine:** Antihistamine

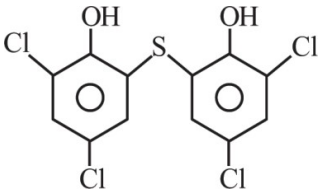
27. Calcium plays important role in neuromuscular function, interneuronal transmission, cell membrane etc.

28.



Number of sp^2 hybridized carbon are '9'.

29.



Chlorine atoms = 4

30. Ofloxacin

ENVIRONMENTAL CHEMISTRY

1. Maximum prescribed concentration of Cu in drinking water is 3 ppm.

2. Use of plastic bags is hazardous to our environment

3. CFC's are responsible for depletion of ozone layer

$$CF_2Cl_2 \xrightarrow{uv} \dot{C}l_{(g)} + |F_2\dot{C}Cl$$

$$C\dot{l} + O_3 \longrightarrow ClO\dot{} + O_2$$

$$ClO\dot{} + O \longrightarrow C\dot{l} + O_2$$

Both statements are correct.

4. Between 10-50 km above sea level lies stratosphere.

5. Air pollution caused by sunlight is photochemical smog and it is oxidising.

6. The lowest region of atmosphere in which human beings live is troposphere. It extends up to a height of 10 km from sea level. Clouds are also formed in this layer.

7. Photochemical smog contains oxides of nitrogen, ozone and hydrocarbons.

8. Eutrophication is a process by which environment gain nutrients for habitats and cause algal bloom, harmful algal produce toxins that are harmful and create dead zones for fish and polluting the environment.

9. Fluoride (F^-) ion conc upto 1 ppm makes the enamel of teeth much harder by converting

$$\underset{\text{hydroxyapatite}}{[3(Ca_3(PO_4)_2.Ca(OH)_2]} \xrightarrow{F^-} \underset{\substack{\text{Fluorapatite}\\(\text{harder})}}{[3(Ca_3(PO_4)_2.CaF_2]}$$

(NCERT)

10. The green house gases are CO_2, $H_2O_{(vapour)}$ & CH_4.

11. In presence of ozone(O_3), oxidising smog gets increased during the day time because automobiles and factories produce main components of the photochemcial smog (oxidising smog) results from the action of sunlight on unsaturated hydrocarbon and nitrogen oxide. Ozone is strong oxidising agent and can react with the unburnt hydrocarbons in the polluted air to produce chemicals.

12. Non-biodegradable wastes are generated by the thermal power plants which produces fly ash. Detergents which are biodegradable causes problem called eutrophication which kills animal life by deprieving it of oxygen.

13. Methane leads to both global warming & photochemical smog.

Methane is generated in large amounts from paddy fields.

CO_2 can be absorbed by photosynthesis, or by formation of acid rain etc., while no such activities are there for methane.

Hence methane is stronger global warming gas than CH_4.

Methane is not a part of reducing smog.

14. According to NCERT only NO_2 from the given options can retard the photosynthesis process in plants.

15. On heating concentration of O_2 in water decreases. So boiling water and water at 80°C having less O_2 concentration. Polluted water also having less O_2 concentration. So water at 4°C having maximum O_2 concentration.

16. **Statement (1)**

CFCs are broken down by powerful UV radiation and releases chlorine free radical which reacts with ozone and start chain reaction.

$$CF_2Cl_{2(g)} \xrightarrow{UV} \dot{C}l_{(g)} + \dot{C}F_2Cl_{(g)}$$

$$\dot{C}l_{(g)} + O_{3(g)} \rightarrow \dot{C}lO_{(g)} + O_{2(g)}$$

$$\dot{C}lO_{(g)} + O_{(g)} \rightarrow \dot{C}l_{(g)} + O_{2(g)}$$

Statement (2)

Atmosphere ozone reacts with nitric oxide to produce nitrogen dioxide and oxygen.

$NO_{(g)} + O_{3(g)} \rightarrow NO_{2(g)} + O_{2(g)}$

17. Clean water could have BOD value of less than 5 ppm whereas highly polluted water could have a BOD value of 17 ppm or more.

18. Photochemical smog causes cracking of rubber, the common component of photochemical smog are ozone, nitric oxide, acrolein, formaldehyde and peroxyacetyle nitrate (PAN).

19. Ozone in the stratosphere is a product of UV radiations acting on dioxygen (O_2) molecules.

$$O_2(g) \xrightarrow{UV} O(g) + O(g)$$

$$O(g) + O_2(g) \overset{UV}{\rightleftharpoons} O_3(g)$$

20. In stratosphere CFCs get broken down by powerful UV radiations releasing $Cl^{\bullet}$

$$CF_2Cl_2(g) \xrightarrow{U.V.} Cl^{\bullet}(g) + {}^{\bullet}CF_2Cl(g)$$

21. BOD values of clean water (A) is less than 5 ppm

So $A < 5$

BOD values of polluted water (B is greater than 17 ppm

So $B > 17$

So Ans. is 3

22. Clean water have BOD less than 5 ppm while highly polluted water has BOD greater or equal to 17 ppm. So, assertion is correct.

BOD is measure of oxygen required to oxidise only bio-degradable organic matter. So, reason is false.

Hence assertion is incorrect but reason is correct

23. Clean water $\longrightarrow$ B.O.D. < 5 ppm

Highly polluted water $\longrightarrow$ B.O.D. > 17 ppm

24. Polar stratospheric clouds provide surface on which hydrolysis of $ClONO_2$ takes place to form HOCl (Hypochlorous acid)

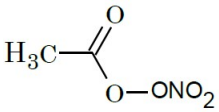
$ClONO_2\,(g) + H_2O(g) \rightarrow HOCl(g) + HNO_3(g)$

25. Classical smog occurs in cool humid climate. It is a reducing mixture of smoke, fog and sulphur dioxide

Photochemical smog has components, ozone, nitric oxide, acrolein, formaldehyde, PAN etc.

$CH_4 + O_3 \rightarrow HCHO + H_2O + CH_2$

$= CH - CHO +$



(PAN - peroxyacetyl nitrate)

26. Photo chemical smog results from the action of sunlight on unsaturated hydro carbons and nitrogen oxide

27. $CaCO_3 + H_2SO_4 \rightarrow CaSO_4 + H_2O + CO_2$

28. Theoretical.

29.

$$NO_2 \xrightarrow{\text{Sun light}} \underbrace{[O]}_{X} + \underbrace{NO}_{Y}$$

$$\underbrace{O_2}_{A}$$

$$\underbrace{O_3}_{B}$$

30. Photochemical smog has high concentration of oxidising agents

NO_2 is produced from NO and O_3 in the presence of sunlight

Classical smog contain smoke, fog and SO_2 and it is known as reducing smog, as chemically it is reducing mixture