CBSE Class 11 Chemistry

Sample Paper 08 (2020-21)

Maximum Marks: 70

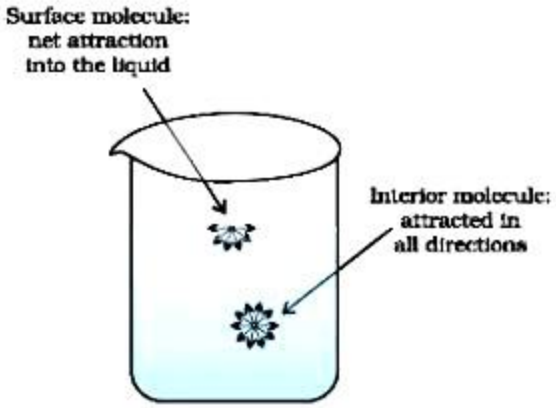
Time Allowed: 3 hours

General Instructions:

i. There are 33 questions in this question paper. All questions are compulsory.
ii. Section A: Q. No. 1 to 16 are objective type questions. Q. No. 1 and 2 are passage based questions carrying 4 marks each while Q. No. 3 to 16 carry 1 mark each.
iii. Section B: Q. No. 17 to 25 are short answer questions and carry 2 marks each.
iv. Section C: Q. No. 26 to 30 are short answer questions and carry 3 marks each.
v. Section D: Q. No. 31 to 33 are long answer questions carrying 5 marks each.
vi. There is no overall choice. However, internal choices have been provided.
vii. Use of calculators and log tables is not permitted.

Section A

1. **Read the passage given below and answer the following questions:**
   A molecule in the bulk of liquid experiences equals intermolecular forces from all sides. The molecule therefore does not experience any net force. But for the molecule on the surface of the liquid, the net attractive force is towards the interior of the liquid. Liquids tend to minimize their surface area. Surface tension is defined as the force acting per unit length perpendicular to the line drawn on the surface of the liquid. It is denoted by the Greek letter γ (Gamma). It has dimensions of kgs^{-2} and in the SI unit, it is expressed as Nm^{-1}. The lowest energy state of the liquid will be when the surface area is minimum. Liquids wet the things because they spread across their surfaces as a thin film. The magnitude of surface tension of a liquid depends on the attractive forces between the molecules. When the attractive forces are large, the surface tension is large.



i. The rise or fall of a liquid within a tube of small is called _____.
   a. surface tension
   b. capillary action
   c. viscosity
   d. none of these

ii. The dimension of surface energy is
   a. Jm^{-1}
   b. KJcm
   c. KJ m
   d. Jm

OR

In the fire polishing of gases, the edges are made smooth by
   a. the glass melt and then solidify make a smooth surface
   b. glass melt and surface take the rounded shape make the surface smooth
   c. both (a) and (b)
   d. none of these

iii. Increases in the temperature
   a. increases in kinetic energy
   b. effectiveness of intermolecular attraction decreases
   c. both (a) and (b)
   d. none of these

iv. The falling drop of water is spherical due to
   a. hydrogen bonding
   b. surface tension
   c. capillary action

d. viscosity

2. **Read the passage given below and answer the following questions:**

Once an organic compound is extracted from a natural source or synthesised in the laboratory, it is essential to purify it. Various methods used for the purification of organic compounds are based on the nature of the compound and the impurity present in it. Finally, the purity of a compound is ascertained by determining its melting or boiling point. This is one of the most commonly used techniques for the purification of solid organic compounds. In crystallisation Impurities, which impart colour to the solution are removed by adsorbing over activated charcoal. In distillation Liquids having different boiling points vaporise at different temperatures. The vapours are cooled and the liquids so formed are collected separately. Steam Distillation is applied to separate substances which are steam volatile and are immiscible with water. Distillation under reduced pressure: This method is used to purify liquids having very high boiling points.

In these questions, a statement of assertion followed by the statement of reason is given. Choose the correct answer out of the following choices:

a. Assertion and reason both are correct statements and reason is the correct explanation for assertion.
b. Assertion and reason both are correct statements and reason is not the correct explanation for assertion.
c. Assertion is the correct statement but reason is wrong statement.
d. Assertion is the wrong statement but reason is correct statement.

i. **Assertion:** Crystallisation is based on the difference in the solubilities of the compound and the impurities in a suitable solvent.
Reason: The impure compound is dissolved in a solvent.

ii. **Assertion:** In chromatography a mixture of substance is applied onto a stationary phase.
Reason: The moving phase is called mobile phase.

iii. **Assertion:** Aniline is separated by steam distillation from aniline – water mixture.
Reason: Steam distillation is used to purify liquids having very high boiling points.

iv. **Assertion:** Chloroform and aniline are easily separated by the technique of distillation.
Reason: Chloroform and aniline have sufficient difference in their boiling points.

OR

Assertion: Glycerol can be separated from spent-lye in the soap industry by chromatography.

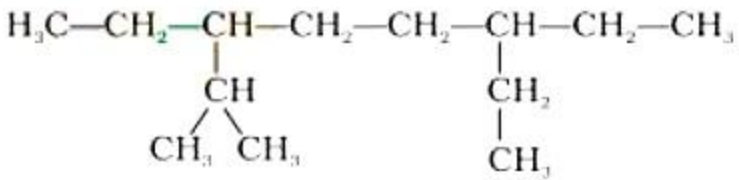
Reason: Fractional distillation is use to separate different fractions of crude oil in petroleum industry.

3. Molecular mass of a compound is the _____ of atomic masses of elements present in a molecule.
   a. sum
   b. lowest
   c. average
   d. maximum
4. For azimuthal quantum number (l) = 2, the values of magnetic quantum number will be:
   a. +2, +1, 0, -1, -2
   b. s, p, d
   c. 0, 1, 2
   d. $2l + 1$

OR

Give the name and atomic number of the inert gas atom in which the total number of d-electrons is equal to the difference between the numbers of total p and total s electrons.

   a. Br (atomic no.=36)
   b. As (atomic no.=36)
   c. Kr (atomic no.=36)
   d. Cl (atomic no.=36)
5. The correct IUPAC name of the following alkane is:



   a. 3 - Isopropyl - 6 - ethyloctane
   b. 5 - Isopropyl - 3 - ethyloctane
   c. 3,6 - Diethyl - 2 - methyloctane

d. 3 - Ethyl - 5 - isopropyloctane

6. In the case of compounds such as CH_3CH_2Cl, CH_3NO_2, etc. which of the following term is used as bond enthalpy?
   a. Minimum bond enthalpy
   b. Maximum bond enthalpy
   c. Bond dissociation enthalpy
   d. Mean bond enthalpy

OR

The lattice enthalpy of an ionic compound is the enthalpy change which occurs when

   a. one gm of an ionic compound dissociates into its ions in a gaseous state.
   b. one mole of an ionic compound dissociates into its ions in a liquid state.
   c. one kg of an ionic compound dissociates into its ions in a liquid state.
   d. one mole of an ionic compound dissociates into its ions in a gaseous state.

7. A chemist dissolves an excess of $BaSO_4$ in pure water at 25°C if its $K_{sp} = 1 \times 10^{-10}$. what is the concentration of barium in the water ?
   a. 10^{-4} M
   b. 10^{-6} M
   c. 10^{-15} M
   d. 10^{-5} M

OR

Assuming complete dissociation, calculate the pH of 0.002 M KOH solution.

   a. 10.93
   b. 2.01
   c. 11.31
   d. 10.11 only

8. Ethylbenzene cannot be prepared by _____.
   a. Clemmensen reduction
   b. Wurtz reaction
   c. Wurtz-Fittig reaction

d. Friedel-Crafts reaction

9. Alkali metals react with water vigorously to form hydroxides and dihydrogen.Which of the following alkali metals reacts with water least vigorously?
   a. Na
   b. K
   c. Cs
   d. Li
10. Toluene reacts with chlorine in the presence of light to give:
   a. p-chlorotoluene
   b. Benzyl chloride
   c. o-chlorotoluene
   d. Benzoyl chloride
11. The types of hybrid orbitals of nitrogen in NO_2^+, NO_3^-, and NH_4^+ respectively are expected to be:
   a. sp, sp^2 and sp^3
   b. sp^2, sp^3 and sp
   c. sp, sp^3 and sp^2
   d. sp^2, sp and sp^3
12. **Assertion:** Steam is a mixture.
   Reason: In a compound, the composition of the elements must be fixed.
   a. Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.
   b. Both assertion and reason are CORRECT but, reason is NOT THE CORRECT explanation of the assertion.
   c. Assertion is CORRECT but, reason is INCORRECT.
   d. Assertion is INCORRECT but, reason is CORRECT.
13. **Assertion:** Graphite is soft and a good lubricating agent.
   Reason: The successive layers in graphite are held together by weak forces of attraction.
   a. Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.
   b. Both assertion and reason are CORRECT but, reason is NOT THE CORRECT explanation of the assertion.

c. Assertion is CORRECT but, reason is INCORRECT.
d. Assertion is INCORRECT but, reason is CORRECT.

14. **Assertion:** Liquefaction of H_2 and He are very difficult.

    Reason: Critical temperature of H_2 and He gases are high.

    a. Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.
    b. Both assertion and reason are CORRECT but, reason is NOT THE CORRECT explanation of the assertion.
    c. Assertion is CORRECT but, reason is INCORRECT.
    d. Assertion is INCORRECT but, reason is CORRECT.

OR

Assertion (A): Three states of matter are the result of balance between intermolecular forces and thermal energy of the molecules.
Reason (R): Intermolecular forces tend to keep the molecules together but thermal energy of molecules tends to keep them apart.

a. Both A and R are true and R is the correct explanation of A.
b. Both A and R are true but R is not the correct explanation of A.
c. A is true but R is false.
d. A is false but R is true.

15. **Assertion:** Oxygen has an oxidation state of -2 in both O_2 and O_3.

    Reason: Oxygen is assigned an oxidation state of -2 in almost all its compounds.

    a. Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.
    b. Both assertion and reason are CORRECT but, reason is NOT THE CORRECT explanation of the assertion.
    c. Assertion is CORRECT but, reason is INCORRECT.
    d. Assertion is INCORRECT but, reason is CORRECT.

16. **Assertion:** Propene reacts with HBr in the presence of peroxides to give 1-bromopropane.

    Reason: Alkenes react with HBr in the presence of peroxides according to anti-Markovnikov's rule.

a. Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.
b. Both assertion and reason are CORRECT but, reason is NOT THE CORRECT explanation of the assertion.
c. Assertion is CORRECT but, reason is INCORRECT.
d. Assertion is INCORRECT but, reason is CORRECT.

Section B

17. What are horizontal rows and vertical columns of the periodic table called?

OR

Why are elements at the extreme left and extreme right the most reactive?

18. Arrange the following carbocation in increasing order of their stability.

$(CH_3)\overset{\otimes}{H}, CH_3CH_2^+$ $(CH_3)_3C^+$, $\overset{+}{C}H_3$

19. Urine has a pH of 6.0. If a patient eliminates 1300 mL of urine per day, how many gram equivalents of the acid he eliminates per day?

OR

Calculate:

i. Dissociation constant of conjugate base of HF, $K_a = 6.8 \times 10^{-4}$.

ii. Dissociation constant of conjugate acid of CO_3^{2-}, $K_b = 2.1 \times 10^{-4}$.

20. When Alkali metal dissolves in liquid ammonia, the solution can acquire different colours. Explain the reason for this type of colour change.

OR

What makes lithium to show properties uncommon to the rest of the alkali metals?

21. Complete the following reaction:

$$Zn(s) + NaOH(aq) \xrightarrow{heat}$$

22. What do you understand by the term 'auto protolysis of water'? What is its significance?
23. Draw structures for each of the following compounds. Why are the given names

incorrect? Write correct IUPAC names.

i. 2-ethylpentane

ii. 5-ethyl-3-methylheptane

24. i. Which orbitals are filled with electrons in the 3rd period?

ii. Which of the lanthanoids is a man-made element?

iii. To which series do man-made elements belong?

25. Calculate the oxidation number of Fe in

i. Fe_3O_4

ii. $Fe_4[Fe(CN)_6]_3$

Section C

26. The ionisation constant of dimethylamine is 5.4×10^{-4}. Calculate its degree of ionisation in Its 0.02 M solution. What percentage of dimethylamine is ionised if the solution is also 0.1 M in NaOH?

OR

What is the equilibrium concentration of each of the substances in the equilibrium when the initial concentration of ICl was 0.78 M?

$2ICl(g) \rightleftharpoons I_2(g) + Cl_2(g)$; $K_c = 0.14$

27. Give the relationship between ΔU and ΔH for gases.

OR

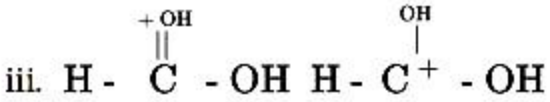
100 mL of a liquid is contained in an insulated container at a pressure of 1 bar. The pressure is steeply increased to 100 bar. The volume of the liquid is decreased by 1 mL at this constant pressure. Find ΔH and ΔU .

28. Why do alkenes prefer to undergo electrophilic addition reaction while arenes prefer electrophilic substitution reactions? Explain.

29. What is the relationship between the members of following pairs of structures? Are they structural or geometrical isomers or resonance contributors?

i.

ii.

iii. 

30. How many significant figures are present in
    a. 4.01×10^2
    b. 8.256
    c. 100

Section D

31. What is meant by the term bond order? Calculate the bond order of: N_2, O_2, O_2^+, O_2^-

OR

Discuss the orbital structures of the following molecules on the basis of hybridization.

i. BH_3
ii. C_2H_2
iii. BeF_2

32. Threshold frequency, ν_0 is the minimum frequency that a photon must possess to eject an electron from a metal. It is different for different metals. When a photon of frequency $1.0 \times 10^{15}\ s^{-1}$ was allowed to hit a metal surface, an electron having 1.988×10^{-19} J of kinetic energy was emitted. Calculate the threshold frequency of this metal. Show that an electron will not be emitted if a photon with a wavelength equal to 600 nm hits the metal surface.

OR

What is photoelectric effect? State the result of photoelectric effect experiment that could not be explained on the basis of laws of classical physics. Explain this effect on the basis of quantum theory of electromagnetic radiations.

33. What is the state of hybridisation of carbon in
    a. CO_3^{2-}
    b. diamond

c. graphite

OR

Describe the general trends in the following properties of the elements in Groups 13 and 14.

i. Atomic size
ii. Ionization enthalpy
iii. Metallic character
iv. Oxidation states
v. Nature of halides

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Solution

Section A

1. i. (b) capillary action

   ii. (a) Jm^{-1}

OR

(b) glass melt and surface take the rounded shape make surface smooth

   iii. (c) both (a) and (b)

   iv. (b) surface tension

2. i. (b) Assertion and reason both are correct statements and reason is not the correct explanation for assertion.

   ii. (b) Assertion and reason both are correct statements and reason is not the correct explanation for assertion.

   iii. (c) Assertion is the correct statement but reason is wrong statement.

   iv. (a) Assertion and reason both are correct statements and reason is the correct explanation for assertion.

OR

(d) Assertion is wrong statement but reason is a correct statement.

3. (a) sum

   Explanation: Molecular mass is the sum of atomic masses of the elements present in a molecule.

   For example ; Molecular mass of CO_2 = Σ atomic mass of one carbon atom & atomic mass of two oxygen atoms

   = [12 + 2(16)]u

   = 44u.

4. (a) +2, +1, 0, -1, -2

   Explanation: The magnetic quantum number gives the number of orbitals in a particular subshell within a principal energy level.

The possible values range from $+l$ through 0 to $-l$, a total of $2l + 1$ values.

OR

(c) Kr (atomic no.=36)

Explanation: The first inert gas which contains d electrons is krypton. Its atomic number is 36 and its electronic configuration is

$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 3d^{10}, 4s^2, 4p^6$

Total number of s electrons = 8 Total number of p electrons = 6 + 6 + 6 = 18 Total number of d electrons = 10 .

Differencein total number of p and s electrons = 18-8= 10

Thus, the inert gas is krypton.

5. (c) 3,6 - Diethyl - 2 - methyloctane

   Explanation: Following the rules of nomenclature, the IUPAC name of the given compound is 3, 6-Diethyl-2-methyloctane.

6. (d) Mean bond enthalpy

   Explanation: For polyatomic molecules, the term means bond enthalpy is used for the enthalpy changes associated with chemical bonds.

OR

(d) one mole of an ionic compound dissociates into its ions in a gaseous state.

Explanation: The lattice enthalpy of an ionic compound is the enthalpy change which occurs when one mole of an ionic compound dissociates into its ions in a gaseous state.

7. (d) 10^{-5} M

   Explanation: $BaSO_4 \rightarrow Ba^{2+} + SO_4^{2-}$

   $K_{sp} = [Ba^{+2}] [SO_4^{-2}]$

   $K_{sp} = x^2 = 10^{-10}$

   $x^2 = 10^{-10}$

   $x = 10^{-5}$

OR

(c) 11.31

Explanation: $KOH \rightarrow K^+ + OH^-$ (As KOH undergoes complete ionization)

$\Rightarrow [OH^-] = [KOH] = 0.02$

We know that, $K_w = [H^+]\,[OH^-] \Rightarrow [H^+] = \frac{K_w}{[OH^-]} = \frac{10^{-14}}{0.02} = 5 \times 10^{-12}$

$\Rightarrow pH = -\log [5 \times 10^{-12}] = 12 - \log 5 = 12 - 0.699 \approx 11.30$

8. (b) Wurtz reaction

   Explanation: Wurtz reaction is used to prepare alkanes with an even number of carbon atoms. To prepare ethylbenzene, the Wurtz Fittig reaction has to be used.

9. (d) Li

   Explanation: Li reacts with water least vigorously, since the density of Li is only about half that of water,so it floats on the surface and ultimately dissappears, giving off H_2 gas

10. (b) Benzyl chloride

    Explanation: In the presence of light, the CH_3 group undergoes a substitution reaction to give benzyl chloride $C_6H_5CH_2Cl$ as the main product.

11. (a) sp, sp^2 and sp^3

    Explanation: The types of hybrid orbitals of nitrogen in NO_2^+, NO_3^-, and NH_4^+ respectively are expected to be sp, sp^2, and sp^3.

12. (d) Assertion is INCORRECT but, reason is CORRECT.

    Explanation: Assertion is INCORRECT but, reason is CORRECT.

13. (a) Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.

    Explanation: Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.

14. (c) Assertion is CORRECT but, reason is INCORRECT.

    Explanation: Assertion is CORRECT but, reason is INCORRECT.

OR

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

Explanation: Both the factors, i.e., intermolecular forces and thermal energy decide the state of matter. Balance is required in these two factors.

15. (d) Assertion is INCORRECT but, reason is CORRECT.

    Explanation: Assertion is INCORRECT but, reason is CORRECT.

16. (a) Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.

Explanation: Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.

Section B

17. In the "long form" of the Periodic Table of the elements, horizontal rows are called periods and the vertical columns are called groups.

OR

Elements at the extreme left and extreme right of periodic table are most reactive. It is due to following reasons:

1. Alkali metals are present at extreme left end of periodic table. Due to greatest atomic size of alkali metals, their ionisation enthalpy is low. These metals can easily lose electrons to form cations. Hence, these metals are very reactive in nature.
2. On the other hand, Halogens (group 17^{th}) are present on extreme right side of periodic table (Noble gases, group 18^{th}, are stable). Due to smallest atomic size of halogens, their electron gain enthalpy is very high. Therefore, these elements can form anions easily by gaining the electrons. So, These elements are also reactive.

18. $\overset{\oplus}{C}H_3 < CH_3\overset{\oplus}{C}H_2 < (CH_3)_2\overset{\oplus}{C}H < (CH_3)_3\overset{\oplus}{C}$

19. According to the question, pH of urine = 6.0

$\therefore [H^+] = 10^{-6}$ M,

Thus, normality of $[H^+] = 10^{-6}$ N

Now, Normality = $\frac{No.\ of\ gram\ equivalent}{Vol.\ of\ solution\ in\ litres}$

No. of gram equivalents = 1.3×10^{-6} g

OR

We know that $K_a \times K_b = 1 \times 10^{-14}$ at 298 K where K_b is base dissociation constant and K_a acid dissociation constant.

Therefore,

i. $HF \rightleftharpoons H^+ + F^-$

K_a (acid) × K_b (conjugate base) = 1.0×10^{-14}

$K_b(F^-) = \frac{1.0\times10^{-14}}{6.8\times10^{-4}} = 1.47 \times 10^{-11}$

ii. $CO_3^{2-} + H^+ \longrightarrow HCO_3^-$

$K_b\left(CO_3^{2-}\right) \times K_a\left(HCO_3^-\right) = 1 \times 10^{-14}$

$K_a(HCO_3^-) = \frac{1\times10^{-14}}{2.1\times10^{-4}} = 4.76 \times 10^{-11}$

20. Alkali metals dissolve in liquid ammonia and give deep blue solutions which are conducting in nature because ammoniated electrons absorb energy in the visible region of light and impart blue colour.

$$M + (x+y)NH_3 \rightarrow [M(NH_3)_x]^+ + \underbrace{e^-(NH_3)_y}_{Ammoniated\ electrons}$$

The solutions are paramagnetic in nature due to presence of unpaired electron. In concentrated solution, the blue colour changes to bronze colour and becomes diamagnetic.

OR

The anomalous behaviour of lithium is due to the : (i) exceptionally small size of lithium atom and lithium ion, and (ii) high polarising power (i.e., charge/ radius ratio). As a result, there is increased covalent character of lithium compounds which is responsible for its anomalous behaviour.

21. $$Zn(s) + 2NaOH(aq) \xrightarrow{\Delta} \underset{Sodium\ Zincate}{Na_2ZnO_2(s)} + H_2(g)$$

This reaction takes place at 550°C. It is used to prepare hydrogen gas in laboratory.

22. Self-ionization of water is known as auto protolysis of water.

$$H_2O(l) + H_2O(aq) \rightarrow H_3O^-(aq) + OH^-(aq)$$

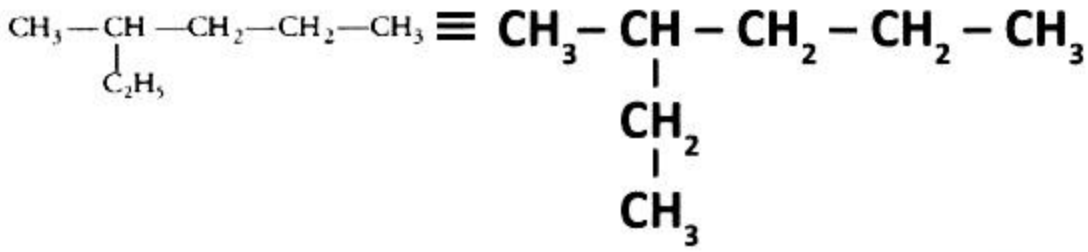
$$acid-1 \quad base-2 \quad acid-2 \quad base-1$$

$$(acid) \quad (base) \quad (conjugate\ acid) \quad (conjugate base)$$

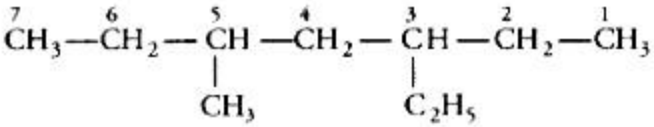
Significance: Due to auto protolysis, water act as both acid as well as base by gaining and losing of H^+ ions (Bronsted acid and base). By this we can say that water is amphoteric molecule.

23. i. In this compound, longest chain is of six carbon atoms and not of five. Also, the methyl group is on the third carbon, hence, the correct IUPAC name of the compound

is 3-methylhexane not 2-ethylpentane.



ii. According to rule of alphabets, the name of substitute starts with 'e' written first than name start from 'm'. Therefore, while numbering, the lower number is given to the ethyl group as compared to the methyl group. Hence, correct IUPAC name of compound is: 3-Ethyl,5-methylheptane.



24. i. In 3rd period, 3s and 3p orbitals are filled.

ii. Promethium ($_{61}$Pm) is a man-made lanthanoid.

iii. Man-made elements belong to the Actinoid series (f-block elements).

25. i. Fe_3O_4 .....3x - 8 = 0 or x = 8/3 (fractional)

Actually the composition of $FeSO_4$ is $FeO.Fe_2O_3$

The O.N of Fe in FeO is +2 and in Fe_2O_3, it is +3.

On the average O.N. comes out to be 8/3

ii. $Fe_4[Fe(CN)_6]_3$. In this case, the O.N. of Fe in the bracket is +2 and that of Fe outside the brackets is +3.

$Fe_4{}^{+3}[Fe^{+2}(CN)_6]_3$

Section C

26. According to the question, ionisation constant of dimethylamine is 5.4 x 10^{-4}.

C = 0.02 M

We know that, $\alpha = \sqrt{\frac{K_b}{C}} = \sqrt{\frac{5.4\times10^{-4}}{0.02}} = 1.64 \times 10^{-1} = 0.164$

In the presence of 0.1 M NaOH, let x b the percentage of dimethylamine ionised. The reaction is

$(CH_3)_2NH + H_2O \rightleftharpoons (CH_3)_2NH_2{}^+ + OH^-$

Initial conc.	0.02	0	0

equili. conc.	(0.02 - Cx) = 0.02	Cx	Cx + 0.1 = 0.1

Here, $K_a = \frac{[(CH_3)_2NH_2^+][OH^-]}{[(CH_3)_2NH]}$

$\therefore 5.4 \times 10^{-4} = \frac{0.02x \times 0.1}{0.02}$

$\Rightarrow$ x = $\frac{5.4 \times 10^{-4} \times 0.02}{0.02 \times 0.1}$

$\Rightarrow$ x = 54 $\times$ 10^{-4}

$\Rightarrow$ x = 0.54%

OR

Suppose at equilibrium, the molar concentration of both I_2 (g) and Cl_2(g) is 'x'mol L^{-1}.

$2ICl(g) \rightleftharpoons I_2(g) + Cl_2(g)$

	ICl	I_2	Cl_2
Initial molar conc.	0.78 M	0	0
Eqn. molar conc.	(0.78 - 2x) M	**x**	**x**

$K_c = \frac{[I_2(g)][Cl_2(g)]}{[ICl(g)^2]} = \frac{(x) \times (x)}{(0.78-2x)^2}$; $\frac{x}{(0.78-2x)} = (0.14)^{1/2} = 0.374$

or x = 0.374 (0.78 - 2x)

x = 0.292 - 0.748 x or 1.748 x = 0.292; $x = \frac{0.292}{1.748} = 0.167$

Therefore,

$[ICl] = (0.78 - 2 \times 0.167)$ = (0.78 - 0.334) = 0.446 M

$[I_2]$ = 0.167 M and $[Cl_2]$ = 0.167 M

27. Let V_A be the total volume of gaseous reactants,

V_B be the total volume of gaseous product.

Let n_A be the number of moles of the reactant,

n_B be the number of moles of the product,

At constant pressure and temperature,

$pV_A = n_A RT$,

$pV_B = n_B RT$

$\Rightarrow pV_B - pV_A = (n_B - n_A) RT$

$\Rightarrow \mathrm{p}\,\Delta V = (\Delta n)_g \mathrm{RT}$

Here, $(\Delta n)_g = n_B - n_A$ is equal to the difference between the number of moles of gaseous products and gaseous reactants.

We know that,

$\Delta H = \Delta U + (\Delta n)_g RT$

Now, ΔH = q_p(heat change under constant pressure),

ΔU = q_v(heat change under constant volume).

Therefore, $q_p = q_v + (\Delta n)_g RT$

OR

According to the question, $p_1 = 1$ bar $, p_2 = 100$ bar, $V_1 = 100\mathrm{mL}, V_2 = 99\mathrm{mL}$.

We know that, $\Delta U = q + W$

For the adiabatic process, q = 0

So, $\Delta U = W$

Now, $W = -p\Delta V = -100(99 - 100) = 100$bar ml

We know that, $\Delta H = \Delta U + \Delta pV$

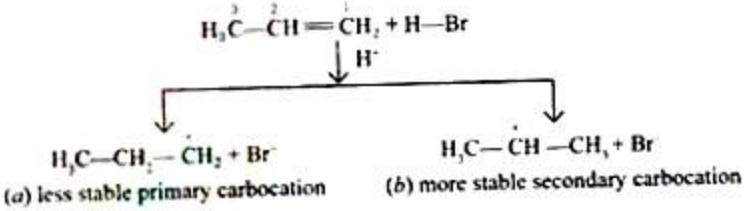
$= 100 + p_2V_2 - p_1V_1$

$= 100 + (100 \times 99) - (1 \times 100)$

= 100 + 9900 - 100

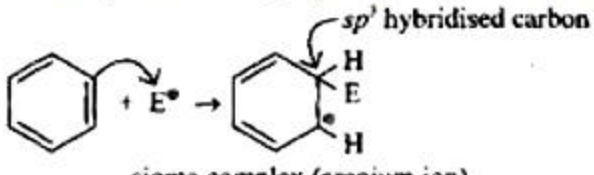
= 9900 bar mL

28. Alkenes are rich source of losely held pi(π) electrons, due to which they show electrophilic addition reaction. For example, HBr provides an electrophile H^+ which attacks the double bond to form carbocation as shown below:



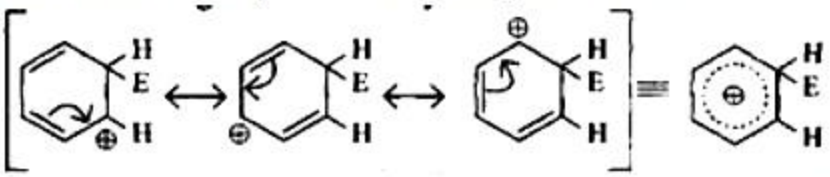
(*a*) less stable primary carbocation (*b*) more stable secondary carbocation

On the other hand, arenes have delocalized (4n+2)π electrons which gives to the great stability of the ring systems by resonance. Therefore, electrophilic substitution take place.



sigma complex (arenium ion)

The arenium ion gets stablished by resonance:



29. i. Structural isomers (actually position isomers as well as metamers)
    ii. Geometrical isomers
    iii. Resonance contributors because they differ in the position of electrons but not atoms

30.

S.No.	Value	Significant figures
1.	4.01×10^2	Three
2.	8.256	Four
3.	100	One

Section D

31. Bond order is defined as half of the difference between the number of electrons present in bonding and antibonding molecular orbitals.

Bond order = $\frac{1}{2}(N_b - N_a)$

E.C. of $N_2 = 1s^2 2s^2 2p_x^1 2p_y^1 2p_z^1$

M.O. configuration of N_2= $[\sigma 1s]^2 [\sigma * 1s]^2 [\sigma 2s]^2 [\sigma^* 2s]^2 [\pi 2p_x]^2 [\pi 2p_y]^2 [\sigma 2p_z]^2$

Bond order (B.O) = $\frac{1}{2}(N_b - N_a)$

$= \frac{1}{2}[10 - 4] = 3$

B.O. of O_2

M.O. of configuration of O_2 =

$(\sigma 1S)^2 (\sigma^* 1S)^2 (\sigma 2S)^2 (\sigma^* 2S)^2 (\pi 2p_z)^2 (\pi 2p_x)^2 (\pi 2p_y)^2 (\pi^* 2p_x)^2$

B.O. = $\frac{1}{2}(N_b - N_a)$

= = $\frac{1}{2}[10 - 6] = 2$

M.O. of the configuration of O_2^+ = $KK[\sigma 2s]^2\ [\sigma^* 2s]^2\ [\sigma 2p_z]^2\ [\pi 2p_x]^2\ [\pi 2p_y]^2\ [\pi * 2p_x]^1$

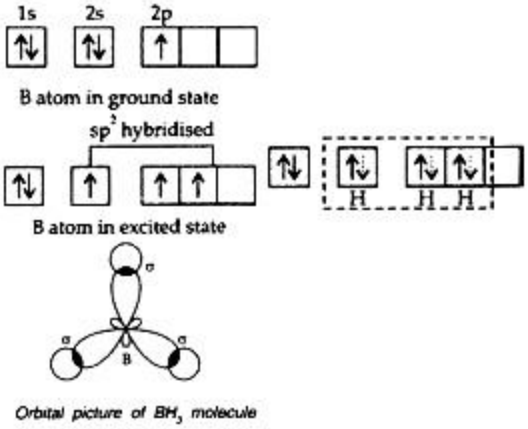
= $\frac{1}{2}$ [8-3] = 2.5

M.O. configuration of O_2^- = $KK[\sigma 2s]^2 [\sigma^* 2s]^2\ [\sigma 2p_z]^2\ [\pi 2p_x]^2\ [\pi 2p_y]^2\ [\pi^* 2p_x]^2\ [\pi^* 2p_y]^1$

= $\frac{1}{2}$ [8-5] = 1.5

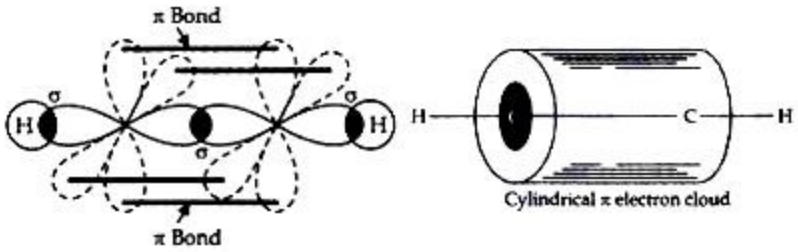
OR

i. Formation of BH_3 (atomic no. of B is 5)



B atom gets hybridized to form three equivalent hybrid orbitals directed towards three corners of an equivalent triangle with B atoms in the center. Bond angle = 120°.

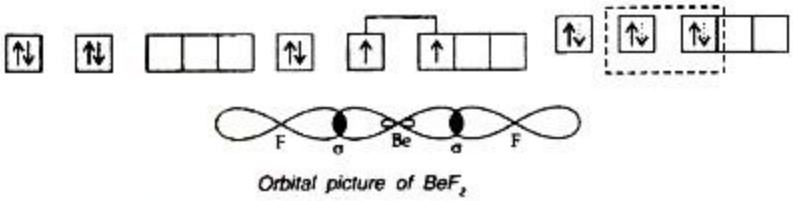
ii. C_2H_2



Orbitals picture of ethyne

Both the carbon atoms are sp hybridized. Both the carbon atoms have also two unhybridized orbitals which overlap sidewise with the similar orbitals of the other carbon atom to form two π bonds.

iii. BeF_2



The orbital picture of BeF_2 molecule is Linear.

32. We know that, $h\nu = h\nu_0$ + K.E.

$\Rightarrow h\nu_0 = h\nu$ - K.E.

$\Rightarrow \nu_0 = \nu - \frac{KE}{h}$ .....(i)

According to the question, $\nu = 1.0 \times 10^{15}\, s^{-1}$, K.E. = $1.988 \times 10^{-19} J, h = 6.626 \times 10^{-34} \mathrm{J}s.$

From (i) we have,

$\nu_0 = 1.0 \times 10^{15} s^{-1} - \frac{1.988 \times 10^{-19} J}{6.626 \times 10^{-34} Js}$

$= \left(1.0 \times 10^{15} - 0.30 \times 10^{15}\right) s^{-1}$

$= 0.7 \times 10^{15} s^{-1} = 7 \times 10^{14} s^{-1}$

According to the question, $\lambda = 600\text{nm} = 600 \times 10^{-9}\text{m} = 6.0 \times 10^{-7}\text{m}$

$\Rightarrow \nu = \frac{c}{\lambda} = \frac{3.0 \times 10^{8} m s^{-1}}{6.0 \times 10^{-7} m} = 5 \times 10^{14} s^{-1}$

We observe that, $\nu < \nu_0$,

Therefore, no electron will be emitted.

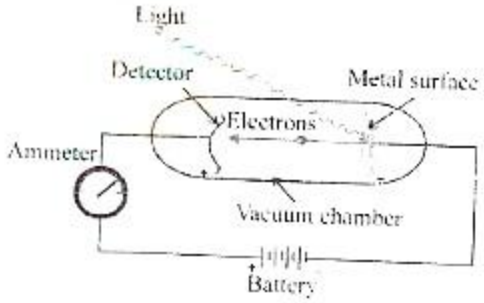
OR

Photoelectric effect: When certain metals are exposed to a beam of light, the electrons are ejected from the metal. This phenomenon is called the photoelectric effect. The electrons ejected are called photoelectrons.

The results of this experiment were:

1. The electrons are ejected from the metal surface as soon as the beam of light strikes the surface, i.e., there is no time lag between the striking of the light beam and the ejection of electrons from the metal surface.
2. The number of electrons ejected is proportional to the intensity or brightness of the light.
3. For each metal; there is a minimum frequency, ν_o below which photoelectric effect is not observed.
4. K.E. of electrons $\propto$ frequency of light.

Equipment for studying the photoelectric effect. Light of a particular frequency strikes a clean metal surface inside a vacuum chamber. Electrons are ejected from the metal and are counted by a detector that measures their kinetic energy:



Explanation of photoelectric effect on the basis of quantum theory: When a photon of

sufficient energy strikes an electron in the atom of the metal, it transfers its energy to the electron and the electron is ejected without delay. Greater the energy of the photon, greater will be the kinetic energy of the ejected electron.

33. The state of hybridization of carbon in:
    a. CO_3^{2-}
        i. C in CO_3^{2-} is sp^2 hybridized and is bonded to 3 oxygen atoms.
        ii. No. of single bonds between carbon and other atoms: 3
        iii. No. of lone pairs on carbon atom: 0
        iv. Now sum up the bond pairs and lone pairs = 3 + 0 =3. sp^2 that is, one s and two p orbitals.
    b. Diamond
        i. Each carbon in diamond is sp^3 hybridized and is bound to 4 other carbon atoms.
        ii. The electronic configuration of carbon is $1s^2\ 2s^2\ 2p^2$, i.e., with four valence electrons spread in the s and p orbitals.
        iii. In order to create covalent bonds in diamond, the s orbital mixes with the three p orbitals to form sp^3 hybridization.
    c. Graphite
        i. Each carbon atom in graphite is sp^2 hybridized and is bound to 3 other carbon atoms.
        ii. Graphite exists as sheets of hexagonal arrays of carbon. Each carbon atom in graphite thus has a trigonal planar geometry, which implies sp^2 hybridization. Moreover, the p orbitals axial to the hexagonal sheets help to bond the layering sheets together.

OR

Group 13

i. **Atomic size:** On moving down the group the size of the atom increases.
ii. **Ionization enthalpy:** Ionization enthalpy decreases down the group.
iii. **Metallic character**: Boron is nonmetallic and all other elements are metallic. Metallic character increases from B to Al but from Al to Tl it decreases due to the poor shielding effect of d-electrons and f-electrons.

iv. **Oxidation states:** All elements show +3 oxidation state but on moving down the group due to inert pair effect +3 oxidation state decreases and +1 oxidation state progressively increases.

v. **Nature of Halides:** These elements react with halogens to form trihalides (except Tl I_3).

$2E(s) + 3\ X_2(g) \rightarrow 2EX_3(s)$ (where X = F, Cl, Br, I)

Halides of Boron and Aluminum are electron-deficient and act as Lewis acids.

Group-14

i. **Atomic size:** On moving down the group the size of the atom increases.

ii. **Ionization Enthalpy:** Ionization enthalpy decreases down the group.

iii. **Metallic character:** In group 14, on moving down the metallic character increases.

iv. **Oxidation states**: The common oxidation states exhibited by these elements are +4 and +2.

v. **Nature of Halides:** These elements can form halides of formula MX_2 and MX_4 (X = F, Cl, Br, I). Most of the compounds (MX_4) are covalent in nature.