CBSE Class 11 Chemistry

Sample Paper 06 (2020-21)

Maximum Marks: 70

Time Allowed: 3 hours

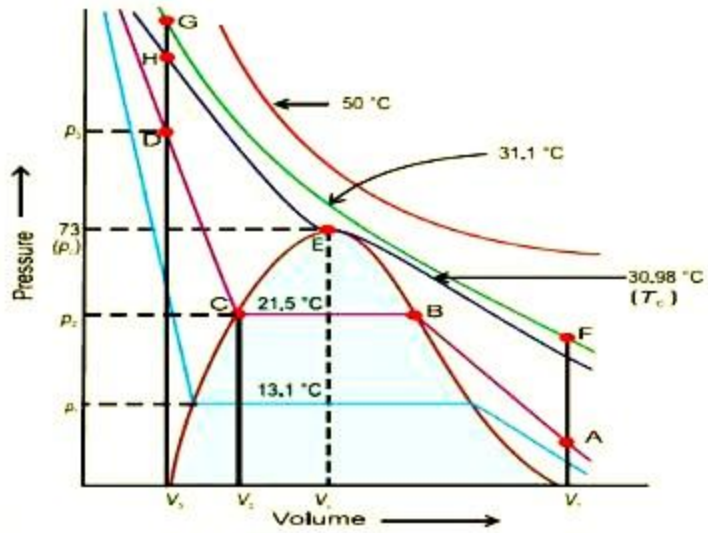
General Instructions:

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 following passage and answer the following questions:**

   Isotherm of CO_2 at various temperatures is first complete data on pressure-volume temperature relations of a substance in both gaseous and liquid state was obtained by Thomas Andrews on Carbon dioxide. Andrews noticed that at high temperatures isotherms look like that of an ideal gas and the gas cannot be liquified even at very high pressure. As the temperature is lowered, the shape of the curve changes and data show considerable deviation from ideal behaviour. The steep line represents the isotherm of liquid. A slight compression from volume V_2 to V_3 results in a steep rise in pressure from p_2 to p_3. The length of the horizontal line increases at lower temperatures. At the critical point, the horizontal portion of the isotherm merges into one point.



i. At what temperature carbon dioxide remain gas

a. 30.98°C

b. 40,41°C

c. 67°C

d. 43.61°C

ii. Critical volume (V_c) is defined as

a. volume of one mole of gas at the critical temperature

b. volume of two moles of gas at the critical temperature

c. volume of three moles of gas at the critical temperature

d. all of these

OR

Gases possess characteristic critical temperature following are the critical temperature of some gases

gas	H_2	He	O_2	N_2
critical temperature	33.2	5.3	154.3	126

from the above data what would be the order of liquefaction of these gases

a. H_2, He, O_2, N_2

b. H_2, O_2, N_2, He

c. He, H_2, O_2, N_2

d. O_2, N_2, H_2, He

iii. The dome-shaped area of isotherm graph represent

a. existence of liquid CO_2 in equilibrium

b. existence of liquid and gaseous CO_2 in equilibrium

c. existence of liquid and solid CO_2 in equilibrium

d. none of these

iv. In isotherm graph at 21.5°C, CO_2 remain gas upto

a. point C

b. point D

c. point A

d. point B

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

The phenomenon of the existence of two or more compounds possessing the same molecular formula but different properties is known as isomerism. Such compounds are called isomers. Compounds having the same molecular formula but different structures (manners in which atoms are linked) are classified as structural isomers. Structural isomers are classified as chain isomer, position isomer, functional group isomer. Meristematic arises due to different alkyl chains on either side of the functional group in the molecule and stereoisomerism and can be classified as geometrical and optical isomerism. Hyperconjugation is a general stabilising interaction. It involves delocalisation of σ electrons of the C—H bond of an alkyl group directly attached to an atom of an unsaturated system or to an atom with an unshared p orbital. This type of overlap stabilises the carbocation because electron density from the adjacent σ bond helps in dispersing the positive charge.

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:** Isopentane, pentane and Neopentane are chain isomers.
Reason: They have a similar molecular formula but different carbon skeleton.

ii. **Assertion:** $CHCH_3^{2+}$ (ethyl cation) has a positively charged carbon atom has an empty p orbital.

Reason: Hyperconjugation is not possible in alkenes and alkylarenes.

iii. **Assertion:** $C_4H_{10}O$ represents methoxypropane ($CH_3OC_3H_7$) and ethoxyethane ($C_2H_5OC_2H_5$).

Reason: Stereoisomerism can be classified as geometrical and optical isomerism.

iv. **Assertion:** The molecular formula C_3H_6O represents an aldehyde and a ketone.

Reason: Two or more compounds having the same molecular formula but different functional groups are called chain isomers.

OR

Assertion: Hyperconjugation is a permanent effect.

Reason: The σ electrons of C-H bond of the alkyl group enter into partial conjugation with the attached unsaturated system or with the unshared p orbital.

3. The gram molar mass of CO_2 is:
   a. 44 g
   b. 46 g
   c. 78 g
   d. 88 g
4. The orbital with quantum numbers n = 4, l = 3 is
   a. 4f
   b. 3d
   c. 4d
   d. 4p

OR

The electronic configuration $1s^2 2s^2 2p^1$ belongs to:

a. lithium
b. Boron
c. Beryllium
d. carbon

5. Boiling point of alkanes are:
   a. is independent of branching.
   b. decreases with increase in molecular mass.
   c. is independent of molecular mass.
   d. increases with increase in molecular mass.
6. The pressure-volume work for an ideal gas can be calculated by using the expression w = $-\int_{V_i}^{V_f} p_{ex}\,dV$. The work can also be calculated from the pV–plot by using the area under the curve within the specified limits. When an ideal gas is compressed (a) reversibly or (b) irreversibly from volume Vi to Vf. choose the correct option.
   a. w (reversible) < w (irreversible)
   b. w (reversible) > w (irreversible)
   c. w (reversible) = w (irreversible)
   d. w (reversible) = w (irreversible) + $p_{ex}.\Delta V$

OR

The enthalpy of combustion of methane, graphite and dihydrogen at 298 K are, - 890.3 kJ mol^{-1}, -393.5 kJ mol^{-1} and 285.8 kJ mol^{-1} respectively. Enthalpy of formation of CH_4 (g) will be

   a. +74.8 kJ mol^{-1}
   b. +52.26 kJ mol^{-1}
   c. - 74.8 kJ mol^{-1}
   d. - 52.27 kJ mol^{-1}
7. If we place solid iodine in a closed vessel after some time the vessel gets filled up with violet vapour. When equilibrium is attained, the intensity of colour will be:
   a. decreases
   b. constant
   c. no colour at all
   d. increases

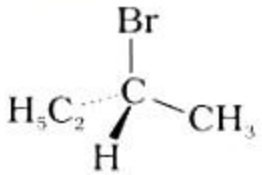
OR

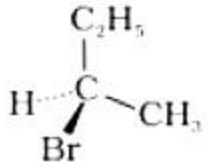
Equilibrium constant for the reaction, $4NH_3(g) + 5O_2(g) \longrightarrow 4NO(g) + 6H_2O$ (g) is written

as:

a. $1/[NH_3]^4[O_2]^5$
b. $[NH_3]^4[O_2]^5 / 2$
c. $K_c = NH_3\,]^4[\,O_2\,]^5 / \,[[NO]^4[H_2O]^6$
d. $K_c = \,[NO]^4[H_2O]^6 / \,[NH_3]^4[O_2]^5$

8. The addition of HBr to 1-butene gives a mixture of products A, B, and C.

A. 

B. 

C. CH_3- CH_2- CH_2- CH_2- Br

The mixture consists of:

a. A and B as major and C as minor products
b. B as minor, A and C as major products
c. A and B as minor and C as major products
d. B as major, A and C as minor products

9. Choose the correct trend of the melting and boiling points in the alkali metal halides: MF, MCl, MI, MBr.
   a. MCl > MBr > MI
   b. MBr > MI
   c. MF > MCl > MBr > MI
   d. MI
10. The general formula of a cycloalkane with one benzene ring is _____.
    a. C_nH_{2n-2}
    b. C_nH_n
    c. C_nH_{2n}
    d. C_nH_{2n+2}
11. Bond lengths are lower in elements having:

a. double bond
b. triple bond
c. crystal structure
d. single bond

12. **Assertion:** 22-carat gold is a compound.
Reason: A compound has fixed composition of the elements present in it.
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 good conductor of heat and electricity.
Reason: Graphite has π-electrons which are mobile.
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:** The value for van der Waal's constant 'a' is higher for ammonia than for nitrogen.
Reason: Intermolecular hydrogen bonding is present in ammonia.
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: At low pressure, van der Waal's equation may be expressed as $pV = RT - \frac{a}{V}$.

Reason: At low pressure b can be neglected in comparison to V.

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.

15. **Assertion:** A substance which gets reduced can act as reducing agent.
Reason: An oxidising agent itself gets oxidised.
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. Both assertion and reason are INCORRECT.

16. **Assertion:** Buta-1, 3-diene and but-1-yne can be distinguished with Tollen's reagent.
Reason: But-1-dyne gives ppt. with Tollen's reagent but buta-1, 3-diene does not.
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. State the modern periodic law.

OR

Explain why the electron gain enthalpy of fluorine is less negative than that of chlorine.

18. Arrange the following in increasing order of C - C bond length:
C_2H_6, C_2H_4, C_2H_2
19. Write conjugate acid and conjugate base of H_2O?

OR

The concentration of H^+ in a soft drink is 3.8×10^{-3} M. What is its pH?

20. Why does the solubility of alkaline earth metal carbonates and sulphates in water decrease down the group?

OR

Why are alkali metals always univalent? Which alkali metal ion forms largest hydrated ion aqueous solution?

21. Saline hydrides are known to react with water violently producing fire. can CO_2, a well known fire extinguisher, be used in this case. Explain.
22. Among NH_3, H_2O and HF, which would you expect to have highest magnitude of hydrogen bonding and why?
23. What do you understated by Resonance energy?
24. How does electronegativity and non – metallic character related to each other?
25. What is the oxidation number of Fe in $[Fe(CO)_5]$?

Section C

26. The pH of 0.005 M codeine ($c_{18}H_{21}NO_3$) solution is 9.95. Calculate the ionization constant and pK_b.

OR

If 0.561 g of KOH is dissolved in water to give 200 mL of solution at 298 K, calculate the concentrations of potassium, hydrogen and hydroxyl ions. What is its pH?

27. Define the following:
    i. First law of thermodynamics
    ii. Standard enthalpy of formation

OR

The enthalpy of vaporisation of liquid diethyl ether $(C_2H_5)_2O$ is 26.0 kJ mol^{-1} at its boiling point (35.0°C). Calculate $\Delta S°$ for the conversion of

i. liquid to vapour and

ii. vapour to liquid at 35°C.

28. (a) Why are alkenes called unsaturated hydrocarbons?

    (b) How will you test the presence of double bond in an alkene?

    (c) Name the products formed when propene is subjected to ozonolysis.

29. Draw formulas for the first five members of each homologous series beginning with the following compounds.

    i. H-COOH

    ii. CH_3COCH_3

    iii. H-CH=CH_2

30. Calculate the number of atoms in each of the following:

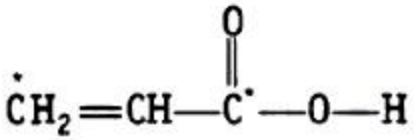
    i. 52 moles of He

    ii. 52 u of He

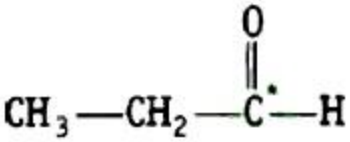
    iii. 52 g of He

Section D

31. What is the type of hybridisation of carbon atoms marked with a star?

    a. 

    b. $CH_3 - \dot{C}H_2 - OH$

    c. 

    d. $\dot{C}H_3 - CH = CH - CH_3$

    e. $CH_3 - \dot{C} \equiv CH$

OR

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

32. State and explain the following:

    i. Aufbau principle

    ii. Pauli exclusion principle

    iii. Hund's rule of maximum multiplicity.

OR

I. Find energy of each of the photons which:

i. correspond to light of frequency 3×10^{15} Hz.

ii. have wavelength of 0.50 $\mathring{A}$

II. Calculate the wavelength, frequency and wavenumber of a light wave whose period is 2.0×10^{-10}s.

33. Give the formula and describe the structure of a noble gas species which is isostructural with:

i. ICl_4^-

ii. IBr_2^-

iii. BrO_3^-

OR

Complete the following reactions:

1. $(NH_4)_2SO_4 + 2NaOH \rightarrow$
2. $2FeCl_3\,(aq) + 3NH_4OH\,(aq) \rightarrow$
3. $AgCl\,(s) + 2NH_3\,(aq) \rightarrow$
4. $NaNO_3 + H_2SO_4 \rightarrow$
5. $3NO_2\,(g) + H_2O\,(l) \rightarrow$
6. $Cu + 4HNO_3\,(conc) \rightarrow$
7. $4Zn + 10HNO_3\,(dil) \rightarrow$
8. $[Fe(H_2O)_6]_2 \; + \; NO \; \rightarrow$
9. $I_2 + 10HNO_3 \rightarrow$
10. $S_8 + 48HNO_3\,(conc) \rightarrow$

CBSE Class 11 Chemistry

Sample Paper 06 (2020-21)

Solution

Section A

1. i. (a) 30.98°C

   ii. (a) volume of one mole of gas at critical temperature

   OR

   d) O_2, N_2, H_2, He

   iii. (b) existence of liquid and gaseous CO_2 in equilibrium

   iv. (c) point B

2. i. Assertion and reason both are correct statements and reason is the correct explanation for assertion.

   ii. Assertion is the correct statement but reason is wrong statement.

   iii. Assertion and reason both are correct statements and reason is not the correct explanation for assertion.

   iv. Assertion is the correct statement but reason is wrong statement.

   OR

   Assertion and reason both are correct statements and reason is the correct explanation for assertion.

3. (a) 44 g

   Explanation: Molar mass of CO_2 = Σ (atomic mass of C, 2*atomic mass of O)

   = [12+2(16)] u

   Since gram molar mass

   = Molar mass expressed in gms.

   $\therefore$ gram molar mass of CO_2

   = 44 g

4. (a) 4f

   Explanation: For n = 4 the possible values of l are 0,1, 2, 3. The orbital with l = 3 is f

orbital.

OR

(b) Boron

Explanation: Boron is a chemical element with symbol B and atomic number 5. So electronic configuration of boron is $1s^2 2s^2 2p^1$.

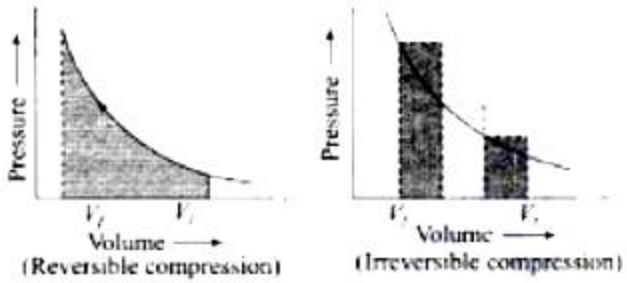
5. (d) increases with increase in molecular mass.

   Explanation: As molecular mass increases, the magnitude of Van der Waals forces of attraction increases and hence boiling point increases accordingly.

6. (a) w (reversible) < w (irrevrsible)

   Explanation: w (reversible) < w (irreversible) (for compression process)

   Justification: Area under the curve is always more in irreversible compression as can be seen from Fig (a) and (b).



OR

(c) - 74.8 kJ mol^{-1}

Explanation: $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O\ \Delta H_1 = -890.3KJ/mol$ ....(1)

$C(s) + O_2 \rightarrow CO_2\ \Delta H_2 = -393.5KJ/mol$ ....(2)

$H_2 + 0.5O_2 \rightarrow H_2O\ \Delta H_3 = -285.8KJ/mol$ ....(3)

$C(s) + 2H_2 \rightarrow CH_4\ \Delta H = \Delta H_2 + 2(\Delta H_3) - \Delta H_1$

$\triangle H$ = -393.5 +2(-285.8) - (-890.3)

= -74.8 kJ/mol

7. (b) constant

   Explanation: We place solid iodine in a closed vessel, after some time the vessel gets filled up with violet vapour and the intensity of colour increases with time. After a certain time, the intensity of colour becomes constant and at this stage, equilibrium is attained. Hence solid iodine sublimes to give iodine vapour and the iodine vapour

condenses to give solid iodine. The equilibrium can be represented as I_2 (solid) $\rightleftharpoons$ I_2 (vapour).

OR

(d) $K_c = [NO]^4[H_2O]^6 / [NH_3]^4[O_2]^5$

Explanation: K_c is equilibrium constant $= \frac{[products]^{stoichiimetry}}{[reactant]^{stoichiimetry}}$

$K_c = [NO]^4[H_2O]^6 / [NH_3]^4[O_2]^5$

8. (a) A and B as major and C as minor products

   Explanation: A and B both involve secondary carbocation but C involves primary carbocation and secondary carbocation is more stable than primary carbocation.

9. (c) MF > MCl > MBr > MI

   Explanation: Smaller is the size of anion less is the polarizing power of anion so greater is the ionic character hence greater will be the melting point.

10. (c) C_nH_{2n}

    Explanation: Cycloalkane with one benzene ring has a formula C_6H_{12}.

    ∴ The formula becomes C_nH_{2n}

11. (b) triple bond

    Explanation: The bond length depends on the strength of the bond. The stronger the bond is, the shorter it will be. The triple bonds are the strongest and hence the shortest. Then comes double bonds which are of intermediate strength between the triple and single bonds. And finally, the single bonds are weaker than the other two. This way, Triple bonds are the shortest. Then comes double bonds. Finally, single bonds are the longest among the three.

    The order of bond lengths is given as Triple bond < Double bond < Single bond.

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. (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.

OR

(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.

15. (d) Both assertion and reason are INCORRECT.

    Explanation: Both assertion and reason are INCORRECT.

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. Modem periodic law states that physical and chemical properties of the elements are a periodic function of their atomic numbers. If the elements are arranged in the order of their increasing atomic number, after a regular interval, elements with similar properties are repeated.

OR

Electron gain enthalpy of fluorine is less than that of chlorine because the added electron in fluorine goes to second quantum level (n=2). Due to small size of fluorine it experiences more repulsion from other electrons in same shell. In case of chlorine, the added electrons goes to the larger quantum level (n=3) and suffers much less repulsion from the other electrons.

18. C_2H_2 (120 pm) < C_2H_4 (134 pm) < C_2H_6 (154 pm)

19. Since, Bronsted base + H^+ = conjugate acid and Bronsted acid – H^+ = conjugate base.

    Therefore, Conjugate acid of H_2O is H_3O^+ (Hydronium ion) and conjugate base of H_2O is OH^- (Hydroxide ion).

OR

Given , $[H^+] = 3.8 \times 10^{-3}$ M

We know that,

pH = - log $[H^+]$

= - log (3.8×10^{-3})

= - [log 3.8 + log 10^{-3}]

= - [0.5798 - 3]

= - 0.5798 + 3

= 2.42

20. The size of anions being much larger compared to cations, the lattice enthalpy will remain almost constant within a particular group. Since the hydration enthalpies decrease down the group, solubility will decrease as found for alkaline earth metal carbonates and sulphates.

OR

They are always univalent because after losing one electron, they acquire stable nearest inert gas configuration. Li^+ forms largest hydrated cations because it has highest hydration energy among all alkali metals.

21. No. If saline hydrides react with water, the reaction will be highly exothermic. Thus the hydrogen evolved in this case can catch fire. CO_2 cannot be used as fire extinguisher in this case because will get absorbed in alkali metal hydrides.
For example, $NaH(s) + H_2O(l) \rightarrow NaOH(aq) + H_2(g)$
22. HF is expected to have highest magnitude of hydrogen bonding since Fluorine (F) is the most electronegative element. Therefore HF has maximum polarity and hence has the highest strength of hydrogen bonding.
23. **Resonance energy:** The difference between the energy of the most stable contributing structure and the energy of the resonance hybrid is known as resonance energy.
Example: The resonance energy of benzene is 147KJ/mole.
24. Electronegativity is directly related to the non – metallic character of elements.
Therefore, the rise in electronegativities across the period is followed by an increase in

non – metallic properties of elements.

Consequently, the decrease in electronegativities down the group is accompanied by an decrease in non – metallic properties of elements.

25. The oxidation number of Fe in $Fe(CO)_5$ is Zero

Explanation/Calculations:

$Fe(CO)_5$ is Iron carbonyl, containing Fe as the central atom which is linked with a neutral group/ligand CO (ie carbonyl group)

Since the carbonyl group itself is a molecule its oxidation number = 0

Now, let the oxidation number of Fe in $Fe(CO)_5$ be represented by x, then

$(x + 5 \times 0) = 0$

$\therefore\ x\ = 0$

Thus, the oxidation number of Fe in $Fe(CO)_5$ is Zero

Section C

26. $Cod + H_2O \rightleftharpoons Cod\ H^+ + OH^-$

pH = 9.95 $\therefore$ pOH = 14 - 9.5 = 4.05, i.e. -log[OH^-] = 4.05

or log [OH^-] = -4.05 $= \bar{5}.95$ or $[OH^-] = 8.913 \times 10^{-5} M$

$K_b\ =\ \frac{[Cod\ H^+]\ [OH^-]}{[Cod]} = \frac{[OH^-]^2}{[Cod]} = \frac{(8.913\ \times\ 10^{-5})^2}{5 \times 10^{-3}} = 1.588 \times\ 10^{-6}$

Therefore, $pK_b = -\log(1.588 \times 10^{-6}) = 6 - 0.1987 = 5.8$

OR

Molarity of KOH, M = $\frac{\text{mass of KOH(g)} \times 1000}{\text{molar mass (KOH)} \times \text{Volume of solution (in mL)}}$

$\Rightarrow$ M = $\frac{0.561 \times 1000}{56 \times 200}$

$\Rightarrow$ M = 0.05 mol L^{-1}

We know that, Molar mass of KOH = 39 + 16 + 1 = 56 g mol^{-1}

Reaction:

$KOH \longrightarrow K^+ + OH^-$

Now, [K^+] = 0.05 M and [OH^-] = 0.05 M

We know that, [H^+][OH] = K_w = 1.0 $\times 10^{-14}$

$\Rightarrow$[H^+] = $\frac{1.0 \times 10^{-14}}{0.05}$

= 20 $\times$ 10^{-14} M

$= 2 \times 10^{-13}$ M

We know that, pH = -log[H^+]

= -log[2×10^{-13}]

= -0.3010 + 13

= 12.7

27. i. First law of thermodynamics: It states that energy can neither be created nor be destroyed. The energy of an isolated system is constant.

    Δu = q + w

    (It can be transferred from one body to another.)

    ii. It is defined as the amount of heat evolved or absorbed when one mole of the compound is from its constituting element in their standard states.

OR

i. We know that, $\Delta_{vap}S^\circ = \frac{\Delta_{vap}H^\circ}{T}$

According to the question, $\Delta_{vap}H^\circ = 26.0 kJmol^{-1}, T = 273 + 35 = 308K$

So, $\Delta_{vap}S^\circ = \frac{26.0 \times 10^3 Jmol^{-1}}{308K} = 84.4 JK^{-1}mol^{-1}$

ii. The conversion of vapour into liquid is condensation.

The enthalpy of condensation is negative of enthalpy of vaporisation.

$\Delta_{vap}H^\circ = -\Delta_{cond}H^\circ$

We know that, $\Delta_{cond}S^\circ = \frac{\Delta_{cond}H^\circ}{T}$

$= \frac{-26.0 \times 10^3 Jmol^{-1}}{308K}$

= - 84.4 JK^{-1} mol^{-1}

28. (a) Alkenes contain two hydrogen atoms less than alkanes and thus they contain C-C double bond (C = C) in their molecule. Thus they are called unsaturated hydrocarbons.

(b) Alkenes react with cold dilute $KMnO_4$ solution to form gycols. Since bright purple colour of $KMnO_4$ disappears during the reaction it is used as a test for the presence of double bond.

(c) A mixture of acetaldehyde and formaldehyde is formed.

29. i. **H-COOH**

CH_3-COOH

CH_3Ch_2-COOH

$CH_3CH_2CH_2$-COOH

$CH_3CH_2CH_2CH_2$-COOH

ii. **$COCH_3CH$**

$CH_3COCH_2CH_3$

$CH_3COCH_2CH_2CH_3$

$CH_3COCH_2CH_2CH_2CH_3$

$CH_3CO(CH_3)_4CH_3$

iii. **$H\text{-}CH{=}CH_2$**

$CH_3CH{=}CH_2$

$CH_3CH_2CH{=}CH_2$

$CH_3CH_2CH_2CH{=}CH_2$

$CH_3CH_2CH_2CH_2CH{=}CH_2$

30. i. 1 mol of He

= 6.022×10^{23} atoms

$\therefore$ 52 mol of He

= $52 \times 6.022 \times 10^{23}$ atoms

= 3.131×1025 atoms

ii. 1 atom of He

= 4 u of He;

(since mass number of He atom ($_2{}^4$ He) is 4 u)

or, 4 u of He

= 1 atom of He

$\therefore$ 52 u of He

= $\frac{1}{4} \times 52$atoms

= 13 atoms of He

iii. 1 mole of He = 4 g

No. of atoms in 4 g of He

= 6.022×10^{23} atoms

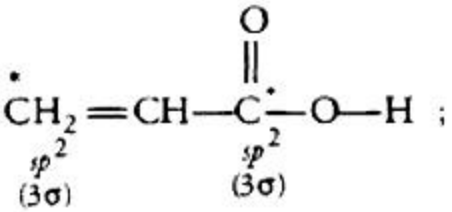
No. of atoms in 52 g of He

$= \frac{6.022 \times 10^{23}}{4} \times 52$ atoms

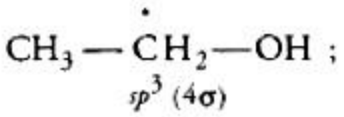
$= 7.8286 \times 10^{24}$ atoms of He

Section D

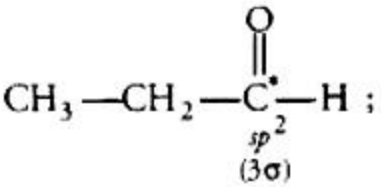
31. a. The hybridisation of marked carbons is same i.e. sp^2 as each C atom forms 3 sigma bonds with neighbouring atoms.



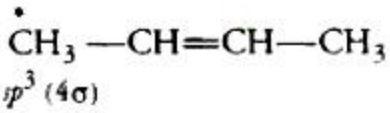
b. The hybridisation of the marked carbon atom is sp^3 as the C atom forms 4 sigma bonds with neighbouring atoms.



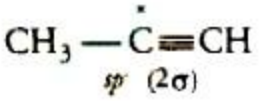
c. The hybridisation of the marked carbon atom is sp^2 as the C atom forms 3 sigma bonds with neighbouring atoms.



d. The hybridisation of the marked carbon atom is sp^3 as the C atom forms 4 sigma bonds with neighbouring atoms.



e. The hybridisation of the marked carbon atom is sp as the C atom forms 2 sigma bonds with neighbouring atoms.



OR

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

32. i. Aufbau Principle: In the ground state of the atoms, the orbitals are filled in the order of their increasing energies. In other words, electrons first occupy the lowest-energy orbital available to them and enter into higher energy orbitals only after the lower energy orbitals are filled.

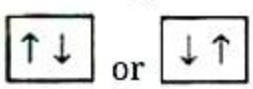
    The order in which the energies of the orbitals increase and hence the order in which the orbitals are filled is as follows

    1s, 2s, 2p, 3s, 3p, 4s, 3d, 4p, 5s

    4d, 5p, 6s, 4f, 5d, 6p, 7s, 5f, 6d, 7p . . .

    ii. Pauli Exclusion Principle: An orbital can have maximum of two electrons and these must have opposite spin.

    For example: Two electrons in an orbital can be represented by

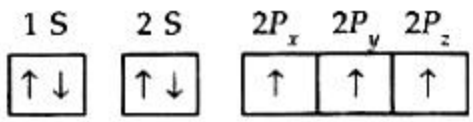
    (i) (ii)

    The two electrons have opposite spin, if one is revolving clockwise, the other is revolving anticlockwise or vice versa.

    iii. Hunds' Rule of Maximum Multiplicity: Electron pairing in P, d and f orbitals cannot

occur until each orbital of a given subshell contains one electron each or is single occupied.

For example: For the element nitrogen which contains 7 electrons, the following configuration can be written.



Total spin of unpaired electrons

$= \frac{1}{2} + \frac{1}{2} + \frac{1}{2} = 1\frac{1}{2}$

OR

I. i. E = hv

$= (6.626 \times 10^{-34}\ \text{Js}) \times (3 \times 10^{15}\ \text{s}^{-1})$

$= 1.988 \times 10^{-18}\ \text{J}$

ii. $E = hv = \frac{hr}{\lambda}$

$= \frac{(6.626 \times 10^{-34}\ \text{Jg}) \times (3 \times 10^{8}\ \text{ms}^{-1})}{(0.50 \times 10^{-10}\ \text{m})}$

$= 3.98 \times 10^{-15}\ \text{s}$

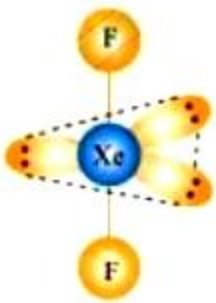
II. i. Frequency $= \frac{1}{\text{Period}} = \frac{1}{2.0 \times 10^{-10}\ \text{s}} = 5 \times 10^{9}\ \text{g}^{-1}$

ii. Wavelength, $\lambda = \frac{c}{v} = \frac{3 \times 10^{8}\ \text{ms}^{-1}}{5 \times 10^{9}\ \text{s}^{-1}} = 6.0 \times 10^{-2}\ \text{m}$

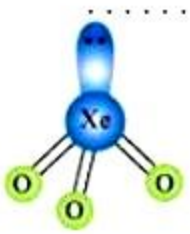
iii. Wave number $\bar{v} = \frac{1}{\lambda} = \frac{1}{6.0 \times 10^{-2}} = 16.66\ \text{m}^{-1}$

33. i. XeF_4 is isoelectronic with ICl_4^- and has square planar geometry.

ii. XeF_2 is isoelectronic to IBr_2^- and has a linear structure.



iii. XeO_3 is isostructural to BrO_3^- and has a pyramidal molecular structure.



OR

i. $(NH_4)_2SO_4 + 2NaOH \rightarrow 2NH_3 + 2H_2O + Na_2SO_4$

ii. $2FeCl_3\,(aq) + 3NH_4OH\,(aq) \rightarrow Fe_2O_3.\ xH_2O_{(s)} + 3NH_4Cl\,(aq)$

iii. $AgCl\,(s) + 2NH_3\,(aq) \rightarrow [Ag(NH_3)_2]\,Cl\ \ (aq)$

iv. $NaNO_3 + H_2SO_4 \rightarrow NaHSO_4 + HNO_3$

v. $3NO_2\,(g) + H_2O\,(l) \rightarrow 2HNO_3\,(aq) + NO\,(g)$

vi. $Cu + 4HNO_3\,(conc) \rightarrow Cu(NO_3)_2 + 2NO_2 + 2H_2O$

vii. $4Zn + 10HNO_3\,(dil) \rightarrow 4Zn(NO_3)_2 + 5H_2O + N_2O$

viii. $[Fe(H_2O)_6]^{2+} + NO \rightarrow [Fe\ (H_2O)_5\,(NO)]^{2+} +\ H_2O$

ix. $I_2 + 10HNO_3 \rightarrow 2HIO_3 + 10NO_2 + 4H_2O$

x. $S_8 + 48HNO_3\,(conc) \rightarrow 8H_2SO_4 + 48NO_2 + 16H_2O$