CBSE Class 11 Chemistry

Sample Paper 07 (2020-21)

Maximum Marks: 70

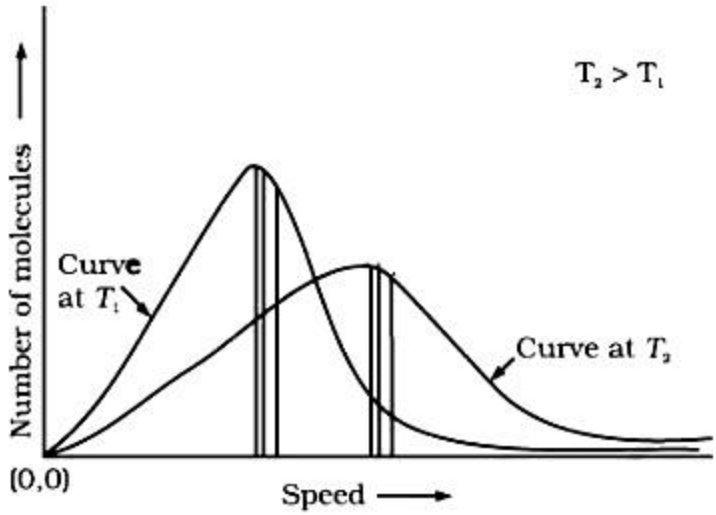
Time Allowed: 3 hours

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:**
   Molecules of gases remain in continuous motion. While moving they collide with each other and with the walls of the container. This results in a change in their speed and redistribution of energy. So the speed and energy of all the molecules of the gas at any instant are not the same, speed distribution also depends upon the mass of molecules. The maxwell-Boltzmann distribution of speed shows that the number of molecules possessing very high and very low speed is very small. The mean square speed is the direct measure of the average kinetic energy of gas molecules. If we take the square root of the mean of the square of speeds then we get a value of speed which is different from most probable speed and average speed. This speed is called the root mean square speed.



i. The rates of diffusion of gases are inversely proportional to the square root of their densities. This statement refers to
   a. Daltons Law
   b. Grahams Law
   c. Avogadros Law
   d. None of the Above

ii. In the Maxwell Boltzmann distribution of speed, the maximum of the curve represents
   a. most probable speed u_{mp}
   b. apparent speed
   c. transient Speed
   d. none of these

OR

Speed distribution curve is burden at
   a. low temperature
   b. high temperature
   c. both (a) and (b)
   d. none of these

iii. The relationship between root mean square speed, average speed, and the most probable speed is
   a. $U_{rms} > U_{av} > U_{mp}$

b. $U_{mp} > U_{av} > U_{rms}$

c. $U_{av} > U_{rms} > U_{mp}$

d. $U_{rms} > U_{mp} > U_{av}$

iv. The ratio between the root mean square speed, average speed and the most probable speed is

a. 1: 1.128 : 1.224

b. 2: 47: 1.34

c. 1: 1.777: 2:45

d. none of these

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

Chromatography is an important technique extensively used to separate mixtures into their components, purify compounds and also to test the purity of compounds. Based on the principle involved, chromatography is classified into different categories. Two of these are Adsorption chromatography and Partition chromatography. Two main types of chromatographic techniques based on the principle of differential adsorption column chromatography, and thin-layer chromatography. Adsorption chromatography is based on the fact that different compounds are adsorbed on an adsorbent to different degrees. Column chromatography involves the separation of a mixture over a column of adsorbent (stationary phase) packed in a glass tube. Thin layer chromatography (TLC) is another type of adsorption chromatography, which involves the separation of substances of a mixture over a thin layer of an adsorbent coated on a glass plate. Partition chromatography is based on continuous differential partitioning of components of a mixture between stationary and mobile phases.

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:** In adsorption chromatography different compounds are adsorbed on an

adsorbent to a different degree.

Reason: Commonly used adsorbents in chromatography are silica gel and alumina.

ii. **Assertion:** In thin layer chromatography separation of the substance of a mixture over a thin layer of absorbent is coated on glass plate.

Reason: The spot of coloured compounds are visible on TLC plate die to their original colour.

iii. **Assertion:** Paper chromatography is a type of partition chromatography.

Reason: Chromatography paper contain water trapped in it which act as the stationary phase.

iv. **Assertion:** In column chromatography mixture of adsorbed on adsorbent is placed on the top of adsorbent.

Reason: Column chromatography is the same as partition chromatography.

OR

Assertion: In chromatography a mixture of substance is applied onto a stationary phase.

Reason: The moving phase is called mobile phase.

3. According to Avogadro Law, equal volumes of all gases at the same temperature and pressure should contain _____ number of molecules.
   a. similar
   b. equal
   c. different
   d. unequal
4. The total energy of an electron in the first excited state of the hydrogen atom is about −3.4 eV. What is the kinetic energy of the electron in this state?
   a. +1.7 eV
   b. -3.4 eV
   c. +6.8 eV
   d. +3.4 eV

OR

What will be the wavelength of a ball of mass 0.1 kg moving with a velocity of 10 ms^{-1}?

a. 6.696×10^{-34} m

b. 6.266×10^{-34} m

c. 6.626×10^{-34} m

d. 6.326×10^{-34} m

5. Organic compounds are found in:
   a. only vegetable kingdom
   b. only Animal kingdom
   c. both animal and vegetable kingdom
   d. only mineral kingdom
6. $\Delta_f U^0$ of formation of CH_4 (g) at certain temperature is –393 kJmol^{-1}. The value of $\Delta_f H^0$ is
   a. $< \Delta_f U^0$
   b. zero
   c. $> \Delta_f U^0$
   d. equal to $\Delta_f U^0$

OR

The enthalpies of all elements in their standard states are:

a. zero

b. < 0

c. unity

d. different for each element

7. 0.023 g of sodium metal is reacted with 100 cm^3 of water. The pH of the resulting solution is _____.
   a. 9
   b. 12
   c. 10
   d. 8

OR

The boiling point of water at atmospheric pressure is _____.

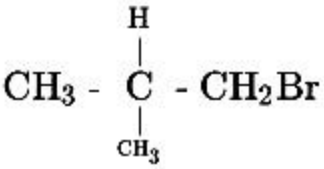
a. 90° C

b. 95° C

c. 110° C

d. 100° C

8. The preparation of alkynes from vicinal dihalides is an example of _____?
   a. Elimination reaction
   b. Addition reaction
   c. Substitution reaction
   d. Rearrangement reaction
9. Alkaline earth metals have a large size of the atoms. Therefore, they shows
   a. Low electopositivity.
   b. Low ionization enthalpies.
   c. Low hydration enthalpies.
   d. Low nuclear charge.
10. Arrange the following alkyl halides in decreasing order of the rate of β - elimination reaction with alcoholic KOH

    A. 

    B. CH_3-CH_2-Br

    C. CH_3-CH_2-CH_2-Br

    a. C > B > A

    b. A > C > B

    c. B > C > A

    d. A > B > C
11. The species CO, CN^- and N_2 are
    a. Isoelectronic
    b. Having coordinated bond
    c. Having low bond energies
    d. Having polar bond
12. **Assertion:** 1 mol of O and 1 mol of O_2 contain equal number of particles.

    Reason: 1 mol of molecules is always double than 1 mol of atoms in all diatomic

molecules.

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:** Diborane forms two-three centred electron-pair bonds.
Reason: B_2H_6 does not have sufficient number of electrons to form normal covalent bonds.

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:** For a certain amount of gas, the product pV is always constant.
Reason: This is statement of Charle's law

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.

OR

Assertion: Nitrogen is unreactive at room temperature but becomes reactive at elevated temperatures (on heating or in the presence of catalysts).
Reason: In nitrogen molecule, there is extensive delocalisation of electrons.

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):** The decomposition of hydrogen peroxide to form water and oxygen is an example of a disproportionation reaction.
Reason (R): The oxygen of peroxide is in -1 oxidation state and it is converted to zero oxidation state in O_2 and -2 oxidation state in H_2O.

    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. Both A and R are false.

16. **Assertion (A):** Toluene on Friedal Crafts methylation gives o - and p - xylene.
Reason (R): CH_3-group bonded to benzene ring increases electron density at o- and p - position.

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

    b. Both A and R are correct but R is not the correct explanation of A.

    c. Both A and R are not correct

    d. A is not correct but R is correct.

Section B

17. List the factors that can influence the ionic radius of an element.

OR

What do you understand by exothermic reaction and endothermic reaction? Give one example of each type.

18. Why does SO_3 act as an electrophile?

19. $2NO(g) + O_2(g) \longrightarrow 2NO_2(g); \Delta H = -117 kJ$

    i. Predict the effect of an increase in the concentration of NO on the equilibrium concentration of NO_2.

    ii. Predict the effect of pressure decrease as a result of increased volume on the equilibrium concentration of NO_2.

OR

How does a catalyst affect the equilibrium constant?

20. Explain why is sodium less reactive than potassium?

OR

Why is the solution of alkali metals in liquid ammonia conducting in nature?

21. What are interstitial hydrides? Give two examples.
22. Why is water molecule polar?
23. Complete the following reactions

i. Iso-propyl bromide $\xrightarrow[\text{heat}]{\text{Alc. KOH}} A \xrightarrow[\text{Peroxide}]{\text{HBr}} B$

ii. n-propyl alchol $\overset{Conc.H_2SO_4}{\underset{443K}{\rightleftharpoons}}$ A $\overset{O_2,Ag}{\underset{heat}{\rightleftharpoons}}$ B

24. Why does electronegativity value increases across a period and decreases down period?
25. What is a " standard hydrogen electrode" ?

Section C

26. The ionization constant of phenol is 1.0×10^{-10}. What is the concentration of phenolate ion in 0.05 M solution of phenol? What will be its degree of ionization if the solution is also 0.01 M in sodium phenolate?

OR

Dihydrogen gas used in Haber's process is produced by reacting methane from natural gas with high temperature steam. The first stage of two stage reaction involves the formation of CO and H_2. In second stage, CO formed in first stage is reacted with more steam in water gas shift reaction.

$CO(g) + H_2O(g) \rightleftharpoons CO_2(g) + H_2(g)$

If a reaction vessel at 400°C is charged with an equimolar mixture of CO and steam so that pCO = pH_2O = 4.0 bar, what will be the partial pressure of H_2 at equilibrium? K_p = 0.1 at 400°C.

27. 1 mole of an ideal gas undergoes reversible isothermal expansion from an initial volume of V_1 to a final volume of 10 V_1 and does 10 kJ of work. The initial pressure was 1 $\times 10^7$ Pa.

i. Calculate V_1.

ii. If there were 2 moles of gas what must its temperature have been?

OR

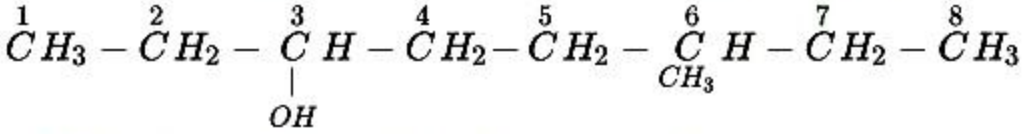
For oxidation of iron,

$4Fe(s) + 3O_2(g) \rightarrow 2Fe_2O_3(s)$

entropy change is – 549.4 JK–1mol–1at 298 K. Inspite of negative entropy change of this reaction, why is the reaction spontaneous?

($\Delta_r H^{\ominus}$ for this reaction is –1648 $\times$ 10^3 J mol^{-1})

28. In the presence of peroxide, addition of HBr to propene takes place according to Anti-Markovnikov's rule but peroxide effect is not seen in the case of HCl and HI. Explain.
29. Write the IUPAC name of the compound from its given structure.



30. Calculate the number of moles in the following.
    i. 7.85 g of iron
    ii. 4.68 mg of silicon
    iii. 65.6 ug of carbon

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. a. i. An atomic orbital has n = 3. What are the possible values of I and m_l?
    ii. List the quantum numbers (ml and I) of electrons for 3d orbital.
    iii. Which of the following orbitals are possible?
    1p, 2s, 2p and 3f
    b. An atom of an element contains 29 electrons and 35 neutrons. Deduce
    i. The number of protons and

ii. The electronic configurations of the element

OR

i. Calculate the total number of electrons present in one mole of methane.

ii. Find (a) the total number and (b) the total mass of neutrons in 7 mg of 14C. (Assume that mass of a neutron = 1.675×10^{-27} kg).

iii. Find (a) the total number and (b) the total mass of protons in 34 mg of NH3 at STP. Will the answer change if the temperature and pressure are changed?

33. Complete the following reactions

i. $\mathrm{HCOOH} \xrightarrow{H_2SO_4}$

ii. $\mathrm{CO + H_2} \xrightarrow[200\ \mathrm{atm, 675K}]{\Delta,\ \mathrm{ZnO, Cr_2O_3}}$

iii. $SiO_2 + C \longrightarrow$

iv. $CaCO_3\ (aq) + CO_2 \longrightarrow$

v. $SiO_2 + NaOH \longrightarrow$

OR

Complete and balance-

a. $2Ag_2O(s) \rightarrow$

b. $2H_2O_2(aq) \rightarrow$

c. $2Zns + 3O_2 \rightarrow$

d. $4HCl + O_2 \xrightarrow{Cucl_2}$

e. $Al_2O_3(s) + 6HCl(aq) + 9H_2O(l) \rightarrow$

f. $Al_2O_3(s) + 6NaOH(aq) + 3H_2O(l) \rightarrow$

CBSE Class 11 Chemistry

Sample Paper 07 (2020-21)

Solution

Section A

1. i. (b) Grahams law

   ii. (a) most probable speed,u_{mp}

OR

(b) high temperature

iii. (a) $U_{rms} > U_{av} > U_{mp}$

iv. (a) 1 : 1.128 : 1.224

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

   ii. Assertion is wrong statement but Reason is correct statement.

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

   iv. Assertion is correct statement but Reason is wrong statement.

OR

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

3. (b) equal

   Explanation: Avogadro's law states that " equal volumes of all gases at the same temperature and pressure contain **an equal** number of molecules."

4. (d) +3.4 eV

   Explanation: Total energy of the electron, E = −3.4 eV

   Kinetic energy of the electron is equal to the negative of the total energy.

   K = −E = − (− 3.4) = +3.4 eV

   Hence, the kinetic energy of the electron in the given state is +3.4 eV.

OR

(c) 6.626×10^{-34} m

Explanation: Mass of ball = 0.1 kg

Velocity of ball = 10 m/s

According to de Broglie equation

Wave length = $\frac{h}{mv} = \frac{6.626 \times 10^{-34}}{0.1 \times 10}$ = 6.626×10^{-34} m.

5. (c) both animal and vegetable kingdom

   Explanation: Compounds which are isolated directly or indirectly from living organisms like plants and animals are called organic compounds.

6. (a) $< \Delta_f U^0$

   Explanation: The combustion of metahne is given as follows:

   $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$

   $Since \triangle_f H^\circ = \triangle_f U^\circ + \triangle n_g RT \; and \; \triangle_f U^\circ = -393 kJmol^{-1},$

   $\triangle_f H^\circ = (-393) + \triangle n_g RT. \; (Here, \; \triangle n_g < 0) \Rightarrow \triangle_f H^\circ < \triangle_f U^\circ$

   OR

   (a) zero

   Explanation: By definition, the enthalpy of formation of elements in their standard state is taken as zero. Therefore, The enthalpies of all elements in their standard states is zero irrespective of the element.

7. (b) 12

   Explanation: Moles of NaOH formed = 0.023/23 =0.001

   Concentration of NaOH = $\frac{(0.001) \times (1000)}{(100)} = 0.01$ M

   pOH=-log[OH-] = - log [0.01] = -log [10-2] = - (-2) log 10 = 2

   We know that, pH + pOH =14

   pH =14-2 = 12

   OR

   (d) 100° C

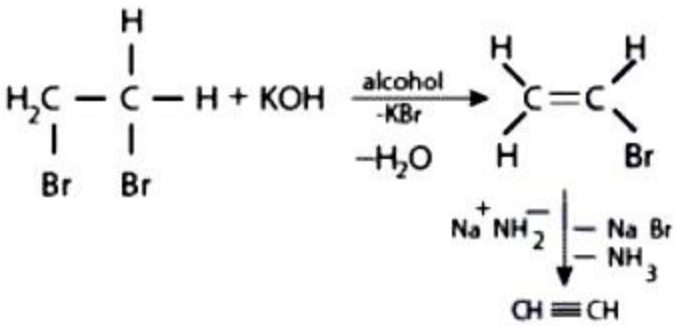
   Explanation: Water and water vapour are in equilibrium position at atmospheric pressure (1.013 bar) and at 100°C in a closed vessel. The boiling point of water is 100°C at 1.013 bar pressure. For any pure liquid at one atmospheric pressure (1.013 bar), the

temperature at which the liquid and vapours are at equilibrium is called the normal boiling point of the liquid. The boiling point of the liquid depends on the atmospheric pressure.

8. (a) Elimination reaction

   Explanation: An elimination reaction is a type of organic reaction in which two substituents are removed from a molecule in either one or two steps. When the starting dihalide is a vicinal dihalide, the alkyne is obtained by two successive elimination reactions.

   Example : Vicinal dihalide,$(CH_2Br - CH_2Br)$ on treatment with$alcoholic KOH$ forms a monosubstituted alkene Vinyl bromide, CH_2CHBr which when reacted with sodium amide, $NaNH_2$ forms ethyne (ie. an alkyne). The steps of conversion are,



9. (b) Low ionization enthalpies.

   Explanation: The reason is that the atoms of alkali metals are of large sizes. therefore, the outermost electron is for away from the nucleus and can be easily removed.

10. (b) A > C > B

    Explanation: A more substituted alkene is preferred in accordance with the Saytzeff's rule. Hence the order.

11. (a) Isoelectronic

    Explanation: Isoelectronic species are elements or ions that have the same, or equal number of electrons. Although isoelectronic species have the same number of electrons, they are different in their physical and chemical properties. All of given species have 14 electrons.

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

    Explanation: Assertion is CORRECT but, reason is INCORRECT.

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. (d) Both assertion and reason are INCORRECT.

    Explanation: Both assertion and reason are INCORRECT.

OR

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

Explanation: Assertion is CORRECT but, reason is INCORRECT.

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

    Explanation: Both A and R are true and R is the correct explanation of A.

    $2H_2O_2$ (ag) $\rightarrow$ $2H_2O$(l) + O_2(g).

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

    Explanation: Aromaticity is shown by compounds possessing the following characteristics:

    - Planarity
    - Complete delocalization of the π electrons in the ring.
    - Presence of (4n + 2) π electrons in the ring where n is an integer (4 = 0, 1, 2,...). This is often referred to as Huckel Rule.

Section B

17. Factors that can influence the ionic radius of an element are:
    i. **Shielding effect:** As the shielding effect increases, the ionic radius increases.
    ii. **Effective nuclear charge:** As the effective nuclear charge in increases, ionic radius decreases.

OR

Exothermic reaction : The reaction accompanied by release of energy in the form of light or heat is called exothermic reaction. ΔH is negative for exothermic reaction.

Example: C+ $O_2 \rightarrow CO_2$; ΔH = -178.3 $kJmol^{-1}$.

Endothermic reactions : The reaction accompanied by absorption of energy is called endothermic reaction. ΔH is positive for endothermic reaction.

Example: $2NH_3 \rightarrow N_2 + 3H_2$. ΔH = +91.8$kJmol^{-1}$.

18. SO_3 acts as an electrophile because three highly electronegative oxygen atoms are attached to Sulphur atom in SO_3 which makes sulphur atom electron deficient.
19. $2NO(g) + O_2(g) \longrightarrow 2NO_2(g); \Delta H = -117kJ$
    i. If [NO] is increased at equilibrium, the reaction will proceed in the forward direction i.e rate of forward reaction will increase and more NO_2 will be formed.
    ii. The decrease in pressure at equilibrium will favour backward reaction as the number of moles of gases increases in the backward direction and hence less NO_2 will be formed.

OR

Addition of catalyst increases the rate of reaction in both forward and backward directions with equal ease, so it does not alter the position of equilibrium. Hence,The equilibrium constant is not affected by catalyst.

20. Ionization enthalpy of potassium is 419 kJ mol^{-1}. While ionization enthalpy of sodium is 496 kJ/mol. Since Ionization enthalpy of potassium is less than that of sodium, potassium is more reactive than sodium.

OR

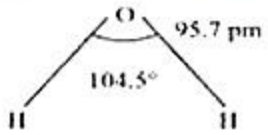
The alkali metals dissolve in liquid ammonia giving deep blue solution which is conducting in nature.

$M + (x + y)NH_3 \rightarrow [M(NH_3)_x]^+ + [e(NH_3)_y]^-$.

Due to presence of ammoniated electrons and cations the solution is conducting in nature.

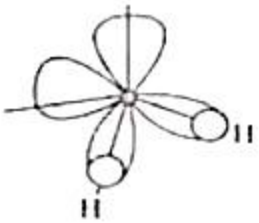
21. Many transition and inner transition metals absorb hydrogen into the interstices of their lattices to yield hydrides also called the interstitial hydrides. These hydrides conduct heat and electricity though not as efficiently as their parent metals do. These hydrides are generally non-stoichiometric and their composition vary with temperature and pressure. For example, $T_iH_{1.73}$, $CeH_{2.7}$
22. Water molecule is a polar molecule because in the gas phase water is a bent molecule with a bond angle of 104.5°, and O-H bond length of 95.7 pm.

i. The bent structure of water



ii. The water molecule as a dipole

iii. The orbital overlap picture in the water molecule.



23. i. Iso-propyl bromide on dehydrohalogenation gives Propene (A) which on reaction with HBr in the presence of peroxide gives 1-Bromopropane as a major product.

$$\underset{\substack{\text{Br}\\ \textit{Iso}\text{-propyl bromide}}}{CH_3CHCH_3} \xrightarrow[\text{Heat}]{\text{Alc. KOH}} \underset{\substack{(A)\\ \text{Propene}}}{CH_3CH{=}CH_2} \xrightarrow[\text{Peroxide}]{HBr} \underset{\substack{(B)\\ \text{1-bromopropane}}}{CH_3CH_2CH_2Br}$$

Hence, (A)- Propene and (B): 1-Bromopropane

ii. n-Propylalcohol on dehydration in the presence of conc.H_2SO_4 gives Propene (A) which on reaction with O_2 in the presence of Ag gives Propylene oxide.

$$\underset{n\text{-propyl alcohol}}{CH_3CH_2CH_2OH} \xrightarrow[443\ K]{\text{conc. } H_2SO_4} \underset{\substack{(A)\\ \text{Propene}}}{CH_3CH{=}CH_2} \xrightarrow[\text{Heat}]{O_2,\ Ag} \underset{\substack{(B)\\ \text{Propylene oxide}}}{CH_3CH{-}CH_2 \text{ (O)}}$$

24. Electronegativity is the tendency of an element to attract the shared pair of electrons towards itself in a covalently bonded molecule. Electronegativity of an element is inversely proportional to its atomic size. It means with increase in atomic size , electronegativity of an element decreases.

1. We know that atomic size increases down the group. Therefore electronegativity decreases down the group.
2. The attraction between the outer electrons and the nucleus increases, as the atomic radius decreases in a period. The electronegativity also increases.

25. Standard hydrogen electrode (SHE) is a standard equipment for measuring the relative electrode potentials of different electrodes , and is therefore , also termed reference electrode. As per IUPAC norms its Standard electrode potential (ΔE^{o}) is taken as 0.000 volt.

Section C

26.

	$C_6H_5OH \rightleftharpoons C_6H_5O^- + H^+$		
Initial	0.05 M		
After disso.	0.05 – x	x	x

Here, $K_a = \frac{[C_6H_5O^-][H^+]}{[C_6H_5OH]}$

$\therefore K_a = \frac{x \times x}{0.05-x} = 1.0 \times 10^{-10}$ (given) or

or $x^2 = 5 \times 10^{-12}$ or x $= 2.2 \times 10^{-6} M$

In presence of 0.01 C_6H_5ONa, suppose y is the amount of phenol dissociated, then at equilibrium

$[C_6H_5OH] = 0.05 - y \simeq 0.05$

$[C_6H_5O^-] = 0.01 + y \simeq 0.01\ M, [H^+] = y\ M$

$\therefore K_a = \frac{(0.01)(y)}{0.05} = 1.0 \times 10^{-10}$ (given) or $y = 5 \times 10^{-10}$

$\therefore \alpha = \frac{y}{c} = \frac{5 \times 10^{-10}}{5 \times 10^{-2}} = 10^{-8}$

OR

Let the partial pressure of hydrogen (H_2) at equilibrium point = p bar

	$CO(g)$ + $H_2O(g)$ $\rightleftharpoons$	$CO_2(g)$ +	$H_2(g)$
Initial pressure:	4.0 bar 4.0 bar	0	0
Eqm. pressure:	(4–p)bar (4 – p) bar	p bar	p bar

$K_p = \frac{pCO_2 \times pH_2}{pCO \times pH_2O}$ or $0.1 = \frac{(p\ bar) \times (p\ bar)}{(4-p)bar \times (4-p)bar}$

$\frac{p^2}{(4-p)^2} = 0.1$ or $\frac{p}{(4-p)} = (0.1)^{1/2}$ = 0.316

p = 0.316(4 - p) or p = 1.264 - 0.316 p

1.316 p = 1.264 or $p = \frac{1.264}{1.316} = 0.96\ bar$ = 0.96 bar

27. According to the question, n = 1, Initial volume = V_1, final volume = 10 V_1, W = 10 kJ, p = 1 $\times 10^7$ Pa.

i. W = $-2.303nRT \log \frac{V_2}{V_1}$

$10 \times 10^3 \text{J} = -2.303 \times 1 \times 8.314 \times T \times \log \frac{10V_1}{V_1}$

$\Rightarrow$ T = 522.3 K

For initial conditions, $p_1 V_1 = n_1 RT$

$\Rightarrow (10^7)\, V_1 = 1 \times 8.314 \times 522.3$

$\Rightarrow V_1 = 4.342 \times 10^{-4} \mathrm{m}^3$

$= 4.342 \times 10^2 \mathrm{cm}^3$

= 434.2 cm^3

ii. If there were 2 moles of the gas, applying $p_1V_1 = n_1RT$, we get

$(10^7)\,(4.342 \times 10^{-4}) = 2 \times 8.314 \times T$

$\Rightarrow T = 261.1\ \mathrm{K}$

OR

One decides the spontaneity of a reaction by considering $\Delta S_{\text{total}}\,(\Delta S_{\text{sys}} + \Delta S_{\text{surr}})$. For calculating ΔS_{surr}, we have to consider the heat absorbed by the surroundings which is equal to $-\Delta_r H^{\ominus}$. At temperature T, entropy change of the surroundings is $\Delta S_{\text{surr}} = -\frac{\Delta_r H^{\ominus}}{T}$ (at constant pressure)

$= -\frac{(-1648 \times 10^3 \mathrm{Jmol}^{-1})}{298\mathrm{K}}$

= 5530 $JK^{-1}mol^{-1}$

Thus, total entropy change for this reaction

$\Delta_r S_{total}$ = 5530 JK^{-1} mol^{-1} + (-549.4 JK^{-1} mol^{-1})

= 4980.6 JK^{-1} mol^{-1}

This shows that the above reaction is spontaneous.

28. The mechanism of addition of HX in the presence of Peroxide is not observed in addition of HCl and HI. This is due to the fact that the H—Cl bond being stronger (430.5 kJ mol^{-1}) than H—Br bond (363.7 kJ mol^{-1}) is not cleaved symmetrically by the free radical and in case of H—I bond is weaker (296.8 kJ mol^{-1}) and iodine free radicals have greater tendency to combine to form iodine molecules instead of adding to the double bond.

29.
- The functional group present is alcohol (-OH). Hence the suffix is '-ol'.
- The longest chain containing -OH has eight carbon atoms. Hence the corresponding saturated hydrocarbon is octane.
- The -OH is on carbon atom 3. In addition, a methyl group is attached at 6^{th} carbon

atom.

Hence, the systematic name/IUPAC name of this compound is **6-Methyloctan-3-ol.**

30. i. Number of moles of iron ($^{55.8}Fe$) = $\frac{\text{mass of iron}}{\text{atomic mass}} = \frac{7.85}{55.8} = 0.141\text{mol}$

ii. Number of moles of silicon($^{28.1}Si$) = $\frac{\text{mass of silicon}}{\text{atomic mass}} = \frac{4.68\times10^{-3}}{28.1} = 1.66 \times 10^{-4}\text{mol}$

iii. Number of moles of carbon(^{12}C) = $\frac{\text{mass of carbon}}{\text{atomic mass}} = \frac{65.6\times10^{-6}}{12} = 5.47 \times 10^{-6}\text{mol}$

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^+ = $KK[\sigma 2s]^2\ [\sigma^* 2s]^2\ [\sigma 2p_z]^2\ [\pi 2p_x]^2\ [\pi 2p_y]^2\ [\pi * 2p_x]^1$

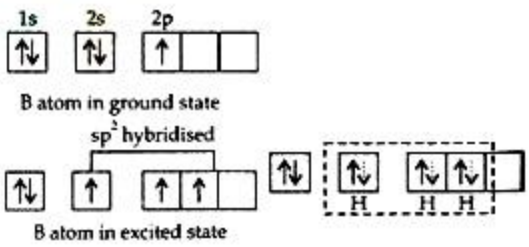
= $\frac{1}{2}$ [8-3] = 2.5

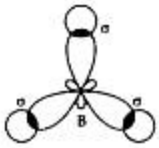
M.O. configuration of O_2^- = $KK[\sigma 2s]^2\ [\sigma^* 2s]^2\ [\sigma 2p_z]^2\ [\pi 2p_x]^2\ [\pi 2p_y]^2\ [\pi^* 2p_x]^2\ [\pi^* 2p_y]^1$

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

OR

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

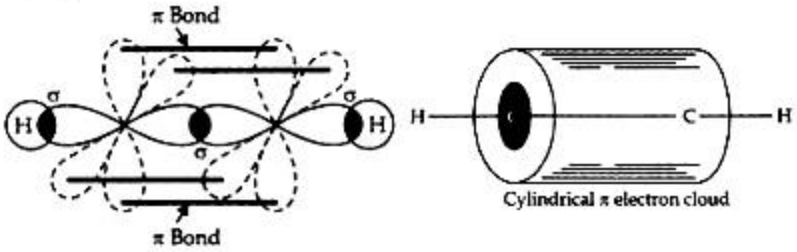




Orbital picture of BH_3 molecule

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°.

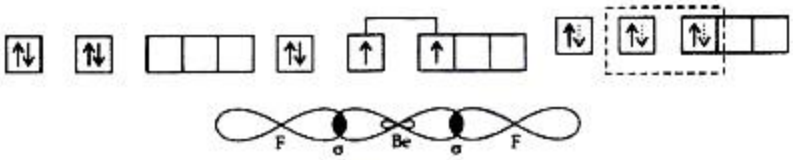
ii. C_2H_2



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



Orbital picture of BeF_2

The orbital picture of BeF_2 molecule is Linear.

32. a. i. For n = 3, I = 0, 1, 2

When I = 0, $m_I = 0$

When I = 1, m_I = -1, 0, + 1

When I = 2, m_I = -2, -1, 0, +1, + 2

ii. n =3, I = 2 and for I = -2, -1, 0, +1, +2

iii. 2s, 2p are possible.

b. An atom of an element contains 29 electrons and 35 neutrons

i. No. of protons = 29

ii. Atomic number = 29

Electronic configuration : $[Ar]^{18}\ 3d^{10}4s^1$.

OR

i. As we know in 1 molecule of methane, 1 carbon atom and 4 atoms of hydrogen is present.

In carbon, there are six electrons and hydrogen consist of one electron each.

So a total number of electrons in methane = 6 + 4 = 10 electrons

By Avogadro's Law, we know that

1 mole of methane contains 6.023×10^{23} atoms. So the total number of electrons of in

1-mole methane = $10\times6.023\times1023 = 6.0^{23}\times10^{24}$ electrons

So the total number of electrons in 1 mole of methane is 6.023×10^{24} electrons

ii. Mass of one neutron = 1.675×10^{-27} kg

1 mole of Carbon atom = 6.023×10^{23} atoms

Number of neutrons in 1 carbon atom = 14 - 6= 8

So the total number of neutrons in 14g of Carbon = $6.023\times10^{23}\times8$ neutrons

So 7mg of Carbon will contain = $\frac{6.023\times10^{23}\times8\times7\times10^{-3}}{14}$

= $[3.37288\times10^{22}]/14$

= 2.4092×10^{21} neutrons

So, Mass of 2.4092×10^{21} neutrons = $[2.4092\times10^{21}] \times [1.675 \times 10^{-24}]$

= 4.035×10^{-3} g

So, in 7 mg of carbon total number of neutrons is 2.41×10^{21} and the total mass of the neutrons is 4.035×10^{-3} g

iii. Molecular Mass of Ammonia = 17g

By Avogadro's Law,

1 mole of Ammonia = 17g of Ammonia = 6.023×10^{23} atoms

Total Number of Protons in Ammonia = 7 + 3= 10

So the total number of protons in Ammonia = 6.023×10^{24} protons

17g of Ammonia contains 6.023×10^{24} protons

So, 34 mg of Ammonia will contain X number of protons

$x = \frac{6.023\times10^{24}\times34\times10^{-3}}{17}$

X = $[6.023\times10^{24}] \times [2\times10^{-3}]$

X = 1.2046×10^{22} protons

Mass of one proton = 1.6726×10^{-24}g

So, Mass of 1.2046×10^{22} protons = $[1.6726 \times 10^{-24}] \times [1.2046 \times 10^{22}]$

$= 20.148 \times 10^{-3}$ g

So, in 34 mg of ammonia total number of protons is 1.205×10^{22} and the total mass of the protons is 20.148×10^{-3} g.

No, the answer will not vary with the change in temperature and pressure because the number of subatomic particles like protons, neutrons, and electrons is fixed for each and every element and it does not vary with temperature and pressure.

33. Reactions:

i. $\mathrm{HCOOH} \xrightarrow[\text{conc. } \mathrm{H_2SO_4}]{373\ \mathrm{K}} \mathrm{H_2O} + \underset{\text{Carbon monoxide}}{\mathrm{CO}}$

ii. $\mathrm{CO} + 2\mathrm{H_2} \xrightarrow[200\ \text{atm, } 675\ \mathrm{K}]{\mathrm{ZnO}, \mathrm{Cr_2O_3}} \underset{\text{Methanol}}{\mathrm{CH_3OH}}$

iii. $\mathrm{SiO_2} + 3\mathrm{C} \longrightarrow \underset{\text{Silicon carbide or carborundum}}{\mathrm{SiC}} + \underset{\text{Carbon monoxide}}{2\mathrm{CO}}$

iv. $\mathrm{CaCO_3} + \mathrm{CO_2} + \mathrm{H_2O} \rightarrow \underset{\text{Calcium bicrabonate (soluble)}}{\mathrm{Ca(HCO_3)_2}}$

v. $\mathrm{SiO_2} + 2\mathrm{NaOH} \longrightarrow \mathrm{Na_2SiO_3} + \mathrm{H_2O}$

OR

a. $2Ag_2O(s) \rightarrow 4Ag(s) + O_2(g)$

b. $2H_2O_2(aq) \rightarrow 2H_2O(l) + O_2(g)$

c. $2Zns + 3O_2 \rightarrow 2ZnO + 2SO_2$

d. $4HCl + O_2 \xrightarrow{CuCl_2} 2\mathrm{Cl_2} + 2\mathrm{H_2O}$

e. $Al_2O_3(s) + 6HCl(aq) + 9H_2O(l) \rightarrow 2[\mathrm{Al(H_2O)_6}]^{3+}(\mathrm{aq}) + 6\mathrm{Cl^-}$

f. $Al_2O_3(s) + 6NaOH(aq) + 3H_2O(l) \rightarrow 2\mathrm{Na_3[Al(OH)_6]}(\mathrm{aq})$