

**CBSE Class 11 Chemistry**  
**Sample Paper 04 (2019-20)**

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**Maximum Marks: 70**

**Time Allowed: 3 hours**

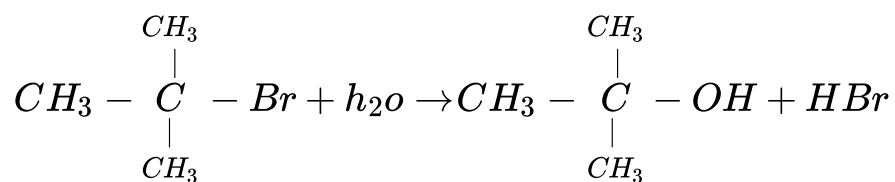
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**General Instructions:**

- a. All questions are compulsory.
  - b. Section A: Q.no. 1 to 16 are very short answer questions (objective type) and carry 1 mark each.
  - c. Section B: Q.no. 17 to 23 are short answer questions and carry 2 marks each.
  - d. Section C: Q.no. 24 to 30 are long answer questions and carry 3 marks each.
  - e. Section D: Q.no. 31 to 33 are also long answer questions and carry 5 marks each.
  - f. There is no overall choice. However an internal choice has been provided in two questions of two marks, two questions of three marks and all the three questions of five marks weightage. You have to attempt only one of the choices in such questions.
  - g. Use log tables if necessary, use of calculators is not allowed.
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**Section A**

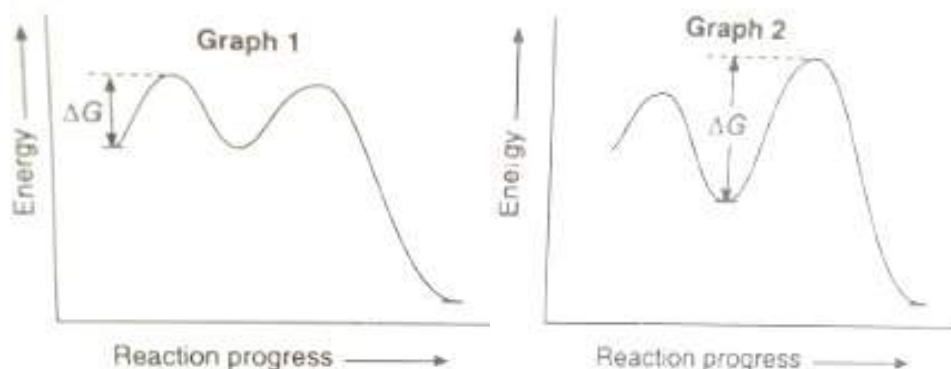
1. S<sub>N</sub>1 reaction is a first-order nucleophilic substitution, e.g.,



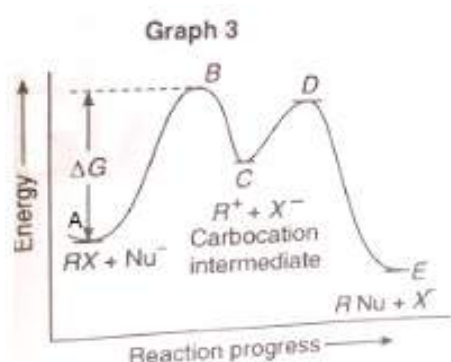
The concentration of nucleophilic does not appear in the rate law expression:

Reaction rate = k[RX]

In a multistep organic reaction, the rate-limiting step is the slowest step. The rate-determining step is represented by the following energy level diagram.



A reaction energy level diagram for an  $S_N1$  reaction. The rate-limiting step is spontaneous dissociation of an alkyl halide to give a carbocation intermediate.



Answer the following questions:

- i. In  $S_N1$  reaction the hybridization changes in the rate determination step, from \_\_\_\_\_ to \_\_\_\_\_.
  - ii. Select the correct statement(s) about the graph 1.
    - a. first step is rate-determining and it is endothermic
    - b. first step is rate-determining and it is exothermic
    - c. the second step is rate-determining and it is exothermic.
    - d. the second step is rate-determining and it is endothermic.
  - iii. Which is the rate-determining step in the graph 2? Tell whether the reaction is exothermic or endothermic?
  - iv. In graph 3 for  $S_N1$  reaction the rate-limiting step is the spontaneous dissociation of alkyl halide and is given by \_\_\_\_\_ step.
  - v. The  $S_N1$  reaction involves the formation of which intermediate?
2. How would the velocity be effected if the position is known?
  3. Why do Na and K have similar properties?

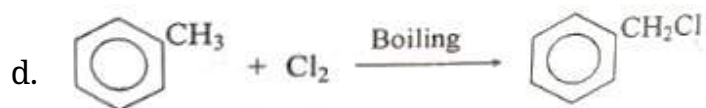
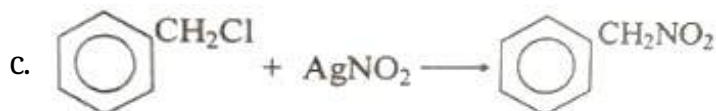
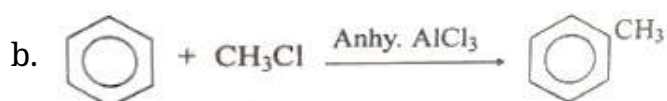
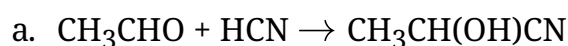
4. When an ideal gas expands into a vacuum, there is neither absorption nor evolution of heat. Why?

5. What is quick lime? What happens when we add water to it?

6. Select the gases which can absorb IR-radiation:

Oxygen, carbon dioxide, methane, nitrogen, chlorofluorocarbons

7. Which of the following is a free radical substitution reaction?



8. Which of the following elements does not show disproportionation tendency?

a. Br

b. F

c. I

d. Cl

9. Molecules in the interior of liquid experience intermolecular

a. attractions in all directions

b. repulsion away from surface only

c. attractions towards surface only

d. repulsion in all directions

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10. Displacement of hydrogen from cold water is done by

- a. all alkali metals
- b. all transition elements
- c. all alkaline earth metals
- d. superoxides

11. Which of the following carbocation is most stable?

- a.  $(CH_3)_3\overset{\oplus}{C}$
- b.  $(CH_3)_3\overset{\oplus}{C}\overset{\oplus}{C}H_2$
- c.  $CH_3\overset{\oplus}{C}HCH_2CH_3$
- d.  $CH_3CH_2\overset{\oplus}{C}H_2$

12. **Assertion:** Diamond is a bad conductor of electricity.

**Reason:** All C-C bond lengths in diamond are of 154 pm.

- 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:** The sum of  $154.2 + 6.1 + 23$  is 183.

**Reason:** The result of addition is reported to the same number of decimal places as that of the term with least number of decimal places.

- a. Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.

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- 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:** Redox reactions are also called neutralisation reactions.

**Reason:** The number of electrons gained or lost in the reaction are balanced.

- 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:** 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.

16. **Assertion:** A lighter gas diffuses more rapidly than a heavier gas.

**Reason:** At a given temperature, the rate of diffusion of a gas is inversely proportional to the square root of its density.

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- 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. How is bond order related to the stability of a molecule?
- 18. What is standard hydrogen electrode? Write
  - (i) its uses
  - (ii) the signs given for oxidation and reduction potentials of electrodes.
- 19. What makes lithium show properties different from rest of the alkali metals?
- 20. Cyclobutane is less reactive than cyclopropane. Justify.
- 21. 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**

Write the type of hybridisation involved in  $\text{CH}_4$ ,  $\text{C}_2\text{H}_4$  and  $\text{C}_2\text{H}_2$ .

- 22. Show the polarization of carbon-magnesium bond in the following structure:  $\text{CH}_3\text{—CH}_2\text{—CH}_2\text{—Mg—X}$ .

**OR**

Starting with the thermodynamic relationship  $G = H - TS$ , derive the following relationship  $\Delta G = -T\Delta S_{\text{total}}$

- 23. The boiling point of alkanes shows a steady increase with an increase in molecular

mass. Why?

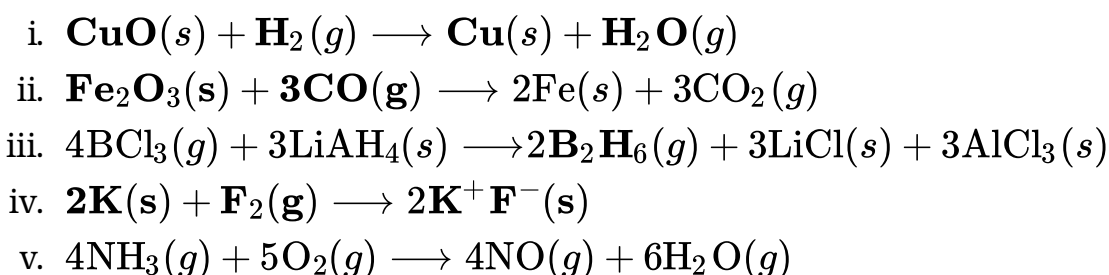
### Section C

24. When 1 g of liquid naphthalene ( $C_{10}H_8$ ) solidifies, 149 J of heat is evolved. Calculate the heat of fusion of naphthalene.
25. Using molecular orbital theory, compare the bond energy and magnetic character of  $O_2^+$  and  $O_2^-$  species.

### OR

The degree of ionization of a 0.1M bromoacetic acid solution is 0.132. Calculate the pH of the solution and the bromoacetic acid.

26. Justify that the following reactions are redox reactions:



27. If 1 gram of each of the following gases are taken at STP, which of the gases will occupy (a) greatest volume and (b) smallest volume?

CO,  $H_2O$ ,  $CH_4$ , NO

28. The average molar mass of a mixture of methane ( $CH_4$ ) and ethane ( $C_2H_6$ ) present in the ratio of a : b is found to be  $20.0 \text{ g mol}^{-1}$ . If the ratio were reversed, what would be the molar mass of the mixture?

29. Among the second period elements, the actual ionization enthalpies are in the order:  
 $Li < B < Be < C < O < N < F < Ne$

Explain why

- i. Be has higher  $\Delta_i H_1$  than B?  
ii. O has lower than N and F?

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**OR**

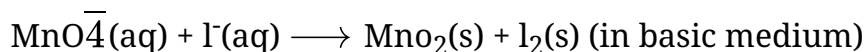
Consider the ground state electronic configurations given below:

- i.  $1s^2 2s^2 2p^6$
- ii.  $1s^2 2s^2 2p^4$
- iii.  $1s^2 2s^2 2p^6 3s^2$
- iv.  $1s^2 2s^2 2p^6 3s^1$
- v.  $1s^2 2s^2 2p^5$ 
  - a. Which of the above configuration is associated with the lowest and which is associated with the highest ionization enthalpy?
  - b. Arrange the above configurations in order of increasing negative electron gain enthalpy.

30. Why does rainwater normally have a pH of about 5.6? When does it become acid rain?

**Section D**

31. Balance the redox reaction by an ion-electron method:



**OR**

- i. Arrange the following.
  - a.  $\text{CaH}_2$ ,  $\text{BeH}_2$  and  $\text{TiH}_2$  in the order of increasing electrical conductance.
  - b.  $\text{LiH}$ ,  $\text{NaH}$  and  $\text{CsH}$  in the order of increasing ionic character.
  - c.  $\text{H—H}$ ,  $\text{D—D}$  and  $\text{F—F}$  in the order of increasing bond dissociation enthalpy.
  - d.  $\text{NaH}$ ,  $\text{MgH}_2$  and  $\text{H}_2\text{O}$  in order of increasing reducing property.
- ii. How many hydrogen-bonded water molecule(s) are associated in  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ ?

32. Assign structure for the following:

- i. An alkyne (X) has molecular formula  $\text{C}_5\text{H}_8$ . It reacts neither with sodamide nor with ammoniacal cuprous chloride.
- ii. A hydrocarbon Y decolourises bromine water. On ozonolysis it give 3-methy

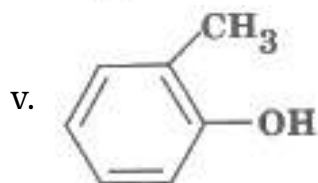
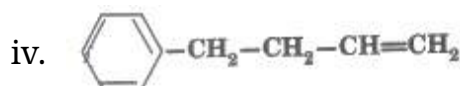
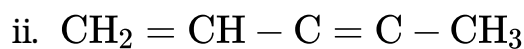
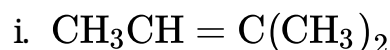


butanal and formaldehyde. Give the name of the compound.

- iii. A hydrocarbon (Z) has molecular formula  $C_8H_{10}$ . It does not decolourise bromine water and is oxidised to benzoic acid on heating with  $K_2Cr_2O_7$ . It can also have three other isomers A, B and C. Write the structures of Z, A, B and C.

**OR**

Write IUPAC names of the following compounds:



33. Using Aufbau principle, write the ground state electronic configuration of following atoms.

- Boron ( $Z = 5$ )
- Neon ( $Z = 10$ ),
- Aluminium ( $Z = 13$ )
- Chlorine ( $Z = 17$ ),
- Calcium ( $Z = 20$ )
- Rubidium ( $Z = 37$ )

**OR**

- Give an example of a molecule in which
  - The ratio of the molecular formula and the empirical formula is 6: 1.
  - Molecular weight is two times of the empirical formula weight.
  - The empirical formula is  $CH_2O$  and the ratio of molecular formula weight and empirical formula weight is 6.

- 
- ii. 1.615 g of anhydrous  $\text{ZnSO}_4$  was left in moist air. After a few days its weight was found to be 2.875 g. What is the molecular formula of hydrated salt?  
(At. masses: Zn = 65.5, S = 32, O=16, H = 1)

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**Solution**  
**Section A**

1.
  - i. From  $sp^3$  to  $sp^2$
  - ii. Option (a) First step is rate-determining and it is endothermic is correct.
  - iii. The second step is the rate-determining and it is an exothermic reaction.
  - iv. The rate-limiting step is given by AB step in graph 3.
  - v. The  $S_N1$  reaction involves the formation of the carbocation intermediate.

2. According to Heisenberg's uncertainty principle,

$$\Delta x \times m\Delta v_x = \frac{h}{4\pi}$$

Where,  $\Delta x$  = uncertainty in position. and  $\Delta v_x$  = uncertainty in velocity.

If the position of the electron is known with high degree of accuracy ( $\Delta x$  is small), then the velocity of the electron will be uncertain ( $\Delta v_x$ ) is large.

3. Both Na and K are members of same group i.e group 1. They have similar chemical properties because they have same number of valence electrons and gradual in change in physical properties due to different number of shells.
4. When a gas expands against vacuum, work done is zero because  $p_{\text{ext}} = 0$ .  
Moreover, In an ideal gas, there are no intermolecular forces of attraction. So, no energy is required to overcome these forces. Hence, the internal energy of the system does not change. Therefore, there is neither absorption nor evolution of heat.
5. Calcium Oxide is known as quick lime. Formula of quick lime is CaO.  
When we add water to quick lime, slaked lime  $[Ca(OH)_2]$  is formed.  
 $CaO + H_2O \rightarrow Ca(OH)_2$
6. Carbon dioxide, methane, and chlorofluorocarbons are the gases which absorb infrared-radiation.

7. (d)



**Explanation:**

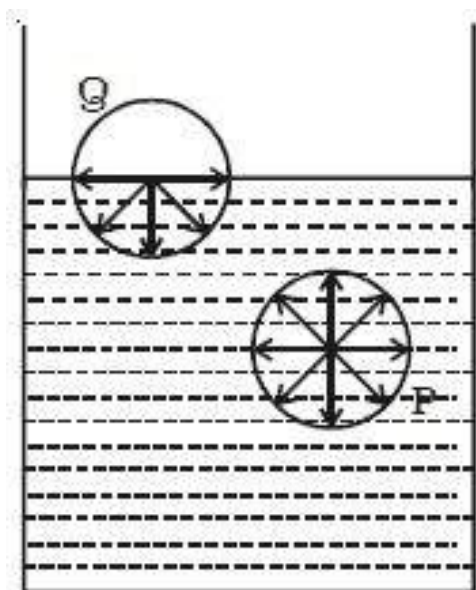


8. (b) F

**Explanation:** F (Fluorine) is most electronegative element so it always show -1 oxidation state.

9. (a) attractions in all directions

**Explanation:** The net force on the molecules presents inside in bulk is zero. For example, the molecule 'p' will experience zero.



10. (a) all alkali metals

**Explanation:** A common characteristic of most Alkali metal is their ability to displace  $\text{H}_2$  (g) from water. This is represented by their large, negative electrode potentials. In this event, the Group 1 metal is oxidized to its metal ion and water is reduced to form hydrogen gas and hydroxide ions. The general reaction of an alkali metal (M) with  $\text{H}_2\text{O}$  (l) is given in the following equation:



From this reaction it is apparent that  $OH^-$  is produced, creating a basic or alkaline environment. Group 1 elements are called alkali metals because of their ability to displace  $H_2$  (g) from water and create a basic solution. Alkali metals are also known to react violently and explosively with water. This is because enough heat is given off during the exothermic reaction to ignite the  $H_2$ (g).

11. (a)  $(CH_3)_3\overset{\oplus}{C}$  **Explanation:**

$(CH_3)_3\overset{\oplus}{C}$  i.e. the tertiary carbocation is most stable. Alkyl groups directly attached to the positively charged carbon stabilise the carbocations due to inductive and hyperconjugation effects.

12. (b) Both assertion and reason are CORRECT but, reason is NOT THE CORRECT explanation of the assertion.

**Explanation:** Both assertion and reason are CORRECT but, reason is NOT THE CORRECT explanation of the assertion.

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) Assertion is INCORRECT but, reason is CORRECT.

**Explanation:** Assertion is INCORRECT but, reason is CORRECT.

15. (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.

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. **Bond order:** - Number of bonds between two atoms is called bond order. More the

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bonds between atoms more will be the **Dissociation Energy** & more will be the stability.

Formula to find Bond order =  $N_B - N_A / 2$

Bond order directly proportional to stability of molecules and dissociation energy and inversely proportional to bond length

where  $N_B$  = Number of the electron in bonding Molecular Orbits

$N_A$  = Number of the electron in antibonding Molecular Orbits

18. Standard hydrogen electrode is an electrode that scientists use for reference on all half cell potentials. Thus it acts as *a reference electrode*. Its Standard electrode potential is taken as 0.000 volt .

(i) It is used to **determine and calculate cell potentials of electrodes using different electrodes or different concentrations.**

(ii) When the given electrode acts as anode SHE, we give **-ve sign to its reduction potential and +ve sign to its oxidation potential.**

19. Lithium shows properties uncommon to rest of the alkali metals because of the following reasons:

- i. Extremely small size of lithium and its ion. As a result, it has very high charge to radius ratio.
- ii. Greater polarising power of lithium ion ( $\text{Li}^+$ ) due to its small size resulting in covalent character.
- iii. Least electropositive character and highest ionisation enthalpy as compared to other alkali metals.

20. In cyclobutane molecule, the C-C-C bond angle is  $90^\circ$  while it is  $60^\circ$  in cyclopropane. Thus, the deviation from the tetrahedral bond angle ( $109^\circ 28'$ ) in cyclobutane is less than in cyclopropane. Therefore, cyclobutane has less bond strain as compared to cyclopropane and thus, cyclobutane is less reactive as compared to cyclopropane.

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

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

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

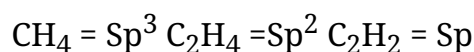
$$\text{Now, Normality} = \frac{\text{No. of gram equivalent}}{\text{Vol. of solution in litres}}$$

$$\text{No. of gram equivalents} = 1.3 \times 10^{-6} \text{ g}$$

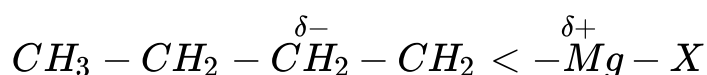
**OR**

Hybridisation = sigma bond + lone pair

If No. is 4 then  $\text{sp}^3$ , If No. is 3 then  $\text{sp}^2$ , If No. is 2 then  $\text{sp}$



22. Carbon is more electronegative than magnesium. So, Mg has a partially positive charge and C has a partially negative charge because a bonded pair of electrons attracted towards carbon.



**OR**

Given,  $G = H - TS$ .

Now,  $G_1 = H_1 - TS_1$  and  $G_2 = H_2 - TS_2$

$$\Rightarrow G_2 - G_1 = H_2 - H_1 - T(S_2 - S_1)$$

$$\Rightarrow \Delta G = \Delta H - T\Delta S$$

$$\text{Also, } \Delta S_{\text{total}} = \Delta S_{\text{sys}} + \Delta S_{\text{surr}}$$

$$\Rightarrow \Delta S_{\text{total}} = \Delta S_{\text{sys}} - \frac{q}{T} \left[ \because \Delta S_{\text{surr}} = \frac{-q}{T} \right]$$

$$\Rightarrow T\Delta S_{\text{total}} = T\Delta S_{\text{sys}} - q$$

$$\Rightarrow T\Delta S_{\text{total}} = T\Delta S_{\text{sys}} - \Delta H$$

$$\Rightarrow T\Delta S_{\text{total}} = -\Delta G$$

$$\Rightarrow \Delta G = -T\Delta S_{\text{total}}$$

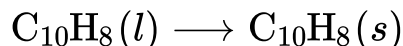
Hence proved.

23. With the increase in molecular weight or the molecular size of the molecule, the surface area of the molecule increases. Due to which the extent of the intermolecular Vanderwall forces increases which causes the increase in the boiling point of alkanes.

### Section C

24. Molecular mass of naphthalene =  $128 \text{ g mol}^{-1}$

Solidification reaction:

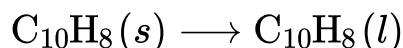


According to the question, heat evolved when 1 g of naphthalene solidifies =  $149 \text{ J}$

Heat evolved when 128 g of naphthalene solidifies =  $149 \times 128 = 19072 \text{ J}$

$$\Delta_{\text{fus}} H^\ominus = -19072 \text{ J}$$

Fusion reaction:



This reaction is the reverse of the solidification.

$$\therefore \Delta_{\text{fus}} H^\circ = +19072 \text{ J}$$

25. i.  $\text{O}_2^+$

Electronic configuration =  $\sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_z^2,$

$$\pi 2p_x^2 = \pi 2p_y^2, \pi^* 2p_x^1 = \pi^* 2p_y^1$$

$$\text{Bond order} = \frac{1}{2}(10 - 5) = 2.5$$

Magnetic property = Paramagnetic.

ii.  $\text{O}_2^-$

Electronic configuration =  $\sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_z^2,$

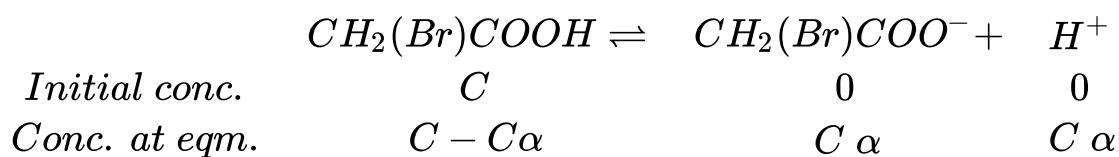
$$\pi 2p_x^2 = \pi 2p_y^2, \pi^* 2p_x^2 \approx \pi^* 2p_y^1$$

$$\text{Bond order} = \frac{1}{2}(10 - 7) = 1.5$$

Magnetic property = Paramagnetic.

The bond order  $\text{O}_2^+$  is greater than the bond order of  $\text{O}_2^-$ . So,  $\text{O}_2^+$  has higher bond energy than  $\text{O}_2^-$ . Both the species contains unpaired electrons and hence are paramagnetic in nature.

OR



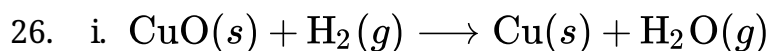
$$K_a = \frac{C\alpha \cdot C\alpha}{C(1-\alpha)} = \frac{C\alpha^2}{1-\alpha} \simeq C\alpha^2 = 0.1 \times (0.132)^2 = 1.74 \times 10^{-3}$$

$$pK_a = -\log(1.74 \times 10^{-3}) = 3 - 0.2405 = 2.76$$

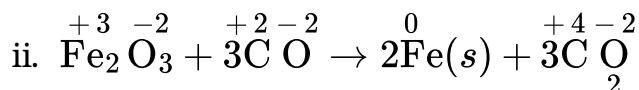


$$[H^+] = C\alpha = 0.1 \times 0.132 = 1.32 \times 10^{-2} M$$

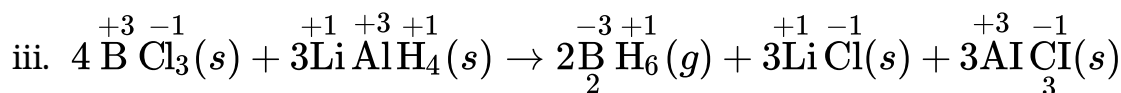
$$pH = -\log(1.32 \times 10^{-2}) = 2 - 0.1206 = 1.88$$



In this case, O.N. of Cu decreases from +2 (in CuO) to 0 (in Cu) and that of H increase from 0 (in H<sub>2</sub>) to +1 (in H<sub>2</sub>O). Therefore, CuO is reduced to Cu while H<sub>2</sub> is oxidised to H<sub>2</sub>O. Thus, this is a redox reaction.

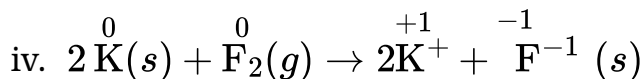


O.N. of Fe decrease from +3 (in Fe<sub>2</sub>O<sub>3</sub>) to 0 (in Fe) and that of C increases from +2 (in CO) to +4 (in CO<sub>2</sub>). Therefore, Fe<sub>2</sub>O is reduced while CO is oxidised. Thus, this is a redox reaction.

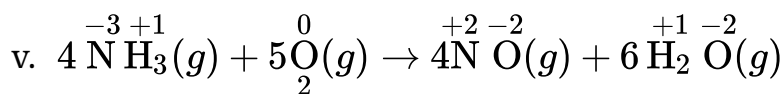


O.N. of B decrease from +3 (in BCl<sub>3</sub>) to -3 in B<sub>2</sub>H<sub>6</sub> and that of H increases from -1 (in LiAlH<sub>4</sub>) to +1 (in B<sub>2</sub>H<sub>6</sub>). Therefore, BCl<sub>3</sub> is reduced and LiAlH<sub>4</sub> is oxidised.

Thus, this is a redox reaction.



O.N. of K decrease from 0 (in K) to +1 (in K<sup>+</sup>) and that of F increases from 0 in (F<sub>2</sub>) to -1 (in F<sup>-</sup>). Hence, K has been oxidised while F<sub>2</sub> has been reduced. Therefore, it is a redox reaction.



In this case, O.N. of N decreases from -3 (in NH<sub>3</sub>) to +2 (in NO) and that of O decreases from 0 (in O<sub>2</sub>) to -2 (in H<sub>2</sub>O). Therefore, NH<sub>3</sub> has been oxidised while O<sub>2</sub> has been reduced. Hence, it is a redox reaction.

27. According to Avogadro's law, Volume of 1 mole gas = 22.4 L at STP.

Molar mass of CO = 28 g/mol

$$\text{Volume of 1g CO} = \frac{22.4}{28} = 0.8 \text{ L.}$$

Molar mass of H<sub>2</sub>O = 18 g/mol

$$\text{Volume of 1g H}_2\text{O} = \frac{22.4}{18} = 1.2 \text{ L.}$$

Molar mass of  $\text{CH}_4 = 16 \text{ g/mol}$

Volume of  $1 \text{ g CH}_4 = \frac{22.4}{16} = 1.4 \text{ L}$ .

Molar mass of  $\text{NO} = 30 \text{ g/mol}$

Volume of  $1 \text{ g NO} = \frac{22.4}{30} = 0.74 \text{ L}$ .

Therefore,  $1 \text{ g CH}_4$  will occupy maximum volume and  $1 \text{ g NO}$  will occupy minimum volume.

28. Molar mass of  $\text{CH}_4 = 1 \times \text{C} + 4 \times \text{H} = 1 \times 12 + 4 \times 1 = 12 + 4 = 16 \text{ g mol}^{-1}$

Molar mass of  $\text{C}_2\text{H}_4 = 2 \times \text{C} + 4 \times \text{H} = 2 \times 12 + 4 \times 1 = 28 \text{ g mol}^{-1}$

When they are present in the ratio  $a : b$ ,

Average molar mass of mixture =  $\frac{a \times 16 + b \times 28}{a + b} = 20 \text{ g mol}^{-1}$  (Given)

i.e.,  $16a + 28b = 20(a + b)$

or  $4a + 7b = 5(a + b)$

or  $a = 2b$

or  $\frac{a}{b} = \frac{2}{1} = 2 : 1$

If the ratio is reversed, now the ratio

$a : b = 1 : 2$

$\therefore$  Average molar mass of mixture =  $\frac{1 \times 16 + 2 \times 28}{1 + 2} = 24 \text{ g mol}^{-1}$

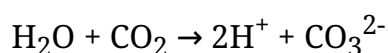
29. Both the observation can be explained in terms of extra-stability of fully filled or half-filled orbitals.

- i. The electronic configuration of Be is  $1s^2 2s^2$ ; whereas that of B is  $1s^2 2s^2 2p^1$ . Be has a completely filled valence orbital and will not easily lose electrons from them to form a cation. B, on the other hand, will easily lose the lone p electron to acquire B-like stable configuration.
- ii. N has the electron configuration  $1s^2 2s^2 2p^3$ , where in the outermost shell s is completely and p is half filled. It is a stable configuration as compared to oxygen whose electronic configuration is  $1s^2 2s^2 2p^4$ . Oxygen will rapidly lose its extra p-electron to acquire a N-like stable configuration.

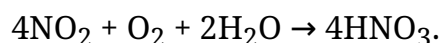
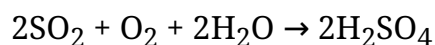
**OR**

- a. Lowest ionisation enthalpy = D  
 Highest ionisation enthalpy = A
- b. Order of increasing negative electron gain enthalpy is:  
 $A < C < D < B < E$

30. Normal rain water is slightly acidic in nature due to oxidation. It normally has a pH of 5.6. It becomes dangerous when pH slightly fall below this value. It becomes acidic due to the formation of  $H^+$  ions from the reaction of rain water with  $CO_2$  present in the atmosphere.



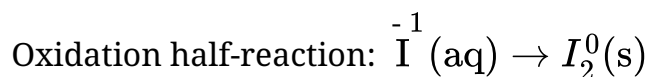
Acid rain is also formed due to the presence of oxides of sulphur and nitrogen in the atmosphere.



### Section D

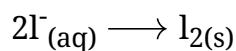
31. **Step 1:**

The two half-reactions involved in the given reaction are:

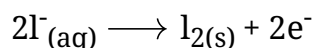


**Step 2:**

Balancing I in the oxidation half-reaction, we have:

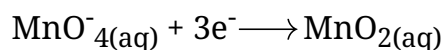


Now, to balance the charge, we add  $2e^-$  to the RHS of the reaction.



**Step 3:**

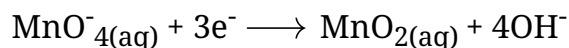
In the reduction half-reaction, the oxidation state of Mn has reduced from +7 to +4. Thus, 3 electrons are added to the LHS of the reaction.



Now, to balance the charge, we add 4  $OH^-$  ions to the RHS of the reaction as the

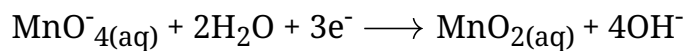
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reaction is taking place in a basic medium.



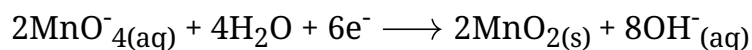
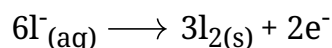
**Step 4:**

In this equation, there are 6 O atoms on the RHS and 4 O atoms on the LHS. Therefore, two water molecules are added to the LHS.



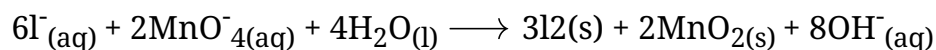
**Step 5:**

Equalising the number of electrons by multiplying the oxidation half reaction by 3 and the reduction half reaction by 2, we have:



**Step 6:**

Adding the two half reactions, we have the net balanced redox reaction as:



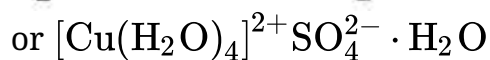
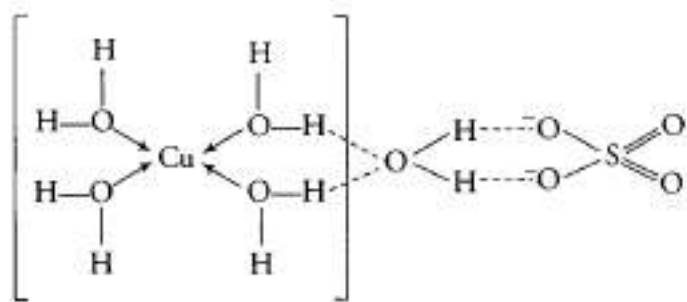
**OR**

i.

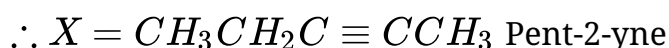
- a.  $\text{BeH}_2 < \text{CaH}_2 < \text{TiH}_2$  because as the size of metal atom increases, ionic character increases.
- b.  $\text{LiH} < \text{NaH} < \text{CsH}$
- c.  $\text{F—F} < \text{H—H} < \text{D—D}$  Bond dissociation energy of  $\text{F—F}$  is less due to repulsion between valence electrons than  $\text{H—H}$  which is shorter. Due to the small size of D as compared to H,  $\text{D—D}$  bond is shorter therefore its bond dissociation energy is highest.
- d.  $\text{H}_2\text{O} < \text{MgH}_2 < \text{NaH}$

$\text{NaH}$  has strong reducing property due to low ionisation enthalpy than  $\text{MgH}_2$  and  $\text{H}_2\text{O}$ . Secondly, Na is more electropositive than hydrogen.

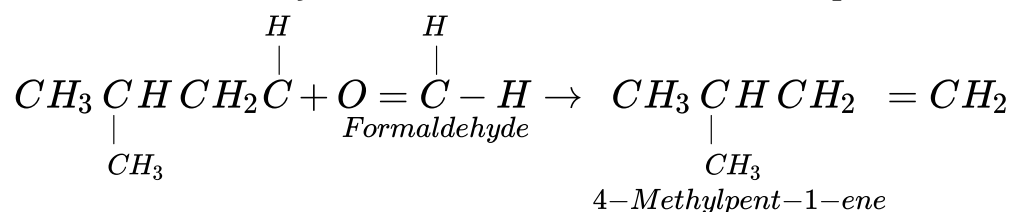
- ii. Only one water molecule, which is outside the brackets (coordination sphere), is hydrogen-bonded to  $\text{SO}_2^{-}$  ion as shown below. The remaining four molecules are linked to  $\text{Cu}^{2+}$  ion by coordinate bonds.



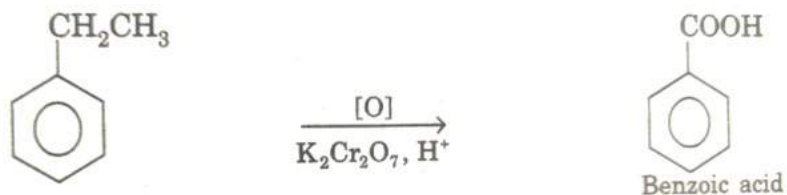
32. i. Alkyne X is  $\text{C}_6\text{H}_8$ . Since it does not react with sodamide or ammoniacal cuprous chloride, the triple bond must not be terminal.



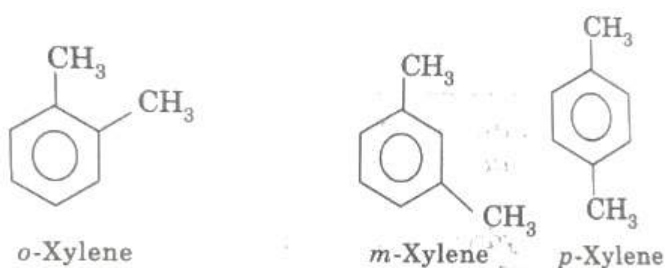
- ii. Hydrocarbon Y is alkene because it decolourises bromine water. From the Products of ozonolysis, the structure of alkene can be predicted.



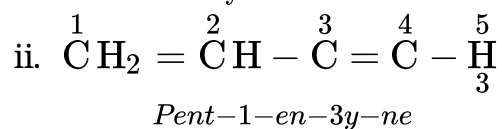
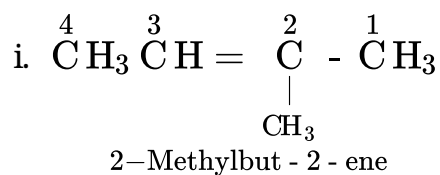
- iii. Since it does not decolourise bromine water, it is arene. Its formula is



The other three isomers are:



**OR**

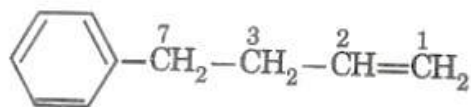


iii.



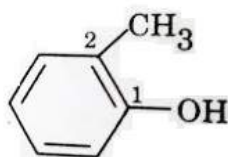
Buta-1,3-diene

iv.



4-Phenylbut-1-ene

v.



2-Methyl phenol

33. i. Boron ( $Z = 5$ )  $1s^2 2s^2 2p^1$   
ii. Neon ( $Z = 10$ )  $1s^2 2s^2 2p^6$   
iii. Aluminium ( $Z = 13$ )  $1s^2 2s^2 2p^6 3s^2 3p^1$   
iv. Chlorine ( $Z = 17$ )  $1s^2 2s^2 2p^6 3s^2 3p^5$   
v. Calcium ( $Z = 20$ )  $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$   
vi. Rubidium ( $Z = 37$ )  $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 5s^1$

**OR**

i.

- a.  $C_6H_6$   
b.  $H_2O_2$   
c.  $C_6H_{12}O_6$

ii. Molecular mass of anhydrous  $ZnSO_4$

$$= 65.5 + 32 + 4 \times 16 = 161.5$$

1.615 g of anhydrous  $ZnSO_4$  combine with water = 1.260 g

$$161.5 \text{ g of anhydrous } ZnSO_4 \text{ combine with } = \frac{1.260}{1.615} \times 161.5$$
$$= 126 \text{ G}$$