

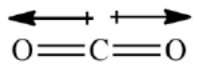
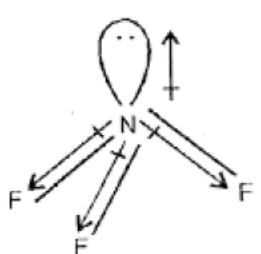
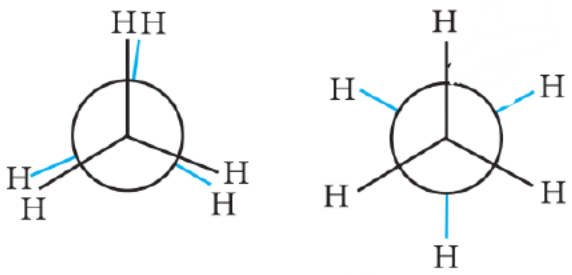





10.	(i) (ii)	State function: enthalpy, free energy Path function: heat, work	1 1	2
11.		Solutions which resist the change in pH on dilution or with the addition of small amount of acid or alkali are called Buffer solutions. E.g. An equimolar mixture of acetic acid and sodium acetate around a pH of 4.75/an equimolar mixture of $\text{NH}_4\text{OH}$ and $\text{NH}_4\text{Cl}$ around a pH of 9.25/carbonic acid – bicarbonate buffer in blood/Any other correct example.	1 1	2
12.		$\text{Cl}_2$ , $\text{NaClO}$ , $\text{KClO}_2$ , $\text{ClO}_2$	2	2
13.	(i) (ii)	Propanone Propanal Functional group isomerism	$\frac{1}{2}$ $\frac{1}{2}$ 1	2
14.		$\text{CH}_3\text{-CHO}$ & $\text{HCHO}$ OR, Ethanal and Methanal OR, Acetaldehyde and Formaldehyde. OR, the equation:  $\text{CH}_3\text{CH}=\text{CH}_2 + \text{O}_3 \longrightarrow \text{CH}_3-\overset{\text{O}}{\underset{\text{O}}{\text{C}}}-\text{CH}-\overset{\text{O}}{\underset{\text{O}}{\text{C}}}-\text{CH}_2 \xrightarrow{\text{Zn}/\text{H}_2\text{O}} \text{CH}_3\text{CHO} + \text{HCHO}$ <p style="text-align: center;">Propene                      Propene ozonide                      Ethanal                      Methanal</p>		2
15.	(i)  (ii)	Cyclohexane OR,  OR, $\text{C}_6\text{H}_{12}$  Chlorobenzene OR,  OR, $\text{C}_6\text{H}_5\text{Cl}$	1  1	2
<b>Answer any 8 questions from 16 to 26. Each carry 3 scores</b>				
16.	(i)  (ii)	Molecular mass of $\text{CO}_2 = 12\text{u} + 32\text{u} = 44\text{u}$ Molar mass of $\text{CO}_2 = 44 \text{ g mol}^{-1}$ Mass percent of carbon = $\frac{\text{Mass of carbon} \times 100}{\text{Molar mass of } \text{CO}_2}$ $= \frac{12 \times 100}{44} = 27.27\%$  (a) and (b) OR, 20g NaOH in 200 mL of solution & 0.5 mol of KCl in 200 mL of solution.	$\frac{1}{2}$  $\frac{1}{2}$ 2	3
17.	(i)  (ii)	$l = 0, 1$ when $l = 0$ , $m_l = 0$ when $l = 1$ , $m_l = -1, 0, +1$ 2s and 2p	1 $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2} + \frac{1}{2}$	3
18.	(i) (ii)	B and O OR, Be and N. This is because after the removal of one electron, Boron gets the stable fully filled electronic configuration ( $1s^2 2s^2$ ) and Oxygen gets the stable half-filled configuration ( $1s^2 2s^2 2p^3$ ). OR, Due to the stable completely filled electronic configuration of Beryllium and half-filled electronic configuration of Nitrogen. OR, 2p electron of boron is more shielded from the nucleus by the inner core of	$\frac{1}{2} + \frac{1}{2}$ 1 1	3

		<p>electrons than the 2s electrons of beryllium. Therefore, it is easier to remove the 2p-electron from boron.</p> <p>In the case of oxygen atom, two of the four 2p-electrons occupy the same 2p-orbital resulting in an increased electron-electron repulsion. So it loses one electron readily than nitrogen.</p>		
19.	(i)	<p>Covalent radius is the half of the distance between two similar atoms joined by a covalent bond in the same molecule.</p> <p>OR, Covalent radius is the half of the inter nuclear distance between two covalently bonded atoms in a covalent molecule.</p>	1	3
	(ii)	<p>Cations are smaller than the parent atom due to the greater effective nuclear charge in cations.</p> <p>Anions are larger than parent atom due to the greater electronic repulsion and less effective nuclear charge in anions.</p> <p>OR, due to the smaller no. of electrons in cation and greater no. of electrons in anion compared to the parent atom.</p>	1	
			1	
20.	(i)	<p>Significance of Dipole moment:</p> <ol style="list-style-type: none"> <li>Dipole moment gives the polarity in a molecule.</li> <li>It gives an idea about the geometry or shape of the molecule.</li> <li>It helps to predict whether a molecule is polar or non-polar.</li> <li>It helps to distinguish between cis and trans isomers.</li> <li>Used to calculate the percentage ionic character in a covalent molecule.</li> </ol> <p><b>[Any one required]</b></p>	1	3
	(ii)	<div style="display: flex; justify-content: space-around; align-items: flex-start;"> <div style="text-align: center;">  <p>Net dipole moment = 0</p> <p>CO<sub>2</sub></p> </div> <div style="text-align: center;">  <p>NF<sub>3</sub></p> </div> </div> <p>[Shape of CO<sub>2</sub> is linear, so its net dipole moment is zero. But NF<sub>3</sub> has a pyramidal shape and so it has a net dipole moment].</p>	1 + 1	
21.		<p>Here <math>K_p = 0.98</math>, <math>T = 298 \text{ K}</math>, <math>R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}</math></p> $\Delta G^{\circ} = -2.303 RT \log K_p$ $= -2.303 \times 8.314 \text{ J K}^{-1} \text{ mol}^{-1} \times 298 \text{ K} \times \log(0.98) = 50.06 \text{ J mol}^{-1}$ <p>Since <math>\Delta G^{\circ}</math> is positive, the reaction non-spontaneous at this temperature. [OR, first find out <math>K_c</math> and then substitute in the above equation].</p>	1 1 1	3
22.	(i)	<p>Here the forward reaction is exothermic. So, low temperature favours forward reaction.</p> <p>Since the no. of moles of gaseous species decreases during forward reaction, high pressure favours it.</p>	1	3
	(ii)	<p>Addition of inert gas like argon at constant volume does not affect the equilibrium.</p>	1	
23.		<p><b>Oxidation number method:</b></p> <p>Step 1: The skeletal equation is: <math>\text{Fe}^{2+} + \text{Cr}_2\text{O}_7^{2-} + \text{H}^+ \longrightarrow \text{Fe}^{3+} + \text{Cr}^{3+} + \text{H}_2\text{O}</math></p>		

		<p>Step 2: Assign oxidation number each element and identify the elements undergoing change in oxidation number.</p> $\overset{+2}{\text{Fe}^{2+}} + \overset{+6}{\text{Cr}_2\text{O}_7^{2-}} + \overset{-2}{\text{H}^+} \longrightarrow \overset{+3}{\text{Fe}^{3+}} + \overset{+3}{\text{Cr}^{3+}} + \text{H}_2\text{O}$ <p>Step 3: Calculate the change in oxidation number per atom and equate them by multiplying with suitable number. Here the oxidation number of Cr is decreased by 3 and that of Fe is increased by 1. In order to equate them multiply <math>\text{Fe}^{2+}</math> by 6 (since there are 2 Cr atoms on LHS).</p> $6 \text{Fe}^{2+} + \text{Cr}_2\text{O}_7^{2-} + \text{H}^+ \longrightarrow \text{Fe}^{3+} + \text{Cr}^{3+} + \text{H}_2\text{O}$ <p>Step 4: Now balance all the atoms except oxygen and hydrogen</p> $6 \text{Fe}^{2+} + \text{Cr}_2\text{O}_7^{2-} + \text{H}^+ \longrightarrow 6 \text{Fe}^{3+} + 2 \text{Cr}^{3+} + \text{H}_2\text{O}$ <p>Step 5: Now balance the ionic charges on both sides. Here the net ionic charge on LHS is +11 and on RHS is +24. To equate them add 13 more <math>\text{H}^+</math> on LHS, since the reaction takes place in acidic medium.</p> $6 \text{Fe}^{2+} + \text{Cr}_2\text{O}_7^{2-} + 14 \text{H}^+ \longrightarrow 6 \text{Fe}^{3+} + 2 \text{Cr}^{3+} + \text{H}_2\text{O}$ <p>Step 6: Now balance hydrogen atoms by adding sufficient number of <math>\text{H}_2\text{O}</math> molecules. Here add 6 more <math>\text{H}_2\text{O}</math> molecules on RHS.</p> $6 \text{Fe}^{2+} + \text{Cr}_2\text{O}_7^{2-} + 14 \text{H}^+ \longrightarrow 6 \text{Fe}^{3+} + 2 \text{Cr}^{3+} + 7 \text{H}_2\text{O}$ <p>Now the equation is balanced.</p> <p><b>OR, Half Reaction method:</b></p> <p>Step-1: Assign the oxidation number of each element and find out the substance oxidized and reduced.</p> $\overset{+2}{\text{Fe}^{2+}} + \overset{+6}{\text{Cr}_2\text{O}_7^{2-}} + \overset{-2}{\text{H}^+} \longrightarrow \overset{+3}{\text{Fe}^{3+}} + \overset{+3}{\text{Cr}^{3+}} + \text{H}_2\text{O}$ <p>Here Fe is oxidized and Cr is reduced.</p> <p>Step-2: Separate the equation into 2 half reactions -oxidation half reaction and reduction half reaction.</p> <p>Oxidation half: <math>\text{Fe}^{2+} \longrightarrow \text{Fe}^{3+}</math>      Reduction half: <math>\text{Cr}_2\text{O}_7^{2-} \longrightarrow \text{Cr}^{3+}</math></p> <p>Step-3: Balance the atoms other than O and H in each half reaction individually.</p> <p>Oxidation half: <math>\text{Fe}^{2+} \longrightarrow \text{Fe}^{3+}</math>      Reduction half: <math>\text{Cr}_2\text{O}_7^{2-} \longrightarrow 2 \text{Cr}^{3+}</math></p> <p>Step-4: Now balance O and H atoms. Add <math>\text{H}_2\text{O}</math> to balance O atoms and <math>\text{H}^+</math> to balance H atoms since the reaction occurs in acidic medium.</p> <p>Oxidation half: <math>\text{Fe}^{2+} \longrightarrow \text{Fe}^{3+}</math>      Reduction half: <math>\text{Cr}_2\text{O}_7^{2-} + 14\text{H}^+ \longrightarrow 2 \text{Cr}^{3+} + 7 \text{H}_2\text{O}</math></p> <p>Step -5: Now balance the ionic charges. For this add electrons to one side of the half reaction.</p> <p>Oxidation half: <math>\text{Fe}^{2+} \longrightarrow \text{Fe}^{3+} + \text{e}^-</math>      Reduction half: <math>\text{Cr}_2\text{O}_7^{2-} + 14\text{H}^+ + 6\text{e}^- \longrightarrow 2\text{Cr}^{3+} + 7\text{H}_2\text{O}</math></p> <p>Step-6: Now add the two half reactions after equating the electrons.</p> <p>Oxidation half: <math>(\text{Fe}^{2+} \longrightarrow \text{Fe}^{3+} + \text{e}^-) \times 6</math></p> <p>Reduction half: <math>(\text{Cr}_2\text{O}_7^{2-} + 14\text{H}^+ + 6 \text{e}^- \longrightarrow 2 \text{Cr}^{3+} + 7 \text{H}_2\text{O}) \times 1</math></p> <p>Overall reaction is: <math>6 \text{Fe}^{2+} + \text{Cr}_2\text{O}_7^{2-} + 14\text{H}^+ \longrightarrow 6 \text{Fe}^{3+} + 2 \text{Cr}^{3+} + 7 \text{H}_2\text{O}</math></p> <p>Now the equation is balanced.</p> <p style="text-align: center;"><b>[Any one method can be used to balance this redox equation]</b></p>	1	
			1	
				3
			1	
			1	
				3
			1	
				3
24.	(i)	<p>Inductive effect: It is a permanent effect arising due to the shifting of sigma electrons through a carbon chain in presence of an atom or group of atom attached to a carbon chain.</p> <p>Electromeric effect: It is the complete transfer of a shared pair of <math>\pi</math>-electrons to one</p>	1	3

		of the atoms joined by a multiple bond in presence of an attacking reagent. It is a temporary effect.	1	
	(ii)	Inductive effect OR, I effect	1	
25.		 <p>(i) Eclipsed                      (ii) Staggered</p> <p>Staggered conformation is more stable than eclipsed form.</p>	2 x 1	3
26.	(i)	CH <sub>2</sub> Br – CH <sub>2</sub> Br OR, 1,2-Dibromoethane OR, Ethylene dibromide	1	
	(ii)	2-Bromopropene OR, CH <sub>3</sub> – CH – CH <sub>3</sub> OR, isopropyl bromide & 	1	3
		1-Bromopropane OR, CH <sub>3</sub> – CH <sub>2</sub> – CH <sub>2</sub> Br OR, n-Propyl bromide	1	
<b>Answer any 4 questions from 27 to 31. Each carry 4 scores</b>				
27.	(i)	Heisenberg's uncertainty principle states that "it is impossible to determine simultaneously, the exact position and exact momentum (or velocity) of an electron." OR, the Mathematical equation: $\Delta x \cdot \Delta p \geq \frac{h}{4\pi}$ OR, $\Delta x \cdot m\Delta v \geq \frac{h}{4\pi}$ OR, $\Delta x \cdot \Delta v \geq \frac{h}{4\pi m}$ Significance: It rules out existence of definite paths or trajectories (orbits) of electrons and other similar particles. OR, We can only say the probability of finding an electron at a given point. OR, We cannot determine the exact position and momentum of an electron.	1	
	(ii)	Here $\Delta x = 0.1 \text{ \AA} = 0.1 \times 10^{-10} \text{ m}$ , $h = 6.626 \times 10^{-34} \text{ Js}$ , $m = 9.1 \times 10^{-31} \text{ kg}$ , $\Delta v = ?$ We know that $\Delta x \cdot m \cdot \Delta v = \frac{h}{4\pi}$ So, $\Delta v = \frac{h}{4\pi \cdot m \Delta x} = \frac{6.626 \times 10^{-34} \text{ Js}}{4 \times 3.14 \times 9.1 \times 10^{-31} \text{ kg} \times 0.1 \times 10^{-10} \text{ m}} = \underline{\underline{5.8 \times 10^6 \text{ m s}^{-1}}}$	1	4
28.		M.O configuration of N <sub>2</sub> : $\sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2 \pi 2p_x^2 \pi 2p_y^2 \sigma 2p_z^2$ . M.O. configuration of Ne <sub>2</sub> : $\sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2 \sigma 2p_z^2 \pi 2p_x^2 \pi 2p_y^2 \pi^* 2p_x^2 \pi^* 2p_y^2 \sigma^* 2p_z^2$ Bond order (B.O) of N <sub>2</sub> = $\frac{1}{2} [N_b - N_a]$ = $\frac{1}{2} [10 - 4] = \frac{1}{2} \times 6 = 3$ Since B.O of N <sub>2</sub> is 3, it contains a triple bond. Bond order (B.O) of Ne <sub>2</sub> = $\frac{1}{2} [N_b - N_a]$ For Ne <sub>2</sub> , B.O = $\frac{1}{2} [10 - 10] = \frac{1}{2} \times 0 = 0$ Since B.O of Ne <sub>2</sub> is zero, it does not exist.	1	
			1	4
			1	
29.	(i)	Hess's law states that the total enthalpy change for a process is the same whether the reaction taking place in a single step or in several steps.	1	

	<p>OR, the total enthalpy change for a process is independent of the path followed. OR, if a reaction takes place in several steps then its standard reaction enthalpy is the sum of the standard enthalpies of the intermediate reactions.</p> <p>(ii) Born-Haber cycle for the determination of lattice enthalpy of NaCl:</p> <p style="text-align: center;"> <math display="block">\Delta_f H^\circ = \Delta_{\text{sub}} H^\circ + \Delta_i H^\circ + \frac{1}{2} \Delta_{\text{bond}} H^\circ + \Delta_{\text{eg}} H^\circ + \Delta_{\text{lattice}} H^\circ</math> OR, <math display="block">\Delta_{\text{lattice}} H^\circ = \Delta_f H^\circ - [\Delta_{\text{sub}} H^\circ + \Delta_i H^\circ + \frac{1}{2} \Delta_{\text{bond}} H^\circ + \Delta_{\text{eg}} H^\circ]</math> </p>	3	4
30.	<p>(i) Heterogeneous equilibrium: An equilibrium process in which the reactants and products are in different phases. OR, e.g. <math>\text{CaCO}_3(\text{s}) \rightleftharpoons \text{CaO}(\text{s}) + \text{CO}_2(\text{g})</math> OR, <math>\text{H}_2\text{O}(\text{s}) \rightleftharpoons \text{H}_2\text{O}(\text{l})</math> OR, any other correct example.</p> <p>(ii) Here <math>K_c = 2 \times 10^{-3}</math>, <math>[\text{A}] = [\text{B}] = [\text{C}] = 3 \times 10^{-4} \text{ M}</math> For the reaction <math>2 \text{A} \rightleftharpoons \text{B} + \text{C}</math>, the reaction quotient (<math>Q_c</math>) = <math>\frac{[\text{B}][\text{C}]}{[\text{A}]^2}</math>  <math display="block">= \frac{3 \times 10^{-4} \times 3 \times 10^{-4}}{(3 \times 10^{-4})^2} = 1</math>  Since <math>Q_c &gt; K_c</math>, the reaction will proceed in the reverse direction.</p>	1 1 1	4
31.	<p><i>Detection of Nitrogen:</i> Sodium fusion extract is boiled with iron (II) sulphate and then acidified with concentrated sulphuric acid. The formation of Prussian blue colour indicates the presence of nitrogen.</p> <p><i>Detection of sulphur:</i> On treating sodium fusion extract with sodium nitroprusside, formation of a violet colour indicates the presence of sulphur.</p> <p>OR, The sodium fusion extract is acidified with acetic acid and lead acetate is added to it. A black precipitate indicates the presence of sulphur.</p> <p><i>Detection of chlorine and bromine:</i> The sodium fusion extract is acidified with nitric acid and then treated with silver nitrate. A white precipitate, soluble in ammonium hydroxide shows the presence of chlorine. A pale yellow (yellowish) precipitate, sparingly soluble in ammonium hydroxide shows the presence of bromine.</p>	1 1 2	4

#####