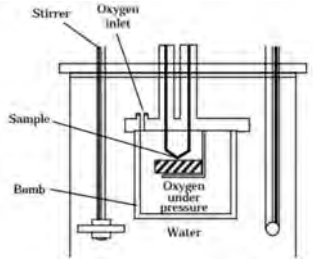
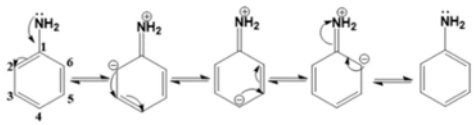
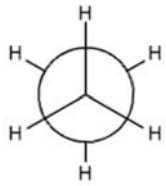
ITL PUBLIC SCHOOL
ANNUAL EXAMINATION (2022-23)

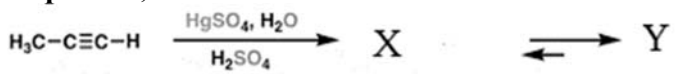
Date: 13.02.2023 **Class: XI**

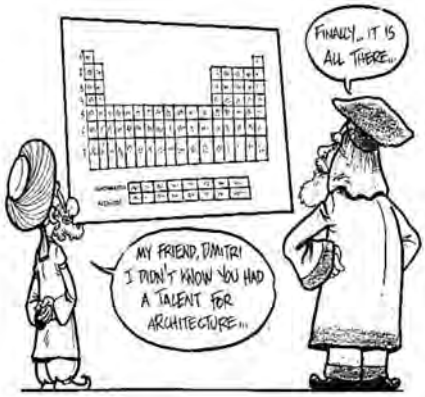
CHEMISTRY (043) – SET A ANSWER KEY

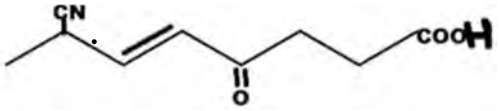
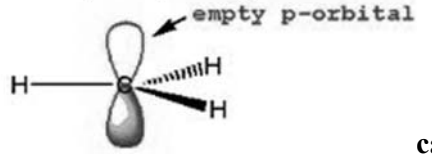
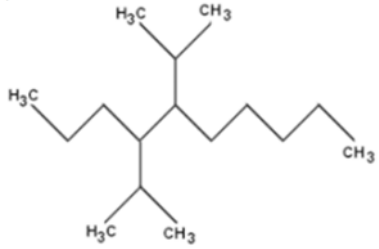
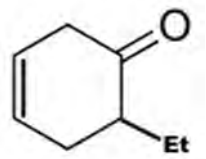
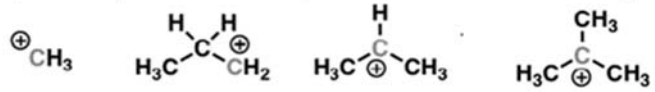
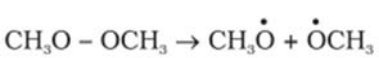
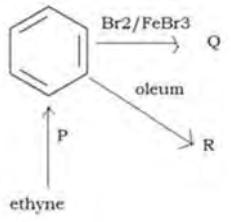
Time: 3hrs **M.M: 70**

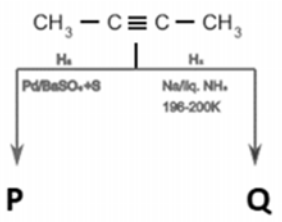
	SECTION – A	
1	The molar mass of carbohydrate is 180 u. What will be the molecular formula of the carbohydrate if its empirical formula is CH_2O? **$C_6H_{12}O_6$**	1
2	LiCl is more covalent than KCl. Comment. **Fajan's rule**	1
3	Arrange the following in increasing order of bond angles H_2O, NH_3, CH_4, and state the reason. **H_2O <NH_3 < CH_4 VSEPR**	1
4	A student used a carbon pencil to write his homework. The mass of this was found to be 5 mg. With the help of this calculate the number of moles of carbon in his homework writing. **4.16×10^{-4}**	1
5	The enthalpy of vaporization of a substance is 8400 J mol^{-1} and its boiling point is –173°C. Calculate the entropy change for vaporization. **84 $JK^{-1}mol^{-1}$**	1
6	Choose from the following mixtures in aqueous solution of equimolar concentration acts as an acidic buffer and the one which acts as the basic buffer solution. (a) NH_4OH and NH_4Cl **Basic buffer** (b) CH_3COOH and CH_3COONa **Acidic buffer**	1
7	Neither q nor w is a state function but q+w is a state function. Explain. **From first law of thermodynamics $\Delta U=q+w$ and ΔU is a state function**	1
8	Give the condensed and bond line structural formula for 2,2,4-Trimethylheptane. **$CH_3C(CH_3)_2CH_2CH(CH_3)CH_2CH_2CH_3$**	1
9	Identify the reagents shown in bold in the following equations as nucleophiles or electrophiles: (a) $CH_3CH_2Cl + \mathbf{OH^-} \rightarrow CH_3CH_2OH + Cl^-$ **Nucleophile** (b) $C_6H_6 + \mathbf{CH_3^+} \rightarrow C_6H_5CH_3 + H^+$ **Electrophile**	1
10	Predict whether entropy **increases**/decreases in the following reaction: H_2O (l) → H_2O (g)	1
11	A 0.66 kg ball is moving with a speed of 100 m/s. Find its de-Broglie wavelength. **10^{-35} m**	1
12	Name the instrument shown below and state its use. **Bomb Calorimeter**  **Bomb calorimeter is used for the measurement of ΔU.**	1
13	Aniline acts as ortho para directing for incoming electrophiles explain by showing resonating structures. 	1
14	Give the Newman conformation of the conformer of Ethane with maximum stability. 	1

	Ques 15 to 18 are Assertion -Reason type questions. Give correct option for each, based on the given outcomes ***(A) Both assertion and reason are correct statements, and reason is the correct explanation of the assertion.*** ***(B) Both assertion and reason are correct statements, but reason is not the correct explanation of the assertion.*** ***(C) Assertion is correct, but reason is wrong statement.*** ***(D) Assertion is wrong, but reason is correct statement.***	
15	**Assertion:** In phenol –OH group activates the benzene ring for the attack by an electrophile. **A** **Reason:** In the resonating structures of phenol the electron density is more on o – and p – positions due to +R-effect.	1
16	**Assertion:** BCl_3 acts as a Lewis acid. **Reason:** BCl_3 can accept a lone pair of electrons from species like ammonia. **A**	1
17	**Assertion:** The lattice enthalpy of an ionic compound is the enthalpy change which occurs when one mole of an ionic compound dissociates into its gaseous ions in gaseous. **Reason:** Lattice enthalpy of an ionic compound can be calculated using Born-Haber cycle. **B**	1
18	**Assertion**: The Balmer series of lines are the only lines in the hydrogen spectrum which appear in the visible region of the electromagnetic spectrum. **Reason:** For Balmer series $n_1 = 1$ in the formula given below. $\bar{\nu} = 109{,}677 \left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)\ \text{cm}^{-1}$ **C**	1
	SECTION – B	
19	The reactant which is entirely consumed in reaction is known as limiting reagent. In the reaction $2A + 4B \rightarrow 3C + 4D$, when 5 moles of A react with 6 moles of B, then (i) which is the limiting reagent? (ii) calculate the amount of C formed **'B' is the limiting reagent. 4.5 mol of C are formed**	2
20	The reaction between gaseous sulfur dioxide and oxygen is a key step in the industrial synthesis of sulfuric acid: $$\mathbf{2SO_2(g)+O_2(g)\rightleftharpoons 2SO_3(g)}$$ A mixture of SO_2 and O_2 was maintained at 800 K until the system reached equilibrium. The equilibrium mixture contained 5.0×10^{-2} M SO_3, 3.5×10^{-3} M O_2, and 3.0×10^{-3} M SO_2.Predict the direction of the reaction if the Kc value is 1×10^{-5}. **$Q = 0.79 \times 10^5$ Backward** **OR** Meenakshi had bought a sealed tube containing brown colored gas NO_2, for a chemistry experiment. Not knowing how to store it, she kept the tube in a refrigerator. After sometime on retrieving the tube, she was amazed as the brown colored gas had disappeared from the tube. After thinking for a while, she simply inserted the tube in hot water and the brown color reappeared. $2NO_2$ (brown) $\rightleftharpoons$ N_2O_4 (colourless) $\Delta H = -23$KJ/mol (i) Explain the principle behind it. **Le Chaterlier's principle** (ii) Will the reaction be product favored or reactant favored if the pressure is increased in above equilibrium? Explain. **Forward**	2
21	The enthalpy of combustion of methane, graphite and dihydrogen at 298K are –890.3 kJ mol^{-1} –393.5 kJ mol^{-1} and – 285.8 kJ mol^{-1} respectively. Calculate enthalpy of formation of methane gas. **-74kJ mol^{-1}** **OR** Calculate the heat of reaction: $C_2H_2(g) + H_2(g) \rightarrow C_2H_4(g)$ if bond enthalpies of C=C, H─H, C≡C and C─H bonds are 147, 104, 160 and 99 KJ mol^{-1} respectively. **-81 kJ mol^{-1}**	2
22	(i) How would you explain the fact that first ionisation enthalpy of sodium is lower than that of magnesium but its second ionisation enthalpy is higher than that of magnesium? **After removing 1 electron from the sodium atom the ion formed acquires the configuration of inert gas, neon. The second electron is removed from one of the 2p-orbitals which are completely filled i.e., have a total of 6 electrons and are closer to the nucleus.**	2

	(ii) Would you expect the second electron gain enthalpy of O as positive, more negative or less negative than the first? Justify your answer. **Positive**	
23	Considering the following sets, answer the given questions **(P) n = 5, ℓ = 1 (Q) n = 6, ℓ = 0 (R) n = 4, ℓ = 2** (i) Which one has the maximum energy? **Q** (ii) Which set contains a maximum number of electrons? **R**	2
24	For the reaction 2 A(g) + B(g) → 2D(g) $\Delta U^0 = -10.5$ kJ and $\Delta S^0 = -44.1$ JK^{-1}.Calculate ΔG^0 for the reaction at 300 K, and predict whether the reaction may occur spontaneously. (R is 8.314 $JK^{-1}mol^{-1}$). **ΔG^0 = 0.165 kJ Non-spontaneous**	2
25	Match the following: **Column I** / **Column II** (a) Magnetic quantum number — (i) Value is 4 for N shell (b) Electron — (ii) Probability density (c) ψ^2 — (iii) Orientation of the orbital (d) Principal Quantum Number 'n' — (iv) Exhibits both momentum and wavelength **a-iii, b-iv, c-ii, d-i**	2
	SECTION – C	
26	Calculate the molarity and molality of 98% H_2SO_4 (by mass) aqueous solution if the density of the solution is 1.84 g/ml. **18.4 M ; 500 m**	3
27	(i) Calculate the number of radial nodes in 3p orbital. **n-l-1 = 1** (ii) Calculate the number of unpaired electrons in Mn after losing three electrons. **4** (Atomic number of Mn is 25) (iii) Draw the shape of the 3dxy orbital.	3
28	(i) What is the degree of dissociation of formic acid (HCOOH) in its 0.001 M solution if K_a of formic acid is 1.6×10^{-4}. Also calculate its pH. **degree of dissociation = 0.4 pH = 3.398** (ii) What will be the conjugate base of H_2S? **HS^-** **OR** (i) What will be the solubility of AgCl in a 0.1 M NaCl solution? (Ksp of AgCl $=1.20\times10^{-10}$) **1.20×10^{-9} M** (ii) What will be the conjugate acid of CH_3COO^-. **CH_3COOH**	3
29	(i) Is the given species aromatic? Support your answer with reasons.  **Planar, cyclic, 6 pi electrons, Huckels rule** (ii) Which of the following will produce only ketones on ozonolysis followed by hydrolysis? 2-methylbut-2-ene, 2-methylpropene, **2,3 dimethylbut-2-ene**, 3-methyl Pent-2-ene Also give the reaction and name of the products formed. **Propan-2-one** (iii) Give reason why hydrocarbon containing odd number of carbon atoms cannot be prepared by Wurtz reaction? **Doubling of carbon chain**	3
30	(i) Identify X and Y in given reaction, along with type of isomerism**. X = Prop-1-en-2-ol Y = Propanone; tautomerism**  (ii) Give the mechanism of addition to HBr with propene to form 2-Bromopropane. **Markovnikov** (iii) How can Ethene and Ethyne be distinguished chemically? **Ethyne reacts with sodium to form sodium acetylide and hydrogen gas. However, this reaction is not given by ethene.** **OR** (i) Give the mechanism of chlorination of benzene to form chlorobenzene. **Electrophilic substitution reaction** (ii) How can ethane and ethene be distinguished chemically? **Bayer's reagent**	3

	(iii) An alkane 'M' on treating with $Br_2/h\upsilon$ gives 'N' which on further reacting with Na in dry ether gives butane. Identify the variables and using them write the reactions. **M = Ethane N = Bromoethane**	
	SECTION – D	
31	 ***When we talk about chemical reactions, we usually discuss the breakage and formation of bonds, gain and loss of electrons, and conversion from one state of matter to another. If we look closely, we might observe hundreds of chemical reactions taking place in our vicinity. You may find it quite surprising that almost one-third of the chemical reactions taking place in the surroundings fall under the category of redox reactions. Redox reactions include different types of chemical changes which occur in nature. The chemical changes may occur slowly, rapidly, or abruptly; say, for example, rusting of iron takes a long time whereas the cleaning of dishes can be done rather quickly.*** Answer the following: (i) Justify whether the thermal decomposition of calcium carbonate reaction is redox or not. **Not redox as no change in oxidation number** (ii) Predict which one out of **P** and **Q** is a better oxidizing agent if $E^o\ P^{2+}/P = +2.34V$ and $E^o\ Q^{2+}/Q = +3.65V$. Also give reason for the same. **Q as higher reduction potential** (iii) Balance the given ionic equation as per the medium given below: $Br^- + Cr_2O_7^{2-} \rightarrow Cr^{3+} + BrO_3^-$ (acidic medium) $Br^- + 8H^+ + Cr_2O_7^{2-} \rightarrow 2\,Cr^{3+} + 4H2O + BrO_3^-$ **OR** (iii) Which of the following species, do not show disproportionation reaction and why? ClO^-, ClO_2^-, ClO_3^- and ClO_4^-. **ClO_4^-.**	(1+1+2=4)
32	 ***The history of the periodic table reflects over two centuries of growth in the understanding of the chemical and physical properties of the elements, with major contributions made by Antoine-Laurent de Lavoisier, Johann Wolfgang Döbereiner, John Newlands, Julius Lothar Meyer, Dmitri Mendeleev, Glenn T. Seaborg, he periodic table is an arrangement of the chemical elements, structured by their atomic number, electron configuration and recurring chemical properties. In the basic form, elements are presented in order of increasing atomic number, in the reading sequence. Then, rows and columns are created by starting new rows and inderting blank cells, so that rows (periods) and columns (groups) show elements with recurring properties (called periodicity). For example, all elements in group (column) 18 are noble gases that hardly have a chemical reaction.*** Answer the following: (i) What would be the IUPAC name and symbol for the element with atomic number 101? **Unnilunium Unu** (ii) Predict the position of an element X in the modern periodic table which atomic number is 29. **Group 11 & period 4** (iii) Give reason for the following statements: (a) Ionization enthalpy of Gallium is more than that of Aluminium. **Size increases, effective nuclear charge decreases** (b)Fluorine has less electron gain enthalpy than Chlorine.**Small size, high electronic repulsion** **OR**	(1+1+2=4)

	(iii) Give reason for the given statements: (a)Ionization enthalpy of Be is more than that of Boron. **because in Boron - complete 2s orbital.** (b) Na^+ and F^- are isoelectronic species. **10 electrons each**	
	SECTION – E	
33	(i) Give the IUPAC name of the following molecules:  (a) **7-Cyano-4-oxooct-5-en-1-oic acid** (b) $CH_3 (CH_2)_2 CH= CH CH (CH_3) CHO$ **2-methylhept-3-en-1-al** (ii) Identify and give any one characteristic property of the given species:  **carbocation ; electrophile** Explain the type of bond fission which leads to formation of such a species. What happens to the stability of above species if one H is replaced by methyl group. **Heterolytic;** **+ I effect stabilizes it** (iii) Arrange in increasing order of acidic characters stating the reason CH_3COOH, FCH_2COOH, CH_3CH_2COOH, $ClCH_2COOH$. **CH_3CH_2COOH< CH_3COOH< $ClCH_2COOH$< FCH_2COOH** **OR** (i) Give the IUPAC name of the following molecules: a)  b)  **6- Ethylcyclohex-3-enone** **4,5-Bis(1-methylethyl)decane** (ii) Arrange the following carbocations in increasing order of stability. Explain with reason.  (iii) Use curved-arrows to show the electron flow and classify as homolysis or heterolysis. Identify reactive intermediate produced. **Homolytic Fission; Free Radical** 	(2+2+1=5) (2+1+2=5)
34	(i) Identify the variables P, Q and R. What product is obtained when Q is treated with nitrating mixture? **4-Nitrobromobenzene** **P = Red hot iron tube; 873K Q = Bromobenzene R=Benzene sulphonic acid**  (ii) How will you convert Phenol to toluene? **Zinc dust and friedelcraft alkylation** (iii) $CH_3CHBrCH_3$ + KOH (alc.) → A + HBr (peroxide) → B Identify A and B and also identify the type of isomerism between B and 2-Bromopropane **A = Propene B = 1-Bromopropane Position isomers**	(2+1+2=5)

	OR (i) Consider the reaction in given figure and answer the following questions:  (a) Identify the variables P and Q. **P cis but-2-ene Q trans-But-2ene** (b) P and Q show a type of stereoisomerism. What is the main reason for its occurrence. **Geometrical isomerism; restricted rotation of double bond** (c) Out of P and Q, which one has a higher boiling point and why? **Cis; due to higher dipole moment** (ii) A gas 'X' on passing through red hot iron at 873K, polymerises to 'Y', which on further reacting with 'Z' gives Acetophenone. Identify the variables and give the reactions involved. What is the conversion of 'Y' to acetophenone known as? **X = Ethyne Y Benzene Z Acyl chloride Friedelcrafts acylation**	(3+2=5)
35	(i) Using VSEPR theory, draw the structure of BrF_5 molecule. **Square pyramidal** (ii) Predict hybridization of P in PCl_5 molecule. **Sp3d** (iii) Which of the following would have a permanent dipole moment and why? CCl_4, **NH_3**, SiF_4 (iv) Using M.O. Theory, compare the bond lengths and magnetic character of O_2 and O_2^{2-} O_2 **Paramagnetic B.O=2 O_2^{2-} Diamagnetic B.O= 1**	(3X1+2=5)