General Certificate of Education (Adv.Level) First Term School Based Assessment January - 2026

Chemistry	Grade 12(2027)	02	T	I,II	Time : Three Hours

Instructions

Additional Reading Time-10 Minutes

Index No : .....

- *Periodic Table is provided*
- *This paper consists of 13 pages*
- *Answer **all** the questions.*
- ***Use of calculators is not allowed***
- *Write your **index number** in the space provided in the answer sheet.*
- *Follow the instructions given on the back of the answer sheet carefully.*
- *In each of the questions 1 to 25, pick one of the alternative from (1), (2), (3), (4) ,(5) which is **correct** or **most appropriate** and **mark your response on the answer sheet with a cross (x) in accordance with the instructions given on the back of the answer sheet.***

Universal gas constant, $R = 8.314\ J\ K^{-1}\ mol^{-1}$
Avogadro constant, $NA = 6.022 \times 10^{23}\ mol^{-1}$
Plank's constant, $h = 6.626 \times 10^{-34}\ JS$
Velocity of Light, $c = 3 \times 10^{8}\ ms^{-1}$

(01)Which of the following chemical species is to have highest boiling point?

1. O_2 2. NO 3. Kr 4. Br_2 5. ICl

(02)Which of the following rules/ principles is/ are violated in the following orbital diagram which represented the ground state electron configuration?



3S 3P 3d

1. Hund's rule
2. Aufbau Principle
3. Aufbau Principle, Hund's rule
4. Aufbau Principle, Pauli exclusion Principle
5. Hund's rule, Pauli exclusion Principle

(03)Electron pair geometry around the central atom of the species F_3BrO_2, $IBrF_3^-$ and $Br_2IO_2^+$ are respectively

1. Trigonal bipyramidal, square planer, tetrahedral
2. Trigonal bipyramidal, tetrahedral, tetrahedral
3. Seesaw, octahedral, tectrahedral
4. Trigonal bipyramidal, octahedral, tetrahedral
5. Square planer, octahedral, tetrahedral

(04)What is the volume of concentrated HCl acid of density $1.26\ gcm^{-3}$ and purity 36% (W/W) required to make $250\ cm^3$ of $0.63\ mol\ dm^{-3}$ HCl solution? $[H-1 \quad Cl-35]$ [in cm^3]

1. 12.5 2. 6.2 3. 25 4. 1.25 5. 10

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(05)An Object emits 9J per second in the 220nm wavelength. How many photons emitted by this object in three seconds? $[h - 6.6 \times 10^{-34} JS]$ $[C - 3 \times 10^{8} ms^{-1}]$

1. 1×10^{19} 2. 4×10^{19} 3. 3×10^{20} 4. 6×10^{19} 5. 3×10^{19}

(06)Select the incorrect statement.

1. Helium atom is the smallest among all atoms.
2. The radius of Mg is larger than the atomic radius of Li.
3. Cl_2 has the smallest boiling point among Cl_2, Br_2 and I_2.
4. Among the elements S, P, O and F the lowest negative value for electron gain energy is shown by F
5. Electronegativity of N, Mg, O, P and S decreases in the order $O > N > S > P > Mg$

(07)Which of the following has the least dipole moment?

1. CH_3OH 2. HF 3. H_2O 4. NCl_3 5. NF_3

(08)What mass of NaBr would certain the Same total number of ions as 168g of AlF_3?
[Al - 27, F - 19, Na - 23, Br - 80]

1. 512g 2. 412g 3. 206g 4. 824g 5. 100g

(09)Composition of Mg^{2+} ion in an aqueous solution of $MgBr_2$ with a density of $1.8 gcm^{-3}$ is 36ppm. Composition of Br^- ions in ppm is (Mg - 24, Br - 80)

1. 240 2. 160 3. 480 4. 80 5. 200

(10)The number of moles of electrons given out when one mole of CH_3COOH $\left[CH_3 - \overset{\overset{O}{\|}}{C} - O - H\right]$ is oxidized to CO_2 under suitable Condition is.

1. 4 2. 6 3. 8 4. 10 5. 12

(11)The number of less stable and unstable lewis dot - dash structures that can be drawn for given molecule?

$$H - \overset{\overset{:O:}{\|}}{C} - \overset{\cdot\cdot}{N} = \overset{\cdot\cdot}{N} - H$$

1. 1 2. 2 3. 3 4. 4 5. 5

(12)The maximum number of electrons that can have quantum number value of $n + l \leq 4$ and $m_s = -\frac{1}{2}$ in an atom of an element is

1. 3 2. 6 3. 8 4. 10 5. 12

(13)Which of the following Compounds has the lowest Volatility?

1. CH_3CH_3 2. CH_3CHCl_2 3. C_2H_5Br 4. $C_2H_2Br_4$ 5. CH_4

(14)A mixture contains FeO and Fe_3O_4. When this mixture is heated in air until constant mass, 5% increase in mass is observed. What is the mass percentage of FeO in the mixture? [Fe-56 O-16]
[Note :- When FeO and Fe_3O_4 are heated in air they are react with O_2 to give Fe_2O_3]

1. 30.45 2. 25.42 3. 80.25 4. 20.25 5. 45.75

(15)Consider the following balanced chemical equation

$$Fe_2O_3 + 2Al \rightarrow 2Fe + Al_2O_3$$

When 320g of Fe_2O_3, 81g of Al were reacted 134.4g Fe were obtained. Under these conditions The limiting reagent and percentage yield Fe respectively are [Fe - 56 O - 16 Al - 27]

1. $Fe_2O_3, 80\%$
2. $Al, 80\%$
3. $Fe_2O_3, 60\%$
4. $Al, 20\%$
5. $Al_2O_3, 80\%$

- Instruction for the question 16 - 20

(1)	(2)	(3)	(4)	(5)
(a) and (b) only correct	(b) and (c) only correct	(c) and (d) only correct	(a) and (d) only correct	any other combination of responses correct

(16)Consider the following structure

$$\underset{P}{CH_3} - \underset{Q}{\overset{\overset{O}{\|}}{C}} - \underset{R}{C \equiv C} - \underset{S}{CH = CH_2}$$

True statement/s of the above structure is/ are?

a) All atoms lie in the same plane

b) Increasing order of $C - C$ length is $R < S < Q < P$

c) All carbon atoms lie in the same plane.

d) Five carbon atoms lie in a straight line

(17)Which of the following statement/s is/are?

a) They should be minimum of two atomic orbitals with different shapes and energy mixed to form hybride orbitals.

b) In a molecule if one atom is SP hybridized, it will definitely have π(pie) bond

c) All atoms are hybridized in a molecule.

d) Hybride energy is between the energies of atomic orbitals which are participate to the formation of hybridization

(18) Which of following statement is/ are true?

a) Electrons do behave as waves and particles at one and the same time

b) Bohr theory is a nuclear model of the atom

c) The nuclear charge felt by the valence electron in a Mg atom is greater than 12

d) e/m ratio of cathode rays varies with the gas inside a cathode ray tube.

(19) An element shows the Oxidation states +3, +5 and +7. The other stable oxidation state/ states shown by this element is/are.

a) +2 b) +1 c) -1 d) +8

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(20) Which of the following is a/ are disproportionation

a) $Mg + Cu^{2+} \rightarrow Mg^{2+} + Cu$

b) $S_2O_3^{2-} + 2H^+ \rightarrow SO_2 + S + H_2O$

c) $Cu_2Cl_2 \rightarrow CuCl_2 + Cu$

d) $Cl_2 + OH^- \rightarrow HOCl + Cl^-$

- From Question 21 - 25 two statements are given. select the most suitable option from the following table regarding the two statements mark appropriately.

	Statement I	Statement II
1	Correct	Correct and explain statement I
2	Correct	Correct and do not explain statement I
3	Correct	InCorrect
4	InCorrect	Correct
5	InCorrect	InCorrect

	First statement	Second statement
(21)	The bond angles of H_2O, NO_2, CO_2 decrease in the order $CO_2 > NO_2 > H_2O$	The electro negativity of the central atom of H_2O, NO_2, CO_2 decrease in the order $O > N > C$
(22)	MgO is more thermally stable than Al_2O_3	Polarizing power is $Al^{3+} > Mg^{2+}$
(23)	The atomic spectrum of hydrogen is a line spectrum	In hydrogen emission spectrum. The energy change due to electron tranfer (ΔE) will be negative.
(24)	The metals are excellent condcutors of electricity regardless of liquid or solid state	Valance electrons are available to take part in localization of forming metallic bonds in metals
(25)	Ice floats on water	The arrangement of water molecules in a regular ordered state of ice occubies more space of liquid water

Part - IIA

Structured Essay

Answer all questions

01) (a) Write on the dotted lines whether the following statements are true or false.

(i) Among the elements P, S *and* Cl, the one which has the highest second ionization energy is S

(.....)

(ii) Three stable resonance structures can be drawn for $H\ CO_3^-$ ion.

(.....)

(iii) When an atom gets filled by electron, they start fill the fourth energy level only after third energy level is filled completely. (.....)

(iv) Bond energy increases in the order $SO_2 < NO_2^- < SO_3 < CO_2$

(.....)

(v) The violet line of the Balmer series of hydrogen spectrum corresponds to the electron transition from main energy level $n = 6$ to $n = 2$ (.....)

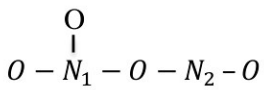
(vi) Of the molecules Cl_2 *and* O_2 which move with the same speed, Cl_2 has the greater de Broglie wave length than that of O_2. (.....)

(b) Draw the most acceptable Lewis dot-dash structure for SF_2NO^- ion.

What are the oxidation states of S and N in the above structure?

.....

(ii) The skeletal structure of $N_2O_4^{2-}$ ion is given below. Draw the most acceptable Lewis structure of it .



(iii) In the structure drawn above, state the shape and oxidation states of the atoms label of N_1 , N_2

Shape N_1 : ..... N_2 : .....

Oxidation state N_1 :..... N_2 : .....

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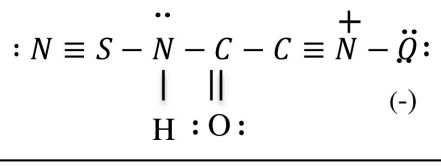
(iv) Draw two resonance structures for the structure draw in (b) (ii) above

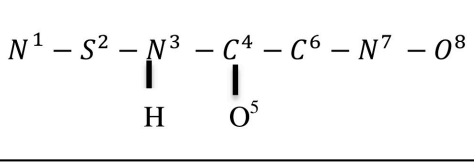
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(v) Based on the following Lewis structure and its labeled skeleton beside it , complete the table below it..





	S^2	N^3	C^4	C^6
(i) VSEPR pairs surrounding the atom				
(ii) Electron pair geometry				
(iii) Shape				
(iv) Hybridization				

(v) Identify the atomic / hybrid orbitals involved in the formation of the following σ bonds.

(I) N^1 - S^2 : N^1 : …….. S^2 : ……..

(II) N^3 - H : N^3 : …….. H : ……..

(III) N^3 - C^4 : N^3 : …….. C^4 : ……..

(IV) C^4 - O^5 : C^4 : …….. O^5 : ……..

(V) C^4 - C^6 : C^4 : …….. C^6 : ……..

(VI) C^6 - N^7 : C^6 : …….. N^7 : ……..

(vi) Identify the atomic / hybrid Orbitals involved in the formation of π bond between the following atoms.

(I) N^1 - S^2 : N^1 : …….. S^2 : ……..

(II) C^4 - O^5 : C^4 : …….. O^5 : ……..

(III)C^6 - N^7 : C^6 : …….. N^7 : ……..

(vii) Mention the approximate values of the bond angles surrounding the following atoms..

(I) S^2 : …….. (II) N^3 : ……

(III) C^4 : …….. (IV) C^6 : ……

(viii) Arrange the atoms S^2 , N^3 , C^4 , C^6 and N^7 in the ascending order of electronegativity.

..... < ..... < ..... < .....

(c) Arrange the following in the increasing order of the properties given in paranthesis.

(i) SO_2 , SO_3, H_2S, SO_4^{2-} (Electronegativity of S)

..... < ..... < ..... < .....

(ii) $F,\ O,\ N,\ Cl$ (first ionization energy)

..... < ..... < ..... < .....

(iii) $O^{2-},\ F^-$, N^{3-} , Mg^{2+} (ionic radius)

..... < ..... < ..... < .....

(iv) $Cr^{3+},\ Fe^{2+},\ Co^{3+},\ Mn^{2+}$ (number of unpaired electrons)

..... < ..... < ..... < .....

(v) $Li,\ Na,\ S,\ Cl$ (amount of energy released when an electron is added to an atom of the element in gaseous state)

..... < ..... < ..... < .....

02) (a) L, M, Q and R are four element in the periodic table existing in the same physical state at room temperature with atomic numbers less than ten. The first ionization energies of M and Q are approximately equal. In the compound formed by M and R, the element M shows its highest oxidation state +2. The element R never exhibits positive oxidation state.

The nucleus of the atom of the element L is similar to the particle Y in the beam of rays used in the experiment for the discovery of neutrons. The atomic radius of the element L is the smallest among all the elements. Although +1 is the commonest oxidation state shown by element Q in its compounds , -1 state is also possible for it.

(i) Write the chemical symbols of $L,\ M,\ Q,\ R\ and\ Y$

L : ..... M : ..... Q : ..... R : ..... Y : .....

(ii) Mention two compounds formed by M and Q and compare their boiling points.

(iii) Arrange the elements $L,\ M,\ Q\ and\ R$ in the increasing order of electronegativity.

(iv) What is the sign (positive/ negative) of electron gain energy of C?

(b) Explain the following briefly.

(i) C, C bond length of the species CO_3^{2-} , CO , CO_2 and $C_2O_4^{2-}$ follow the order $C_2O_4^{2-} > CO_3^{2-} > CO_2 > CO$.

(ii) First ionization energy of Mg is greater than that of Al.

(iii) Covalent character $KF < NaF < LiF$

(iv) The stability of NO_4^{3-} , $NO_3^-\ and\ NF_5$, follows the order $NF_5 < NO_4^{3-} < NO_3^-$.

(c) State the major secondary interaction that exist in the species.

(i) $ICl_{(s)}$: .....

(ii) $NaCl_{(aq)}$: .....

(iii) $CH_{4(g)}$: .....

(iv) $HCHO_{(\ell)}$: .....

(v) F^- / HF: : .....

03) (a) A sample of a hydrated alkaline earth metal carbonate, $MCO_3.XH_2O$, weighing 8.7 g was heated at 150^0C until a constant mass was obtained. After heating, 4.2 g of the anhydrous carbonate (MCO_3) remained When the anhydrous salt was heated further at a higher temperature it decomposed into the metal oxide and carbon dioxide. The mass of the remaining solid was 2 g.

(i) Calculate the molar mass of the oxide formed

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(ii) Calculate the molar mass of metal and Identify the metal M

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(iii) Calculate the number of moles of the anhydrous salt, MCO_3

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(iv) Calculate the number of moles of water vapour released on first heating

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(v) Determine the value of x in the hydrate.

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(b) Write the IUPAC Names of the following compounds.

(i) NH_3 : .....

(ii) $MgCl_2$: .....

(iii) MnO_2 : .....

(iv) $HClO_3$: .....

(v) $FeBr_2$: .....

(c) Answer the following questions regarding H_20 Molecule.

(i) Deduce the molecular geometry and electron pair geometry

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(ii) Indicate the direction of the dipole moment.

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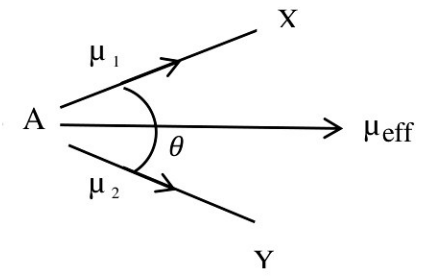
(iii) Calculate the dipole moment of a single O-H bond Induced charge on 5.01×10^{-30} C. inter nuclear distance of O –H bond : 1 A

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(iv) Calculate the resultant dipole momentum of OH bonds? (In unit D) $1D = 3.34 \times 10^{-30}\ Cm$ equation.



$$\mu_{eff} = \sqrt{\mu_1^2 + \mu_2^2 + 2\mu_1\,\mu_2 cos\theta}$$

cos104.5 = - 0.25

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04) (a) Vinegar contains acetic acid (CH_3COOH) A $100\ cm^3$ sample required $50\ cm^3$ of $0.1\ M\ NaOH$ for neutralization.. (Density of vinegar $1.2\ gcm^{-3}$

(i) Write the neutralization reaction ?

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(ii) Calculate moles of $NaOH\ used.$

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.....

(iii) Calculate moles of CH_3COOH present in 100 cm^3 solution

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(iv) Find the mass of 100 cm^3 of vinegar.

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.....

(v) Calculate w/w% of $CH_3\ COOH$ *[C-12, 0-16, H-1]*

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(b) Balance the following equations by writing redox half-ionic equations.

(i) $H_2O_2 + H^+ + I^- \rightarrow I_2 + H_2O$

half ionic equation of Oxidizing agent: .....

half ionic equation of Reducing agent: .....

Balanced the above equation : .....

(ii) $KMnO_4 + H_2SO_4 + H_2S -> K_2SO_4 + S + Mn\ SO_4 + H_2O$

half ionic equation of Oxidizing agent: .....

half ionic equation of Reducing agent: .....

Balanced the above equation : .....

(iii) $S0_2 + FeCl_3 + H_2O \rightarrow H_2SO_4 + FeCl_2 + HCl$

half ionic equation of Oxidizing agent: .....

half ionic equation of Reducing agent: .....

Balanced the above equation : .....

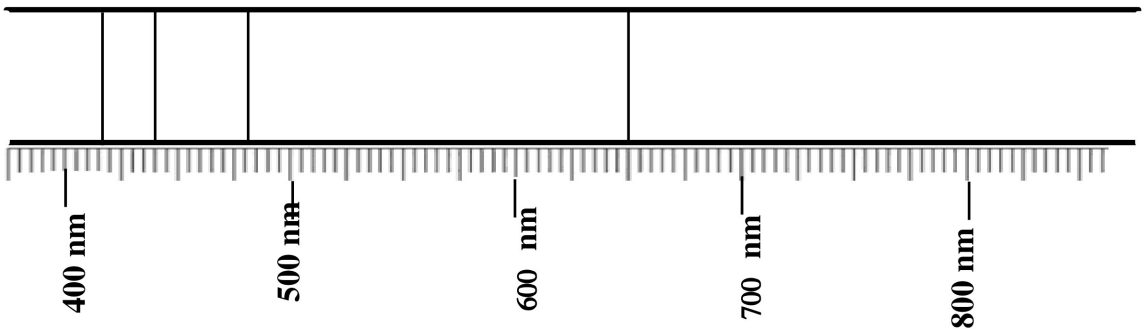
(iv) $Mg + Con\ HNO_3 \rightarrow Mg(NO_3)_2 + NO_2 + H_2O$

half ionic equation of Oxidizing agent: .....

half ionic equation of Reducing agent: .....

Balanced the above equation : .....

(c) In Hydrogen Spectrum, the Balmer series is show below (violet ,Blue , green, and red lines) $h = 6.62\times10^{-34}JS$



(i) Arrange in increasing wavelength

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(ii) Draw possible electron transitions.

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(iii) Calculate photon energy of the lowest-energy Balmer transition

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(iv) Find wavelength of the lowest-energy Paschen transition.

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Part – II B
Essay
Answer all questions

05) (a) A group of students carried out Cathode Ray experiment in laboratory. Answer the following questions.

(i) Give the conditions required for Cathode Ray to be formed.

(ii) Give four properties of Cathode rays.

(iii) Write any three differences between Cathode Ray and Positive Ray.

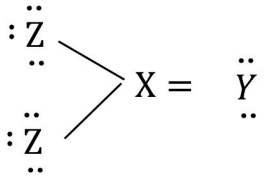
(b) (i) Write down the De-Broglie equation

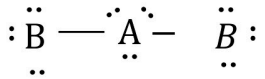
(ii) A particle has a De-Broglie wavelength of $1 \times 10^{-8}\, m$. If its mass is $6.11 \times 10^{-32}\, kg$, find its speed.

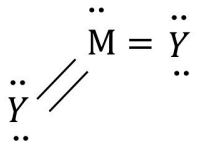
(iii) Calculate the one Photon Energy of light with wavelength $450\, nm$. $(h - 6.626 \times 10^{-34}\, Js\,,\ C = 3 \times 10^{8}\, ms^{-1})$

(iv) Find the one mole photon energy for the above light.

(c) Identify the element involved in the following shapes of the molecules.The electronegativities in the order 2.4 < X < 3 = Z < Y < B

(i)  (Trigonal planar)

(ii)  (Linear)

(iii)  (Angular)

06) (a) A group of students decided to determine the molarity of $Fe\ C_2\ O_4$ using acidic $K_2\ Cr_2\ O_7$. The solution X contains $250\ cm^3$ of $Fe\ C_2\ O_4$, $10\ cm^3$ of solution X was taken in a titration flask and then titrated with $0.2\ mol\ d\ m^{-3}$ $K_2Cr_2O_7$ solution acidified with $H_2\ SO_4$. The burette reading at the end point was $20\ cm^3$.

(i) Write down the half ionic oxidation reaction.

(ii) Write down the half ionic reduction reaction.

(iii) Write the balanced ionic equation.

(iv) Write down the complete balanced equation.

(v) Calculate the molarity of $Fe\ C_2\ O_4$ solution?

(vi) Hence , find the required mass of FeC_2O_4 to prepare solution X.

(vii) Indicate the main hindrance/ difficulty in the above titration.

$(Fe - 56,\ C\ \ - 12,\ O\ \ - 16\,,\ H - 1)$

(b) Briefly explain the followings .

(i) Boiling point of $NO_{(g)}$ is greater than $O_{2(g)}$

(ii) Iodine molecule is more soluble in KI than water.

(iii) Thermal stability of group 2 carbonates increases down the group.

(iv) Physical state of group 17 elements changes down the group.

07) (a) A mixture contains $NaBr\ and\ MgCl_2$, in the molar ratio of $3:2$ respectively. This solid mixture was dissolved completely in water. When the resulting solution was treated with excess of $AgNO_{3(aq)}$, the precipitates $AlCl\ and\ AgBr$ were obtained.

(i) Write all balanced equations involved above.

(ii) Calculate the mass percentage of $AgBr$ in the precipitate. $(Ag-108,\ Br-80,\ Cl-35.5)$

(b) A sample of $0.5\ g$, containing $CaCO_3$, was dissolved in excess of $1\ mol\ dm^{-3}$, $15\ cm^3$ HCl. The resulting solution was diluted with distilled water to give $250\ cm^3$ volume. A $25\ cm^3$ portion of this solution was titrated with $0.1\ mol\ dm^{-3}$ $NaOH$ in the presence of phenolphthalein as an indicator. The burette reading was $12\ cm^3$.

(i) Write all balanced chemical equations involved in the procedure.

(ii) Calculate the mole number of $NaOH$ in the titration.

(iii) Calculate the remaining number of moles of HCl in $250\ cm^3$ solution.

(iv) Find the mass percentage of $CaCO_3$ in the sample. $(Ca-40, C-12, O-16)$

(c) Calculate the following for the solution of $(NH_4)_2\,SO_4.Fe_2(SO_4)_3$ having the composition $120\ ppm$

(i) Concentration of $Fe^{3+}\ ions$ in $moldm^{-3}$.

(ii) Number of SO_4^{2-} ions in $100\ cm^3$ of the solution. $(N-14, H-1, S-32, O-16,\ Fe-56)$

ආවර්තිතා වගුව/ஆவர்த்தன அட்டவணை/The Periodic Table

	1 H																2 He
1	3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
2	11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
3	19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
4	37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
5	55 Cs	56 Ba	La-Lu	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
6	87 Fr	88 Ra	Ac-Lr	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Cn	113 Nh	114 Fl	115 Mc	116 Lv	117 Ts	118 Og
7																		

57 La	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu
89 Ac	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr

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