Provincial Department of Education - NWP

02	E	I

First Term Test - Grade 12 - 2019

Index No : .....

Chemistry I

Two Hours

Answer all the questions.

- **In each of the question 1 to 50 ,pick one of the alternatives 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 N_A = 6.022×10^{23} mol^{-1}
Plank's constant h = 6.626×10^{-34} J s Velocity of light c = 3×10^{8} m s^{-1}

1. Name of the each scientist and their activity is correctly mentioned in,

	The charge of the electron	Radioactivity	Neutron	Quantization of energy
(1)	Thomson	marie and pierre curie	Chadwick	Einstein
(2)	Millikan	Becquerel	Chadwick	Plank
(3)	Millikan	Rutherford	Stoney	Einstein
(4)	Rutherford	Marrie Currie	Marsden	Plank
(5)	Thomson	Becquerel	Chadwick	Rutherford

2. Which of the following electromagnetic radiations has the highest wave length ?
   1. Ultra violet rays. 2. Visible rays. 3. Infrared rays.
   4. Micro Waves 5. Radar waves.

3. The electron configuration of the ion or iron in the molecule of FeO.
   1. $1S^2\ \ 2S^2\ 2P^6\ \ 3S^2\ 3P^6\ 3d^5\ \ 4S^2$
   2. $1S^2\ \ 2S^2\ 2P^6\ \ 3S^2\ 3P^6\ 3d^6\ \ 4S^2$
   3. $1S^2\ \ 2S^2\ 2P^6\ \ 3S^2\ 3P^6\ 3d^5$
   4. $1S^2\ \ 2S^2\ 2P^6\ \ 3S^2\ 3P^6\ 3d^3\ \ 4S^2$
   5. $1S^2\ \ 2S^2\ 2P^6\ \ 3S^2\ 3P^6\ 3d^6$

4. Select the pair of atoms which forms a bond only by the linear overlapping of two p orbitals ?
   1. H and H 2. H and Cl 3. Cl and Cl
   4. O and O 5. N and N

5. When the following reaction is taking place

(a) (b)
$CH_2 = CH - CH_3 + H_2 \rightarrow CH_3CH_2CH_3$

(A) The hybridization of C^a changes sp^2 to sp^3
(B) The oxidation number of C^a changes -2 to -3.
(C) The oxidation number of C^b changes -2 to $+2$.

The true statements is / are,

1. A, B Only 2. A, C Only 3. A, B, C
4. Only B Only 5. A Only

6. Select the element, shows a positive electron gain energy.

1. Cl 2. Na 3. N 4. F 5. Al

7. Which is **not true** regarding the modern periodic table ?

1. Majority of the elements present in the periodic table are metals.
2. Among the elements of the P block, there exist the elements belong to three states of solid, liquid and gas.
3. The modern periodic table is prepared, based on the atomic number.
4. Nuclei of all the elements of the periodic table have protons and neutrons.
5. Within first 6 periods of the periodic table there are 11 elements which exist in gaseous state at the room temperature.

8. The number of resonance structures can be drawn for the ion HCO_3^- is,

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

- **Considering the following information's answer the questions number 9 and 10.**

A radiation having a frequency of 656nm causes to form the first line of Balmer series of the atomic spectrum of hydrogen.

h = 6.62×10^{-34} J C = $3 \times 10^8\ ms^{-1}$

9. Select the suitable energy levels of hydrogen atom to occur the relevant electron transition to form the above mentioned line.

1. n = 3 to n = 2 2. n = 2 to n = 1 3. n = 1 to n = 2
4. n = 2 to n = 3 5. n = 3 to n = 1

10. The energy of a photon of the above radiation with that wave length KJ is,

1. 3×10^{-30} 2. 3×10^{-13} 3. 3×10^{-9} 4. 3×10^{-28} 5. 3×10^{-12}

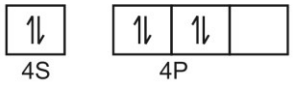
11. A compound which contains *C* and *H* only is known as a hydrocarbon. In a certain hydrocarbon the mass percentage of *H* is about 12%. The relative molecular mass of that compound is about 100. The accurate relative molecular mass of that hydrocarbon is,

1. 96 2. 98 3. 100 4. 94 5. 102

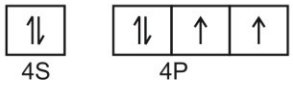
12. Which of the followings is not a property of cathode rays ?
    1. When an electric field is applied in the path of them, they attract to the positively charged plate.
    2. For the cathode rays obtained from the different gasses, e/m ratio is constant.
    3. It deflects towards the north pole at a magnetic field.
    4. They travel in a straight line.
    5. The nature of cathode rays does not depend on the gas inside the cathode ray tube or cathode material.

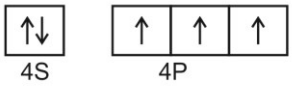
13. The maximum number of electrons possible in the sub energy level given by $l = 3$ is,
    1. 32 2. 6 3. 8 4. 18 5. 14

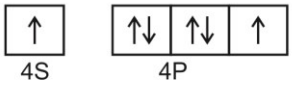
14. The atomic number of Se is 34. The correct orbital diagram of electrons which are present in the valence shells is,

(1) 

(2) 

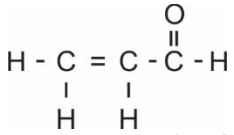
(3) 

(4) 

(5) 

15. Select the compound which has the highest electronegative C atom.
    1. $COCl_2$ 2. CH_3Cl 3. CH_3F
    4. CH_4 5. $H-\overset{\overset{O}{\|}}{C}-H$

16. The number of σ and π bonds present in the following molecule is,



    1. 7,2 2. 8,1 3. 8,2 4. 7,1 5. 5,4

17. The mass ratio of S and O in an oxide formed by S is 1:1. The molecular formula of that compound is,
    1. SO_3 2. SO 3. SO_4 4. S_2O_3 5. SO_2

18. The IUPAC name of $NaHPO_4$ is,
    1. Sodium Phosphate
    2. Sodium hydrogen Phosphate
    3. Sodium hydrogenphosphate
    4. Sodiam hydrogenphosphate
    5. Sodium Biphosphate

19. The variation of atomic radius, first ionization energy and electronegativity across a period left to right and down a group of the periodic table is correctly given by,

		Down the group	**Across a period left to right**
(1)	Atomic radius	increase	increase
(2)	First ionization energy	increase	decrease
(3)	Electronegativity	increase	increase
(4)	Atomic radius	increase	decrease
(5)	First ionization energy	decrease	normally increase

20. The successive ionization data, of 4 consecutive elements A, B, C and D are given below.

Element	**Successive ionization energy $kJmol^{-1}$**			
	I_1	I_2	I_3	I_4
A	2100	3950	6150	9300
B	490	4560	6950	9500
C	736	1450	7750	10500
D	575	1800	2740	11600

Select the groups of A, B, C and D in the periodic table.

1. $18\ ,\ 1\ ,\ 2\ ,\ 3$ 2. $18\ ,\ 1\ ,\ 2\ ,\ 13$ 3. $8\ ,\ 1\ ,\ 2\ ,\ 13$
4. $8\ ,\ 1\ ,\ 2\ ,\ 3$ 5. $1\ ,\ 2\ ,\ 13\ ,\ 14$

21. The solution P is prepared by dissolving $2.13\,g$ of $Al(NO_3)_3$ in $100\,cm^3$ of distilled water. $10\,cm^3$ of that solution is separated and diluted it up to $1\,dm^3$ to prepare the solution Y. The concentration of NO_3^- in the solution Y in ppm, $(Al = 27\ ,\ N = 14\ ,\ O = 16)$

1. 62 2. 18.6 3. 186 4. 184 5. 86

22. Which of the followings is given by the angular momentum quantum number of azimuthal quantum number,

1. Orientation of the orbital.
2. Spinning of electron in orbitals.
3. Shape of the orbital.
4. The number of sub shells.
5. The main energy level in which the electrons in the atoms are included.

23. Which is false regarding the species $N^{-3}\ ,\ O^{-2}\ ,\ F^-$ and Ne.

1. Nuclei of them have similar number of protons to the number of protons present in the nucleus of Ne.
2. Their radii vary as $N^{-3} > O^{-2} > F^- > Ne$.
3. They are iso electronic.
4. They have the same electron configuration.
5. Their nuclear charges vary as $N^{-3} < O^{-2} < F^- < Ne$

24. The processes shown by the following reactions are mentioned correctly in,

(A) $\mathbf{X(g) \rightarrow X^{+}(g) + e}$

(B) $\mathbf{Y(g) + e \rightarrow Y^{-}(g)}$

(C) $\mathbf{Z^{-}(g) \rightarrow Z(g) + e}$

	Electron gain energy	Electron affinity	First ionization energy
(1)	A	B	C
(2)	B	C	A
(3)	A	C	B
(4)	B	A	C
(5)	C	B	A

25. The concentration of a HCl solution with the density of $1.17\ gcm^{-3}$ and the mass percentage of 36.5% in $moldm^{-3}$,

1. 10.32 2. 11.7 3. 12.42 4. 11.54 5. 12.5

26. Select the molecule / ion which has Zero dipole moment.

1. CH_3Cl 2. HCl 3. SO_3^{2-} 4. XeF_4 5. PCl_5

27. When $25cm^3$ of $0.1\ moldm^{-3}$ $AgNO_3(aq)$ is mixed with 10 cm^3 of $0.25\ moldm^{-3}$ $KCl\ (aq)$ solution, $AgCl(s)$ precipitate is formed. The mass of the precipitate formed is,
$Ag = 108$, $Cl = 35.5$

The reaction ;

$AgNO_3\ (aq) + KCl\ (aq) \rightarrow AgCl\ (s) + KNO_3(aq)$

1. 362mg 2. 359 mg 3. 361 mg 4. 3.62g 5. 3.59 g

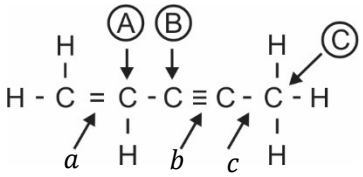
28. Consider the following nuclear reaction.

$^{9}_{4}Be + {}^{4}_{2}He \rightarrow {}^{12}_{6}C + X$

X is,

1. a β Particle 2. γ radiation 3. a neutron 4. a proton 5. an α Particle

By considering the given molecule below, answer the questions number 29 and 30.



29. The hybridizations of C atoms mentioned as A, B, C respectively,

1. sp , sp^3 , sp 2. sp^2 , sp , sp^2 3. sp^3 , sp , sp^2
4. sp^2 , sp , sp^3 5. sp^2 , sp^2 , sp^3

30. The correct order of increasing bond lengths mentioned as a, b, c is,

1. $a < b < c$ 2. $b < c < a$ 3. $b < a < c$
4. $a < c < b$ 5. $c < b < a$

- **For each of the questions 31 to 40 , one or more responses out of the four responses (a) , (b) , (c) and (d) given is /are correct. Select the correct response/responses in accordance with the instructions given on your answer sheet , mark**

(1) If only (a) and (b) are correct. (2) If only (b) and (c) are correct.
(3) If only (c) and (d) are correct. (4) If only (d) and (a) are correct.
(5) If any other number or combination of responses is correct.
Summary of above Instructions,

1	2	3	4	5
Only (a) and (b) are correct	**Only (b) and (c) are correct**	**Only (c) and (d) are correct**	**Only (a) and (d) are correct**	**Any other number or combination of responses is correct**

31. The mass of ^{12}C atom is,

a). $\frac{12}{6.022 \times 10^{23}}$ g b). 12 u c). $\frac{12}{6.022 \times 10^{23}} \times \frac{1}{12}$ g d). $\frac{6.022 \times 10^{23}}{12}$ g

32. Select the molecule / molecules which is/ are having non zero dipole moment ?

a). BCl_3 b) NH_3 c) SO_2 d) SF_6

33. Select the molecule / molecules which does not / do not obey to the octet rule.

a). $BeCl_2$ b) NO_2 c) CO_2 d) PCl_5

34. Select the ions / molecules with a similar number of unpaired electrons,

a). Ni^{2+} b) Fe^{3+} c) V d) Si

35. Select the molecules / ions which have the shape and the electron pair geometry which are similar to each other.

a) SO_4^{2-} b) CH_4 c) PCl_3 d) ICl_3

36. The main secondary interactions existing among the given molecules mention correctly in,

(a) $H_2O\ (l)$ – H bonds
(b) $Cl_2(g)$ and $H_2O\ (l)$ – H bonds dipole - induced dipole
(c) $HCl(g)$ – H bonds
(d) $Xe(g)$ – London forces

37. Consider the following reaction,

$MnO_4^- + 5Fe^{+2} + 8H^+ \rightarrow Mn^{+2} + 5\,Fe^{+3} + 4H_2O$

Which of the followings is / are the true regarding this reaction?

(a) The oxidation number of MnO_4^- reduces +6 to +2.

(b) The oxidation number of MnO_4^- reduces +7 to +2.

(c) Fe^{+2} Oxidizes to Fe^{+3}.

(d) MnO_4^- acts as the reducing agent.

38. The following 4 oxidation states are shown by N.

+5 , +3 , +1 , -3

The set / sets of examples as compounds / ions for showing the above oxidation states are mentioned correctly according to the given order of their oxidation states is / are,

(a) N_2O_5 , N_2O , N_2O_3 , NH_4^+

(b) NO_3^- , N_2O , NO_2 , NH_3

(c) N_2O_5 , N_2O_3 , N_2O , NH_4Cl

(d) NO_2F , NO_2^- , NO_2 , NH_3

39. Select the correct electron configuration / configurations among the following electron configurations.

(a) $[Ar]3d^{10}4s^1$ (b) $[Kr]5s^25p^2$ (c) $[Ar]3d^44s^2$ (d) $[Ne]3d^23p^6$

40. Which of the followings is / are true regarding the chemical bonds?

(a) The chemical bonds are formed by the atoms with incomplete octet to fulfill that deficiency.

(b) The covalent bonds are formed only by sharing a pair of electrons between two atoms of the same type of an element.

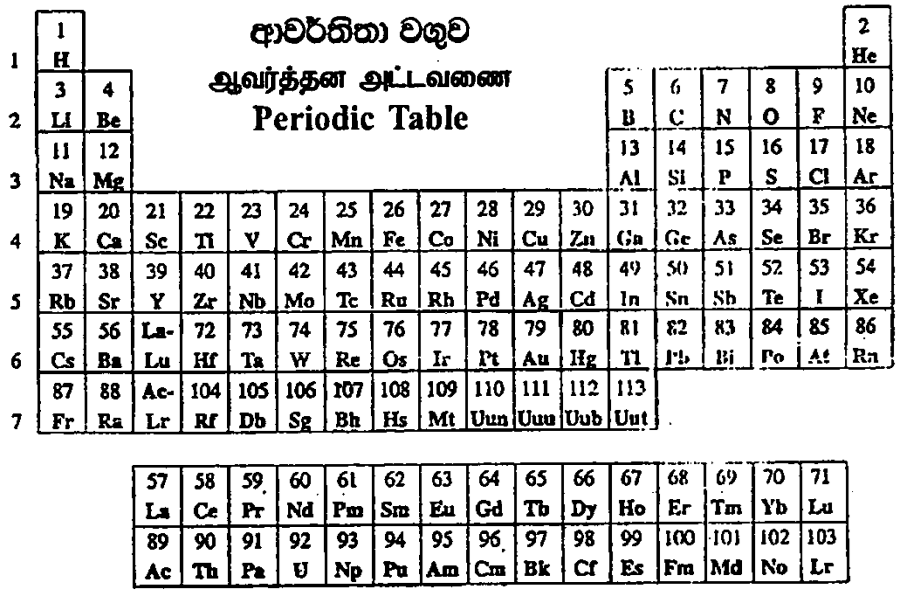
(c) In the formation of ionic bonds, the static electric attractions are formed between cations and anions.

(d) When the electron pair is provided by one atom to share between both atoms, then a dative covalent bond is formed.

- **In question numbers 41 to 50, two statements are given in respect of each question. From the table given below, select the response out of the responses (1), (2), (3), (4) and (5) that best fits the two statements and mark appropriately on your answer sheet.**

1st Statement	2nd Statement	Response
True	True and explains the 1st statement correctly	1
True	True but does not explain the first statement correctly	2
True	False	3
False	True	4
False	False	5

	First Statement	Second Statement
41.	He has the highest first ionization energy among the noble gases.	He has only $1s$ electrons.
42.	Isotopes of the same molecule have the same atomic numbers and different mass numbers.	The physical and chemical properties of isotopes are similar.
43.	Bond angles of $AlCl_3$ and NH_3 are similar each other.	Around Al and N three electron repulsion units are present in each of them.
44.	The radii of Cl^- ion and the Ar atom are similar each other.	Both Cl^- ion and Ar atom have the same electron configurations.
45.	CF_4 is a polar molecule.	The electronegativity of F is greater than C.
46.	The boiling point of I_2 takes a higher value than Br_2.	For the molecules with high molecular mass, in determining the physical properties. priority should be given to London dispersion forces.
47.	The ionic nature of the bond of K and Cl is lower than the ionic nature of the bond between Na and Cl.	The ionic or covalent nature is determine by the electronegativity difference of the 2 atoms of the bond in the molecule.
48.	The density of ice is lower than that of water.	At 0^0 C , there are four H bonds present around all the water molecules tetrahedrally.
49.	The elements of the same group of the periodic table have the similar physical and chemical properties.	The electron configurations of the elements belong to the same group are similar to each other.
50.	The strength of the metallic bond of Mg is higher than the metallic bond of Na.	The radius of Mg^{+2} is larger than the radius of Na^+ .



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Provincial Department of Education - NWP

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First Term Test - Grade 12 - 2019

Index No : ....

Chemistry II

Three Hours

- *A Periodic Table is provided*
- ***Use of calculators is not allowed.***
- *Universal gas constant,* $R = 8.314\ \text{J K}^{-1}\ \text{mol}^{-1}$
- *Avogadro constant,* $N_A = 6.022 \times 10^{23}\ \text{mol}^{-1}$

❑ PART A — Structured Essay

- *Answer **all** the questions on the question paper itself.*
- *Write your answer in the space provided for each question. Please note that the space provided is sufficient for the answer and that extensive answers are not expected.*

❑ PART B and PART C — Essay

- *Answer **four** questions selecting **two** questions from each part. Use the papers supplied for this purpose.*
- *At the end of the time allotted for this paper, tie the answers to the three Parts **A**, **B** and **C** together so that Part **A** is on top and hand them over to the Supervisor.*
- *You are permitted to remove* **only** *Parts **B** and **C** of the question paper from the Examination Hall.*

For Examiner's Use Only

Part	Question No.	Marks
A	1	
	2	
	3	
	4	
B	5	
	6	
	7	
C	8	
	9	
	10	
Total		
Percentage		

Final Mark

In Numbers	
In Letters	

Code Numbers

Examiner	
Checked by	1
	2
Supervised by	

Part - A – Structured Essay

(01) a). The following questions are related to the second period elements of the periodic table.
To answer the questions i to v write the symbol or the chemical formula of the element / compound.

i. The element, having the highest second ionization energy .....

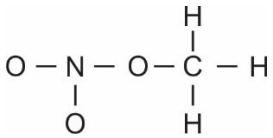
ii. The element / elements, showing a positive value for the electron gain energy .....

iii. The element which shows the highest boiling point .....

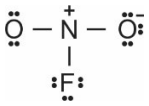
iv. The chemical formula of the compound, formed by the elements with the highest electronegativity and lowest electronegativity. .....

v. The element which forms electron deficient linear covalent compounds usually .....

a). i Draw the most acceptable Lewis dot - dash structure for (methyl nitrate). The skeletal structure is given below.



ii. The most stable Lewis dot - dash structure for the molecule NO_2F is given below. Draw another 2 Lewis dot dash structures (resonance structures). Mention the relative stability of them. Give reasons for the stability.



iii. By considering the Lewis dot dash structure given below, mention the followings in the given table.

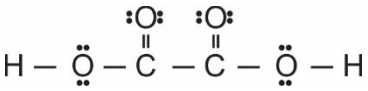
I. VSEPR pairs around the atom.

II. Electron pair geometry around the atom.

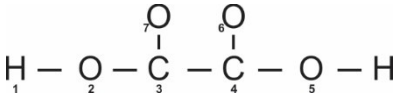
III. Shape around the atom.

IV. Hybridization of the atom.

V. Oxidation number



The atoms are numbered as follows,



Atom	O^2	C^3
I. VSEPR pairs around the atom.		
II. Electron pair geometry around the atom.		
III. Shape around the atom.		
IV. Hybridization of the atom.		
V. Oxidation number		

iv. Mention the atomic / hybrid orbitals which participate for the formation of the following σ bonds of the Lewis dot - dash structure given in the part (iii) above.

I. $H - O^2$ H ... ... O^2 ... ...

II. $O^2 - C^3$ O^2 ... ... C^3 ... ...

III. $C^3 - C^4$ C^3 ... ... C^4 ... ...

IV. $C^4 - O^6$ C^4 ... ... O^6 ... ...

v. Identify the atomic orbitals which participate for the formation of the following π bonds given in the Lewis dot - dash structure of the (iii) above.

I. $C^3 - O^7$ C^3 ... ... O^7 ... ...

II. $C^4 - O^6$ C^4 ... ... O^6 ... ...

c) Arrange the followings in to the increasing order of the properties given in the brackets. (Reason are not required)

(i) NH_3 , NH_2^- , NH_4^+ (Electronegativity of N atom)

.....

(ii) $NOCl$, NO_2^- , NO^+ ($N-O$ bond length)

.....

(iii) $MgCO_3$, $BeCO_3$, $CaCO_3$ (decomposition temperature)

.....

(02) a) i. Write the electron configuration of Cr with the atomic number of 24 and the number of unpaired electrons of Cr atom, exists in the ground state.

.....

.....

ii. Write the electron configuration of Cr.

.....

iii. Write the electron configurations of +3 and +6 cations formed by Cr.

.....

.....

iv. How many electrons present in the outer most shell of $+3$ ion of Cr.

.....

.....

v. Name an anion of Cr, having the oxidation state of $+6$. Write the IUPAC name of it.

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vi. Write IUPAC names of the following compounds.

$NaClO$ .....

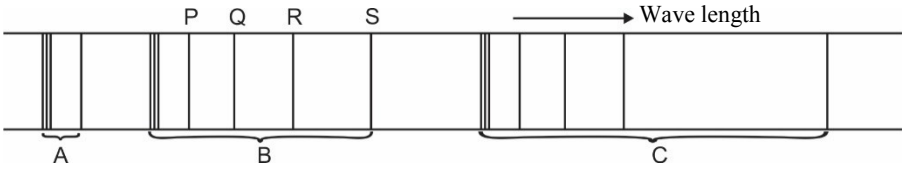
Fe_2S_3 .....

vii. Fill in the table regarding the primary and secondary into.

Type of interactions	

Substance	Primary interactions	Secondary interactions
i. liquid bromine.		
ii. Solid sodium.		
iii. Hydrogen Fluoride		
iv. Ice.		
v. Para nitrophenol		

b) The variation of the line spectrum of H with the wave length is given below.



i. Identify the series of lines A, B, and C. Mention the relevant regions of electromagnetic radiation in which each of the series belong.

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ii. Mention the values of n_f and n_i relevant to the line with the highest wave length of each series of lines.

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iii. Explain the reasons to exist each series of lines of the emission spectrum of H separately.

.....

.....

.....

iv. What are the colours of each lines P, Q, R, S of series B.

.....

.....

.....

c) Fill in the table considering the quantum number n, l, m_l which is used to describe the atomic orbitals.

Quantum number	n	l	m_l	Atomic orbital
I	.....	.....	+1	2P
II	4	2	-2	.....
III	.....	.....	.....	3S

i. Calculate the energy of a photon of red light, having the wave length of 700nm.

.....

.....

.....

ii. Calculate the energy supplied by a mole of photon of red light.

.....

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.....

(03) a) Write the half ionic reactions and hence the balanced chemical equations for the following reactions.

i. Reaction of $KMnO_4$ and $SO_2(g)$, Mn^{2+} and SO_4^{2-} ions are formed as main products.

.....

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.....

ii. Reaction of $KMnO_4$ and Fe in basic medium, Fe^{2+} and MnO_2 are formed as main products.

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b) i. A compound which is having the molecular formula of $MSO_4.xH_2O$ contains 36% of H_2O by mass. Calculate the value of x.

(M = 64 , S = 32 , O = 16 , H = 1)

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.....

ii. Calculate the mass of CuO required, to obtain $200kg$ of Cu , in Cu extraction using CuO.
(Cu = 63.5 , O = 16)

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(04) a) i. A compound which is having a molar mass of $248\,\text{gmol}^{-1}$ contains 18.5% of Na, 25.8% of S and 51.6 % of O and 4.0% of H by mass. Determine the molecular formula of that compound.
(Na = 23 , O = 16 , S = 32 , H = 1)

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ii. If all H atoms are present as water molecules only, write the chemical formula of the compound.

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iii. Calculate the composition of K_2SO_4 present in a solution which is prepared by dissolving $20mg$ of K_2SO_4 in $500g$ of water,

i) in ppt

ii) in ppm

.....

.....

.....

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.....

b) $20.00\ cm^3$ of standardized $0.01\ moldm^{-3}$ HNO_3 acid solution is required to react completely with $25.00\ cm^3$ of a $Ba(OH)_2$ solution with an unknown concentration.

i. Write the balanced chemical equation for the reaction between HNO_3 and $Ba(OH)_2$

.....

ii. Calculate the concentration of $Ba(OH)_2$ solution.

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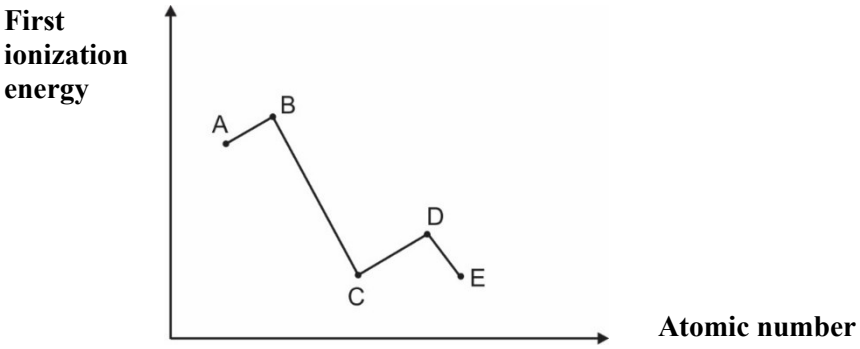
Chemistry - Grade 12
Part B - Essay

- **Answer two questions only**

(05) (a) A, B, C, D are E are 5 consecutive. elements of the periodic table. The variation of First ionization energies of them are represented below.



i. Which of the above elements shows the ns^2np^1 configuration?
ii. Explain the reasons to increase the first ionization energy of D than the first ionization energy of E.
iii. Sketch the variation of the second ionization energies of the elements A,B, C, D and E
iv. Mention the variation of the atomic radius of the above elements.
v. Write the chemical formula of the compound which is formed by combining the elements A and D together.

(b) Write the oxidation number of the underlined atom of the following species.
i. $K\underline{Mn}O_4$ ii. $H_2\underline{O_2}$ iii. $H\underline{Cl}O_3$ iv. $\underline{N}H_4^+$ v. $\underline{Cr_2}O_7^{2-}$

(c) 10.2 g of solid KNO_3 , which is contaminated with impurities heated strongly to obtained a constant mass of a residue. The mass of that residue was $8.92g$.
When $KNO_3\ (s)$ undergoes thermal decomposition, $KNO_2\ (s)$ and $O_2\ (g)$ are obtained as products. $(K = 39\ ,\ O = 16\ ,\ N = 14)$
(i) Write the balance equation for the thermal decomposition of $KNO_3\ (s)$.
(ii) Calculate the mass percentage of $KNO_3\ (s)$ in the above mixture.

(06) (a) A label of a commercial H_2SO_4 acid bottle is mentioned below.

$\left(\frac{w}{w}\right)\% = 49.0\%$
Density $= 1.2\ gcm^{-3}$
Molar mass $= 98\ gmol^{-1}$

i. Calculate the concentration of H_2SO_4 acid above in the unit of $moldm^{-3}$.
ii. $25cm^3$ of the above H_2SO_4 acid is added to a volumetric flask and diluted up to $250cm^3$. calculate the concentration of new H_2SO_4 solution prepared.
iii. Calculate the volume of H_2SO_4 acid solution prepared in part (ii) above required to react completely with 30 cm^3 $1moldm^{-3}$ $NaOH$ solution.
$H_2SO_4 + NaOH \rightarrow Na_2SO_4 + H_2O$

(b) $50cm^3$ of $0.25\ moldm^{-3}\ Ba(OH)_2$ solution and $25\ cm^3$ of $0.25\ moldm^{-3}\ H_2SO_4$ solution are mixed. $BaSO_4$ is precipitated here.

i. Write the balanced chemical equation for the above reaction.
ii. Calculate the mass of $BaSO_4$ formed.
iii. Calculate the unreacted Ba^{2+} ions in the solution.
($Ba = 137\ ,\ S = 32,\ O = 16,\ H = 1$)

(07) (a) Explain whether the following statements are true or false, by giving reasons.

i. $C - O$ bond length of $H\ CO_3^-$ is identical.
ii. Ionic properties of AgF, AgCl and AgI is varied as $AgF > AgCl > AgBr$
iii. The electronegativity of S atom of the species of $SO_3^{2-}, SO_4^{2-}, SO_2$ and SO_3 is varied as, $SO_3^{2-} < SO_4^{2-} < SO_2 < SO_3$
iv. $H\hat{O}H$ bond angle of H_2O is lower than $H\hat{S}H$ bond angle of H_2S.
v. The electron gain energy of F is lower than the electron gain energy of Cl.

(b) i. In a sample of chlorine gas, two isotopes were found as $^{35}_{17}Cl$ and $^{35}_{17}Cl$. If the average relative atomic mass of chlorine is 35.5, calculate the relative abundance percentages of each isotope.
ii. Draw an energy level diagram to show the formation of the lines of lyman series and paschen series of emission spectrum of hydrogen.
iii. Draw the line diagram of it to the direction of increasing frequency.

Part C

- **Answer two questions only.**

(08) (a)(i) Derive the shapes of the following species around the central atoms.

i. SCl_4 ii. XeF_2 iii. NO_2^-
iv. H_3^+O v. $KMnO_4$

(b)(i) Write the IUPAC names of the following compounds.

ii. N_2O_5 ii. FeC_2O_4 iii. $NaClO_4$
iv. H_2SO_3 v. Fe_2S_3

(c) Balance following nuclear reactions.

(i) $^{226}_{88}Ra \rightarrow \ ^{\square}_{\square}X\ + \ ^{222}_{86}Ra$

(ii) $^{9}_{4}Be + \ ^{\square}_{2}He \rightarrow \ ^{1}_{\square}n\ + \ ^{12}_{6}C$

(09) (a) (I) i. In a certain compound, 24.27% of C and 4.07% of H are present by mass and the rest is Cl. Determine the empirical formula of this compound.
(C = 12 , H = 1 , Cl = 35.5)

ii. If the molar mass of that compound is $99g\ mol^{-1}$ determine the molecular formula of it.

(II) i. The atomic number of Cu is 29. write the electron configuration of it as $1S^2\ 2S^2$ ... ...

ii. How many unpaired electrons are present in Cu^{2+} ion , formed by Cu.

iii. Write the set of quantum numbers relevant to the last electron of Cu .

(b) (I) i. Calculate the frequency of a radiation having wave length of 305nm.
(C = $3x10^8 ms^{-1}$, h = 6.624 x 10^{-34} JS)

ii Calculate the energy of one moles of photon of the above radiation.

(II) Consider the following reaction takes place in acidic radium.

$$H^+ + MnO_4^- + C_2O_4^{2-} \rightarrow Mn^{2+} + CO_2 + H_2O$$

i Write the oxidation and reduction half reactions of the above reaction.

ii Write the balance chemical equation for the above reaction.

(10) (a) i. Describe that how to prepare $250cm^3$ of $1.5\ moldm^{-3}\ HCl$ solution by mixing $3\ moldm^{-3}\ HCl$ and $1\ moldm^{-3}\ HCl$ solutions.

ii. $0.5\ mol\ of\ NaCl$ is dissolved in $90g$ of H_2O. Calculate the mole fractions of $NaCl$ and H_2O .

iii. Calculate the composition of $NaCl$ in the solution in ppm unit.

(b) i. Contrast the differences of a σ bond and a π bond considering 3 facts.

ii Write three information's each that can be obtained directly and cannot be obtained directly by a Lewis structure.

iii. Write separately the number of repletion units (VSEPR pairs) and lone pairs of electrons present around C atom mentioned as $*$ in the following molecule / ion. Mention the hybridization of those C atoms.

(i) $CH_3\overset{*}{C}OCl$ (ii) $S\overset{*}{C}N^-$

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ஆவர்த்தன அட்டவணை
Periodic Table

1	1 H																2 He
2	3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
3	11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
4	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
5	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
6	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
7	87 Fr	88 Ra	Ac-Lr	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Uun	111 Uuu	112 Uub	113 Uut					

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

(1) – 2	(11) – 2	(21) – 3	(31) 1	(41) – 2
(2) – 5	(12) – 3	(22) – 3	(32) – 2	(42) – 3
(3) – 5	(13) – 5	(23) – 1	(33) – 4	(43) – 1
(4) – 3	(14) – 3	(24) – 2	(34) – 4	(44) – 4
(5) – 1	(15) – 4	(25) – 4	(35) – 1	(45) – 4
(6) – 3	(16) – 1	(26) – 5	(36) – 5	(46) – 1
(7) – 4	(17) – 5	(27) – 2	(37) – 2	(47) – 1
(8) – 3	(18) – 2	(28) – 3	(38) – 3	(48) – 2
(9) – 1	(19) – 5	(29) – 4	(39) – 4	(49) – 5
(10) – 5	(20) – 2	(30) – 3	(40) – 3	(50) – 3

Part - A – Structured Essay

(01) a). The following questions are related to the second period elements of the periodic table.
To answer the questions i to v write the symbol or the chemical formula of the element / compound.

i. The element, having the highest second ionization energy ..... Li .....

ii. The element / elements, showing a positive value for the electron gain energy ..... Be , N .....

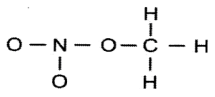
iii. The element which shows the highest boiling point .....C.....

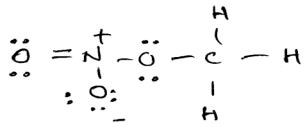
iv. The chemical formula of the compound, formed by the elements with the highest electronegativity and lowest electronegativity. ..... LiF .....

v. The element which forms electron deficient linear covalent compounds usually ..... Be .....

5 × 5 marks = 25

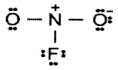
a). i Draw the most acceptable Lewis dot - dash structure for (methyl nitrate). The skeletal structure is given below.

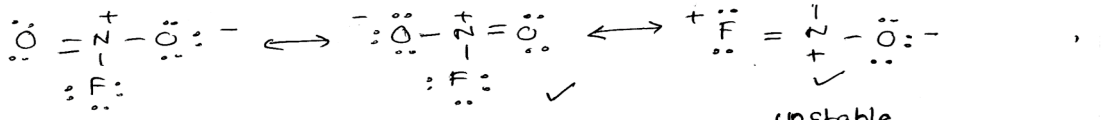




10 marks

ii. The most stable Lewis dot - dash structure for the molecule NO_2F is given below. Draw another 2 Lewis dot dash structures (resonance structures). Mention the relative stability of them. Give reasons for the stability.





Lewis dot-dash structure

stable ✓
✓ different charges on closest atoms.
✓ -ve charge on more electronegative 2 Oxygen.

unstable.
✓ Similar charges on closest atoms
✓ (+)ve charge on more electronegative F
✓ charge distribution is high

For the structures 5 × 2 = 10 marks
stability / unstability 3 × 2 = 06 marks
reasons 1 × 5 = 05 marks.

iii. By considering the Lewis dot dash structure given below, mention the followings in the given table.

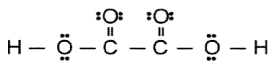
I. VSEPR pairs around the atom.

II. Electron pair geometry around the atom.

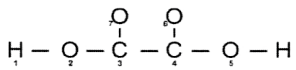
III. Shape around the atom.

IV. Hybridization of the atom.

V. Oxidation number



The atoms are numbered as follows,



Atom	O^2	C^3
I. VSEPR pairs around the atom.	4	3
II. Electron pair geometry around the atom.	tetrahedral	triangular planer
III. Shape around the atom.	angular	triangular planer
IV. Hybridization of the atom.	sp^3	sp^2
V. Oxidation number	-2	+3

10 x 1 marks = 10

iv. Mention the atomic / hybrid orbitals which participate for the formation of the following σ bonds of the Lewis dot - dash structure given in the part (iii) above.

I. $H - O^2$ H ... 1s at.orb ... O^2 ... sp^3 h.o ...

II. $O^2 - C^3$ O^2 ... sp^3 h.o ... C^3 ... sp^2 h.o ...

III. $C^3 - C^4$ C^3 ... sp^2 h.o ... C^4 ... sp^2 h.o ...

IV. $C^4 - O^6$ C^4 ... sp^2 h.o ... O^6 ... $2p / 2p^3$ h.o. a.o ...

8 x 1 marks = 8

v. Identify the atomic orbitals which participate for the formation of the following π bonds given in the Lewis dot - dash structure of the (iii) above.

I. $C^3 - O^7$ C^3 ... 2p ... O^7 ... 2p ...

II. $C^4 - O^6$ C^4 ... 2p ... O^6 ... 2p ...

4 x 2 marks = 8

c) Arrange the followings in to the increasing order of the properties given in the brackets. (Reason are not required)

(i) NH_3 , NH_2^- , NH_4^+ (Electronegativity of N atom)

$NH_2^- < NH_3 < NH_4^+$

(ii) $NOCl$, NO_2^- , NO^+ ($N - O$ bond length)

$NO^+ < NOCl < NO_2^-$

(iii) $MgCO_3$, $BeCO_3$, $CaCO_3$ (decomposition temperature)

$BeCO_3 < MgCO_3 < CaCO_3$

3 x 6marks = 18

(02) a) i. Write the electron configuration of Cr with the atomic number of 24 and the number of unpaired electrons of Cr atom, exists in the ground state.

$1s^2\ 2s^2 2p^6 3s^2 3p^6 3d^5 4s^1$

no. of unpaired electrons = 6

ii. Write the electron configuration of Cr.

$[Ar] 3d^5 4s^1$

iii. Write the electron configurations of +3 and +6 cations formed by Cr.

Cr^{3+} = $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^3$

Cr^{6+} = $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$

iv. How many electrons present in the outer most shell of +3 ion of Cr.

11

v. Name an anion of Cr, having the oxidation state of +6. Write the IUPAC name of it.

CrO_4^{2-} chromate ,

OR $Cr_2O_7^{2-}$ dichromate .

vi. Write IUPAC names of the following compounds.

$NaClO$ Sodium hypo chlorite

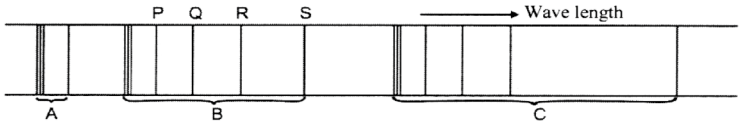
Fe_2S_3 Iron (III) Sulphide .

6 x 4marks = 24

vii. Fill in the table regarding the primary and secondary into.

Type of interactions / Substance	Primary interactions	Secondary interactions
i. liquid bromine.	pure covalent.	London forces.
ii. Solid sodium.	—	metallic bonds.
iii. Hydrogen Fluoride	polar covalent	London forces, H bonds.
iv. Ice.	polar covalent	London forces
v. Para nitrophenol	polar covalent	H bonds, London forces.

b) The variation of the line spectrum of H with the wave length is given below. 10 x 2marks = 20



i. Identify the series of lines A, B, and C. Mention the relevant regions of electromagnetic radiation in which each of the series belong.

A - lyman series - ultraviolet region.

B - Balmer series. - visible region.

C - paschen series. - infra red region

6 x 2marks = 12

ii. Mention the values of n_f and n_i relevant to the line with the highest wave length of each series of lines.

	n_f	n_i
A series	1	2
B	2	3
C	3	4

6 x 2 marks = 12

iii. Explain the reasons to exist each series of lines of the emission spectrum of H separately.

Energy difference among the energy levels of one series of lines is considerably different from the energy difference among the energy levels of another series of lines.

02 marks.

iv. What are the colours of each lines P, Q, R, S of series B.

P – Purple. R – blue green
Q – blue. S – red

04 marks.

c) Fill in the table considering the quantum number n, l, m_l which is used to describe the atomic orbitals.

Quantum number	n	l	m_l	Atomic orbital
I	2	1	+1	2P
II	4	2	-2	4d
III	3	0	0	3S

6 × 1 marks = 6

i. Calculate the energy of a photon of red light, having the wave length of 700nm.

$E = \frac{hc}{\lambda} = \frac{6.626 \times 10^{-34}\ Js \times 3 \times 10^{8}\ ms^{-1}}{700 \times 10^{-9}\ m}$ ✓

$= 2.84 \times 10^{-19}\ J$. ✓

3 × 4 marks = 12

ii. Calculate the energy supplied by a mole of photon of red light.

$E \times 6.022 \times 10^{23}\ J mol^{-1}$

$= 2.84 \times 10^{-19} \times 6.022 \times 10^{23}\ J mol^{-1}$ ✓

$= 17.1 \times 10^{4}\ J mol^{-1}$ ✓

2 × 4 marks = 8.

(03) a) Write the half ionic reactions and hence the balanced chemical equations for the following reactions.

i. Reaction of $KMnO_4$ and $SO_2(g)$, Mn^{2+} and SO_4^{2-} ions are formed as main products.

$MnO_4^- + 5e + 8H^+ \rightarrow Mn^{2+} + 4H_2O$ —①

$SO_2 + 2H_2O \rightarrow SO_4^{2-} + 2e + 4H^+$ —②

$2KMnO_4 + 5SO_2 + 2H_2O \rightarrow 2MnSO_4 + K_2SO_4 + 2H_2SO_4$

3 × 10 marks = 30

ii. Reaction of $KMnO_4$ and Fe in basic medium, Fe^{2+} and MnO_2 are formed as main products.

$MnO_4^- + 3e + 2H_2O \longrightarrow MnO_2 + 4OH^-$ —①

$Fe \rightarrow Fe^{2+} + 2e$ —②

$2KMnO_4 + 3Fe + 4H_2O \longrightarrow 2MnO_2 + 3Fe(OH)_2 + 2KOH$

3 × 10 marks = 30

b) i. A compound which is having the molecular formula of $MSO_4.xH_2O$ contains 36% of H_2O by mass. Calculate the value of x.

(M = 64, S = 32, O = 16, H = 1)

r.m.m $= 160 + 18x$ ✓

$\frac{18x}{(160+18x)} = \frac{36}{100}$ ✓

$1800x = 36(160 + 18x)$

$1152x = 5760$ ✓

$x = 5$ ✓

(4 × 5 marks = 20)

ii. Calculate the mass of CuO required, to obtain $200kg$ of Cu, in Cu extraction using CuO.

(Cu = 63.5, O = 16)

molar mass of CuO $= 63.5 + 16 = 79.5\ g mol^{-1}$ ✓

percentage of Cu $= \frac{63.5}{79.5} \times 100 = 79.9\%$ ✓

CuO mass required $= \frac{100}{79.9} \times 200$ ✓

$= 250.3\ kg$ // ✓ 4 × 5 marks = 20

(04) a) i. A compound which is having a molar mass of $248\,gmol^{-1}$ contains 18.5% of Na, 25.8% of S and 51.6 % of O and 4.0% of *H* by mass. Determine the molecular formula of that compound.

(Na = 23 , O = 16 , S = 32 , H = 1)

	Na	S	O	H	
mass	18.5	25.8	1.7	4	✓
molar ratio	$\frac{18.5}{23}$	$\frac{25.8}{32}$	$\frac{1.7}{16}$	$\frac{4}{1}$	✓
	0.80	0.80	3.23	4	✓
Simple molar ratio	$\frac{0.80}{0.80}$	$\frac{0.80}{0.80}$	$\frac{3.23}{0.80}$	$\frac{4}{0.80}$	✓
	1	1	4.0	5	✓

Empirical formula = $NaSO_4H_5$ ✓

mass of molecular formula = (mass of empirical formula)n ✓

$248 = 124 \times n$ ✓

$n = 2$

molecular formula = $Na_2S_2O_8H_{10}$ ✓

ii. If all *H* atoms are present as water molecules only, write the chemical formula of the compound.

$Na_2S_2O_3 . 5H_2O$ ✓

10 × 4 marks = 40

iii. Calculate the composition of K_2SO_4 present in a solution which is prepared by dissolving $20mg$ of K_2SO_4 in $500g$ of water,

i) in ppt

ii) in ppm

mass fraction $= \frac{20 \times 10^{-3} g}{500.02 g}$

composition in ppt $= \frac{0.02 g \times 10^3}{500.02 g}$ ✓ $= 0.039$ ppt ✓

in ppm $= \frac{0.02 g \times 10^6}{500.02 g}$ ✓ $= 39.9$ ppm ✓

4 × 5 marks = 20

b) $20.00\,cm^3$ of standardized $0.01\,moldm^{-3}$ HNO_3 acid solution is required to react completely with $25.00\,cm^3$ of a $Ba(OH)_2$ solution with an unknown concentration.

i. Write the balanced chemical equation for the reaction between HNO_3 and $Ba(OH)_2$

$2HNO_3(aq) + Ba(OH)_2(aq) \longrightarrow Ba(NO_3)_2(aq) + 2H_2O(l)$ ✓

ii. Calculate the concentration of $Ba(OH)_2$ solution.

$HNO_3 : Ba(OH)_2 = 2 : 1$

no. of moles of HNO_3 required $= \frac{0.01\ moldm^{-3} \times 20\ dm^3}{1000}$ ✓

$= 0.0002$ mol

$Ba(OH)_2$ moles in $25.00cm^3 = \frac{0.0002\ mol}{2}$ ✓

$= \frac{0.0001}{25} \times 1000\ moldm^{-3}$ ✓

$= 0.004\ moldm^{-3}$ ✓

5 × 8 marks = 40

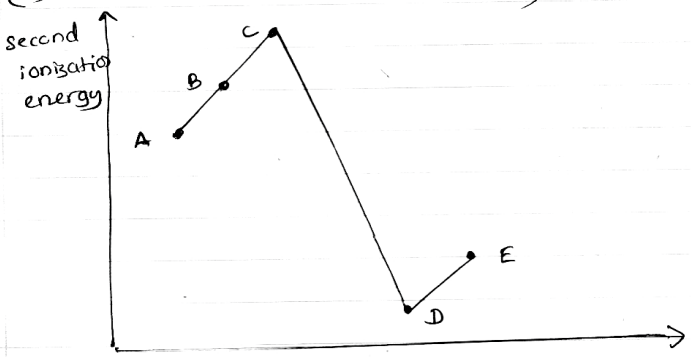
Essay. – Answers

(5) (a) (i). E ✓ [05 marks]

(ii) The general configuration of D is ns^2 and ✓
it is a stable configuration. ✓
The general configuration of E is $ns^2 2p^1$ and ✓
it is an unstable configuration ✓
∴ The removal of an electron from the D having a ~~not~~ stable configuration is difficult relative to E. ✓
∴ The first ionization energy of D is greater than that of E ✓

[04 × 6 = 24 marks]

(iii)



(2 × 5) + (1 × 2) = 12 marks

(iv) Atomic radius, C > D > E > A > B [05 marks]

(v) DA_2 [04 marks]

(b). (i) $K\underset{+7}{Mn}O_4$ (ii) $\underset{-1}{H_2O_2}$ (iii) $\underset{+5}{HClO_3}$

(iv) $\underset{-3}{NH_4^+}$ (v) $\underset{+6}{Cr_2O_7^{2-}}$

(10 × 5) [50 marks]

(01) (c)

(c) (i) $2KNO_3(s) \xrightarrow{\Delta} 2KNO_2(s) + O_2(g)$ (06 marks)

(ii) O_2 mass evolved = (10.2 − 8.92) g
= 1.28 g ✓

O_2 moles evolved = $\frac{1.28\,g}{32\,g\,mol^{-1}}$ ✓ = 0.04 mol ✓

Stoichiometry of $O_2 : KNO_3$ = 1 : 2

moles of KNO_3 in the sample = 2 × 0.04 mol
= 0.08 mol

KNO_3 mass in the sample = 0.08 mol × 101 g mol^{-1}
= 8.08 g

mass percentage of KNO_3 = $\frac{8.08\,g}{10.2\,g} \times 100\%$

= 79.2 %

(04 × 11 = 44 marks)

(a) (i) mass of $1cm^3$ of the solution = 1.2g.

mass of in $1000cm^3$ of the solution = $1.2g \times 1000$

= 1200g ✓

mass of H_2SO_4 in $1dm^3$ of the solution = $1200g \times \frac{49}{100}$

moles of H_2SO_4 in $1dm^3$ of the solution = $\frac{1200g \times 49}{98\ g\ mol^{-1} \times 100}$ ✓

= 0.6 mol

∴ the concentration of H_2SO_4 = 6 $mol\ dm^{-3}$ ✓

5 × 5 = 25 marks

(ii) H_2SO_4 moles in $25cm^3$ of H_2SO_4 acid = $\frac{6}{1000} \times 25$ ✓

$= 1.5 \times 10^{-1}$ mol

H_2SO_4 moles in $250cm^3$ of H_2SO_4 solution = 1.5×10^{-1} mol ✓

∴ The concentration of the new H_2SO_4 solution = $\frac{1.5 \times 10^{-1} \times 1000}{250}$ ✓

= 0.6 mol dm^{-3} ✓

5 × 4 = 20 marks

(iii) $H_2SO_4 + 2NaOH \longrightarrow Na_2SO_4 + 2H_2O$ ✓

H_2SO_4 : NaOH

1 : 2 ✓

number of moles of NaOH = $\frac{1}{1000} \times 30$ ✓

= 0.03 mol. ✓

∴ H_2SO_4 moles consumed = $0.03 \times \frac{1}{2}$ ✓

= 0.015 mol ✓

The volume of H_2SO_4 consumed = $\frac{0.015 \times 1000cm^3}{0.6}$ ✓

$= 25cm^3$ ✓

5 × 8 = 40 marks.

(b) (i) $Ba(OH)_2 + H_2SO_4 \longrightarrow BaSO_4 + 2H_2O$ ✓

(ii) $Ba(OH)_2$ moles added $= \frac{0.25}{1000} \times 50$ ✓

$= 0.0125$ mol ✓

H_2SO_4 moles added $= \frac{0.25}{1000} \times 25$

$= 0.00625$ mol ✓

	$Ba(OH)_2$	$+ H_2SO_4$	$\longrightarrow BaSO_4$	$+ 2H_2O$
Initial moles	12.5×10^{-3}	6.25×10^{-3}		
reacted moles	6.25×10^{-3}	6.25×10^{-3} ✓		
unreacted moles	6.25×10^{-3} ✓		6.25×10^{-3}	

$\therefore$ $BaSO_4$ moles formed $= 6.25 \times 10^{-3}$ mol ✓

$BaSO_4$ mass formed $= 6.25 \times 10^{-3}$ mol $\times$ 233 g mol^{-1}

$= 1.45$ g. ✓

(iii) unreacted $Ba(OH)_2$ moles in the solution $= 6.25 \times 10^{-3}$ mol

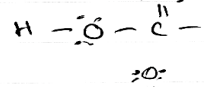
unreacted Ba^{2+} moles in the solution $= 6.25 \times 10^{-3}$ mol ✓

concentration of unreacted Ba^{2+} in the solution $= \frac{6.25 \times 10^{-3} \text{ mol}}{75}$ ✓

$= 0.083$ mol dm^{-3} ✓

(5 × 13 = 65 marks)

07) (a) (i) Lewis structure :

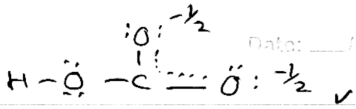


✓

resonance structures :

✓

resonance hybrid



✓

HCO_3^- exists as a hybrid as above ✓

C–O bond length of C–O bonded to H is different to the other C–O bond lengths ✓ (increasing)

$\therefore$ C–O bond lengths in HCO_3^- are not identical. ✓

$\therefore$ Statement is false ✓

(2 × 7 = 14 marks)

(ii) AgF AgCl AgI

common cation Ag^+ ✓

∴ polarizing power is constant. ✓

in anions, charge is the same ✓

radii vary as $F^- < Cl^- < I^-$ ✓

∴ polarizability $F^- < Cl^- < I^-$ ✓

∴ covalent character $AgF < AgCl < AgI$

ionic properties $AgF > AgCl > AgI$ ✓

∴ statement is true ✓

(2 × 7 = 14 marks)

Optional answer

common element is Ag ✓ (3)

electronegativity vary as $F > Cl > I$ (3)

'elec n difference $AgF > AgCl > AgI$ (3)

ionic properties $AgF > AgCl > AgI$ (5)

∴ Statement → True ✓ (2)

(iii)

	SO_3^{2-}	SO_4^{2-}	SO_2	SO_3
hybr:	sp^3	sp^3	sp^2	sp^2 ✓
charge on atoms	0	0	0	0
oxid. num. on central atom	+4	+6	+4	+6 ✓

When S character ↑ electronegativity ↑ ✓

positive nature ↑ in oxidation number of the central atom then electronegativity ↑ ✓

∴ electronegativity $SO_3^{2-} < SO_4^{2-} < SO_2 < SO_3$ ✓

Statement → true ✓

(2 × 7 = 14 marks)

(iv)

both H_2O & H_2S are angular ✓

Electronegativity of O > Electronegativity of S ✓

bond electrons of O–H more close to the central atom than the bond p'ns of S–H. ✓

∴ repulsions of O–H in H_2O > repulsions of S–H in H_2S ✓

∴ $H\hat{O}H$ bond angle > $H\hat{S}H$ bond angle. ✓

∴ Statement → false.

(2×7 = 14 marks)

(v) Both F, Cl release energy when gaining an electron ✓

If the atomic radius ↓ ∴ then the attraction to the nucleus is ↑. ✓

Therefore the amount of energy releasing of F

Should be greater than Cl. ✓

But in F, radius is too small

also added electron feels a small repulsion

∴ The energy releasing in F when gaining ✓ an electron is less than that of Cl ✓

∴ Electron gaining energy of F is smaller than that of Cl

∴ Statement is true.

(b) (i) if relative abundance of one isotope of Cl ($^{35}_{17}Cl$) is x,

$$35.5 \checkmark = 35 \times \frac{x}{100} \checkmark + 37 \times \frac{(100-x)}{100} \checkmark$$

$$3550 = 35x + 3700 - 37x$$

$$2x = 150$$

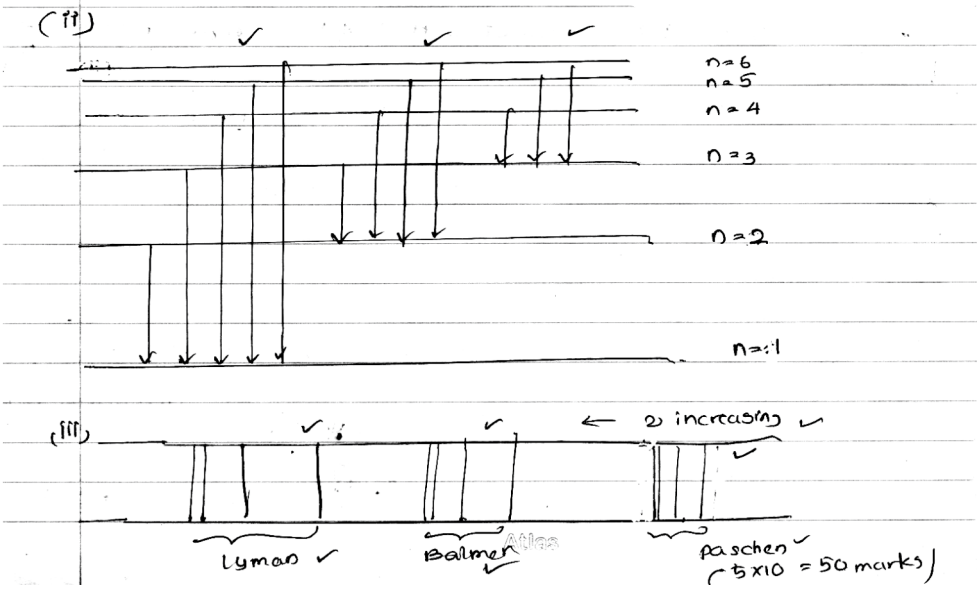
$$x = 75 \checkmark$$

relative abundance of $^{35}_{17}Cl$ = 75%

" " of $^{37}_{17}Cl$ = 25%

(5×6 = 30 marks)

(ii)



(5 x 10 = 50 marks)

(8) (a) (i) SCl_4.

electron pairs around central atom } = 5 ✓

VSEPR pairs = 5 ✓

σ bonds = 4

lone pairs = 1 ✓

∴ shape is see-saw ✓

(ii) XeF_2

electron pairs around central atom = 5

VSEPR pairs = 5.

σ bonds = 2

l.p. = 3

∴ shape is linear

(ii) NO_2^-

electron pairs around cen. atom = 4

VSEPR pairs. = 3

σ bonds = 2

l.p. = 1

∴ shape is angular. =

(v) H_2SO_3

elect. p. around con atom = 5

VSEPR pairs = 4

σ bonds = 3

l.p. = 1

shape → pyramidal

(vi) $KMnO_4$

e'n p. an. cent at. = 7

VSEPR pa. = 4

σ bonds = 4

l.p. = 0

shape → tetrahedral

12×5 = 60marks

(i) N_2O_5 - dinitrogen pentoxide

(ii) FeC_2O_4 - iron (II) oxalate.

(iii) $NaClO_4$ - Sodium perchorate.

(iv) H_2SO_3 - Sulfurous acid.

(v) Fe_2S_3 - iron (III) Sulfide.

(10 ×5)
50marks

(ii) (i)

(ii) $^{4}_{2}He$, $^{1}_{0}n$ (10×4) 40 marks

09. (a) I)(i)

	C	:	H	:	Cl
mass ratio	24.27	:	4.07	:	71.66 ✓
mole ratio	$\frac{24.27}{12}$	:	$\frac{4.07}{1}$	:	$\frac{71.66}{35.5}$ ✓
	2.02	:	4.07	:	2.01 ✓
Simplest mole ratio	$\frac{2.02}{2.01}$	:	$\frac{4.07}{2.01}$	:	$\frac{2.01}{2.01}$ ✓
	1.0	:	2.02	:	1
	1	:	2	:	1 ✓

1 : 2 : 1 ✓

Empirical formula C_1H_2Cl ✓

(ii).

$$n = \frac{99}{(12+2+35.5)} \checkmark$$

$$n = \frac{99}{49.5} \checkmark$$

$$n = 2 \checkmark$$

molecular formula $C_2H_4Cl_2$ ✓

60 marks

(II) (i) $_{29}Cu - 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}\ 4s^1$ ✓

(ii) $Cu^{2+} - 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^9\ 4s^0$

Degree @ $e = 1$ ✓

(iii) $(4, 0, 0, +\frac{1}{2})$ ✓

(10×3)

30 marks

(b)(I) (i). $C = \nu\lambda$

$3\times10^8\ ms^{-1} = \nu \times 305\times10^{-9}\ m$ ✓

$$\nu = \frac{3\times10^8\ ms^{-1}}{305\times10^{-9}\ m}$$

$\nu = 9.8\times10^{14}\ s^{-1}$ ✓ (6×2)

12marks

(ii). Energy of a mole of photon;

$E = h\nu$

$E = 6.624\times10^{-34}\ Js \times 9.8\times10^{14}\ s^{-1} \times 6.022\times10^{23}$ ✓

$E = 390.9\times10^3\ J.$

$E = 390.9\ KJ$ ✓ (6×2)

12marks

(II) (i). oxidation half reaction;

$C_2O_4^{2-} \longrightarrow 2CO_2 + 2e.$ ✓

reduction half reaction;

$8H^+ + 5e + MnO_4^- \longrightarrow Mn^{2+} + 4H_2O.$ ✓

(ii) $5C_2O_4^{2-} + 16H^+ + 2MnO_4^- \rightarrow 2Mn^{2+} + 10CO_2 + 8H_2O.$ ✓

(12×3)

36 marks

10. (a) (i)

$3\ mol\ dm^{-3}$ HCl	$1\ mol\ dm^{-3}$ HCl	
$V\ cm^3$	$(250-V)\ cm^3$	

$$\frac{3}{1000} \times V + \frac{1}{1000}(250-V) = \frac{1.5}{1000} \times 250 \quad (5\times3)$$

15 marks

$$3V + 250 - V = 375$$

$$2V = 125$$

$$V = 62.5\ cm^3$$

10 marks

When $62.5\ cm^3$ of $3\ mol\ dm^{-3}$ HCl and $187.5\ cm^3$ of $1\ mol\ dm^{-3}$ HCl are mixing together inside a beaker, $250\ cm^3$ of $1.5\ mol\ dm^{-3}$ HCl is obtained.

5 marks

II (i) moles of H_2O $= \frac{90}{18\ g\ mol^{-1}}$

$= 5\ mol$

mole fraction of NaCl $= \frac{0.5}{5+0.5}$

$= \frac{5}{55}$

$= \frac{1}{11}$

mole fraction of H_2O $= \frac{5}{5.5}$

$= \frac{10}{11}$

(ii) composition of NaCl $= \frac{1}{11} \times 10^6$

$= 90909.09\ ppm$

(b) (i) (5×8)

40 marks

σ bond	π bond
* Energy is high	* energy is low
* orbitals linearly overlap	* orbitals laterally overlap
* Overlapping is occurred between the unhybridised orbitals and between the hybridised orbitals	* Overlapping is occurred between unhybridised orbitals

(5×6)

30 marks

Informations

(ii) can gain directly :-

* charge on atom.
* distribution of valence e'ns (b.ps l.e.p.)
* atoms in the compounds

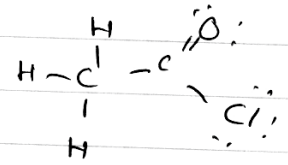
(5 × 3 = 15 marks)

Information gained indirectly :-

* Shape around central atom
* hybridization
* Oxidation number
* e'n pair geometry
* bond angles.

(5 × 3 = 15 marks)

(i)



around C

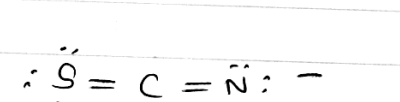
repulsion units = 3 ✓

l.p. = 0 ✓

hybr. sp^2

(04)

(ii)



around C

repulsion u. = 2

l.p. = 0 ✓

hybr. = sp

(04)

(02 × 6 = 12)

20 marks.