SECTION A [50 MARKS]

ANSWER **ALL** QUESTIONS

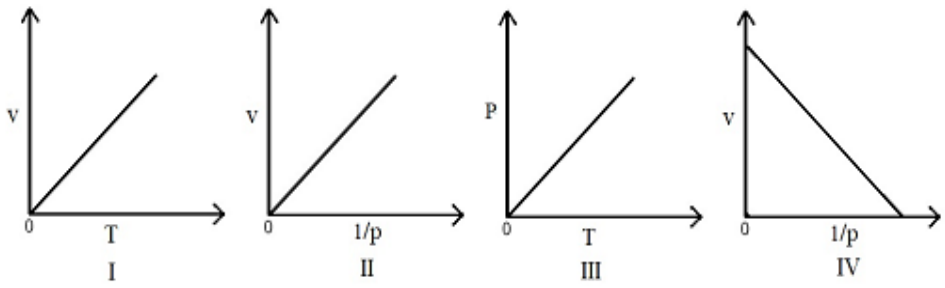
Question 1

a. Direction: For each question, there are four alternatives A, B, C and D. Choose the correct alternative and circle it. Do not circle more than ONE alternative. If there are more than ONE circled, NO score will be awarded. **[25]**

i. Standard Temperature and Pressure (STP) values are most often used for gases as their characteristics change dramatically with temperature and pressure. Which of the following set has the correct values of STP?

A 0 Kelvin and 1 atmosphere
B 273 Kelvin and 0 atmosphere
C 273 Kelvin and 760 atmospheres
D 273 Kelvin and 1 atmosphere

ii. Which one of the following graphs correctly represents Boyle's Law?



A I
B II
C III
D IV

iii. The percentage composition of oxygen in $CaSO_4$ is

A 47.05%.
B 11.76%.
C 16%.
D 18.18%.

iv. Tshering has a balloon which contains 5.22 moles of helium. How many grams of helium are present in the balloon?

A 20g
B 10g
C 21g
D 4g

v. A compound has an empirical formula of C_2H_4O with a molar mass of 132g. What is the molecular formula of the compound?

A $C_4H_4O_5$
B C_2H_4
C $C_{10}H_{12}$
D $C_6H_{12}O_3$

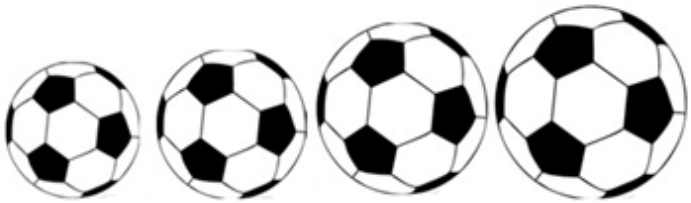
vi. The molar volume of an ideal gas at STP is

A 2100 cm^3.
B 2200 cm^3.
C 2300 cm^3.
D 22400 cm^3.

vii. When an aqueous solution of $NaCl$ is electrolysed, the gas evolved at cathode is

A hydrogen.
B chlorine.
C oxygen.
D hydrogen peroxide.

viii. Footballs of different sizes are filled with the same number of gas molecules. Which football has the highest pressure?



A I
B II
C III
D IV

ix. Which one of the following is an example of a non-electrolyte?

A sodium hydroxide
B copper sulphate
C table salt
D urea

x. The complete equipment used to carry out electrolysis is known as an electrolytic

A cell.
B circuit.
C current.
D process.

xi. Chlorine reacts with hydrogen to form hydrogen chloride. As chlorine is more electronegative, it attracts shared paired of electrons towards itself. What type of compound is HCl?

A non-polar covalent compound
B polar covalent compound
C ionic compound
D metallic compound

xii. Some halogen compounds have a negative impact on the environment. The compound that depletes the ozone layer is

A sodium fluoride.
B chlorofluorocarbon.
C hydrogen fluoride.
D polytetrafluoroethylene.

xiii. Chlorine water bleaches coloured materials due to presence of

A hypochlorous acid.
B chloride ion.
C hydrochloric acid.
D hydrogen Ion.

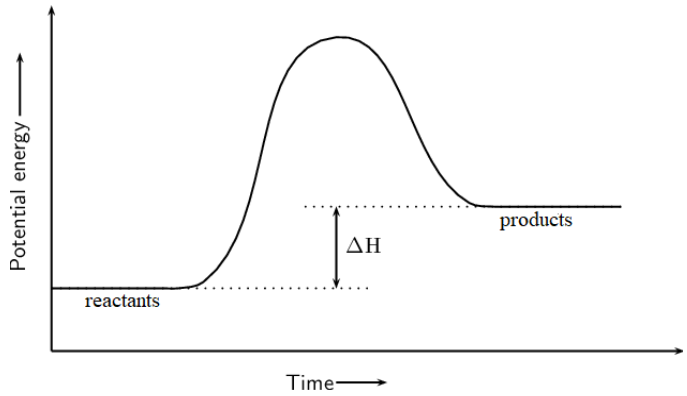
xiv. Fluorine is the most electronegative element because it

A exhibits positive oxidation state.
B has variable oxidation state.
C has negative oxidation state.
D has low nuclear charge.

xv. The correct sequence of filling up orbitals is

A 1s 2s 3s 2p 3p 4s 3d.
B 1s 2s 2p 3s 3p 4s 3d.
C 1s 2s 2p 3s 3p 3d 4s.
D 1s 2s 2p 3p 3s 4s 3d.

(Use the diagram below to answers the questions xvi and xvii)



xvi. Which of the following statements best describes the energy diagram?

A It is an exothermic reaction and heat is absorbed.
B It is an endothermic reaction and heat is released.
C It is an exothermic reaction and heat is released.
D It is an endothermic reaction and heat is absorbed.

xvii. The value of enthalpy would be

A more than zero.
B less than zero.
C equal to zero.
D remains the same.

xviii. The branch of chemistry that deals with changes in heat energy during chemical reactions is called

A chemical energetics.
B thermochemistry.
C green chemistry.
D analytical chemistry.

xix. The number of ligands and oxidation number present in the compound $[Fe(H_2O)_6]^{3+}$ is

A 6 and 3.
B 3 and 6.
C 3 ad 2.
D 2 and 3.

xx. Which of the following is an example of an endothermic reaction?

A photosynthesis
B burning of wood
C respiration
D fermentation

xxi. What is the number of electron(s) required by a halogen to form a halide ion?

A 17
B 8
C 7
D 1

xxii. Which of the following hydrocarbon family has the highest boiling point?

A alkane
B halo-alkane
C ether
D alcohol

xxiii. The structural formula of butanol is

A C_4H_8OH.
B C_4H_9OH.
C $C_4H_{10}OH$.
D C_4H_7OH.

xxiv. The reaction of carboxylic acids with alcohols in the presence of conc. H_2SO_4 as a catalyst is

A combustion.
B esterification.
C oxidation.
D neutralization.

xxv. Which of the following sequence is correct for the oxidation of alcohol?

A ethanol→ ethanol → ethanoic acid
B ethanol→ ethanoic acid→ ethanal
C ethanal→ ethanol→ ethanoic acid
D ethanal→ ethanoic acid→ ethanol

b. Match each item under column A with the item in column B. Rewrite the correct pairs by writing the alphabet against the number in the space provided. **[5]**

Column A	Column B
1. Avogadro's constant 2. Metallic conductors 3. Wood alcohol 4. Transition element 5. Aldehyde	a) catalytic activity b) CH_3OH c) free electrons d) $-CHO$ e) 22.4 f) 6.023×10^{23} g) $-COOH$

1.	
2.	
3.	
4.	
5.	

c. Fill in the blanks with appropriate word(s) **[5]**

i.	Number of moles present in 100g of $CaCO_3$ is ……	
ii.	The orange colored compound present in breathalyzer is …… …..	
iii.	The chemical reaction that involves loss of electrons is called……..	
iv.	In gas law, syringe and marshmallows are used to determine relationship between volume and ……	
v.	The biofuel mixture of 30 % ethanol and petrol is called ……...	

d. Write True or False. Rewrite the False statement ONLY. **[5]**

i. The smaller the size of a halogen atom, the stronger is its oxidising power.

ii. In an atom, the 'p' orbital can accommodate a maximum of six electrons.

iii. Hydrochloric acid dissolves in water with the absorption of heat.

iv. The high solubility of ethyl alcohol in water is due to the formation of high intra-molecular hydrogen bonding.

v. The gram molecular mass of $Ca(OH)_2$ is 58g.

i.	
ii.	
iii.	
iv.	
v.	

e. Answer the following questions.

i. Masses of atoms are expressed relative to the mass of a carbon-12. Give **TWO** reasons. **[2]**

ii. How many gram(s) of sodium makes one mole? **[1]**

iii. A sample of a gas at 1 atmosphere has a volume of 1.5 L. What would be its volume at 5 atmosphere pressure? **[2]**

iv. The volume occupied by one mole of helium at STP is 22.4 L. What would be the volume occupied by one mole of oxygen at STP? **[1]**

v. When sodium hydroxide is slowly added to iron(II) sulphate solution, a dirty green precipitate is formed.

a. Write the balanced chemical equation for the reaction. **[1]**

b. Name the precipitate. **[1]**

vi. Define electrolyte. **[1]**

vii. Why is burning of ethanol fuel considered as neutral to the environment? **[1]**

SECTION B [50 MARKS]

ATTEMPT **ANY FIVE** QUESTIONS

Question 2

a) A gas occupies 4.2 L at 1atm at 300K. Determine the volume occupied at 293K and 420Hg. **[2]**

b) On passing an electric current, water dissociates to form ions. Name the ions formed.

i. Cation **[1]**

ii. Anion **[1]**

c) Study the table and write the answers in the space provided. **[3]**

Mole(s)	**Molecules**	**Volume at S.T.P (L)**
2 moles	12.046×10^{23}	**A**……
1 mole	**B**……..	22.4
C……	9.034×10^{23}	33.6

A.	
B.	
C.	

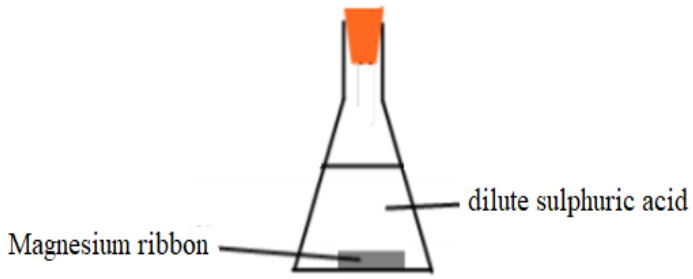
d) A coordination compound is formed when a transition metal ion reacts with a ligand. Give **TWO** features of transition metal ion that favors the formation of co-ordinate bond. **[2]**

e) Define oxidation number. **[1]**

Question 3

a) Nicotine, an alkaloid in the nightshade family of plants is responsible for the addictive nature of cigarettes. It contains 74.02% C, 8.710% H and 17.27% N. The relative molecular mass of the compound is 162.
Determine the empirical formula and molecular formula of the compound. **[4]**

b) The diagram below shows the reaction of magnesium ribbon with sulphuric acid. Answer the questions based on the illustration.



i. Name the thermochemical reaction. **[1]**

ii. Write the balanced chemical equation for the reaction **[1]**

c) Give **ONE** reason for the following statements:

i. Scandium is not considered as a transition metal although its a member of d-block elements. **[1]**

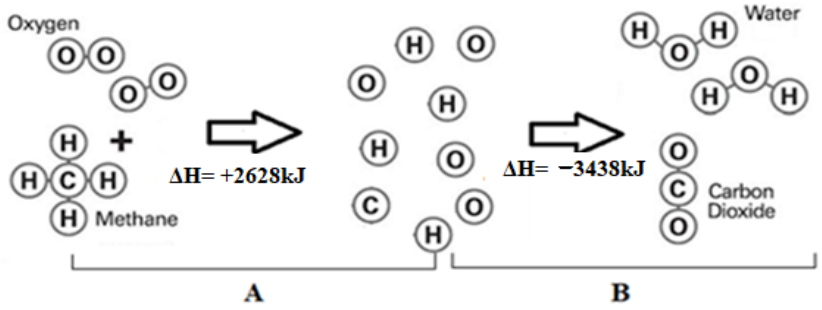
ii. Fluorine has a lesser value of electron affinity than chlorine. **[1]**

iii. Fractional distillation is used for rectification of ethanol. **[1]**

iv. The atomic size decreases across the period of halogen. **[1]**

Question 4

a) When methane is burned with oxygen, it produces carbon dioxide and water vapour. Study the chemical reaction below and answer the questions that follow.



i. Identify the reactions occurring in A and B. **[1]**

A.	
B.	

ii. Calculate the change in enthalpy for the entire reaction. **[1]**

b) Study the table.

Elements	**Nuclear charge**	**Shielding electron**	**Effective nuclear charge**
X	+7	**A…….**	+5
Y	**B……..**	+10	+4
Z	+19	+18	**C……**

i. Write the answers in the spaces provided below. **[3]**

A.	
B.	
C.	

ii. Define shielding effect. **[1]**

c) Why does the size of an anode decrease during the electro refining of metals? **[1]**

d) An inflated ball reduces in size when kept on a concrete floor during winter. Which gas law best explains this phenomenon? Justify your answer. **[2]**

e) The displacement reaction of halogens with halide ions show their oxidizing power and their reducing power in aqueous solution. Is this reaction $Br_2 + 2I^- \longrightarrow ?$ possible? Give **ONE** reason. **[1]**

Question 5

a) Write the electronic configuration in spdf notations using Aufbau's principle for the following elements:

i. $_{10}Ne$ **[1]**

ii. $_{24}Cr$ **[1]**

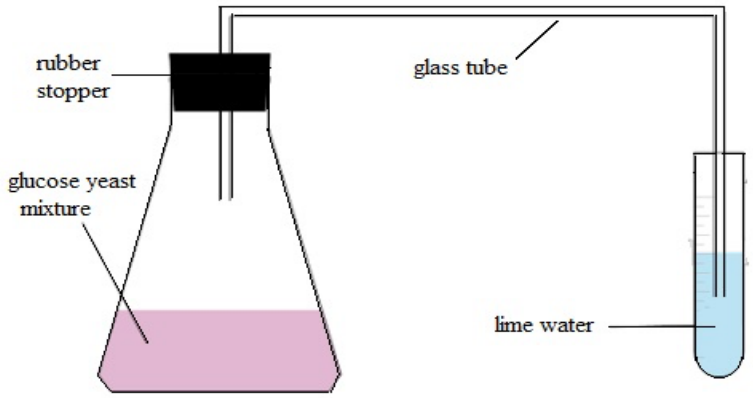
b) Calculate the following based on the equation given:

$Fe_2O_{3(s)} + 3CO \rightarrow 2Fe_{(s)} + 3CO_{2(g)}$

(Atomic weight of Fe=56)

Determine the volume of $CO_{2(g)}$ that will be produced from 80g of Fe_2O_3 at STP. **[2]**

c) The diagram below shows a step involved in the preparation of ethanol from starch using yeast extract.



i. Name the process that occurs in the conical flask. **[1]**

ii. Write the balanced chemical reaction. **[1]**

iii. Which gas turns lime water milky in the test tube? **[1]**

d) A vessel contains 2.6 L of a gas at 1200 mm Hg. If the pressure of the gas is doubled, what would be the new volume at the same temperature? **[2]**

e) Why is ethanol collected before water during distillation? **[1]**

Question 6

a) You are provided with the following materials:
a beaker, copper wire, battery, a torch bulb, silver nitrate solution, impure silver rod and a thin sheet of pure silver to be used as electrodes

Using the above materials, design a set-up to purify the impure silver rod. In your set-up label the electrodes, electrolyte and battery terminals. **[3]**

b) Write **ONE** difference for the following based on what is given in the brackets.

i. Nitrogen and oxygen (gram molecular mass) **[1]**

Nitrogen	Oxygen	

ii. Alkane and alkyne (general formula) **[1]**

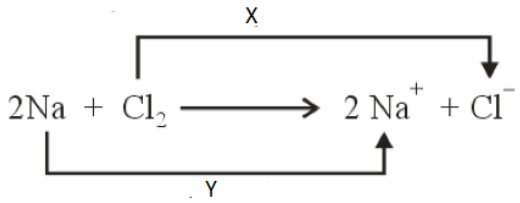
Alkane	Alkyne	

c) Name the following:

i. energy stored in a substance **[1]**

ii. transition element used in a thermometer **[1]**

d) The reaction of sodium with chlorine to form sodium chloride is an example of redox reaction as shown in the reaction below.



i. Identity the processes occurring at X and Y. **[2]**

X	
Y	

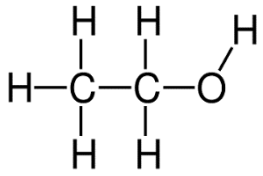
ii. Define redox reaction. **[1]**

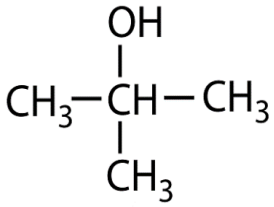
Question 7

a) State Aufbau's principle. **[1]**

b) At what temperature will a mass of 198g of carbondioxide gas at 2 atmospheric pressure take up a volume of 35L? (Gas constant = 0.0821 L atm $K^{-1}mol^{-1}$) **[3]**

c) Give the IUPAC name for following structures. **[2]**

i. 

ii. 

i.	
ii.	

d) Give **ONE** advantage and **ONE** disadvantage of adding chlorine in a swimming pool. **[2]**

e) Tobacco and alcohol products contain psychoactive drug. Consumption of both causes number of health diseases and social problems. Tobacco products are banned in Bhutan but not alcohol. Do you think alcohol should be also banned? Support your answer with **TWO** reasons. **[2]**

