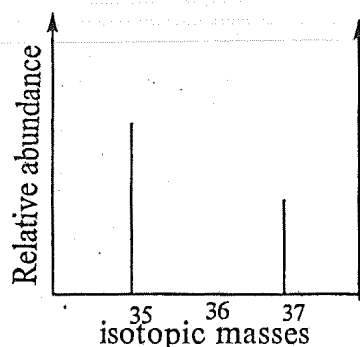


PART II

GENERAL AND PHYSICAL CHEMISTRY

SET 1 : SECTION A (CGCEB 2009)

1. The diagram below shows the mass spectrum of chlorine, atomic number 17. The relative atomic mass of chlorine can be obtained from the spectrum.



- (a) (i) What do you understand by "relative atomic mass"?-----

- (ii) From the spectrum, give the masses of the isotopes

Isotope 1-----

Isotope 2-----

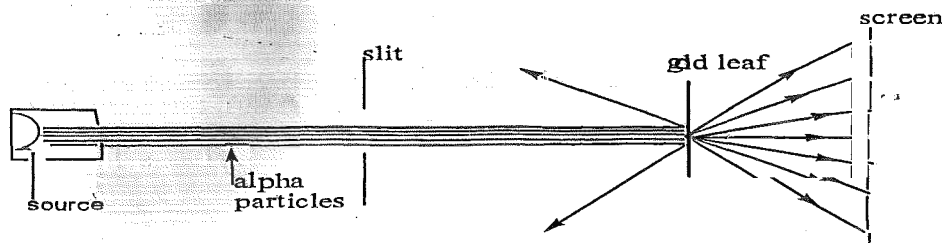
- (iii) Give the number of protons, electrons, and neutrons in each isotope

Isotopes	protons	electrons	neutrons
Isotope 1			
Isotope 2			

- (iv) Given that the relative abundances are 75.53 and 24.47 percent respectively. Calculate the relative atomic mass of chlorine -----

(6 marks)

- (b) Below is the diagram of the Rutherford gold-leaf experiment used in the determination of the structure of the atom



- (i). Give the possible source of  $\alpha$ -particles -----
- (ii). State the mass and charge of the  $\alpha$ -particles-----
- (iii). Give TWO observations that were obtained from the experiment
- (Observation 1) -----

(Observation 2) -----

(iv). State four conclusions that were obtained from the experiment

1<sup>st</sup> -----

2<sup>nd</sup> -----

3<sup>rd</sup> -----

4<sup>th</sup> -----

(8 marks)

(c) The first and second ionisation energies of argon (atomic number 18) are 1521 KJ mol<sup>-1</sup> and 2666 KJ mol<sup>-1</sup> respectively and for potassium (atomic number 19) are 419 KJ mol<sup>-1</sup> and 3051 KJ mol<sup>-1</sup> respectively.

(i). Give TWO reasons to explain the differences in the first and second ionisation energies of

Argon-----

Potassium-----

(ii). Write the electronic configuration of the ion K<sup>2+</sup> (using the spd notation)-----

(iii) What information can be obtained about the arrangement of electrons from ionisation energies? -----

6 marks (Total 20 marks)

2. You are given the following data:

Process	$\Delta H^\circ$ KJ mol <sup>-1</sup>
A. $K_{(s)} \rightarrow K_{(g)}$	+ 90
B. $Cl_{2(g)} \rightarrow 2Cl_{(g)}$	+ 121
C. $K_{(g)} \rightarrow K_{(g)}^+$	+ 418
D. $Cl_{(g)} \rightarrow Cl_{(g)}^-$	- 364
E. $K_{(g)}^+ \rightarrow K_{(aq)}^+$	- 322
F. $Cl_{(g)}^- \rightarrow Cl_{(aq)}^-$	- 364
G. $K_{(g)}^+ + Cl_{(g)}^- \rightarrow KCl_{(s)}$	- 701

(a) (i) Use the data to construct a Born-Haber cycle for the formation of potassium chloride

-----  
 -----  
 -----  
 -----

(ii). What bonds are broken in the atomisation of Potassium?-----

Chlorine? -----

(iii). Sketch a labelled diagram to show the type of bonding in solid potassium-----

-----  
 -----  
 -----

# E-CHEMISTRY SELF TUTORIALS FOR ADVANCED LEVEL

- (iv). Calculate the heat of hydration for potassium chloride -----  
-----  
-----

6 marks

- (b) (i) Sketch the dot and cross models to represent the species  $(\text{CuCl}_4)^{2-}$  and  $\text{NH}_3 \cdot \text{BF}_3$

- (ii). Indicate in the models a dative covalent bond and a simple covalent bond

- (iii). Sketch the shape and predict the bond angles of the species  $\text{NH}_3$ ,  $\text{BH}_3$ . -----  
-----  
-----

5 marks

- (c) Hydrogen bonding is an example of intermolecular forces. Intermolecular forces influence the physical properties of substances.

- (i). Why does water ( $\text{H}_2\text{O}$ ) have hydrogen bonding whereas hydrogen sulphide ( $\text{H}_2\text{S}$ ) has none? -----  
-----

- (ii). In the table below state a named physical property and a named example where the intermolecular force has influenced the physical property.

	Name physical property	Specific example
Van der Waal force		
Hydrogen bonding		

5 marks

- (d) (i) From the data below, draw an energy cycle diagram for the formation of propane ( $\text{C}_3\text{H}_8$ ) and calculate the heat of formation.  
 $\Delta H_c^\ominus(\text{C}_3\text{H}_8) = -890 \text{ kJ mol}^{-1}$ ,  $\Delta H_c^\ominus(\text{H}_2) = -286 \text{ kJ mol}^{-1}$ ,  $\Delta H_{\text{at}}^\ominus(\text{C}_{(\text{s})}) = -394 \text{ kJ mol}^{-1}$  -----  
-----  
-----

- (ii) By what other means could the  $\Delta H_f$  for propane be obtained?-----

4marks

(Total 20 marks)

3. (a) The peroxodisulphate ion ( $S_2O_8^{2-}$ ) reacts with iodide ions according to the equation



The progress of the reaction was followed by withdrawing aliquots (small samples) of the reaction mixture, quenching them and titrating the samples with thiosulphate to obtain the amount of iodine produced at various times, as well as the concentration of the peroxodisulphate ion.

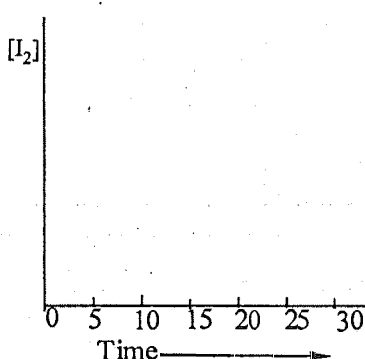
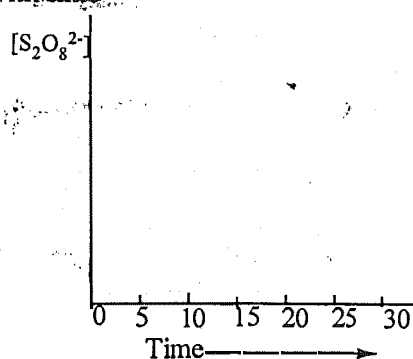
- (i). What other method could be used to follow the progress of the reaction?-----

What variable will be measured? -----

- (ii). Why is it necessary to "quench" the reaction? -----

- (iii). How would you quench the reaction? -----

- (iv). In the space below, sketch how the concentration of reactant/ and product indicated will vary with time



8 marks

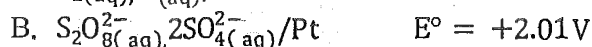
- (b) The experiment data obtained for the reaction is given below

Experiment	Initial concentrations ( $\text{mol dm}^{-3}$ )		Initial rate of reaction ( $\text{mol dm}^{-3}\text{s}^{-1}$ )
	$[S_2O_8^{2-}]_{(aq)}$	$[I_{(aq)}^-]$	
1	$3.8 \times 10^{-2}$	$3.0 \times 10^{-2}$	$7.0 \times 10^{-6}$
2	$7.6 \times 10^{-2}$	$3.0 \times 10^{-2}$	$14.0 \times 10^{-6}$
3	$7.6 \times 10^{-2}$	$6.0 \times 10^{-2}$	$28.0 \times 10^{-6}$

- (i). What is the order of the reaction with respect to  
 $I_{(aq)}^-$ ? -----  
 $S_2O_8^{2-}_{(aq)}$ ? -----
- (ii). Write the rate expression and the overall order of reaction  
 Rate expression -----  
 Overall order of the reaction -----

4 marks

(c) Given the following standard electrode potentials:

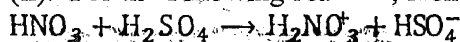


- (i). What is a standard electrode potential? -----  
-----
- (ii). Write the half equation for the reduction process in the equation of the kinetic study (in (a) above) -----
- (iii). Write the cell diagram for the cell made by linking the electrodes A and B -----
- (iv). Calculate the e.m.f of the cell-----  
-----
- (v). Name the instrument that could be used to measure the cell e.m.f and give one main characteristics of the instrument  
Instrument -----  
Characteristic-----

6 marks

(d) (i) What is an acid according to Bronsted-Lowry?

(ii). For the following reaction, identify an acid and its conjugate base.



Acid-----conjugate-----

2 marks

(Total 20 marks)

## SET 2 : SECTION A (CGCEB 2010)

### General and Physical Chemistry

1. (a) Explain the following terms as applied to the atom

- (i). The nucleus -----
- (ii). Atomic number -----
- (iii). Isotope -----

3 marks

(b) (i) What information is obtained from the following about the structure of the atom?

- (A). Mass spectrum -----
- (B). The line emission spectrum-----
- (ii). In the mass spectrometer, what is the function of
- (A). The electron gun -----
- (B). The magnet -----
- (iii) Calculate the relative atomic mass of neon given the following data  
 $^{20}\text{Ne} = 114$ ,  $^{21}\text{Ne} = 0.2$  and  $^{22}\text{Ne} = 11.2$