SERANGOON JUNIOR COLLEGE
General Certificate of Education Advanced Level
Higher 2

CANDIDATE NAME	
CLASS	**INDEX NUMBER**

CHEMISTRY 9746/02

Preliminary Examination 26 August 2009
Paper 2 Structured 1 hr 30min

Additional Materials: Data Booklet
Writing Papers

Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

Write your name and class on all the work you hand in.
You may use a soft pencil for any diagrams, graphs or rough work.

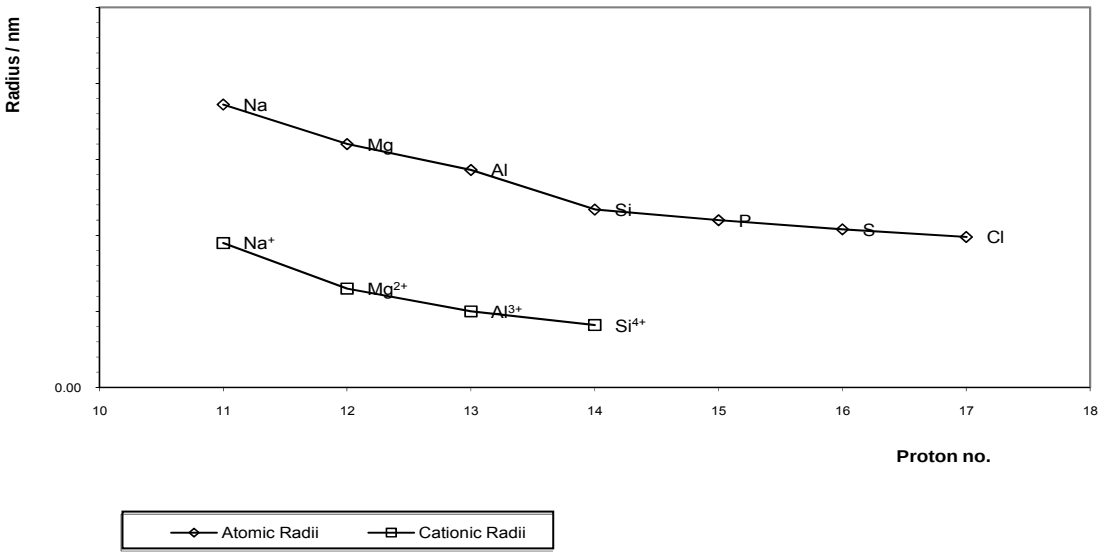
Answer **all** questions in the space provided.

At the end of the examination, fasten all your work securely together.
The number of marks is given in the brackets [ ] at the end of each question or part questions.

For Examiner's Use	
1	
2	
3	
4	
5	
Total	

This document consists of **12** printed pages and **0** blank page

1 The atomic and cationic radii of Period 3 elements, Na to C*l*, are plotted in the graph below, in order of increasing atomic number.



(a) Explain each of the following:

(i) The atomic radius decreases across the period from Na to C*l*.

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(ii) The cationic radius of Na^+ is smaller than its atomic radius.

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[4]

(b) **(i)** Indicate, on the graph, the relative positions of the ions, P^{3-}, S^{2-} and Cl^-.

(ii) Explain your answer in **(b)(i)**.

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[3]

(c) **(i)** Write down the electronic configuration of sulphur in its ground state.

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(ii) Explain the following phenomenon: Sulphur can react with fluorine to form SF_2, SF_4 and SF_6 but oxygen can react with fluorine to form OF_2 only.

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[2]

(d) The successive ionisation energies in kJ mol^{-1} of an element **A** are as follows:

740, 1500, 7700, 10500, 13600, 18000, 21700

State the Group in which **A** belongs to and explain your answer. Suggest the formula of the chloride of **A**.

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[3]

[Total: 12]

For Examiner's Use

2 A pheromone is a chemical substance that, when secreted by an individual of a species, for example the insects, can elicit a certain type of behaviour in other individuals. Compound **B** below is an alarm pheromone secreted by several species of ants, to send out warning signals to other ants.

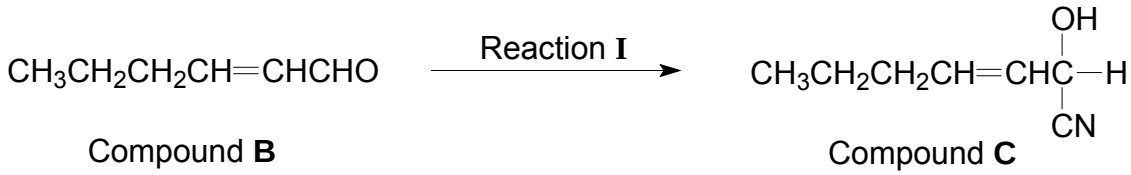
$CH_3CH_2CH_2CH{=}CHCHO$

Compound **B**

(a) State the type of isomerism that exists in compound **B.**

……**[1]**

(b) Compound **B** can undergo the following conversion:



Compound **B** Compound **C**

State the reagents and condition required for reaction **I**. Outline the mechanism of reaction **I**, including curly arrows, showing the movement of electrons, and all charges.

Reagents and Condition: …….

[4]

(c) **(i)** Compound **C** has a chiral carbon. Illustrate the isomerism exhibited with the aid of structural formulae.

(ii) Compound **C**, however, does not rotate plane polarised light. Explain this phenomenon with reference to the mechanism mentioned in **(b)**.

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[3]

(d) The reaction of hydroxide ion with chloromethane to yield methanol and chloride ion is an example of nucleophilic substitution reaction:

$$OH^- + CH_3Cl \rightarrow CH_3OH + Cl^-$$

The value of ΔH^θ for the reaction is –75 kJ mol^{-1}, and the value of ΔS^θ is +54 J mol^{-1}.

(i) What is the value of ΔG^θ at 298 K?

ΔG^θ =……..kJ mol^{-1}

(ii) Predict whether the reaction is feasible at 298 K?

……

(iii) Will temperature affect the feasibility of the reaction? Explain.

……..

[4]

[Total: 12]

3 Ammonia is manufactured in the Haber process.

N_2 (g) + $3H_2$ (g) $\rightleftharpoons$ $2NH_3$ (g) $\Delta H = -92$ kJ mol^{-1}

Le Chatelier's principle predicts that the highest yield of ammonia is obtained at high pressure and low temperature. However, in practice, these conditions are not used.

(a) Using Le Chatelier's principle, explain why the above conditions are used.

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[3]

(b) Suggest two reasons why these conditions of high pressure and low temperature are not used in the industry.

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[1]

(c) The gases are usually passed through a tower packed with lumps of metal. Identify the metal used and suggest a reason for the use of this metal.

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[2]

(d) Under certain conditions, when nitrogen and hydrogen are mixed in a 1:3 mole ratio, there is 78% conversion of nitrogen to ammonia at equilibrium. Write an expression for the equilibrium constant K_p. Calculate K_p for this reaction if the total pressure of the equilibrium mixture was found to be 5×10^7 Pa.

[3]

(e) Calculate the total pressure at equilibrium where ammonia is 90% dissociated into its elements under the same conditions.

[3]

[Total: 12]

For Examiner's Use

4 A 20.0 cm^3 sample of 0.0100 mol dm^{-3} of ethanoic acid is titrated with 0.0200 mol dm^{-3} of sodium hydroxide at 25 ^oC. Given that the K_a of ethanoic acid is given to be 1.80 x 10^{-5} mol dm^{-3}.

(a) Explain the term acid dissociation constant, K_a, as applied to ethanoic acid.

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[1]

(b) Calculate the initial pH of the 20.0 cm^3 sample of ethanoic acid.

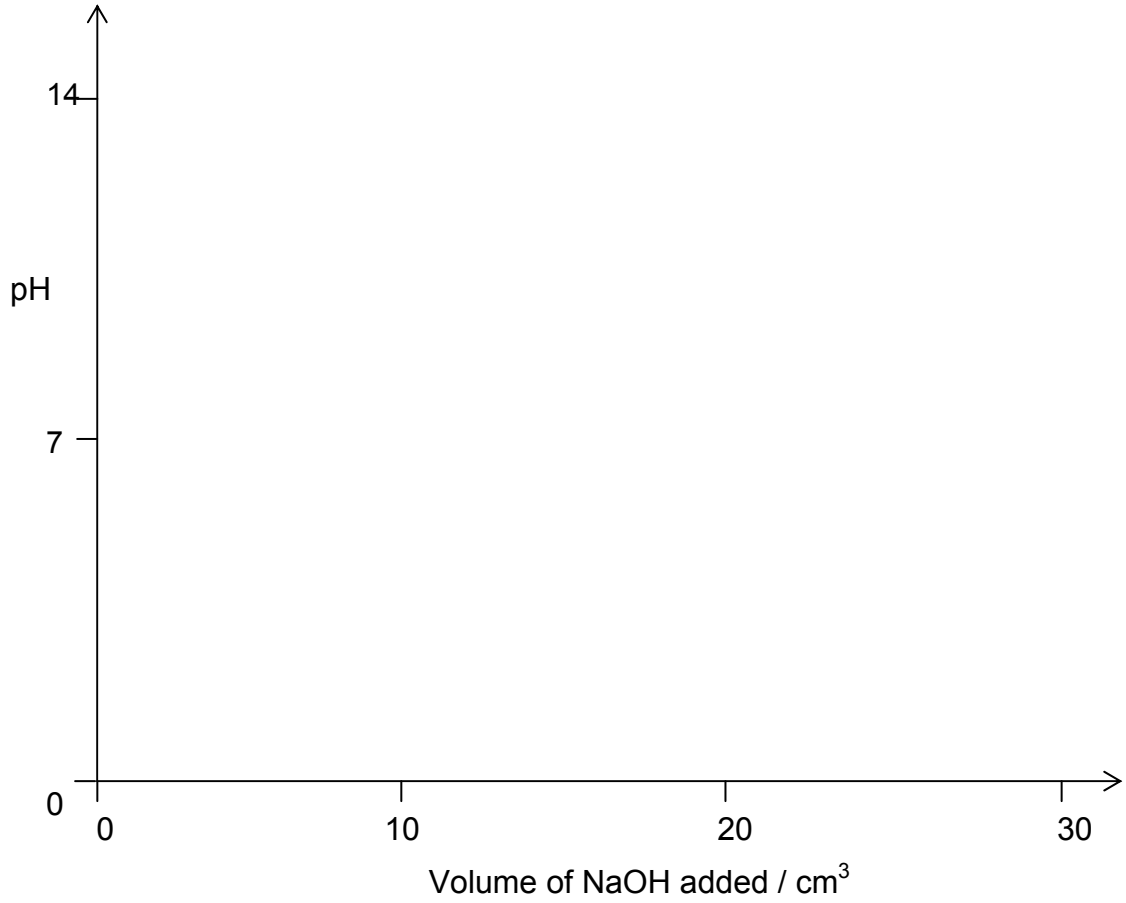
[2]

(c) Calculate the equivalence volume of sodium hydroxide and hence, the end point pH.

[4]

(d) The reaction is continued until 30 cm^3 of sodium hydroxide has been added. On the given grid, using the pH values you have determined from **(b)** and **(c)**, sketch how the pH changes and indicate clearly the buffer region.

[3]



(e) State and explain the choice of a suitable indicator for this reaction.

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[2]

[Total: 12]

For Examiner's Use

5 (a) A gaseous mixture containing O_3 and N_2O in a 2000 cm^3 gas canister exerts a pressure of 81.06 kPa at 25 °C.

(i) Calculate the total number of moles of gases in the gas canister and hence M_r of the gaseous mixture if the mass of the gaseous mixture is 1.80 g.

(ii) State two assumptions made in your calculations.

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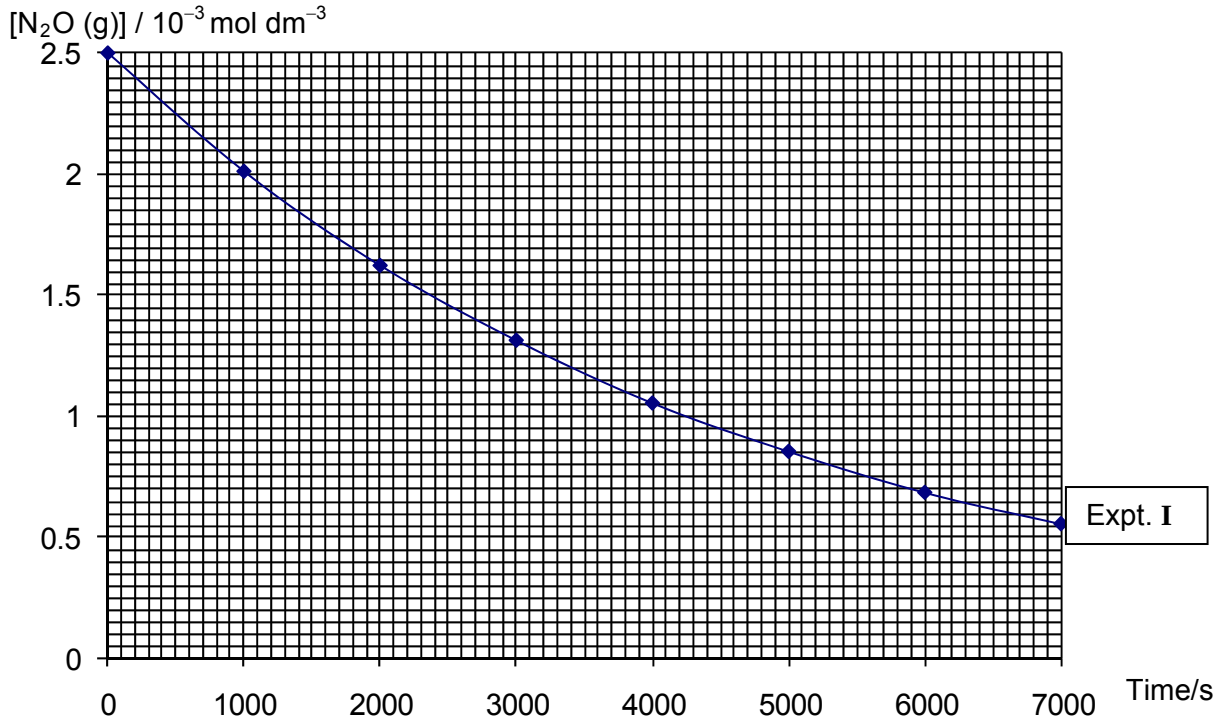
[5]

For Examiner's Use

(b) Nitrous oxide or dinitrogen oxide, N_2O, is commonly known as "laughing gas" due to the euphoric effects of inhaling it. It is used in surgery and dentistry for its anaesthetic and analgesic effects. At 1200 K, in the presence of gold wire, dinitrogen oxide decomposes as shown:

$$2N_2O(g) \longrightarrow 2N_2(g) + O_2(g)$$

To follow the rate of reaction, the change in concentration of a sample of N_2O is measured against time. The results are shown below:



(i) Find the order of reaction with respect to N_2O.

(ii) Calculate the rate constant for the reaction.

(iii) The experiment was repeated using N_2O with an initial concentration of 1.25×10^{-3} mol dm^{-3}. On the same axes, sketch the graph of concentration of N_2O against time for this new experiment. Label the graph as Experiment **II**.

[4]

For Examiner's Use

(c) Two graphite electrodes were submerged into a beaker containing copper (II) sulphate solution. The circuit was connected to a power supply.

(i) State what would be observed at the anode, cathode and the electrolyte after some time.

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(ii) Explain why bubbles of gas are produced at the cathode when the power supply is turned on for a prolonged period of time.

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[3]

[Total: 12]

~END OF PAPER~