ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Advanced Level

CHEMISTRY 9189/1

PAPER 1

NOVEMBER 2012 SESSION 2 hours

Additional materials:
- Answer paper
- Data Booklet
- Mathematical tables and/or electronic calculator

TIME: 2 hours

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces provided on the answer paper/answer booklet.

Answer **six** questions.

Answer **two** questions from Section A, **one** question from Section B, **two** questions from Section C and **one** other question chosen from any section.

Write your answers on the separate answer paper provided.

If you use more than one sheet of paper, fasten the sheets together.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.

You are reminded of the need for good English and clear presentation in your answers.

This question paper consists of 7 printed pages and 1 blank page.

[Turn over

Section A

*Answer at least **two** questions from this section.*

1 **(a)** Define

(i) *empirical formula,*

(ii) *molecular formula.* [2]

(b) Compound Y contains nitrogen and hydrogen only and has 87.5 % by mass of nitrogen.

(i) Given that the relative molecular mass of Y is 32, determine its empirical and molecular formulae.

(ii) Draw a dot and cross diagram of Y and hence predict its shape, stating the bond angles. [5]

(c) Compound Y is used to remove oxygen in some electrochemical processes, giving nitrogen as one of the products.

(i) Write the equation for the reaction between Y and oxygen.

(ii) Use data from the Data Booklet to calculate the enthalpy change for the above reaction and hence state another use for Y. [5]

[Total: 12]

2 **(a)** Liquid ammonia and aqueous ammonia dissociate to give ammonium ions, the dissociations reaching equilibrium.

(i) Construct equations for the dissociation of each of the two substances.

(ii) Write the equilibrium constant expression, K_b, for the dissociation of aqueous ammonia.

(iii) Calculate the K_b value of aqueous ammonia given that 0.01 $moldm^{-3}$ of the solution yield equilibrium concentration of 4.30×10^{-4} $moldm^{-3}$ for each product, stating any assumption you have made. [5]

(b) Mixtures of aqueous solutions of ammonia and ammonium chloride act as buffers.

(i) Name the type of buffer made by these solutions.

(ii) Write equations to show how the ammonia/ ammonium chloride buffer system works.

(iii) Use your K_b value in **(a) (iii)** to calculate the pH of the buffer solution that would be formed when 1.0 g of ammonium chloride is added to 1.0 dm^3 of 0.01 $moldm^{-3}$ ammonia solution. [7]

[Total: 12]

3 **(a)** Explain the following statements:

1. ammonia dissolves easily in water whereas methane is insoluble in water

2. silicon (IV) oxide is a solid at room temperature which does not melt until 1 883K whereas carbon dioxide is a gas at room temperature and melts at 217K

3. fish owe their survival in very cold winters to hydrogen bonding in water [5]

(b) **Table 1** shows some physical properties of substances **A, B** and **C.**

Table 1

substance	M_r	melting point/ °C	boiling point/ °C	electrical conduction
A	60	1 610	2 205	none
B	74.5	772	1 407	conducts in liquid state
C	85	– 95	69	none

Use the information in **Table 1** to deduce the lattice structures of **A, B,** and **C.** [3]

(c) **(i)** State the **two** main assumptions made in the kinetic theory of ideal gases.

(ii) Use the assumptions in **(i)** to explain why real gases begin to behave more like ideal gases at low pressure. [4]

[Total:12]

Section B

*Answer at least **one** question from this section*

4 **(a)** Limestone, a sedimentary deposit of remains of marine invertebrates contain calcium carbonate. The solid formed on strong heating of limestone is called quicklime and is used in the purification of iron to remove silica impurities.

(i) Write equations for the reactions described above.

(ii) State and explain the differences in the thermal stabilities of calcium carbonate and barium carbonate. [5]

(b) **(i)** Describe the behaviour of quicklime and barium oxide with water.

(ii) Give the approximate pH values of the solutions formed in **(i)** [3]

(c) The process by which calcium carbonate is used to remove sulphur dioxide from flue gases produced when coal is burnt in power stations is called Flu Gas Desulphurisation, FGD. Calcium sulphite is produced which is then oxidised in air to form calcium sulphate.

(i) Write equations for the reactions which take place during the FDG process.

(ii) State **one** use for each of calcium carbonate (other than FGD) and calcium sulphate. [4]

[Total: 12]

5 **(a)** Define

(i) *transition element,*

(ii) *ligand.* [2]

(b) **(i)** Describe how a complex ion is formed between Cu^{2+} ion and water ligands.

(ii) Explain the observations which are made when excess aqueous ammonia is added to an aqueous solution of copper (II) sulphate.

[6]

(c) Use of the Data Booklet is relevant to this question.

During titrations of $FeSO_{4(aq)}$ with $KMnO_4$, excess dilute H_2SO_4 is added to the reaction mixture .

Explain why dilute HC*l* cannot be used in place of H_2SO_4 during such titrations. [4]

[Total:12]

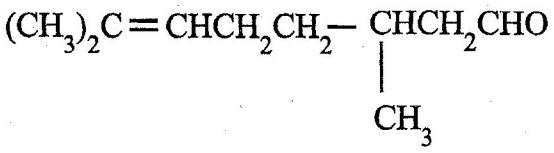
Section C

*Answer at least **two** questions from this section*

6 **(a)** Distinguish between structural and optical isomerism. [1]

(b) **Fig. 1** shows the structure of isomers, **A** and **B**, found in the vernom of the African honey bee.

A



B

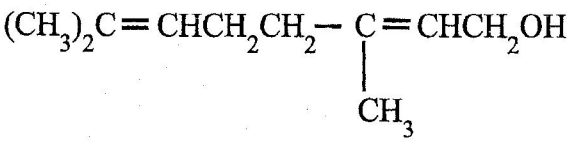


Fig. 1

(i) What type of isomerism, apart from structural isomerism, is exhibited by **A** and **B**.

Draw the structures of these isomers.

(ii) Describe a simple test to distinguish **A** from **B**. Give reagents used and observations made. [6]

(c) Reaction of **B** with hot $KMnO_4$ gives **three** products.

(i) Draw the displayed structural formula of the products.

(ii) One of the products reacts with both PCl_5 and a mixture of aqueous I_2 and NaOH.

Write equations to show these reactions. [5]

[Total:12]

7 **(a)** Distinguish between the terms nucleophile and electrophile. [2]

(b) Using but -2-ene and butanal as examples, describe and explain the difference between electrophilic and nucleophilic addition reactions.

Your explanation should include:

(i) reagents and conditions used

(ii) structural formulae of organic products formed

(iii) mechanism of each reaction

[10]
[Total:12]

8 **Fig. 2** shows the structure of caffeine, a drug found in tea and coffee.

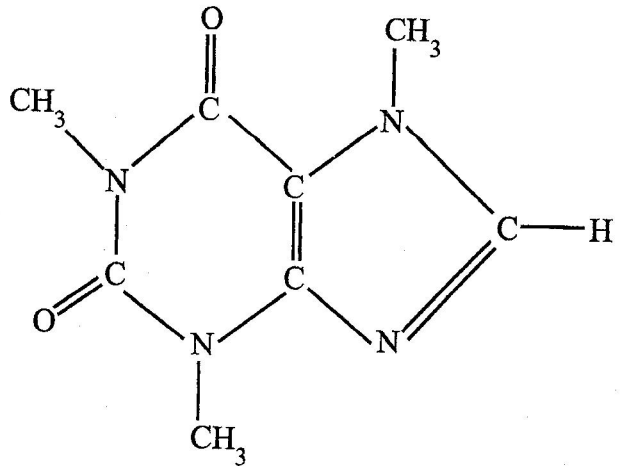


Fig. 2

(a) Identify the **three** functional groups in caffeine. [3]

(b) By giving structures of organic products and naming types of reactions undergone, describe how caffeine reacts with

(i) $Br_{2(aq)}$,

(ii) hot NaOH,

(iii) cold HCl. [6]

(c) Calculate the concentration of caffeine in a 300 cm^3 cup of coffee given that the cup contains 3×10^{-2} g of caffeine. [3]
[Total:12]

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