INTERNATIONAL BACCALAUREATE
BACCALAURÉAT INTERNATIONAL
BACHILLERATO INTERNACIONAL

N99/420/S(2)

CHEMISTRY

Standard Level

Tuesday 16 November 1999 (afternoon)

Paper 2 — 1 hour

A

Candidate name:	Candidate category & number:

This examination paper consists of 2 sections, Section A and Section B.
The maximum mark for each section is 20.
The maximum mark for this paper is 40.

INSTRUCTIONS TO CANDIDATES

Write your candidate name and number in the boxes above.

Do NOT open this examination paper until instructed to do so.

Section A: Answer ALL of Section A in the spaces provided.

Section B: Answer ONE question from Section B. You may use lined pages at the end of this paper or attach extra sheets of paper with your candidate number clearly marked at the top.

At the end of the examination, complete box B below with the number of the question answered in Section B.

B

QUESTIONS ANSWERED	
A/ ALL	
B/	
Number of extra sheets attached	

C

EXAMINER	TEAM LEADER
/20	/20
/20	/20
TOTAL /40	TOTAL /40

D

IBCA
/20
/20
TOTAL /40

EXAMINATION MATERIALS

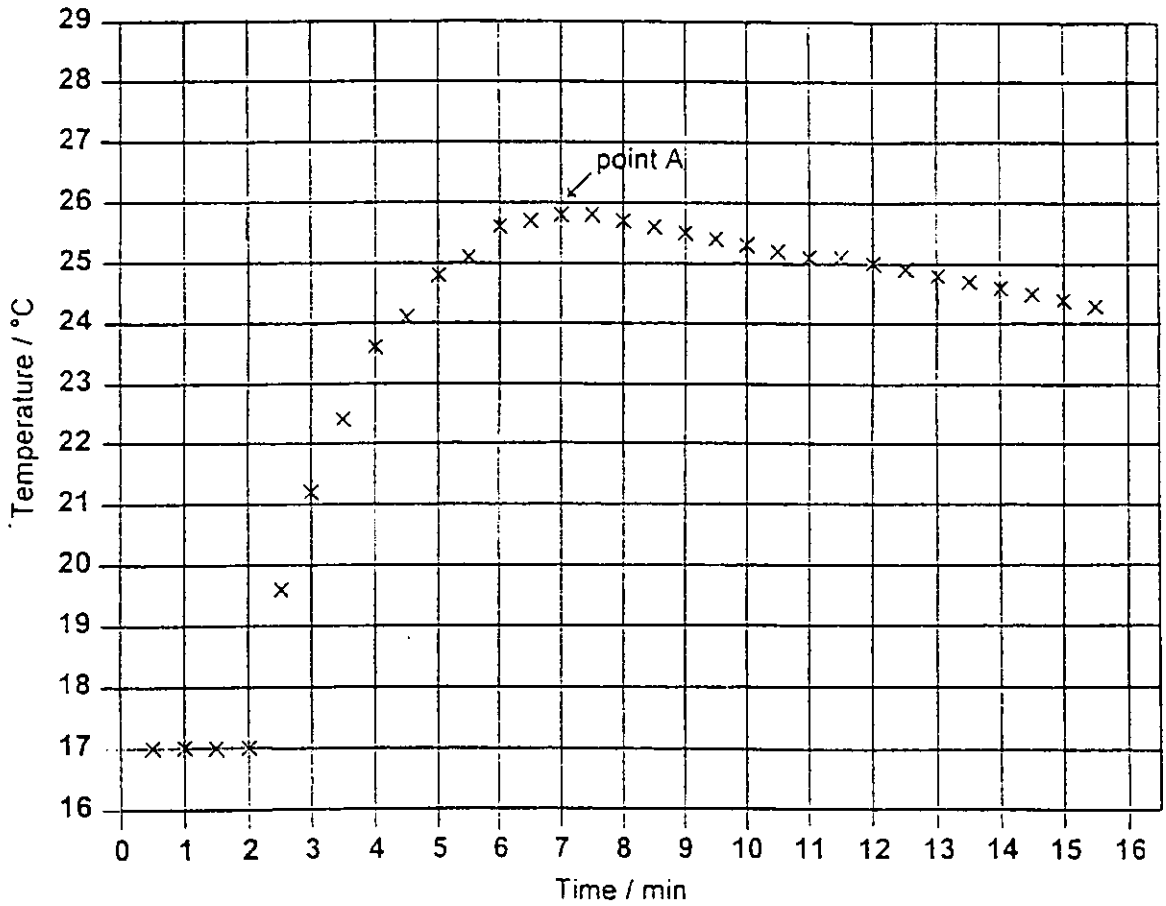
Required:
Chemistry Data Booklet
Calculator
Millimetre square graph paper

Allowed:
A simple translating dictionary for candidates not working in their own language

SECTION A

Answer ALL questions in this section.

1. In order to determine the enthalpy change of reaction between zinc and copper(II) sulfate, a student placed 50.0 cm^3 of 0.200 $mol\,dm^{-3}$ copper(II) sulfate solution in a polystyrene beaker. The temperature was recorded every 30 seconds. After two minutes 1.20 g of powered zinc was added. The solution was stirred and the temperature recorded every half minute for the next 14 minutes. The results obtained were then plotted to give the following graph:



(a) Write the equation for the reaction taking place. *[1]*

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(b) Determine which of the two reagents was present in excess. *[2]*

. . . . . .

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(Question 1 continued)

(c) The highest temperature is reached at point **A**. Explain what is happening in the system at this point. *[1]*

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. . . . . .

(d) By drawing a suitable line on the graph estimate what the rise in temperature would have been if the reaction had taken place instantaneously. *[2]*

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(e) Calculate how much heat was evolved during the reaction. Give your answer to **three** significant figures. *[2]*

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(f) What is the enthalpy change of reaction in kJ mol^{-1}? *[1]*

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. . . . . .

(g) The accepted value for the enthalpy change of reaction is -218 kJ mol^{-1}. What is the percentage error for the value obtained in this experiment? *[1]*

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. . . . . .

(h) Suggest **one** reason why there is disagreement between the experimental value and the accepted value. *[1]*

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. . . . . .

2. CCl_2F_2 is no longer used in refrigerators as it can damage the ozone layer.

(a) Draw the Lewis structure for CCl_2F_2. *[1]*

(b) Predict the shape of a molecule of CCl_2F_2. *[1]*

. . . . . .

. . . . . .

(c) State, giving your reasons, whether a molecule of CCl_2F_2 is polar or non-polar. *[2]*

. . . . . .

. . . . . .

3. Ethanoic acid, CH_3COOH, is a weak acid.

(a) What is meant by the term *weak acid*? *[1]*

. . . . . .

. . . . . .

(b) Give the equation for the reaction of ethanoic acid with water and clearly identify all the Brønsted-Lowry acids and bases. *[3]*

(c) Give the structural formula for the conjugate base of ethanoic acid. *[1]*

SECTION B

Answer ONE of the questions in this section. You may use the lined pages at the end of this paper or attach extra sheets of paper with your candidate number clearly marked at the top.

4. (a) Ethanol can be oxidised first to ethanal then to ethanoic acid by warming with an acidified solution of potassium dichromate(VI).

(i) Describe the colour change that occurs during the reaction. *[1]*

(ii) Explain why the boiling points of ethanol and ethanoic acid are considerably higher than the boiling point of ethanal. *[3]*

(b) When ethanol is warmed with ethanoic acid in the presence of an acid catalyst a new product is formed.

(i) Write the balanced equation for the reaction that takes place using the **structural** formulas of the organic reactants and products. *[3]*

(ii) State **one** simple way in which you would be able to tell if the organic product has been formed. *[1]*

(iii) State and explain how the solubility of the product in water compares with the solubililty of the two reactants in water. *[2]*

(c) When a protein is hydrolysed it can be broken down into its constituent amino acids. Two such amino acids are glycine and cysteine. The structures of these amino acids are given in Table 20 in the Data Booklet.

(i) One of these amino acids can show *optical activity*. Explain what is meant by this term and describe the optical activity of two optical isomers of the same compound. Identify which of the two amino acids is optically active, explain why it has this property and show clearly the structures of the two enantiomers (optical isomers). *[6]*

(ii) Glycine and cysteine can undergo a condensation reaction. Give the balanced equation for this reaction showing clearly the structural formula of the organic product formed. Name the type of covalent bond formed in this reaction. *[4]*

5. (a) Chlorine can be prepared in the laboratory by reacting chloride ions with an acidified solution of manganate(VII) (permanganate) ions. The unbalanced equation for the reaction is:

$$Cl^-(aq) + MnO_4^-(aq) + H^+(aq) \rightarrow Mn^{2+}(aq) + Cl_2(g) + H_2O(l)$$

Give the oxidation numbers of chlorine and manganese in the reactants and products. Write the balanced equation and identify the reducing agent in the reaction. *[5]*

(b) Bromine can be obtained from molten sodium bromide using electricity. Draw a clearly labelled diagram of the apparatus showing where the bromine is formed. Give the half-equation for the reaction occurring at the negative electrode (cathode) and state, with an explanation, whether this is an oxidation or reduction process. State why the products formed at the two electrodes must be kept separate from each other. *[5]*

(c) You are provided with aqueous solutions of chlorine, bromine and iodine and also aqueous solutions of sodium chloride, sodium bromide and sodium iodide. Describe how you could confirm experimentally the oxidising ability of the halogens and state what would be observed for each test carried out. Write equations for any reactions that occur and list the halogens in order of decreasing oxidising ability. *[10]*

6. Account for the following observations on the atomic/ionic/molecular level.

(a) The melting points of chlorine, sodium and silicon increase in the order $Cl_2 < Na < Si$. *[5]*

(b) The radii of a potassium atom, a chloride ion, an atom of argon and a potassium ion are in the order $K > Cl^- > Ar > K^+$. *[5]*

(c) The chemical reactions of the oxides of sodium, Na_2O, aluminium, Al_2O_3, and sulfur, SO_2, can be used to illustrate the change from metallic to non-metallic properties across Period 3 (Na–Ar) of the Periodic Table. *[5]*

(d) The first ionisation energy (IE) of sodium is lower than the first ionisation energy of magnesium. The second ionisation energies of sodium and magnesium are higher than their respective first ionisation energies. The second ionisation energy of sodium is higher than the second ionisation energy of magnesium.

That is: IE Na^+ > IE Mg^+ > IE Mg > IE Na *[5]*