INTERNATIONAL BACCALAUREATE
BACCALAURÉAT INTERNATIONAL
BACHILLERATO INTERNACIONAL

N01/420/S(2)

CHEMISTRY
STANDARD LEVEL
PAPER 2

Name

Number

Tuesday 13 November 2001 (afternoon)

1 hour

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. Write your answers in a continuation answer booklet, and indicate the number of booklets used in the box below. Write your name and candidate number on the front cover of the continuation answer booklets, and attach them to this question paper using the tag provided.
- At the end of the examination, indicate the number of the Section B question answered in the box below.

QUESTIONS ANSWERED		EXAMINER	TEAM LEADER	IBCA
SECTION A	ALL	/20	/20	/20
SECTION B QUESTION	. . . . .	/20	/20	/20
NUMBER OF CONTINUATION BOOKLETS USED	. . . . .	TOTAL /40	TOTAL /40	TOTAL /40

SECTION A

*Candidates must answer **all** questions in the spaces provided.*

1. Hydrogen and iodine are placed in a closed container and allowed to react at 750 °C and one atmosphere pressure. The following equilibrium is reached:

$$H_2(g) + I_2(g) \rightleftharpoons 2HI(g) \qquad \Delta H = -10 \text{ kJ mol}^{-1}$$

(a) State the qualitative effect of an increase in pressure on the rate of the forward reaction and on the equilibrium position. Explain your answer in each case. *[4]*

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(b) After equilibrium has been established, some H_2 is added to the system. Describe the changes in the concentrations of I_2 and HI until a new equilibrium is established. *[2]*

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2. Ethanol is used as a fuel because it undergoes combustion.

(a) Write a balanced chemical equation for the combustion of ethanol. *[2]*

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(b) The standard enthalpy of combustion, $\Delta H_c^{\ominus}$, and the relative molecular masses, M_r, of a series of alkanols are given below:

Alkanol	CH_3OH methanol	CH_3CH_2OH ethanol	$CH_3CH_2CH_2OH$ propan-1-ol	$CH_3CH_2CH_2CH_2OH$ butan-1-ol
$\Delta H_c^{\ominus}$ / kJ mol^{-1}	–715	–1371	–2010	–2673
M_r	32.0	46.0	60.0	74.0

(i) Calculate the relative molecular mass of pentan-1-ol and thus estimate $\Delta H_c^{\ominus}$ for pentan-1-ol using the graph below. *[2]*

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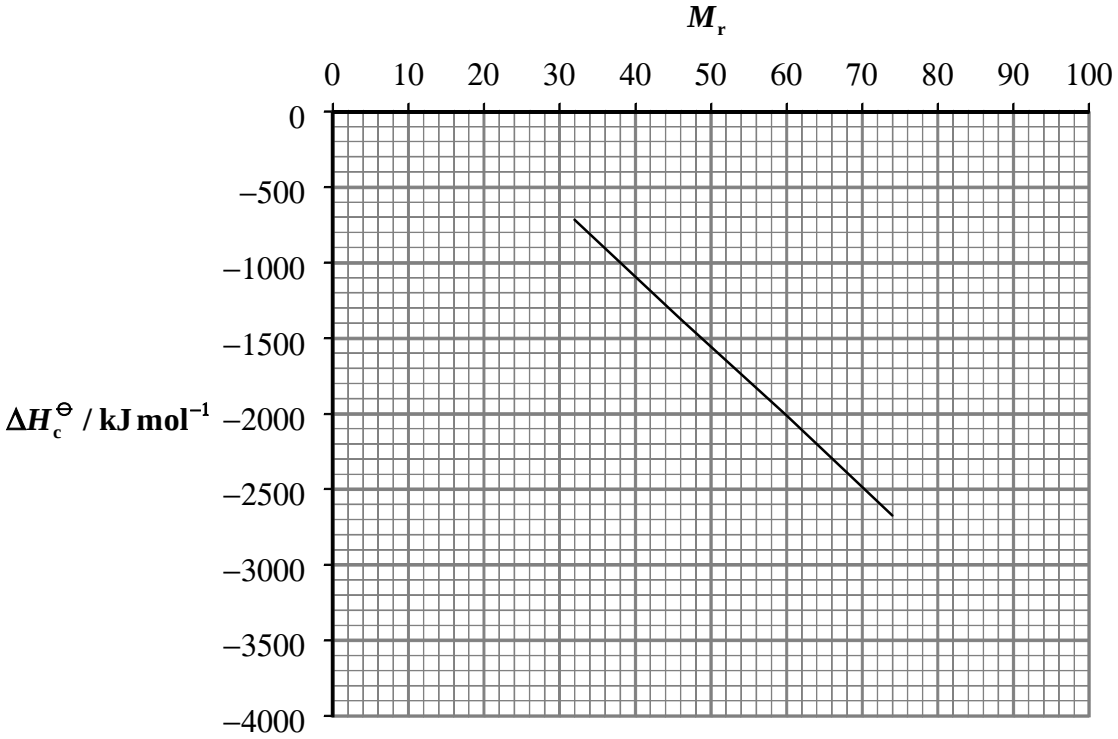

(This question continues on the following page)

(Question 2 (b) continued)

(ii) How would the value of the standard enthalpy of combustion of pentan-2-ol compare with that of pentan-1-ol? Explain your answer. *[2]*

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3. (a) Boron and aluminium are in the same group in the periodic table. Based on their electron configurations, explain why the first ionisation energy of boron is greater than that of aluminium. *[2]*

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(b) Aluminium and silicon are in the same period. Explain why the first ionisation energy of silicon is greater than that of aluminium. *[2]*

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4. (a) Explain why lead(II) chloride, $PbCl_2$, does not conduct electricity in the solid state but does in the molten state. *[2]*

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(b) Write balanced half-equations, with state symbols, for the reaction at each electrode when molten lead(II) chloride is electrolysed. *[2]*

Anode (positive electrode): . . . . . .

Cathode (negative electrode): . . . . . .

SECTION B

*Answer **one** question. Write your answers in a continuation answer booklet. Write your name and candidate number on the front cover of the continuation answer booklets, and attach them to this question paper using the tag provided.*

5. Chlorine forms compounds with both sodium and hydrogen.

(a) Give the formula of each compound. Describe in terms of electrons, the bonding in each compound and account for the difference. *[5]*

(b) Predict and explain the relative melting points of the two compounds. *[4]*

(c) Predict and explain the relative electrical conductivities of the two compounds in the solid and liquid states. *[3]*

(d) Both compounds are soluble in water. Explain how water is able to dissolve both compounds. *[6]*

(e) Explain why carbon tetrachloride, CCl_4, does not dissolve in water. *[2]*

6. (a) A 1.00 g sample of an organic compound contains 0.400 g carbon, 0.0666 mol hydrogen and 2.02×10^{22} atoms of oxygen. Determine the empirical formula of the compound. *[3]*

(b) (i) Draw the structural formula of methyl methanoate. State the conditions and the starting materials for the preparation of methyl methanoate in the laboratory. Write a balanced chemical equation for the reaction. *[6]*

(ii) Draw the structural formula of an isomer of methyl methanoate. State **two** physical properties and **one** chemical property that would be different for the two compounds. State how each of these properties differ for the two compounds. *[5]*

(c) (i) Explain the term condensation and state the structural features of the monomers required to form condensation polymers. How does addition polymerisation differ from condensation polymerisation? *[3]*

(ii) Terylene is a polymer produced from the polymerisation of the two monomers ethane-1,2-diol and benzene-1,4-dicarboxylic acid. State what type of polymer Terylene is and draw the structural formula of its repeating unit. *[3]*

7. Five unlabelled bottles are known to contain the following 0.10 $mol\,dm^{-3}$ aqueous solutions:

CH_3COOH , NaCl, NaOH, HCl, NH_3

(a) Describe and explain how the pH values of these five solutions could be used to identify them. *[5]*

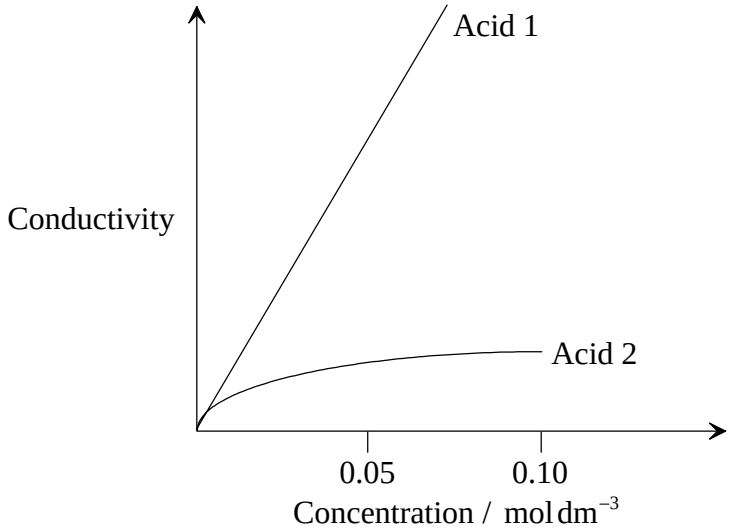
(b) Experiments were conducted to illustrate some properties of sodium hydrogencarbonate, $NaHCO_3$.

(i) In one experiment some solid $NaHCO_3$ was added to aqueous NaOH. After stirring the pH decreased to 9. Write a balanced chemical equation for the reaction and explain the decrease in pH. *[2]*

(ii) In another experiment solid $NaHCO_3$ was added to an aqueous solution of HCl. After stirring the pH increased to 5. Write a balanced equation for the reaction and explain this result. *[2]*

(c) Describe how the two reactions of $NaHCO_3$ in (b) illustrate the Brønsted–Lowry theory of acids and bases. *[2]*

(d) The graph below shows how the conductivity of a strong and a weak monoprotic acid change as the concentration changes:



(i) Identify the strong acid and the weak acid from the above data. Give reasons for your choices. *[6]*

(ii) Describe how magnesium metal can be used to distinguish between solutions of the strong acid and the weak acid of the same concentration. *[2]*

(iii) Compare the volume of 0.10 $mol\,dm^{-3}$ NaOH required to react exactly with 10.0 cm^3 of 0.10 $mol\,dm^{-3}$ solutions of each of these acids. *[1]*