INTERNATIONAL BACCALAUREATE
BACCALAURÉAT INTERNATIONAL
BACHILLERATO INTERNACIONAL

CHEMISTRY
STANDARD LEVEL
PAPER 2

Tuesday 16 May 2000 (afternoon)

1 hour

Name

Number

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 the lined pages at the end of this paper or continue 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

*Answer **all** questions from this section.*

1. Solutions of acids of the same concentration are prepared. The acids and their equilibrium constants, K_c, are:

Acid	K_c (at 25° C) mol dm^{-3}
CH_3COOH	1.7×10^{-5}
HCN	4.0×10^{-10}
HCl	very large
HF	5.6×10^{-4}

(a) Write down the equilibrium expression for HCN. *[2]*

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(b) Write down these solutions in order of **decreasing** pH. *[1]*

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(c) Write down these solutions in order of **increasing** concentration of molecules of acid present in the solution. *[1]*

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(d) For the solution of CH_3COOH, write down the formulas of all the chemical species present. *[1]*

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(e) Write the name **and** formula of the conjugate base of HF. *[2]*

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(f) State, giving a reason, an experimental method other than pH measurement, that would distinguish between the solutions of HCl and HF. *[2]*

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2. (a) Define, in words or with an equation, the first ionisation energy of Na. *[2]*

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. . . . . .

(b) State how the first ionisation energy varies down group 1. *[1]*

. . . . . .

(c) Li, Na and K react with water. Which of the three reactions will be the most vigorous? Explain this at an atomic level. *[2]*

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(d) State whether the second ionisation energy of sodium is less than, the same as, or greater than the first ionisation energy. Explain your answer. *[2]*

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3. (a) In hydrogen gas what happens to the average speed of the molecules if the temperature is increased? *[1]*

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(b) Explain, in terms of molecules, what happens to the **pressure** of a sample of hydrogen gas if its volume is halved and the temperature kept constant. *[3]*

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SECTION B

*Answer only **one** of the questions in this section. You may use the lined pages at the end of this paper or continue 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.*

4. (a) Use these equations, which refer to aqueous solutions, to answer the questions which follow:

$$Fe(s) + Cu^{2+}(aq) \rightarrow Fe^{2+}(aq) + Cu(s)$$

$$Cu(s) + 2Ag^{+}(aq) \rightarrow Cu^{2+}(aq) + 2Ag(s)$$

$$Mg(s) + Fe^{2+}(aq) \rightarrow Mg^{2+}(aq) + Fe(s)$$

(i) List the four metals above in order of **decreasing** reactivity. *[1]*

(ii) Define *oxidation*, in electronic terms, using **one** example from above. *[2]*

(iii) Define *reduction*, in terms of oxidation number, using **one** example from above. *[2]*

(iv) State and explain which is the **strongest reducing agent** in the examples above. *[2]*

(v) State and explain which is the **strongest oxidising agent** in the examples above. *[2]*

(vi) Deduce whether a silver coin will react with aqueous magnesium chloride. *[2]*

(b) Sketch a diagram of a cell used to electrolyse a molten salt. Label the essential components. *[4]*

(c) Describe how electrode reactions occur in an electrolytic cell and state the products at each electrode when molten copper(II) chloride is electrolysed. *[5]*

5. (a) (i) Explain what is meant by the term *standard enthalpy change of reaction.* *[3]*

(ii) Describe an experiment to determine the enthalpy change of the reaction between dilute hydrochloric acid and aqueous sodium hydroxide. Show how the value of ΔH would be calculated from the data obtained. *[9]*

(iii) Draw an enthalpy level diagram for the neutralisation reaction above. Indicate on your diagram the enthalpy change of the reaction and hence compare the relative stabilities of reactants and products. *[4]*

(b) Explain, giving **one** example, the usefulness of Hess's Law in determining ΔH values. *[4]*

6. (a) Discuss the factors which affect the boiling points of covalently bonded compounds by reference to the following pairs of organic substances, whose boiling points are given:

- ethane (184 K) and butane (273 K);
- ethane (184 K) and bromoethane (311 K);
- bromoethane (311 K) and ethanol (352 K). *[8]*

(b) For each of the following conversions:

(i) ethene → poly(ethene)

(ii) ethanol → ethyl ethanoate

(iii) any 2-aminoacid → a tripeptide

identify the type of reaction, the reagent(s) needed, the condition(s) needed and the structural formula of the product. *[12]*