

CHEMISTRY

Standard Level

Thursday 6 May 1999 (afternoon)

Paper 2

1 hour

A

Candidate name:	Candidate category & number:								
	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10%; height: 20px;"></td> <td style="width: 10%;"></td> </tr> </table>								
<p>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.</p> <p style="text-align: center;">INSTRUCTIONS TO CANDIDATES</p> <p>Write your candidate name and number in the boxes above.</p> <p>Do NOT open this examination paper until instructed to do so.</p> <p>Section A: Answer ALL of Section A in the spaces provided.</p> <p>Section B: Answer ONE question from Section B. 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.</p> <p>At the end of the examination, complete box B below with the number of the question answered in Section B.</p>									

B

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

C

EXAMINER	MODERATOR
/20	/20
/20	/20
TOTAL	TOTAL
/40	/40

D

IBCA
/20
/20
TOTAL
/40

EXAMINATION MATERIALS

Required:

Chemistry Data Booklet

Calculator

Millimetre square graph paper

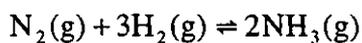
Allowed:

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

SECTION A

Answer ALL the questions in this Section.

1. Ammonia, NH₃, is manufactured by the Haber process according to the following equilibrium reaction:



The following data gives approximate values for the yield of ammonia at various temperatures and pressures.

Temperature (° C)	Pressure (atm)	Molar % of NH ₃ at equilibrium
400	200	40
400	300	50
400	400	57
450	200	25
500	200	18

Use the data to deduce:

- (a) (i) the effect of pressure on the yield of ammonia. Explain your answer. [2]

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- (ii) whether the synthesis of ammonia is endothermic or exothermic. Explain your answer. [2]

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- (b) State what combination of pressure (*i.e.* high or low) and temperature (*i.e.* high or low) would give the highest % of ammonia. [1]

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- (c) Write the equilibrium constant expression, K_c , for the formation of ammonia. [2]

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(This question continues on the following page)

(Question 1 continued)

(d) State and explain what happens to the value of K_c if the temperature is increased. [2]

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(e) How does the catalyst affect:

(i) the rate of formation of ammonia; [1]

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(ii) the position of equilibrium? [1]

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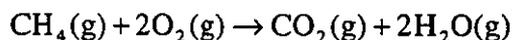
2. (a) Define *average bond enthalpy*. [2]

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(b) Using the following average bond enthalpies (kJ mol⁻¹);

C-H 412, O=O 496, C=O 743, O-H 463

calculate the enthalpy change for the following reaction: [2]



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3. (a) State and explain the trend in boiling points of the first 10 members of the alkene series. [3]

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(b) Explain why methanol has a **much** higher boiling point than ethane ($M_r = 30$). [2]

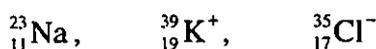
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SECTION B

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

4. (a) A carbon atom has a mass number of 12 and an atomic number of 6. Define the underlined terms and draw a diagram showing clearly the arrangement of fundamental particles in this carbon atom. [4]

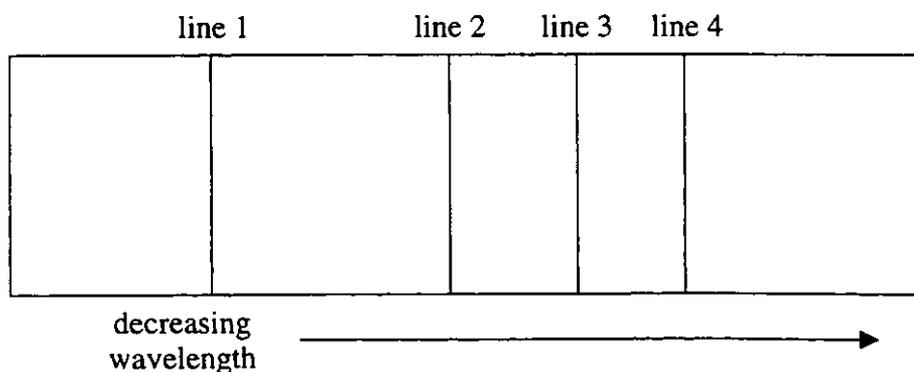
(b) For each of the species listed below, state the number of protons, neutrons and electrons, and give the electronic configuration: [6]



(c) For the three elements Na, K and Cl, state, with a reason in each case, which pair is in the same group and which pair is in the same period of the Periodic Table. [4]

(d) In addition to ${}^{35}\text{Cl}$ there is another naturally occurring isotope of chlorine with a mass number of 37. If the relative atomic mass of chlorine is 35.5, state and explain which isotope is the more abundant. [2]

(e) Part of the hydrogen spectrum is shown below.



(i) State **two** features of the part of the spectrum that occur to the right of line 4. [2]

(ii) What change in the hydrogen atom occurs to produce a line in the spectrum? [2]

5. This question refers to chemical bonding.

- (a) Draw electron dot structures for methane, ammonia and water. Use these structures to explain why the molecular bond angles decrease in the order;

methane > ammonia > water [7]

- (b) Draw electron dot structures for N_2 and F_2 and explain why F_2 is much more reactive than N_2 . [3]

- (c) Explain why the melting point of the elements increase in the order;

sodium < magnesium < aluminium < silicon [5]

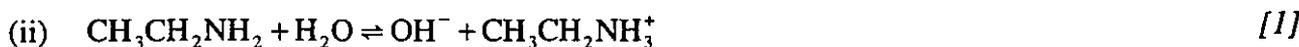
- (d) Compare the polarity of the bonds N–Cl and C–Cl. Are the molecules NCl_3 and CCl_4 polar or non-polar? In all your answers give your reasons. [5]

6. (a) By means of balanced equations, give **three** different types of chemical reaction of an acid, such as aqueous sulphuric acid. [3]

- (b) (i) Define an acid and a base according to the Brønsted–Lowry theory. [1]

- (ii) Ammonia acts as a base in water. Write a balanced equation for this reaction and state what would be observed if the final solution were tested with pH paper. [3]

- (c) In the following reactions identify clearly the acid, conjugate base, base and conjugate acid;



- (d) Using the equation (i) in (c), state and explain the relative strengths of nitric and sulphuric acid. [2]

- (e) What is the difference between a strong acid and a weak acid? How could you distinguish between them experimentally? [4]

- (f) Two acidic solutions, **A** and **B**, of equal concentration, have pH values of 2 and 6 respectively.

- (i) Indicate which acid is stronger and calculate how many times more acidic it is. [3]

- (ii) Give **two** ways in which solution **A** could be treated to produce a solution of pH 6. [2]

