

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CHEMISTRY



Paper 3 (Extended)

0620/03

October/November 2005

1 hour 15 minutes

Candidates answer on the Question Paper.
No Additional Materials required.

Candidate
Name

--

Centre
Number

--	--	--	--	--

Candidate
Number

--	--	--	--

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use a pencil for any diagrams, graphs or rough working.

WRITE IN THE BOXES PROVIDED ON THE QUESTION PAPER

DO **NOT** WRITE IN THE BARCODE.

DO **NOT** WRITE IN THE GREY AREAS BETWEEN THE PAGES.

Do not use staples, paper clips, highlighters, glue or correction fluid.

You may use a calculator.

Answer **all** questions.

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

A copy of the Periodic Table is printed on page 16.

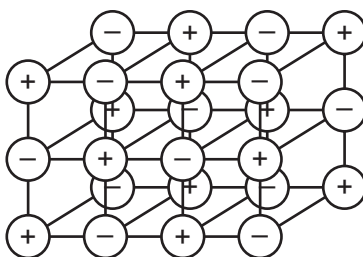
For Examiner's Use	
1	
2	
3	
4	
5	
6	
7	
Total	

This document consists of **14** printed pages and **2** blank page.



- 1 (a) The structure of a typical ionic compound is a regular arrangement of positive and negative ions.

For
Examiner's
Use



- (i) What is the name of this regular arrangement of particles?

..... [1]

- (ii) Give **two** physical properties of ionic compounds.

.....
..... [2]

- (b) Ions are formed by electron loss or gain. The electron distribution of a magnesium atom is $2 + 8 + 2$ and of a nitrogen atom is $2 + 5$.

- (i) Give the formula of the magnesium ion.

..... [1]

- (ii) Give the formula of the nitride ion.

..... [1]

- (iii) What is the formula of the ionic compound, magnesium nitride?

..... [1]

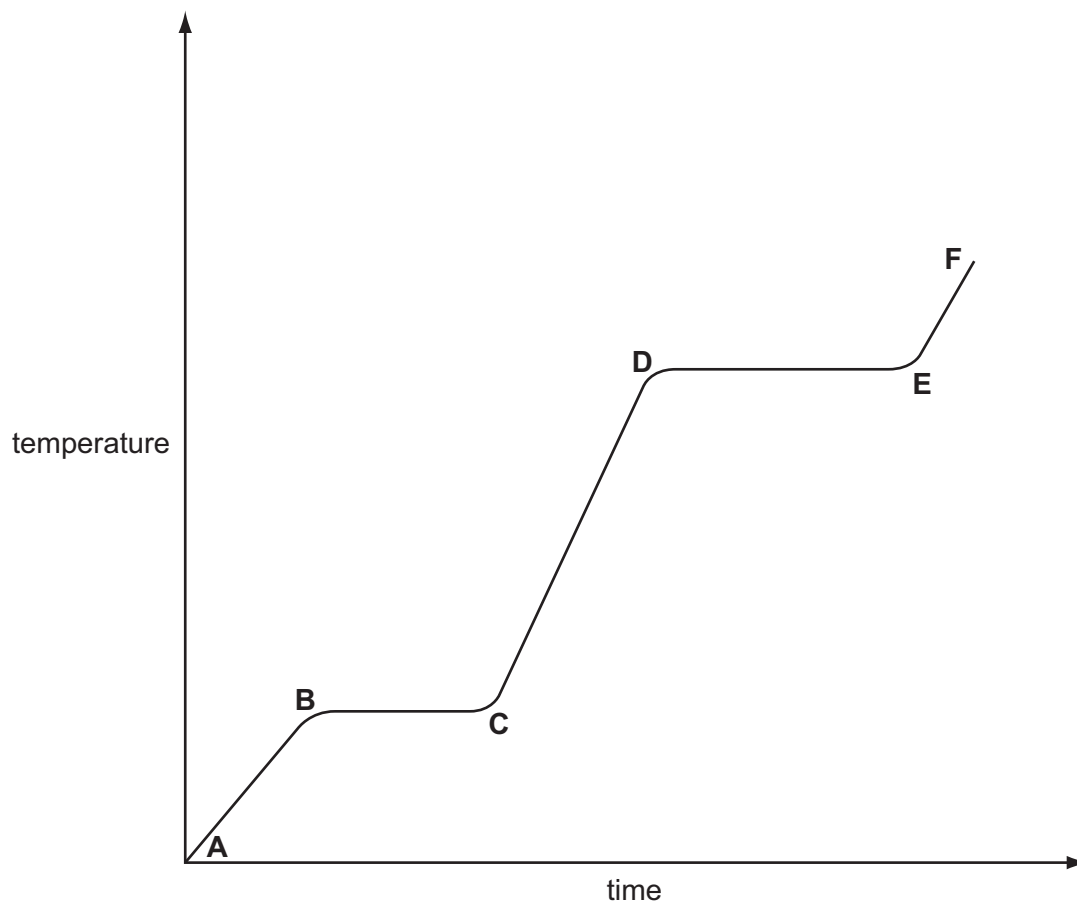
- (iv) In this compound there is an ionic bond. Why are the two ions attracted to each other?

..... [1]

- 2 Ethanoic acid is a colourless liquid at room temperature. It has the typical acid properties and forms compounds called ethanoates.

For
Examiner's
Use

- (a) A pure sample of ethanoic acid is slowly heated from 0°C to 150°C and its temperature is measured every minute. The results are represented on the graph below.



- (i) Name the change that occurs in the region **D** to **E**.

..... [1]

- (ii) What would be the difference in the region **B** to **C** if an impure sample had been used?

..... [1]

- (iii) Sketch on the graph how the line would continue if the acid was heated to a higher temperature. [1]

- (iv) Complete the following table that compares the separation and movement of the molecules in regions **C** to **D** with those in **E** to **F**.

For
Examiner's
Use

	C to D	E to F
separation (distance between particles)
movement of particles	random and slow
Can particles move apart to fill any volume?

[5]

- (b) Complete the word equations for the reactions of ethanoic acid.

calcium + ethanoic acid \longrightarrow
+

..... + ethanoic acid \longrightarrow zinc ethanoate + water [2]

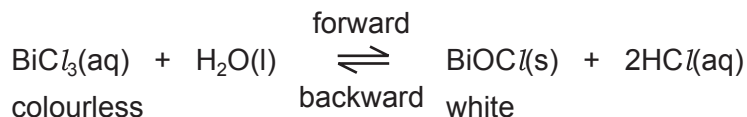
- (c) Write the symbol equation for the reaction between ethanoic acid and sodium hydroxide.

..... [2]

- 3 Reversible reactions can come to equilibrium. They have both a forward and a backward reaction.

For
Examiner's
Use

- (a) When water is added to an acidic solution of bismuth(III) chloride, a white precipitate forms and the mixture slowly goes cloudy.



- (i) Explain why the rate of the forward reaction decreases with time.

.....
 [2]

- (ii) Why does the rate of the backward reaction increase with time?

.....
 [1]

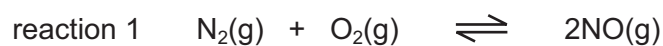
- (iii) After some time why does the appearance of the mixture remain unchanged?

.....
 [2]

- (iv) When a few drops of concentrated hydrochloric acid are added to the cloudy mixture, it changes to a colourless solution. Suggest an explanation.

.....
 [2]

(b) Both of the following reactions are reversible.



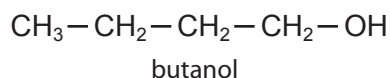
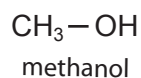
- (i) Suggest a reason why an increase in pressure does not affect the position of equilibrium for reaction 1.

..... [1]

- (ii) What effect would an increase in pressure have on the position of equilibrium for reaction 2? Give a reason for your answer.

.....
..... [2]

- 4 The alcohols form a homologous series. The first member is methanol and the fourth is butanol.



For
Examiner's
Use

- (a) (i) Give **two** general characteristics of a homologous series.

.....

 [2]

- (ii) Calculate the mass of one mole of the C₈ alcohol.

.....
 [2]

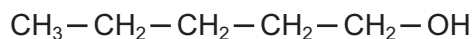
- (b) Give the name and structural formula of the third member of this series.

name [1]

structural formula

[1]

- (c) The structural formula of the fifth member, pentan-1-ol, is drawn below.



- (i) Draw the structural formula of an isomer of this alcohol.

[1]

(ii) Predict the names of the product(s) formed when pentan-1-ol

For
Examiner's
Use

- reacts with an excess of oxygen,

..... and [1]

- is dehydrated to form an alkene,

..... [1]

- is oxidised by acidified potassium dichromate(VI).

..... [1]

- 5 Strontium and zinc are both metals with a valency of 2. Strontium is more reactive than zinc. Its chemistry is similar to that of calcium.

For
Examiner's
Use

- (a) (i) Complete the following table that shows the number of protons, electrons and neutrons in each particle.

particle	protons	electrons	neutrons
^{88}Sr			
^{90}Sr			
$^{65}\text{Zn}^{2+}$			

[3]

- (ii) Explain why ^{88}Sr and ^{90}Sr are isotopes.

..... [1]

- (iii) Complete the electron distribution of an atom of strontium.

2 + 8 + 18 + + [1]

- (b) The major ore of zinc is zinc blende, ZnS .

- (i) Describe how zinc is extracted from zinc blende.

.....

 [2]

- (ii) Give a use of zinc.

..... [1]

(c) The major ore of strontium is its carbonate, SrCO_3 . Strontium is extracted by the electrolysis of its molten chloride.

(i) Name the reagent that will react with the carbonate to form the chloride.

..... [1]

(ii) The electrolysis of molten strontium chloride produces strontium metal and chlorine. Write ionic equations for the reactions at the electrodes.

negative electrode (cathode)

positive electrode (anode) [2]

(iii) One of the products of the electrolysis of concentrated aqueous strontium chloride is chlorine. Name the other two.

..... [2]

(d) Both metals react with water.

(i) Write a word equation for the reaction of zinc and water and state the reaction conditions.

word equation [1]

conditions [2]

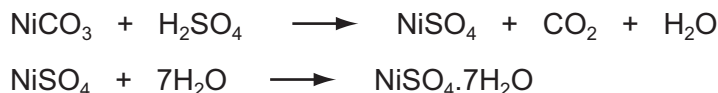
(ii) Write an equation for the reaction of strontium with water and give the reaction condition.

equation [2]

condition [1]

- 6 (a) The following method is used to make crystals of hydrated nickel sulphate.

An excess of nickel carbonate, 12.0 g, was added to 40 cm³ of sulphuric acid, 2.0 mol/dm³. The unreacted nickel carbonate was filtered off and the filtrate evaporated to obtain the crystals.



Mass of one mole of NiSO₄·7H₂O = 281 g

Mass of one mole of NiCO₃ = 119 g

- (i) Calculate the mass of unreacted nickel carbonate.

Number of moles of H₂SO₄ in 40 cm³ of 2.0 mol/dm³ acid = 0.08

Number of moles of NiCO₃ reacted =

Mass of nickel carbonate reacted = g

Mass of unreacted nickel carbonate = g [3]

- (ii) The experiment produced 10.4 g of hydrated nickel sulphate. Calculate the percentage yield.

The maximum number of moles of NiSO₄·7H₂O that could be formed =

.....

The maximum mass of NiSO₄·7H₂O that could be formed = g

The percentage yield = % [3]

- (b) In the above method, a soluble salt was prepared by neutralising an acid with an insoluble base. Other salts have to be made by different methods.

- (i) Give a brief description of how the soluble salt, rubidium sulphate could be made from the soluble base, rubidium hydroxide.

.....

.....

.....

..... [3]

For
Examiner's
Use

- (ii) Suggest a method of making the insoluble salt, calcium fluoride.

*For
Examiner's
Use*

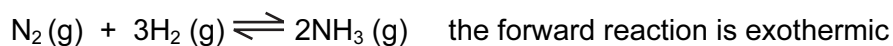
.....

.....

.....

..... [3]

- 7 In 1909, Haber discovered that nitrogen and hydrogen would react to form ammonia. The yield of ammonia was 8%.



catalyst platinum
temperature 600 °C
pressure 200 atm

For
Examiner's
Use

- (a) Describe how hydrogen is obtained for the modern process.

.....
..... [2]

- (b) (i) What is the catalyst in the modern process?

..... [1]

- (ii) Explain why the modern process, which uses a lower temperature, has a higher yield of 15%.

.....
..... [2]

- (c) (i) Complete the following table that describes the bond breaking and forming in the reaction between nitrogen and hydrogen to form ammonia.

bonds	energy change /kJ	exothermic or endothermic
1 mole of $\text{N} \equiv \text{N}$ broken	+945
3 moles of broken	+1308
6 moles of $\text{N} - \text{H}$ formed	-2328

[3]

- (ii) Explain, using the above data, why the forward reaction is exothermic.

.....
..... [2]

BLANK PAGE

BLANK PAGE

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

University of Cambridge International Examinations is part of the University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.

DATA SHEET
The Periodic Table of the Elements

Group																				
I	II											III	IV	V	VI	VII	0			
		<div>1H Hydrogen1</div>																<div>2He Helium2</div>		
<div>7Li Lithium3</div>	<div>9Be Beryllium4</div>																<div>19F Fluorine9</div>		<div>20Ne Neon10</div>	
<div>23Na Sodium11</div>	<div>24Mg Magnesium12</div>																<div>16O Oxygen8</div>		<div>35.5Cl Chlorine17</div>	<div>40Ar Argon18</div>
<div>39K Potassium19</div>	<div>40Ca Calcium20</div>	<div>45Sc Scandium21</div>	<div>48Ti Titanium22</div>	<div>51V Vanadium23</div>	<div>52Cr Chromium24</div>	<div>55Mn Manganese25</div>	<div>56Fe Iron26</div>	<div>59Co Cobalt27</div>	<div>59Ni Nickel28</div>	<div>64Cu Copper29</div>	<div>65Zn Zinc30</div>	<div>70Ga Gallium31</div>	<div>73Ge Germanium32</div>	<div>75As Arsenic33</div>	<div>79Se Selenium34</div>	<div>80Br Bromine35</div>	<div>84Kr Krypton36</div>			
<div>85Rb Rubidium37</div>	<div>88Sr Strontium38</div>	<div>89Y Yttrium39</div>	<div>91Zr Zirconium40</div>	<div>93Nb Niobium41</div>	<div>96Mo Molybdenum42</div>	<div>101Tc Technetium43</div>	<div>101Ru Ruthenium44</div>	<div>103Rh Rhodium45</div>	<div>106Pd Palladium46</div>	<div>108Ag Silver47</div>	<div>112Cd Cadmium48</div>	<div>115In Indium49</div>	<div>119Sn Tin50</div>	<div>122Sb Antimony51</div>	<div>128Te Tellurium52</div>	<div>127I Iodine53</div>	<div>131Xe Xenon54</div>			
<div>133Cs Caesium55</div>	<div>137Ba Barium56</div>	<div>139La Lanthanum57</div>	<div>178Hf Hafnium72</div>	<div>181Ta Tantalum73</div>	<div>184W Tungsten74</div>	<div>186Re Rhenium75</div>	<div>190Os Osmium76</div>	<div>192Ir Iridium77</div>	<div>195Pt Platinum78</div>	<div>197Au Gold79</div>	<div>201Hg Mercury80</div>	<div>204Tl Thallium81</div>	<div>207Pb Lead82</div>	<div>209Bi Bismuth83</div>	<div>210Po Polonium84</div>	<div>210At Astatine85</div>	<div>222Rn Radon86</div>			
<div>Fr Francium87</div>	<div>226Ra Radium88</div>	<div>227Ac Actinium89</div>																		
*58-71 Lanthanoid series																				
90-103 Actinoid series																				
<div>a = relative atomic mass</div>																				
<div>X = atomic symbol</div>																				
<div>b = proton (atomic) number</div>																				
		<div>140Ce Cerium58</div>	<div>141Pr Praseodymium59</div>	<div>144Nd Neodymium60</div>	<div>150Sm Samarium62</div>	<div>152Eu Europium63</div>	<div>157Gd Gadolinium64</div>	<div>159Tb Terbium65</div>	<div>162Dy Dysprosium66</div>	<div>165Ho Holmium67</div>	<div>167Er Erbium68</div>	<div>169Tm Thulium69</div>	<div>173Yb Ytterbium70</div>	<div>175Lu Lutetium71</div>						
		<div>232Th Thorium90</div>	<div>238Pa Protactinium91</div>	<div>238U Uranium92</div>	<div>238Pu Plutonium94</div>	<div>238Am Americium95</div>	<div>238Cm Curium96</div>	<div>238Bk Berkelium97</div>	<div>238Cf Californium98</div>	<div>238Es Einsteinium99</div>	<div>238Fm Fermium100</div>	<div>238Md Mendelevium101</div>	<div>238No Nobelium102</div>	<div>238Lr Lawrencium103</div>						

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).