WELSH JOINT EDUCATION COMMITTEE

General Certificate of Secondary Education

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240/02

ADDITIONAL SCIENCE

HIGHER TIER (Grades D-A*)

CHEMISTRY 2

A. M. WEDNESDAY, 13 June 2007

(45 minutes)

For Examiner's use only	
Total Marks	

ADDITIONAL MATERIALS

In addition to this paper you may require a calculator.

INSTRUCTIONS TO CANDIDATES

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

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

You are reminded of the necessity for good English and orderly presentation in your answers.

The Periodic Table is printed on the back cover of the examination paper and the formulae for some common ions on the inside of the back cover.

No certificate will be awarded to a candidate detected in any unfair practice during the examination.

*Answer **all** questions.*

1. Potassium nitrate dissolves in water to form a solution of potassium nitrate. The table below shows the maximum mass of potassium nitrate that can dissolve in 100 g of water at different temperatures. The maximum mass of solid that can dissolve in 100 g of water is called the solubility of a substance.

Temperature / °C	*Solubility of potassium nitrate* / g per 100 g of water
0	13
10	21
20	32
30	47
40	64
50	84

(i)   Plot the points on the grid opposite and draw a smooth curve through them. Two points have been plotted for you. [3]

(ii) Use the graph to find the solubility of potassium nitrate at 35 °C. [1]

.... g per 100 g of water.

(iii) Use the graph to calculate the mass of potasium nitrate that would dissolve in 50 g of water at 25 °C. [2]

....

....

....

(iv) Calculate the mass of potassium nitrate **crystals** that would form when a solution containing 64 g of potassium nitrate in 100 g of water was cooled to 20 °C. [2]

....

....

....

solubility of potassium nitrate / g per 100 g of water
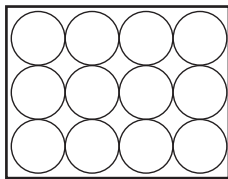
temperature / °C

Turn over.

8
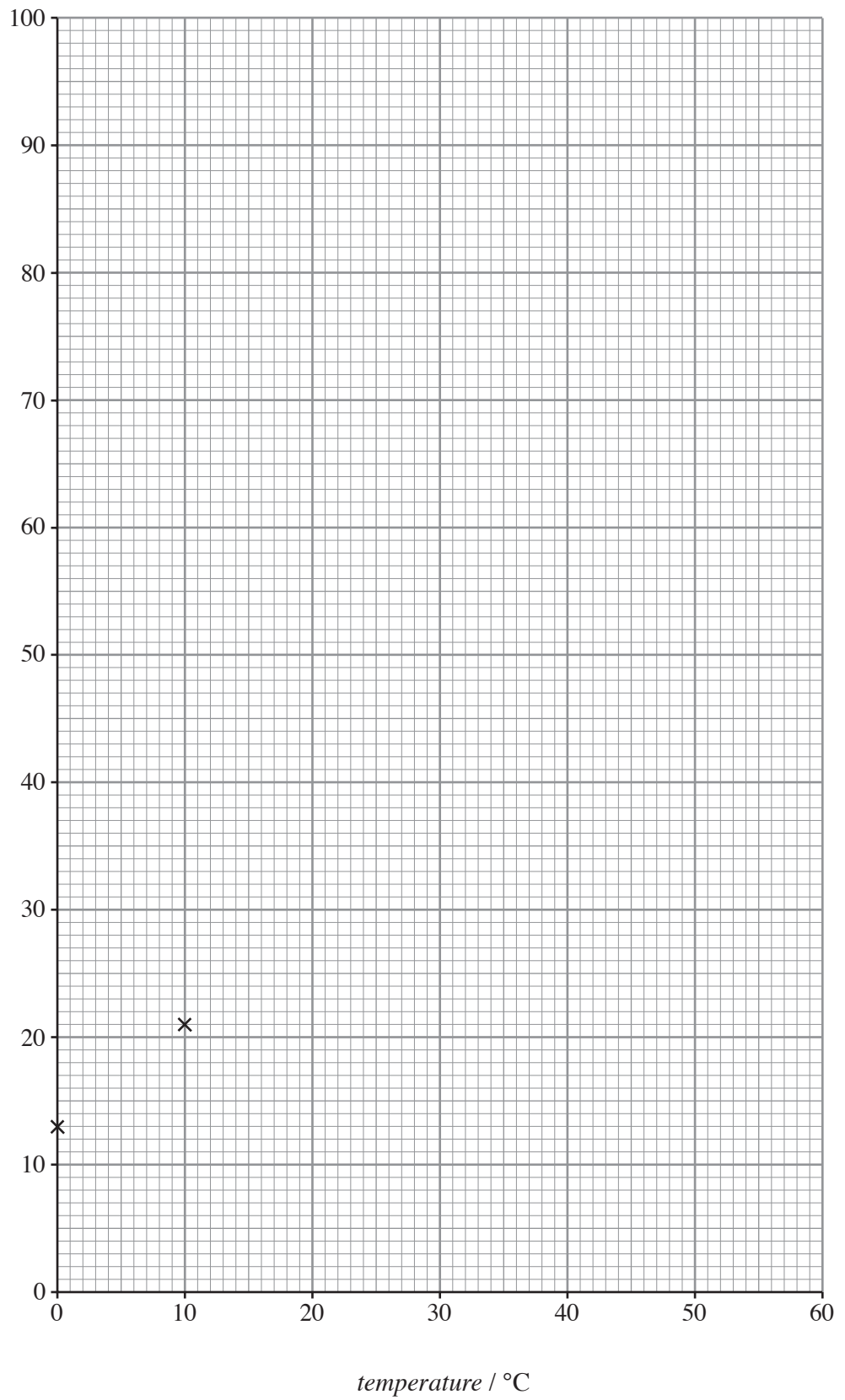
2. Nitinol (NiTi) is an example of a shape memory alloy which was first developed in 1962-63.

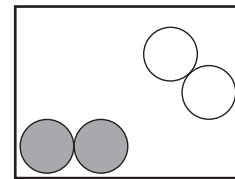(i) Name the **two** metals present in this alloy. [1]

.... and ....

(ii) State which of the following, **A**, **B**, **C**, **D** or **E**, best represents the structure of solid nitinol. [1]

A
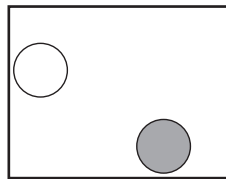
B

C
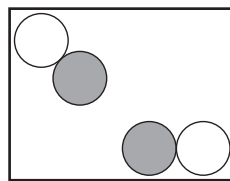
D
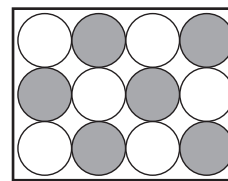
E

The structure of nitinol is best represented by ....

(iii) Give **one** use of nitinol. [1]

....

(iv) State the special property that nitinol has compared with other alloys or metals. [1]

....

....

(v) Photochromic materials are examples of smart materials.

I. Photochromic materials have an unusual property. State this property. [1]

....

....

II. Give an example of such a material in every-day use. [1]

....

6

3. The following diagram shows how aluminium is extracted from its ore.

oxygen — ... — molten aluminium oxide
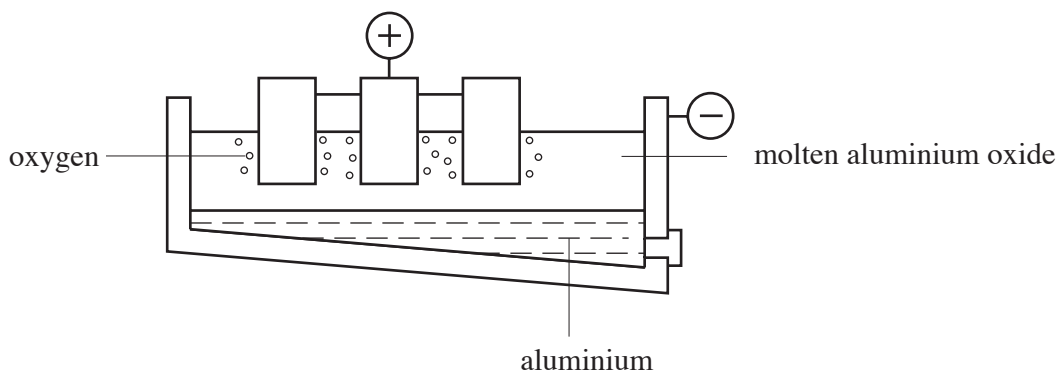
aluminium

(i) Give the name of the process used in the extraction of aluminium. [1]

....

(ii) Give the name of the electrolyte used in this extraction. [1]

....

(iii) The word equation for the overall reaction that takes place during the extraction is shown below.

aluminium oxide ⟶ aluminium + oxygen

During the reaction, reduction takes place. Use the above word equation to explain the meaning of the term ***reduction***. [1]

....

....

(iv) The extraction of aluminium from its ore uses large amounts of electricity and is therefore very expensive. State **one** method of reducing the cost of aluminium metal. [1]

....

(v) Aluminium is a very good conductor of electricity and has a low density.
Give **one** use of aluminium which relies on **both** of these properties. [1]

....

4. (i) The table below gives some properties of 4 different substances labelled **A**, **B**, **C** and **D**. These four substances are diamond, iron, methane and sodium chloride but not necessarily in that order.

Substance	Melting point / °C	Boiling point / °C	Conducts electricity	Conducts heat	Density / g cm^{-3}
A	801	1465	yes when molten	no	2·16
B	1540	2750	yes	yes	7·9
C	3800	4800	no	no	3·5
D	-182	-162	no	no	0·47

Use **only** the information in the table to identify **each** of the following substances and to give a reason for your choice.

I. *Iron*. [2]

Substance ....
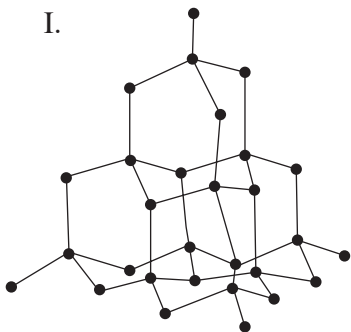
Reason ....

....

II. *Methane*. [2]

Substance ....

Reason ....

....

(ii)   Name the form of carbon represented by the structure: [2]

I.

....
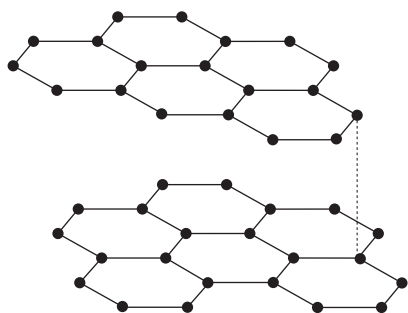
II.

....

Turn over.

6

5. (i) Sodium, atomic number 11, reacts with oxygen, atomic number 8, to form sodium oxide.

The electronic structure of sodium is 2,8,1 and of oxygen is 2,6.

Explain, by means of a diagram or otherwise, the electronic changes that take place during the formation of sodium oxide. Include the charges on the ions. [4]
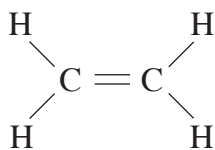
....

....

....

....

(ii) Water, H_2O, consists of molecules. Hydrogen has the atomic number 1.

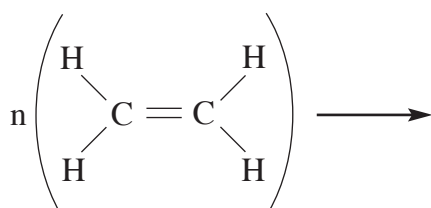By means of a diagram, show the bonding in a water molecule. [2]

6

6. (i) Give the **name** of the hydrocarbon with the structural formula shown below. [1]

....

(ii) The hydrocarbon shown above can be used to make a polymer.
Complete the symbol equation for making the polymer. [2]

....

(iii) A different polymer is known as PVC. Give the chemical name for PVC. [1]

....

(iv) PVC has many different uses. PVC-covered cables are used in electric blankets and PVC is used to make window frames.

Give the **main** reason, apart from cost, for using

I. PVC-covered cables in electric blankets, [1]

....

II. PVC for window frames. [1]

....

Turn over.

7. *(a)* When chlorine gas is passed over heated iron filings, a brown solid is formed.

During an experiment the following results were obtained.

Mass of iron filings and container   =   3.660 g
Mass of iron chloride formed and the container   =   4.725 g
Mass of container   =   3.100 g

Calculate

(i)   the mass of the iron filings used,   [1]

....

(ii)   the mass of the chlorine used,   [1]

....

(iii)   the simplest formula of the iron chloride.   [2]

$$[A_r(Fe) = 56; \quad A_r(Cl) = 35.5]$$

Working must be shown in your answer.

....

....

....

(b) Magnesium reacts with oxygen to form magnesium oxide. The balanced symbol equation for the reaction is shown below.

$$2\,Mg \quad + \quad O_2 \quad \longrightarrow \quad 2\,MgO$$

(i)   Use the equation for the reaction between magnesium and oxygen to calculate the maximum mass of magnesium oxide formed when 12 g of magnesium reacts with excess of oxygen.   [3]

$$[A_r(Mg) = 24; \quad A_r(O) = 16]$$

....

....

....

....

(ii)   During an actual experiment, only 18 g of magnesium oxide was formed from 12 g of magnesium. Calculate the percentage yield of the reaction.   [2]

....

....

....

9

8. A student was given two bottles labelled **A** and **B**. Both contained white solids. One was ammonium chloride and the other was sodium chloride. Using sodium hydroxide solution, describe how the student would be able to find out which was the ammonium chloride and which was the sodium chloride. [4]

Describe what was done and how any gas produced was identified.

....

....

....

....

....

....

....

Turn over.

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FORMULAE FOR SOME COMMON IONS

POSITIVE IONS		NEGATIVE IONS	
Name	**Formula**	**Name**	**Formula**
Aluminium	Al^{3+}	Bromide	Br^-
Ammonium	NH_4^+	Carbonate	CO_3^{2-}
Barium	Ba^{2+}	Chloride	Cl^-
Calcium	Ca^{2+}	Fluoride	F^-
Copper(II)	Cu^{2+}	Hydroxide	OH^-
Hydrogen	H^+	Iodide	I^-
Iron(II)	Fe^{2+}	Nitrate	NO_3^-
Iron(III)	Fe^{3+}	Oxide	O^{2-}
Lithium	Li^+	Sulphate	SO_4^{2-}
Magnesium	Mg^{2+}		
Nickel	Ni^{2+}		
Potassium	K^+		
Silver	Ag^+		
Sodium	Na^+		

PERIODIC TABLE OF ELEMENTS

Group

1	2		3	4	5	6	7	0
								4 He 2 Helium
1 H 1 Hydrogen								
7 Li 3 Lithium	9 Be 4 Beryllium		11 B 5 Boron	12 C 6 Carbon	14 N 7 Nitrogen	16 O 8 Oxygen	19 F 9 Fluorine	20 Ne 10 Neon
23 Na 11 Sodium	24 Mg 12 Magnesium		27 Al 13 Aluminium	28 Si 14 Silicon	31 P 15 Phosphorus	32 S 16 Sulphur	35 Cl 17 Chlorine	40 Ar 18 Argon
39 K 19 Potassium	40 Ca 20 Calcium	45 Sc 21 Scandium / 48 Ti 22 Titanium / 51 V 23 Vanadium / 52 Cr 24 Chromium / 55 Mn 25 Manganese / 56 Fe 26 Iron / 59 Co 27 Cobalt / 59 Ni 28 Nickel / 64 Cu 29 Copper / 65 Zn 30 Zinc	70 Ga 31 Gallium	73 Ge 32 Germanium	75 As 33 Arsenic	79 Se 34 Selenium	80 Br 35 Bromine	84 Kr 36 Krypton
86 Rb 37 Rubidium	88 Sr 38 Strontium	89 Y 39 Yttrium / 91 Zr 40 Zirconium / 93 Nb 41 Niobium / 96 Mo 42 Molybdenum / 99 Tc 43 Technetium / 101 Ru 44 Ruthenium / 103 Rh 45 Rhodium / 106 Pd 46 Palladium / 108 Ag 47 Silver / 112 Cd 48 Cadmium	115 In 49 Indium	119 Sn 50 Tin	122 Sb 51 Antimony	128 Te 52 Tellurium	127 I 53 Iodine	131 Xe 54 Xenon
133 Cs 55 Caesium	137 Ba 56 Barium	139 La 57 Lanthanum / 179 Hf 72 Hafnium / 181 Ta 73 Tantalum / 184 W 74 Tungsten / 186 Re 75 Rhenium / 190 Os 76 Osmium / 192 Ir 77 Iridium / 195 Pt 78 Platinum / 197 Au 79 Gold / 201 Hg 80 Mercury	204 Tl 81 Thallium	207 Pb 82 Lead	209 Bi 83 Bismuth	210 Po 84 Polonium	210 At 85 Astatine	222 Rn 86 Radon
223 Fr 87 Francium	226 Ra 88 Radium	227 Ac 89 Actinium						

Key:

Mass number → A

X — Element Symbol

Atomic number → Z

Name