Candidate Name	Centre Number	Candidate Number
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WJEC CBAC

GCSE

240/02

ADDITIONAL SCIENCE

HIGHER TIER

CHEMISTRY 2

A.M. WEDNESDAY, 26 May 2010

45 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**4**	
2.	**6**	
3.	**8**	
4.	**3**	
5.	**4**	
6.	**7**	
7.	**9**	
8.	**5**	
9.	**4**	
Total	**50**	

ADDITIONAL MATERIALS

In addition to this paper you may require a calculator and a ruler.

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

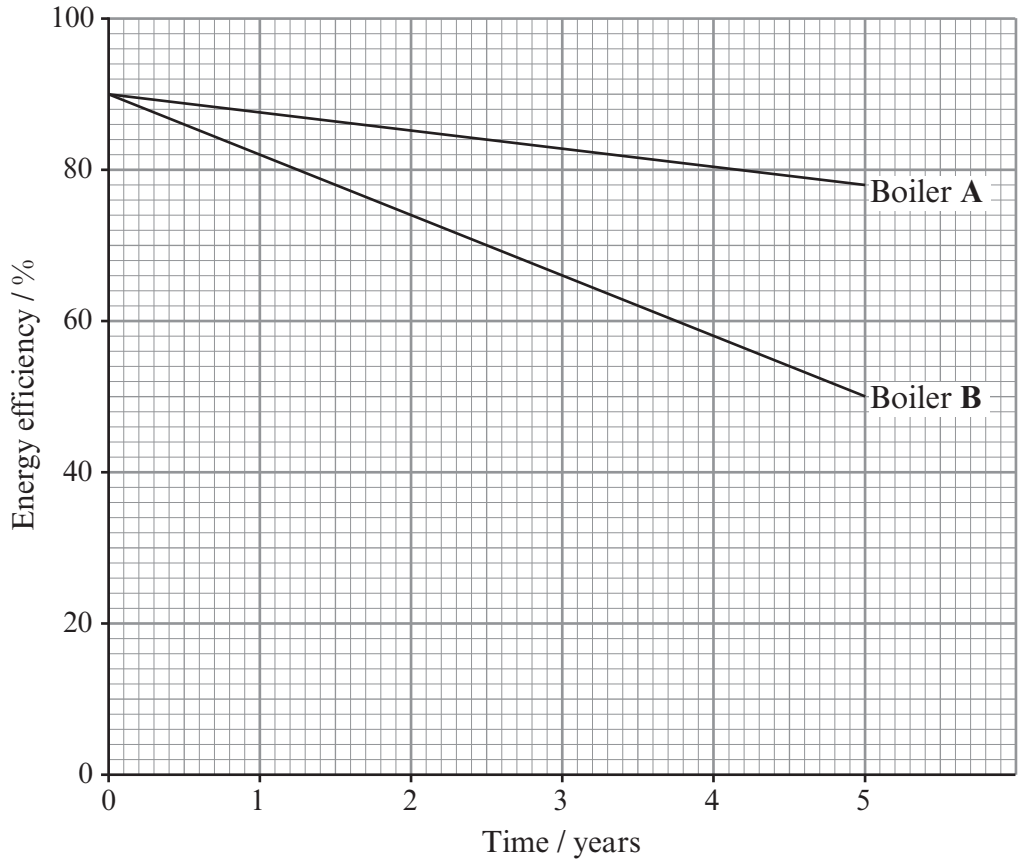
The number of marks is given in brackets at the end of each question or part-question.

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.

Answer **all** *questions.*

1. The following graph shows how the energy efficiency of two identical water boilers changes during the first 5 years of use.



Use the graph to answer part (a).

(a) Calculate the

I. **difference** in efficiency between boilers **A** and **B** after 1 year, [1]

..... %

II. **decrease** in efficiency of boiler **B** over 5 years. [1]

..... %

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(b) Both boilers have been used for the same amount of time in different hard water areas.

(i) Give a reason why the efficiency of both boilers is decreasing. [1]

.....

.....

(ii) State why the efficiency of boiler **A** decreases less than that of boiler **B**. [1]

.....

.....

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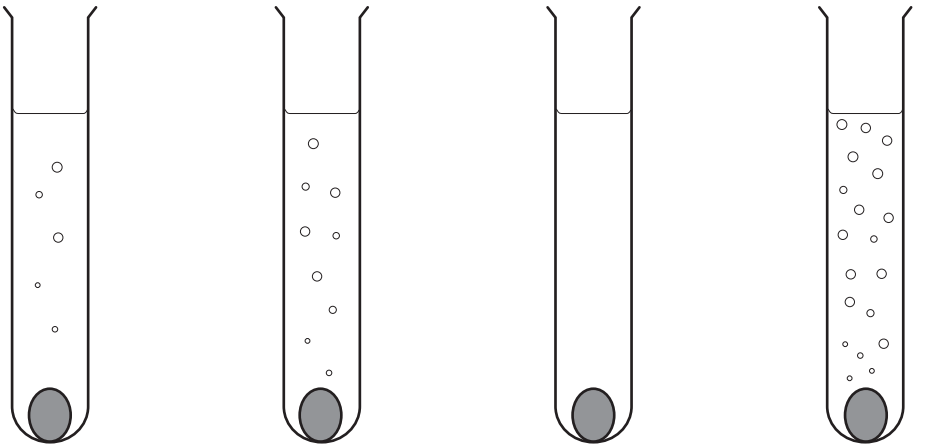
2. Four metals, iron, zinc, copper and magnesium, were placed in hydrochloric acid of equal concentration at room temperature. The diagrams below show what happened.



Iron Zinc Copper Magnesium

(i) Place the metals in order of reactivity, with the **most reactive** first. [1]

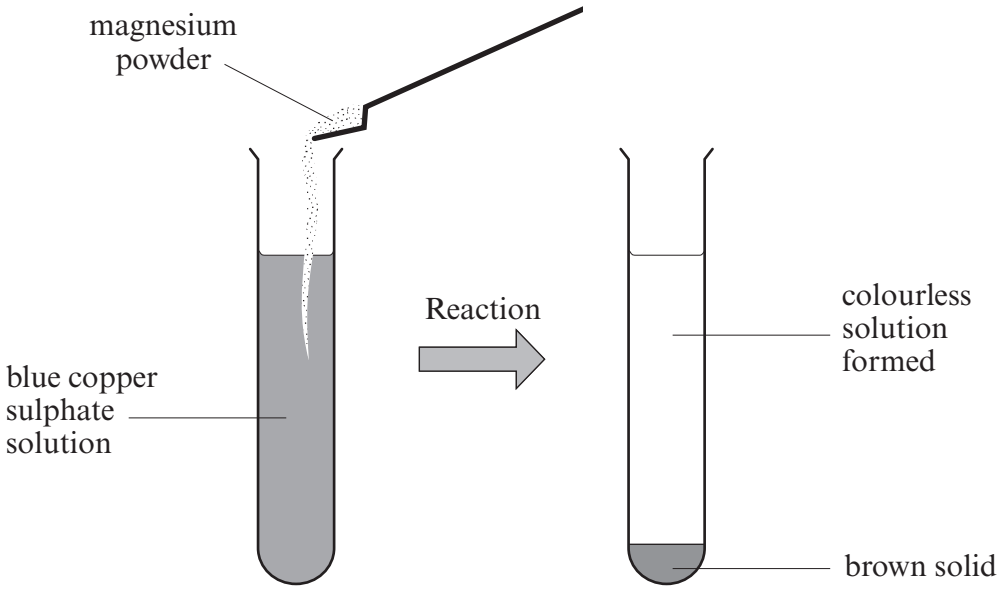
Most reactive .....

.....

.....

Least reactive .....

(ii) The following diagram shows what happens when magnesium powder is added to copper sulphate solution.



I. Give a **word** equation for the reaction. [2]

..... + ... ⟶ ..... + ...

II. Explain, in terms of the reactivity series, why this reaction takes place. [1]

.....

(iii) When iron oxide is heated with carbon, iron is produced. The iron oxide is ***reduced***. Aluminium oxide cannot be reduced by carbon.

I. State what this tells you about the position of carbon in the reactivity series, relative to that of iron and aluminium. [1]

.....

II. Suggest a method by which aluminium oxide can be reduced. [1]

.....

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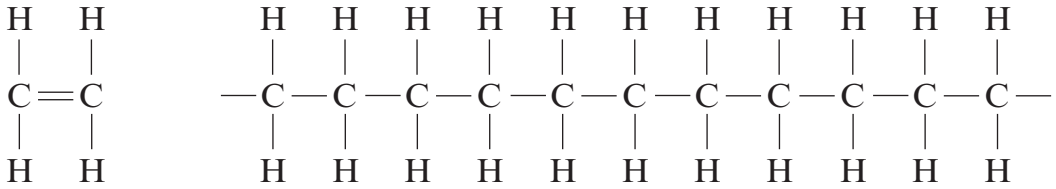
3. *(a)* The following diagram shows the structure of an ethene molecule and part of a polyethene molecule.



ethene **part of a polyethene molecule**

(i) Name the process taking place when polyethene is made from ethene. [1]

.....

(ii) Using the structures above, give **two** differences between a molecule of ethene and a molecule of polyethene. [2]

Difference 1 .....

.....

Difference 2 .....

.....

(iii) Calculate the relative molecular mass, M_r, of ethene, C_2H_4. [2]

$A_r(H) = 1$ $A_r(C) = 12$

$M_r(C_2H_4)$ = ...

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(b) Plastics such as polyethene have low melting points and can be easily melted and remoulded. They are known as **thermoplastics**.

Other plastics such as bakelite have very high melting points and tend to burn or char when heated. They are known as **thermosets**.

(i) Explain the **difference** between thermosets and thermoplastics in terms of their structures. [2]

.....

.....

.....

.....

(ii) Give **one** use for thermosets. ..... [1]

8

4. Name a type of smart material and explain why it is described as a smart material by **referring to its properties**. [3]

.....

.....

.....

.....

3

5. The following table shows information about the atoms of some elements.

The Periodic Table of Elements shown on the **back cover of this examination paper** may be of use in answering this question.

Element	Symbol	Number of protons	Number of neutrons	Number of electrons
sodium	$^{23}_{11}Na$	11	12	11
boron	$^{11}_{5}B$	5	.....	5
scandium	.....	21	24	21

(i) Complete the table. [2]

(ii) Name the part of an atom where protons and neutrons are to be found. [1]

.....

(iii) Give the relative mass and charge of a neutron. [1]

Mass ..... *Charge* .....

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6. (i) Calcium reacts with chlorine to form calcium chloride.

Using the electronic structures given below, show by means of a **diagram** the electronic changes that take place during the formation of calcium chloride. Show the **charges** on the ions formed. [3]

Calcium = 2,8,8,2 Chlorine = 2,8,7

(ii) Chlorine can also react with hydrogen to produce hydrogen chloride. Using the electronic structures given below, show the bonding in hydrogen chloride. [2]

Hydrogen = 1 Chlorine = 2,8,7

(iii) Explain, in terms of bonding, why calcium chloride is a high melting point solid, whereas hydrogen chloride is a gas at room temperature. [2]

.....

.....

.....

7

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7. Ammonia is manufactured from nitrogen and hydrogen by the Haber process.

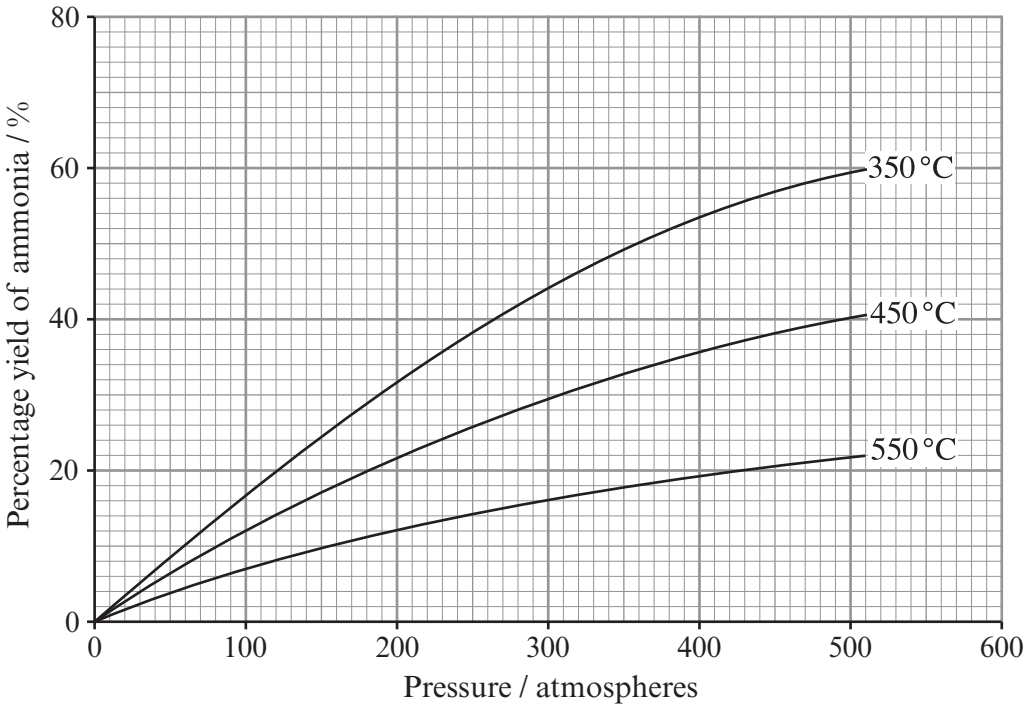
(a) (i) Give a **balanced symbol** equation for the reaction. [3]

..... + ... ⇌ .....

(ii) Give the meaning of the symbol ⇌ used in the above equation. [1]

.....

(b) The graph below shows how the yield of ammonia depends on the temperature and pressure used.



(i) Use the graph to find the temperature and pressure needed to give a 50% yield of ammonia. [1]

Temperature ..... °C *Pressure* ..... atm

(ii) Sketch on the grid above, the curve you would expect if the process were repeated at a temperature of 250 °C. [1]

(iii) State the effect of increasing pressure on the percentage yield of ammonia. [1]

.....

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(c) One of the main uses of ammonia is in the production of fertilisers such as ammonium nitrate.

During a typical process, the theoretical yield is 180 tonnes of ammonium nitrate per day. However, the actual yield is only 162 tonnes.

Calculate the percentage yield of this reaction. [2]

Percentage yield ..... %

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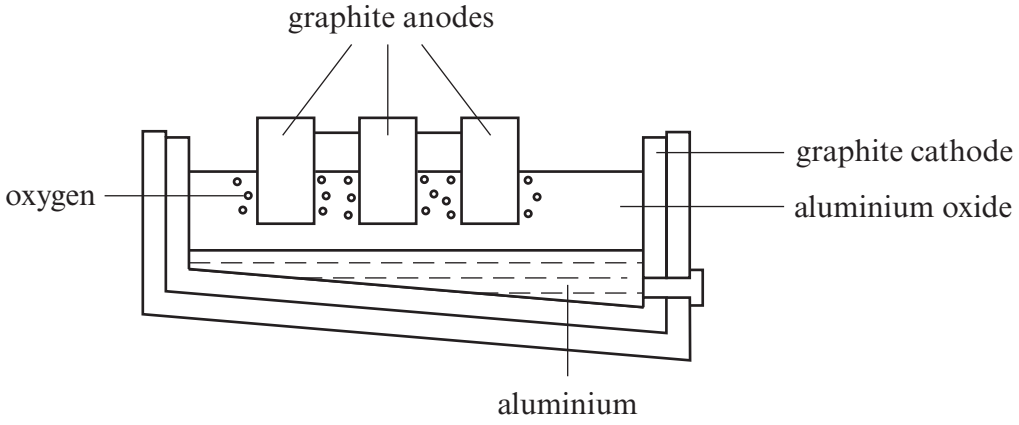
8. The following diagram shows the apparatus used for the industrial extraction of aluminium from its oxide.



(i) I. Give the state (*solid*, *liquid* or *gas*) of the aluminium oxide used in this process. [1]

.....

II. Explain why it must be in this state. [1]

.....

.....

(ii) Complete the following electrode equation for the production of aluminium. [1]

$$Al^{3+} + \text{.....} \longrightarrow Al$$

(iii) State how molecules of oxygen, O_2, are formed at the graphite anodes. [2]

.....

.....

.....

Examiner only

9. A hydrocarbon was found to contain 72 g of carbon and 16 g of hydrogen.

(i) Using the figures given above, calculate the **simplest** formula for this hydrocarbon. You must show your working. [3]

$A_r(C) = 12$; $A_r(H) = 1$

Simplest formula .....

(ii) Another hydrocarbon has the formula C_4H_{10}. Write a **structural** formula for this hydrocarbon. [1]

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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

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

Key: