Candidate Name	Centre Number	Candidate Number
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WJEC CBAC

GCSE

240/02

ADDITIONAL SCIENCE

HIGHER TIER

CHEMISTRY 2

A.M. MONDAY, 18 January 2010

45 minutes

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

VP*(W10-240-02)

Answer **all** *questions*.

1. The following table shows the properties of four substances **A**–**D**.

Substance	Melting point / °C	Boiling point / °C	State at 20 °C	Soluble in water?	Does it conduct electricity?
A	842	1484	solid	insoluble	yes
B	615	876	solid	soluble	only when in solution or molten
C	–210	–196	gas	soluble	no
D	650	1091	solid	insoluble	yes

Use the substances A–D to answer the following questions.

(i) State which **two** of the substances, **A**–**D**, are metals and give **one** reason for your choice. [2]

..... and ..... are metals.

Reason .....

.....

(ii) State which of the substances, **A**–**D**, is an ionic compound and give **one** reason for your choice. [2]

Letter .....

Reason .....

.....

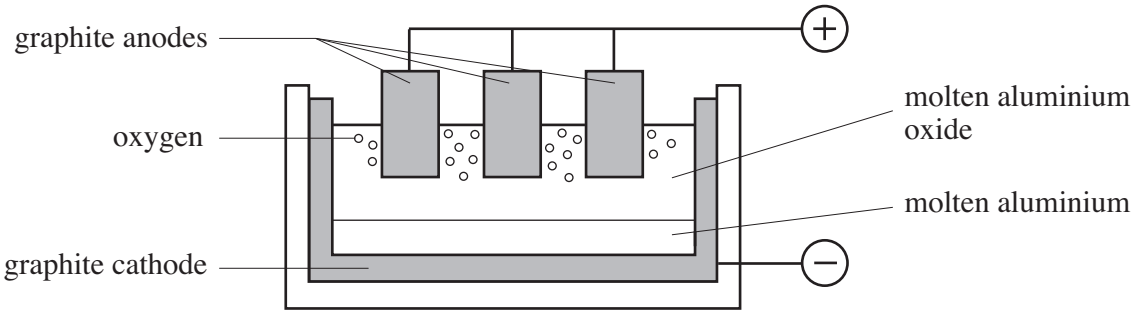
(iii) State which of the substances, **A**–**D**, is a simple molecular substance and give **one** reason for your choice. [2]

Letter .....

Reason .....

.....

2. The following diagram shows the apparatus used for the extraction of aluminium from its oxide by the process of electrolysis.



(i) Name the type of energy required for **electrolysis**. ..... [1]

(ii) The electrolyte used in this process is aluminium oxide.

I. Use the table of common ions on the **inside back cover of this examination paper** to give the **symbols** of the ions present in aluminium oxide. [1]

..... and .....

II. Use your answer to explain why aluminium is formed at the cathode. [1]

.....

.....

(iii) Give the **word** equation for the overall reaction taking place during this process. [2]

..... ⟶ ..... + ...

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3. (i) State why it is difficult to measure the mass of individual atoms. [1]

.....

.....

(ii) The relative atomic mass of an atom is represented by A_r.
State what M_r represents. [1]

.....

(iii) Calculate the M_r of calcium carbonate, $CaCO_3$. [2]

$A_r(Ca) = 40$; $A_r(C) = 12$; $A_r(O) = 16$.

$M_r(CaCO_3)$ = ...

4

Examiner only

4. 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 help in answering this question.

Element	Symbol	Number of protons	Number of neutrons	Number of electrons
sodium	$^{23}_{11}Na$	11	12	11
potassium	$^{39}_{19}K$	19	.....	19
silicon	.....	14	14	14

(i) Complete the table. [2]

(ii) State in terms of protons, neutrons and electrons what is meant by the term:

I. atomic number; [1]

.....

.....

II. mass number. [1]

.....

.....

(iii) Explain why atoms have no overall charge. [1]

.....

.....

Turn over.

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5. Smart materials are materials whose properties change with changes in their surroundings.

(i) Two types of smart material are thermochromic paints and photochromic paints. Give **one** similarity and **one** difference between the properties of these materials. [2]

Similarity .....

.....

Difference .....

.....

(ii) 'Magic snow' is a special type of smart material that is capable of absorbing many times its own weight in water. It swells rapidly when it gets wet to form a snow-like mass.

I. Name the type of smart material present in 'magic snow'. [1]

.....

II. Explain, in terms of structure, why this type of material is able to swell to such a degree. [1]

.....

.....

(iii) One medical use of a particular smart material is as an implant under the skin that slowly releases medication. Suggest **one** reason why some scientists are concerned about this use. [1]

.....

.....

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6. *(a)* Magnesium reacts with oxygen to form magnesium oxide.

(i) Using the electronic structures given below, show by means of a diagram the electronic changes that take place during the formation of magnesium oxide. Show the charges on the ions formed. [3]

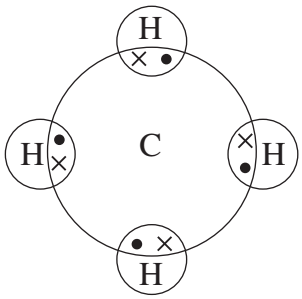
magnesium = 2,8,2 oxygen = 2,6

(ii) State why magnesium oxide is a high melting point solid. [1]

.....

.....

(b) The diagram below shows the type of bonding present in methane, CH_4.



(i) Name this type of bonding. ..... [1]

(ii) The bonds within the molecule are very strong. Despite this, methane has a low boiling point. Explain why. [1]

.....

.....

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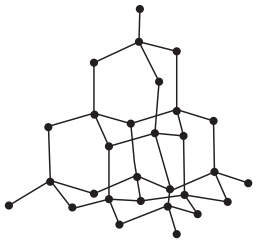
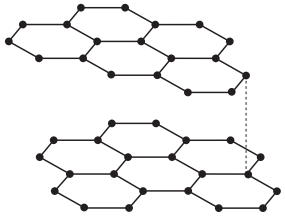
(c) The structures of diamond and graphite are shown below.



diamond



graphite

(i) Give the reason why:

I. diamond is hard; [1]

.....

.....

II. graphite can be used as a lubricant. [1]

.....

.....

(ii) State which of the above structures conducts electricity, giving a reason for your answer. [1]

Electrical conductor .....

Reason .....

.....

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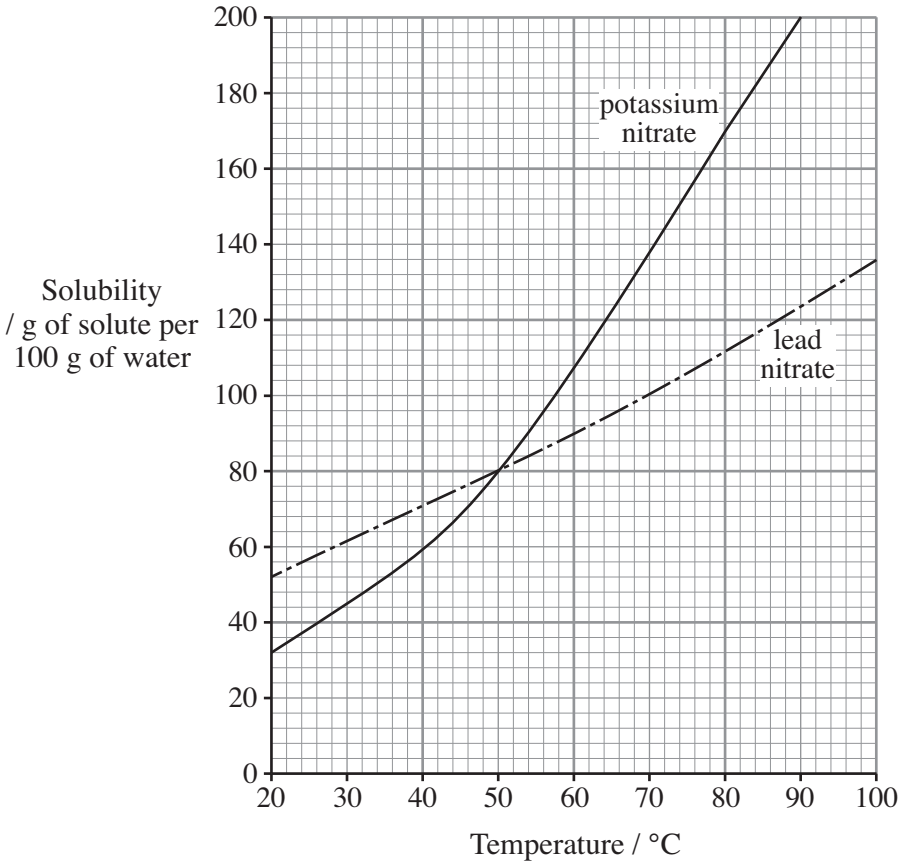
7. The following graph shows the solubility curves for potassium nitrate and lead nitrate.



From the graph above give:

(i) the temperature at which the solubility is the same for both potassium nitrate and lead nitrate; [1]

Temperature = ... °C

(ii) the difference between the solubilities of lead nitrate and potassium nitrate at 80°C; [1]

Difference = ... g per 100 g of water

(iii) the mass of crystals that would form if a saturated solution of potassium nitrate in 100 g of water was cooled from 90°C to 30°C. [1]

Mass of crystals formed = ... g

3

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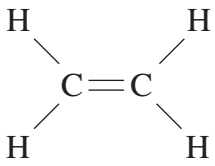
8. Alkenes such as ethene, C_2H_4, are important raw materials for making polymers such as polythene. The structure of ethene is given below.



(i) Ethene is known as an **unsaturated** hydrocarbon. Explain the meaning of the term **unsaturated**. [1]

.....

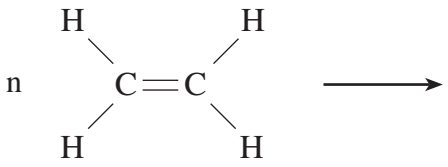
.....

(ii) One method of producing ethene is by the cracking of large saturated hydrocarbons. Give **two** conditions needed for cracking. [2]

.....

.....

(iii) Complete the following **symbol** equation for the production of polythene from ethene. [2]



.....

(iv) Apart from the possible danger to wildlife, give **one** reason why people are concerned about the use of plastics such as polythene. [1]

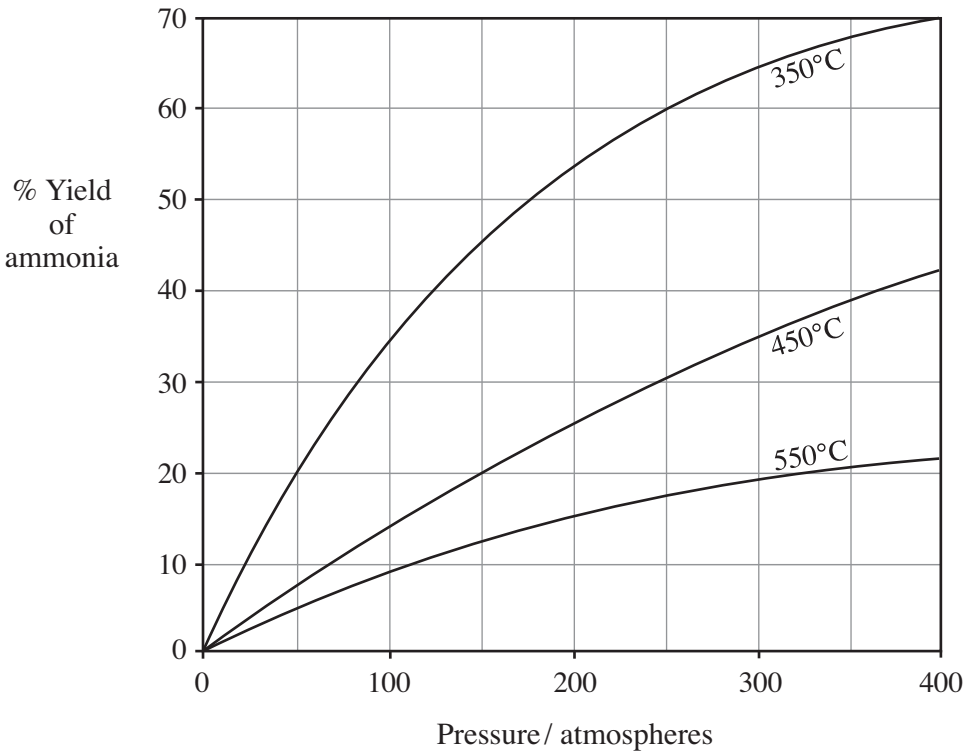
.....

.....

Examiner only

9. Ammonia is produced from atmospheric nitrogen by the Haber process.

The following graph shows how the % yield of ammonia depends on the conditions used.



(a) A temperature of 350°C and pressure of 400 atmospheres would give a 70% yield. However, the industrial process is carried out at 450°C and 200 atmospheres pressure which gives a yield of less than 30%.

Give a reason for using:

(i) a temperature of 450°C rather than 350°C; [1]

.....

.....

(ii) a pressure of 200 atmospheres rather than 400 atmospheres. [1]

.....

.....

Examiner only

(b) The first stage in the production of nitric acid involves the oxidation of ammonia. The equation for the reaction is shown below.

$$4NH_3 + 5O_2 \longrightarrow 4NO + 6H_2O$$

(i) Use the equation above to calculate the mass of nitrogen monoxide, NO, produced from the oxidation of 85 tonnes of ammonia. [3]

$A_r(N) = 14$; $A_r(H) = 1$; $A_r(O) = 16$.

Mass = ... tonnes

(ii) Using the formula below, calculate the atom economy for producing nitrogen monoxide, NO, in this reaction.

[2]

$$\textbf{atom economy} = \frac{\textbf{theoretical mass of required product}}{\textbf{total mass of reactants used}} \times \textbf{100\%}$$

Atom economy = ... %

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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^{+}		

Turn over.

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: