Surname	Centre Number	Candidate Number
Other Names		0

GCSE

0240/02

ADDITIONAL SCIENCE
HIGHER TIER
CHEMISTRY 2

A.M. TUESDAY, 29 January 2013

45 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**8**	
2.	**7**	
3.	**4**	
4.	**6**	
5.	**3**	
6.	**7**	
7.	**10**	
8.	**5**	
Total	**50**	

0240 020001

ADDITIONAL MATERIALS

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

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

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.

Examiner only

Answer **all** *questions.*

1. *(a)* Complete the following table of information about the atoms of some elements. [5]

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

Element	Symbol	Number of protons	Number of neutrons	Number of electrons
sodium	$^{23}_{11}Na$	11	12	11
calcium	$^{40}_{20}Ca$	20	....	....
aluminium	....	13	14	13
....	$^{39}_{19}K$	19	....	19

(b) Atoms of different elements each have a different mass, known as the relative atomic mass (A_r). The relative atomic mass compares the masses of different atoms on a scale which gives hydrogen a mass of 1. State why the actual mass of an atom is not used. [1]

....

....

(c) Calculate the relative molecular mass (M_r) of nitric acid, HNO_3. [2]

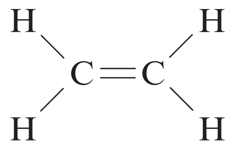
$A_r(H) = 1$ $A_r(N) = 14$ $A_r(O) = 16$

$M_r(HNO_3)$ = ...

8

Examiner only

2. *(a)* Complete the table below by giving the structural formulae for methane and ethane. [2]

Name	methane	ethane	ethene
Formula	CH_4	C_2H_6	C_2H_4
Structural formula			

(b) Ethene can be produced during a process known as cracking.

$$C_{12}H_{26} \longrightarrow C_{10}H_{22} + C_2H_4$$

State **two** conditions necessary for cracking to take place. [2]

.... and ....

(c) Polythene is produced from ethene.

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

....

(ii) Give **one** use of polythene. [1]

....

(iii) Give **one** reason why the recycling of plastics such as polythene is important for the environment. [1]

....

....

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7

Examiner only

3. *(a)* (i) Nappies contain a type of smart material that is capable of absorbing many times its own weight of water. Name this type of smart material. [1]

....

(ii) In terms of structure, state how this type of smart material is able to absorb such a large amount of water. [1]

....

....

(iii) Apart from nappies, give **one** other use for this type of smart material. [1]

....

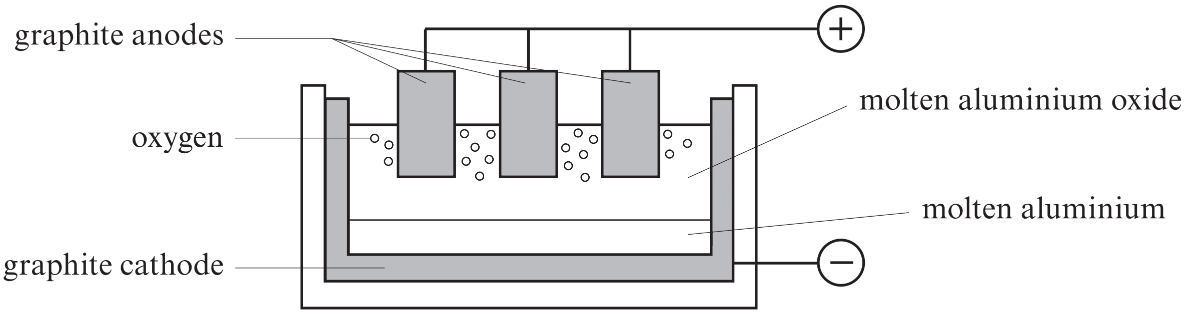
(b) Shape memory alloys are another type of smart material. State the property of shape memory alloys that makes them more suitable than traditional materials for making spectacle frames. [1]

....

4

Examiner only

4. The following diagram shows the apparatus used in industry to extract aluminium from its ore by the process of electrolysis.



(a) Name the type of energy required for electrolysis to take place. [1]

....

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

(i) Use the table of common ions inside the back cover of this examination paper to give the symbols of the ions present in aluminium oxide. [1]

.... and ....

(ii) Why do aluminium ions move towards the cathode? [1]

....

....

(c) State why the aluminium oxide must be molten in order for electrolysis to take place. [1]

....

....

(d) Give the **word** equation for the overall reaction taking place. [2]

.... ⟶ .... + ...

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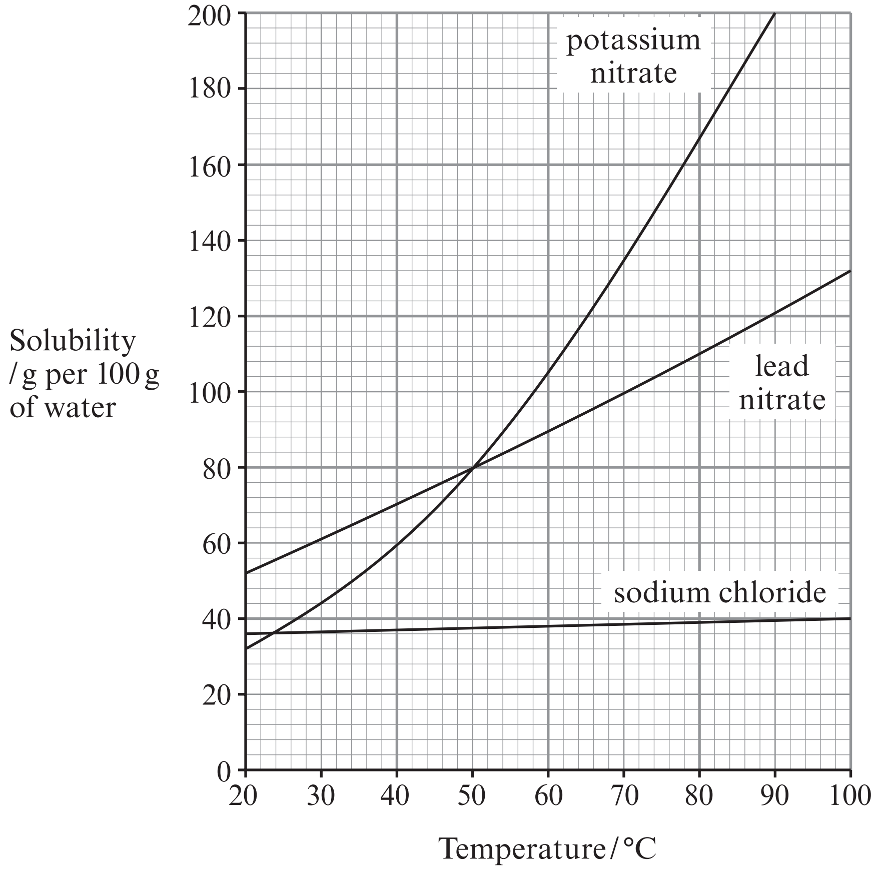
Examiner only

5. The following graph shows the solubility curves for potassium nitrate, lead nitrate and sodium chloride.



(a) Give the temperature at which the solubility is the same for both potassium nitrate and lead nitrate. [1]

.... °C

(b) Give the solubility of sodium chloride at 60 °C. [1]

.... g per 100 g of water

(c) Calculate the mass of crystals that would form if 100 cm^3 of a saturated solution of potassium nitrate was cooled from 90 °C to 30 °C. [1]

Mass of crystals formed = ... g

3

Examiner only

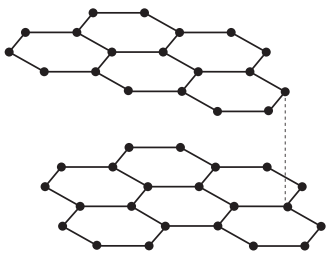
6. *(a)* Potassium reacts with chlorine to form potassium chloride. Draw diagrams to show the electronic changes that take place as potassium ions and chloride ions are formed. Include the charges on the ions.

The electronic structures of the elements are as follows. [3]

potassium = 2,8,8,1 chlorine = 2,8,7

(b) Chlorine gas, Cl_2, consists of chlorine molecules.
Draw a diagram to show the bonding in a chlorine molecule. [2]

(c) The following diagram shows the structure of graphite.



Explain why graphite can be used as a lubricant. [2]

....

....

....

7

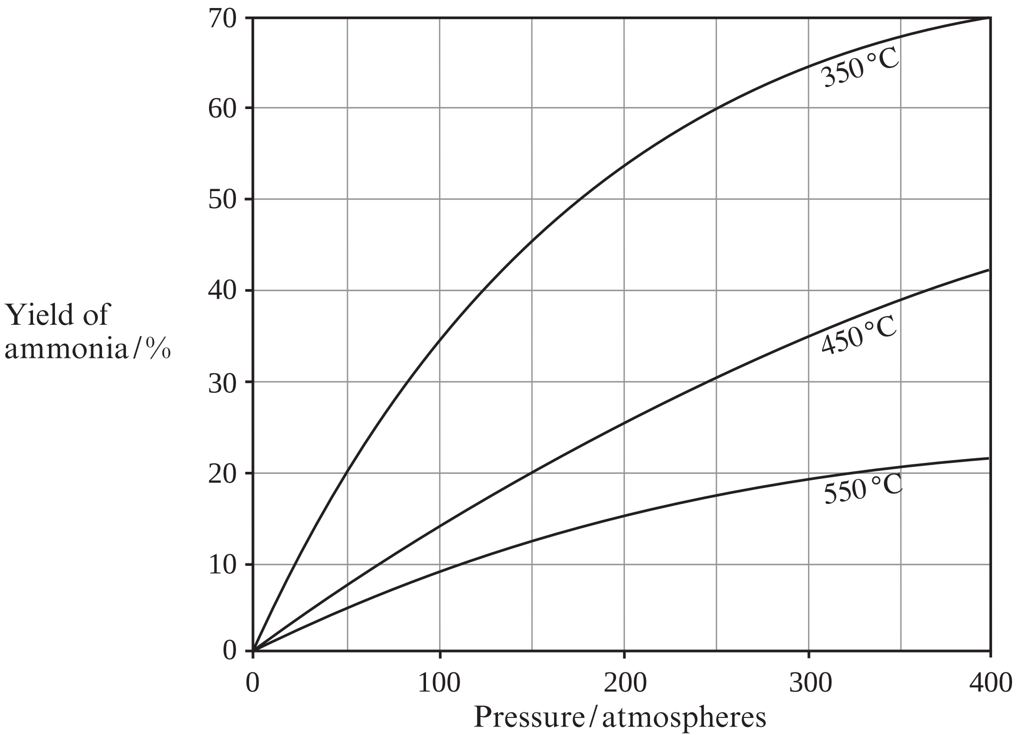
Examiner only

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

(a) Complete and balance the symbol equation for the reaction. [2]

$$N_2 + \square \; \square \rightleftharpoons \square \; NH_3$$

(b) The following graph shows how the yield of the reaction depends on the conditions used.



(i) Use the graph above to give the yield of ammonia at a pressure of 400 atmospheres and a temperature of 350 °C. [1]

.... %

(ii) The industrial process is carried out at 450 °C and 200 atmospheres of 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

(c) One use of ammonia is in the production of nitric acid.

The first stage in the process involves the oxidation of ammonia.

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

(i) Using the equation above, calculate the mass of nitric oxide, NO, produced from the oxidation of 255 tonnes of ammonia. [3]

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

Mass of nitric oxide = ... tonnes

(ii) Calculate the atom economy of this reaction. [2]

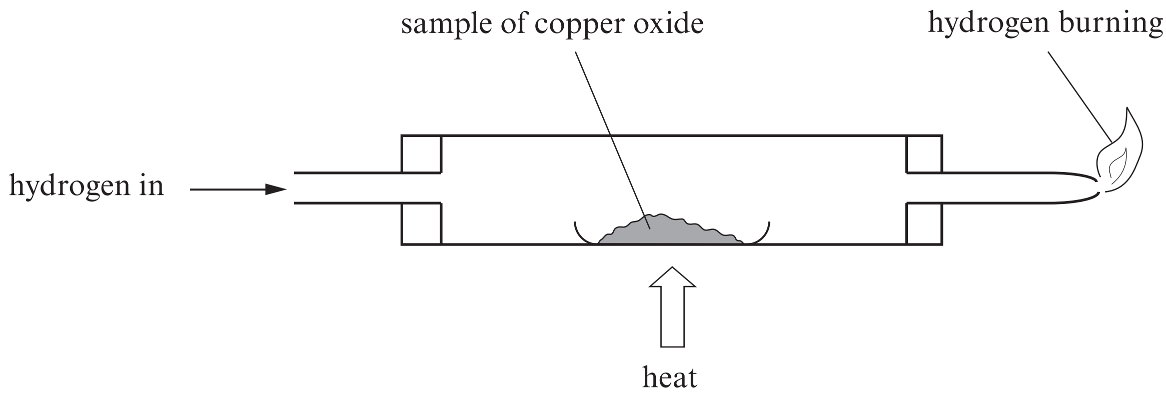
$$\text{atom economy} = \frac{\text{theoretical mass of required product}}{\text{total mass of reactants used}} \times 100\%$$

Atom economy = ... %

10

Examiner only

8. A sample of 3.6 g of copper oxide is reduced by heating in a stream of hydrogen gas, using the apparatus shown below. After heating, 3.2 g of copper had been produced.



(a) Give the meaning of the term *reduction.* [1]

....

(b) Use the figures given above to calculate

(i) the mass of oxygen in the copper oxide, [1]

Mass of oxygen = ... g

(ii) the empirical formula for this oxide of copper. [3]

You must show your working.

$A_r(O) = 16 \qquad A_r(Cu) = 64$

Empirical formula ....

5

END OF PAPER

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^{+}		
Zinc	Zn^{2+}		

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:

Mass number → A

X ← Element Symbol

Atomic number → Z

Name