| Surname | Centre Number | Candidate Number |
|---|---|---|
| Other Names | | 0 |

# New GCSE

4462/02

# SCIENCE A
## HIGHER TIER
## CHEMISTRY 1

A.M. MONDAY, 14 January 2013

1 hour

| For Examiner's use only | | |
|---|---|---|
| **Question** | **Maximum Mark** | **Mark Awarded** |
| **1.** | **6** | |
| **2.** | **6** | |
| **3.** | **6** | |
| **4.** | **6** | |
| **5.** | **4** | |
| **6.** | **6** | |
| **7.** | **6** | |
| **8.** | **8** | |
| **9.** | **6** | |
| **10.** | **6** | |
| **Total** | **60** | |

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**ADDITIONAL MATERIALS**

In addition to this paper you will need a calculator and a ruler.

**INSTRUCTIONS TO CANDIDATES**

Use black ink or black ball-point pen. Do not use gel pen or correcting fluid.

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.

If you run out of space, use the additional page(s) at the back of the booklet, taking care to number the question(s) correctly.

**INFORMATION FOR CANDIDATES**

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

You are reminded that assessment will take into account the quality of written communication used in your answer to questions **4** and **10**.

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.

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*Answer* **all** *questions.*

**1.** The following table shows some information about some Group 7 elements.

| Name | Formula | State at room temperature (20 °C) | Colour of vapour | Melting point (°C) |
|---|---|---|---|---|
| chlorine | $Cl_2$ | gas | yellow-green | –101 |
| bromine | ..... | liquid | orange-brown | –7 |
| iodine | $I_2$ | solid | purple | 114 |

*(a)* Give the formula for bromine. ..... [1]

*(b)* A pupil predicted the **boiling point** of chlorine to be –10 °C.

Using the information in the table, suggest **two** reasons why the pupil gave this value. [2]

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*(c)* Chlorine is a poisonous gas.

State **one** use of chlorine which relates to its poisonous nature. [1]

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*(d)* Fluorine is above chlorine in this group of the Periodic Table.

Use the information in the table to predict **two** properties of fluorine. [2]

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**2.** The following table shows the main products formed during the burning of coal and hydrogen.

| Fuel | Main product(s) of burning |
|---|---|
| coal | carbon dioxide<br>sulfur dioxide<br>water |
| hydrogen | water |

*(a)* (i) Name the **three** elements that must be present in coal to give the products shown in the table. [1]

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(ii) Coal is a finite (non-renewable) resource.

State what is meant by a *finite resource*. [1]

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*(b)* (i) Balance the symbol equation for the burning of hydrogen in air. [1]

$$\square\ H_2 + O_2 \longrightarrow \square\ H_2O$$

(ii) State the chemical test for hydrogen gas and give the expected result. [1]

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(iii) Give **two** disadvantages of using hydrogen as a fuel. [2]

1. .....

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2. .....

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**3.** *(a)* Crude oil is a mixture of hydrocarbons.

State how it was formed. [2]

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*(b)* The table below shows properties of some fractions that can be obtained from crude oil.

| Fraction | Size of molecule (number of carbon atoms) | Boiling point range (°C) | Colour of fraction | Viscosity at room temperature | How it burns |
|---|---|---|---|---|---|
| fuel gas | $C_1$-$C_4$ | –160 to 20 | colourless | | very easily with a clean yellow flame |
| petrol | $C_5$-$C_{10}$ | 20 to 70 | pale yellow | runny | easily with a clean yellow flame |
| naphtha | $C_8$-$C_{12}$ | 70 to 120 | yellow | fairly runny | quite easily with a yellow flame and some soot |
| kerosene | $C_{10}$-$C_{16}$ | 120 to 240 | dark yellow | quite viscous | harder to burn with quite a smoky flame |
| diesel oil and lubricating oil | $C_{15}$-$C_{30}$ | 240 to 350 | brown | viscous | hard to burn and a smoky flame |

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Use the information in the table opposite to answer parts (i) and (ii).

(i) Describe how any **two** properties of crude oil fractions depend on the size of the molecule. [2]

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(ii) Two fuels used in caravans are propane, $C_3H_8$, and butane, $C_4H_{10}$. Both fuels are used in the summer but propane is preferred during the winter.

Explain why. [2]

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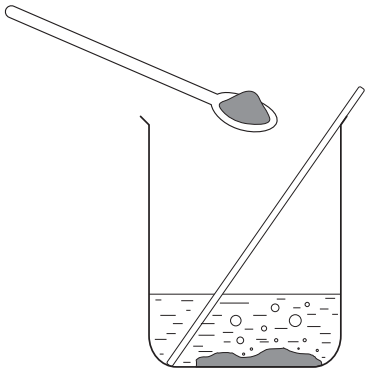
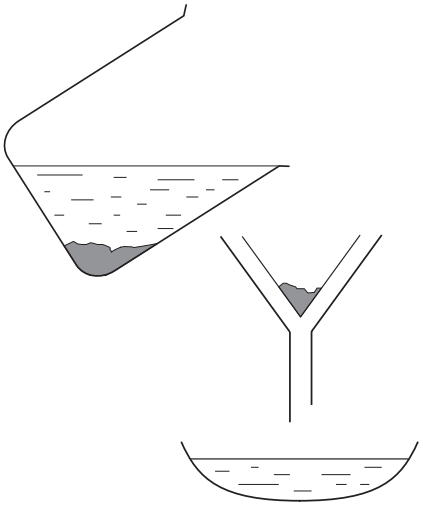
**4.** Copper sulfate crystals can be prepared by reacting copper carbonate with dilute sulfuric acid.

The unlabelled diagrams below show two of the three stages involved.





Describe the preparation of copper sulfate crystals by this method. [6 QWC]
Include in your answer what you would expect to **see** at each stage.

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**5.** Complete the following table. [4]

| Name of compound | Formula of positive ion | Formula of negative ion | Formula of compound |
|---|---|---|---|
| ammonium hydroxide | ..... | $OH^-$ | $NH_4OH$ |
| lithium sulfate | $Li^+$ | $SO_4^{2-}$ | ..... |
| lead nitrate | $Pb^{2+}$ | $NO_3^-$ | ..... |
| calcium hydrogencarbonate | $Ca^{2+}$ | ..... | $Ca(HCO_3)_2$ |

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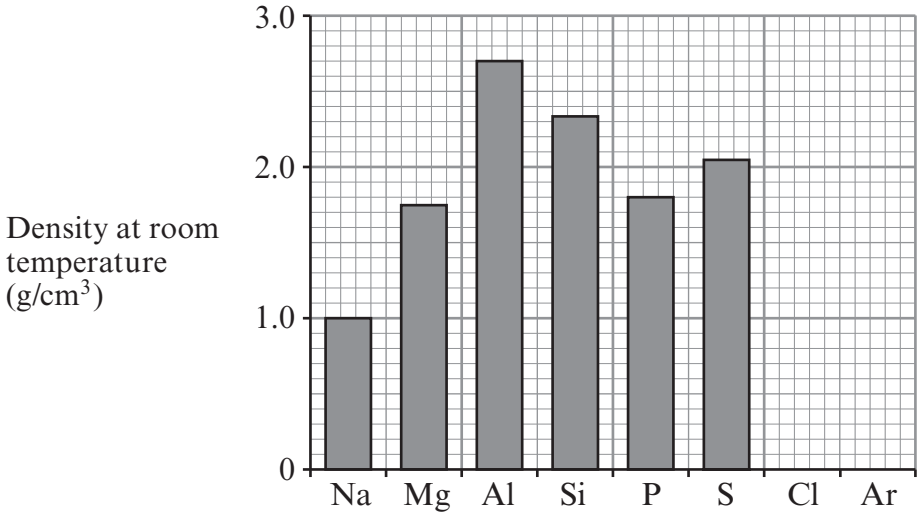
**6.** *(a)* A bar chart of the densities *at room temperature* of all the elements in Period 3 of the Periodic Table is shown below.




(i) Name **all** the **metals** in this period. [1]

.....

(ii) Name the element in this period that has both metallic and non-metallic properties. [1]

.....

(iii) Give the reason that the bars for chlorine and argon are too small to be seen. [1]

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(iv) Give the trend in the densities of the **metals** going across this period. [1]

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*(b)* The table below gives the melting points of all the elements in Period 3.

| Element | Na | Mg | Al | Si | P | S | Cl | Ar |
|---|---|---|---|---|---|---|---|---|
| Melting point (°C) | 98 | 650 | 660 | 1410 | 44 | 113 | –101 | –189 |

How well does the evidence in the table support the following statement?

*'The melting points of non-metals **decrease** from left to right across the Periodic Table.'* [2]

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**Turn over.**

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**7.** The order of reactivity of some elements is shown below.

| | |
|---|---|
| *Most reactive* | sodium |
| | calcium |
| | magnesium |
| | aluminium |
| | carbon |
| | zinc |
| | iron |
| | hydrogen |
| | lead |
| | copper |
| | silver |
| *Least reactive* | gold |

Predict, giving a reason for your answer, whether the following pairs of substances react and give any expected observation(s).

*(a)* Iron and copper sulfate solution [2]

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*(b)* Magnesium and dilute hydrochloric acid [2]

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*(c)* Aluminium oxide and carbon [2]

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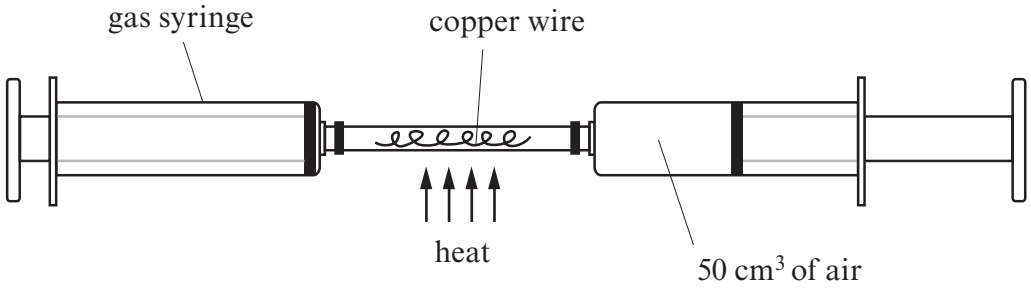
**8.** Two gas syringes, containing a total 50 $cm^3$ of air, were connected as shown in the diagram below. The copper wire was heated strongly and the air passed over it five times. The hot copper reacted with the oxygen in the air. The apparatus was then allowed to cool to room temperature before the volume of gas remaining in the syringes was measured.




Results

| | |
|---|---|
| Initial volume of air | 50 $cm^3$ |
| Final volume of gas | 41 $cm^3$ |

*(a)* Gases expand when heated. State why the apparatus was allowed to cool to room temperature before taking the final reading. [1]

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*(b)* (i) Calculate the percentage of oxygen in the air using the results from the above experiment. [2]

*Percentage of oxygen* = ..... %

(ii) The actual percentage of oxygen in the air is 21%. Assuming no leakages in the apparatus give **one** possible reason why the experiment did not give this expected value. [1]

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Examiner only

*(c)* (i) During the experiment the shiny brown copper reacted and turned black. Name this black substance.

..... [1]

(ii) What change would you expect in the mass of the solid during the experiment? Give a reason for your answer. [1]

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.....

*(d)* (i) Name the gas that makes up the biggest proportion of that remaining in the syringes. [1]

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(ii) Name the very unreactive gas used to fill light bulbs that is also present in the syringes. [1]

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**Turn over.**

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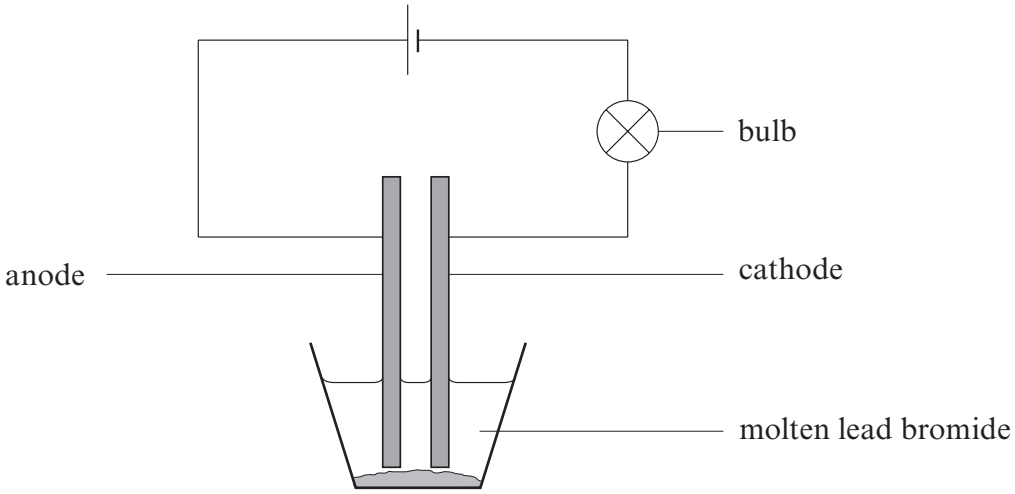
**9.** The diagram below shows the apparatus used during the electrolysis of molten lead bromide.




*(a)* For electricity to flow the lead bromide must be molten. Give the reason for this. [1]

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*(b)* Balance the electrode equation which takes place at the anode. [1]

$\square\ Br^- \_ \square\ e^- \longrightarrow Br_2$

*(c)* (i) State, **in terms of electrons**, what happens to the lead ions at the cathode. [1]

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(ii) Describe what you would expect to observe at the cathode. [1]

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(iii) Electrolysis is allowed to continue for some time before the apparatus is cooled to room temperature. The bulb remains lit. Explain this observation. [2]

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**10.** Explain how natural processes keep the carbon dioxide and oxygen content of the atmosphere approximately constant. Discuss how human activities are changing the balance between these gases. [6 QWC]

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**END OF PAPER**

| Question number | **Additional page, if required. Write the question numbers in the left-hand margin.** |
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| Question number | **Additional page, if required. Write the question numbers in the left-hand margin.** |
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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 | $Li^{+}$ | Sulfate | $SO_4^{2-}$ |
| Magnesium | $Mg^{2+}$ | | |
| Nickel | $Ni^{2+}$ | | |
| Potassium | $K^{+}$ | | |
| Silver | $Ag^{+}$ | | |
| Sodium | $Na^{+}$ | | |
| Zinc | $Zn^{2+}$ | | |

# 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 Sulfur | $^{35}_{17}$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: