

Surname	Centre Number	Candidate Number
Other Names		0



**GCSE**

4472/01



W15-4472-01

**ADDITIONAL SCIENCE/CHEMISTRY**

**CHEMISTRY 2  
FOUNDATION TIER**

A.M. TUESDAY, 13 January 2015

1 hour

For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1.	4	
2.	3	
3.	9	
4.	4	
5.	5	
6.	5	
7.	6	
8.	7	
9.	9	
10.	8	
<b>Total</b>	<b>60</b>	

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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.

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.

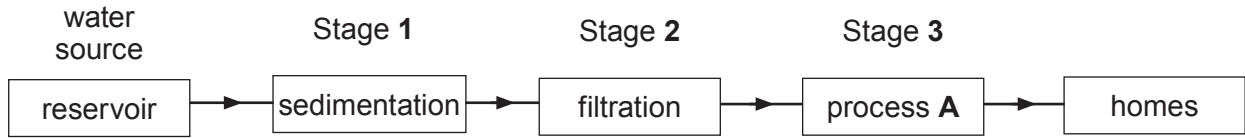
You are reminded of the necessity for good English and orderly presentation in your answers.

Assessment will take into account the quality of written communication (QWC) in your answer to question **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.

Answer **all** questions.

1. (a) The diagram below shows the three main stages in the treatment of public water supplies.



(i) Reservoirs are a water source for public water supplies. Give the name of **one** other source. [1]

.....

(ii) Give the number of the stage where large insoluble particles settle out and are removed from the water. [1]

Stage .....

(iii)

<b>fluoridation</b>	<b>chlorination</b>	<b>boiling</b>	<b>distillation</b>
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In stage **3** the water is sterilised to kill bacteria and micro-organisms. Choose from the box above the name given to process **A**. [1]

Process **A** .....

(b) In drought conditions, suggest **one** way you could conserve water without affecting personal hygiene. [1]

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 .....

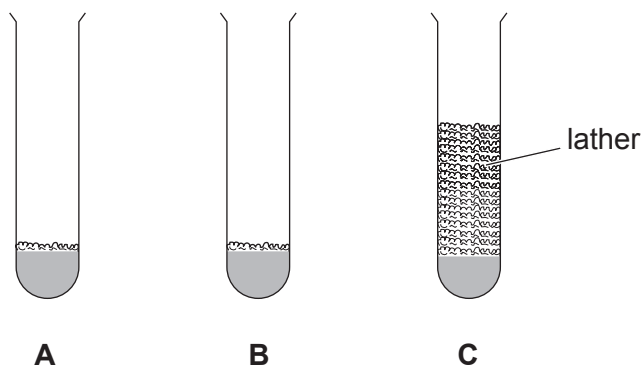
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2. Draw a line to link each type of smart material to its property.

[3]

Smart material	Property
thermochromic pigment	absorbs water up to 1000 times its volume
hydrogel	changes colour with changing temperature
shape memory alloy	regains its original shape when heated
photochromic pigment	changes colour with changing light intensity

3. (a) An investigation was carried out to compare the hardness of three water samples **A**, **B** and **C**.
- (i)  $1\text{ cm}^3$  of soap solution was added to  $5\text{ cm}^3$  of the three water samples. Each tube was shaken for 1 minute. The results are shown in the diagram below.



State which of the samples contain hard water. Give the reason for your answer.

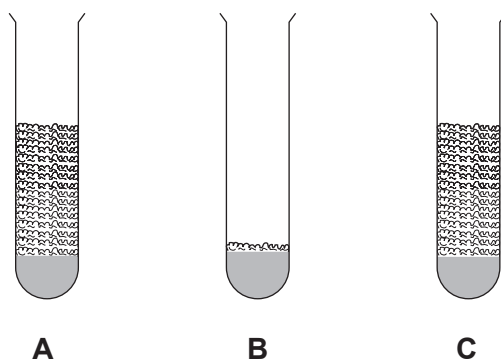
[2]

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- (ii) Water can contain temporary or permanent hardness. Water containing temporary hardness can be softened by boiling.

$1\text{ cm}^3$  of soap solution was added to  $5\text{ cm}^3$  of **boiled** samples of **A**, **B** and **C**. Each tube was shaken for 1 minute. The results are shown below.



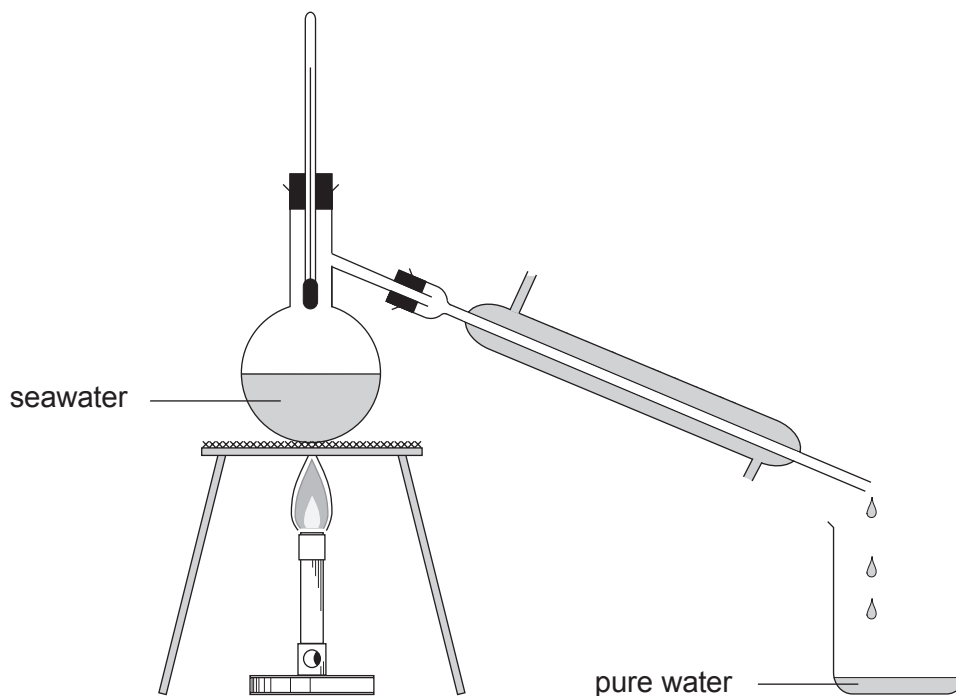
State what these results tell you about samples **A**, **B** and **C**. Include your reasoning.

[2]

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- (b) The diagram below shows apparatus that can be used to obtain pure water from seawater.



- (i) Describe how pure water is separated from seawater.

[3]

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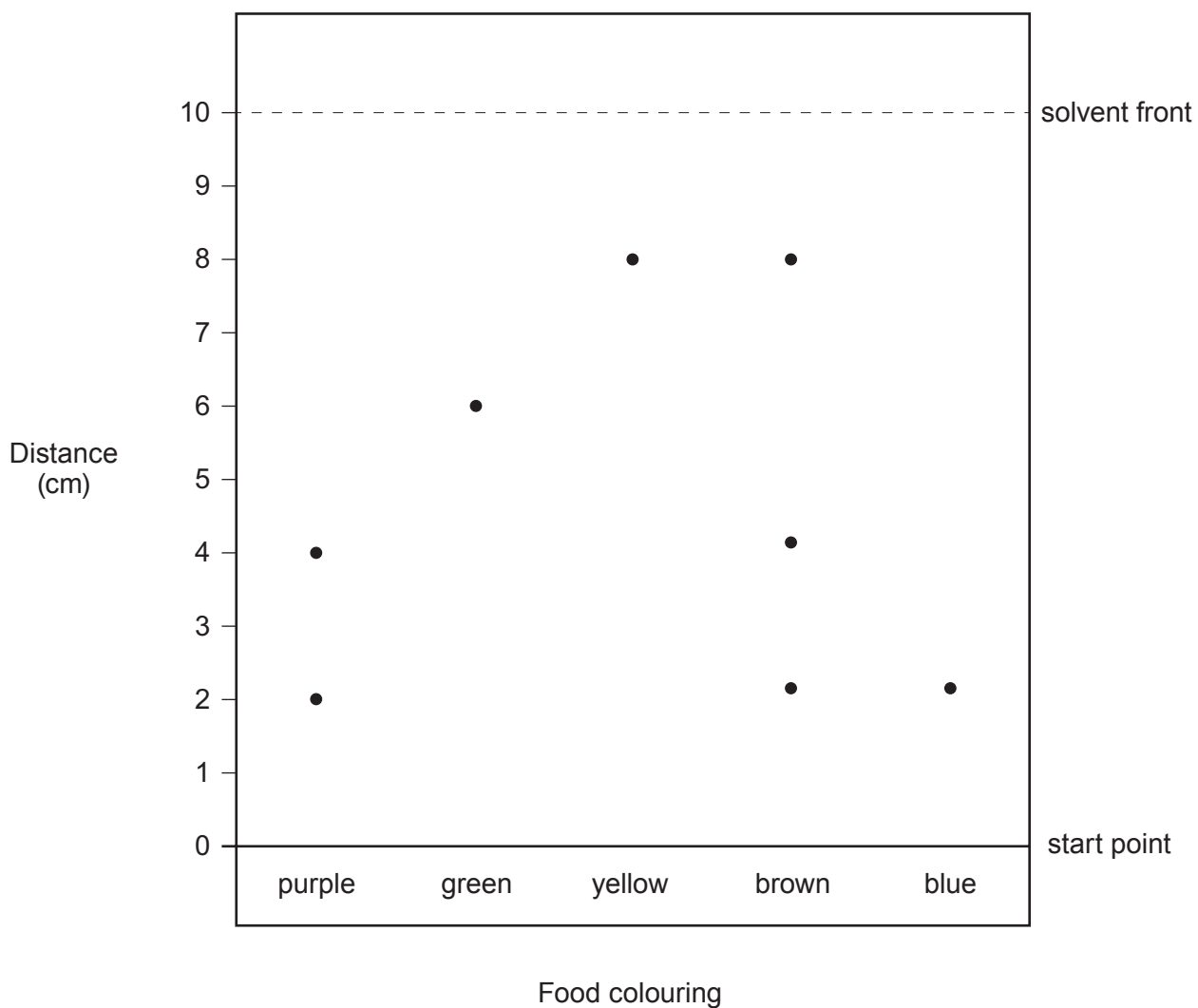
- (ii) Suggest what you would **see** if  $1\text{ cm}^3$  of soap solution were added to  $5\text{ cm}^3$  of pure water in a test tube and the tube shaken for 1 minute. Give the reason for your answer.

[2]

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.....

4. The diagram below shows the chromatogram of several food colourings.



(a) Use the chromatogram to give the **two** food colourings that are mixed to make brown food colouring. [1]

..... and .....

- (b) The  $R_f$  value of a substance can be used to identify that substance.  
The  $R_f$  value for a red food colouring is 0.4.

Use the equation below to calculate the distance this red food colouring would move on this chromatogram. [2]

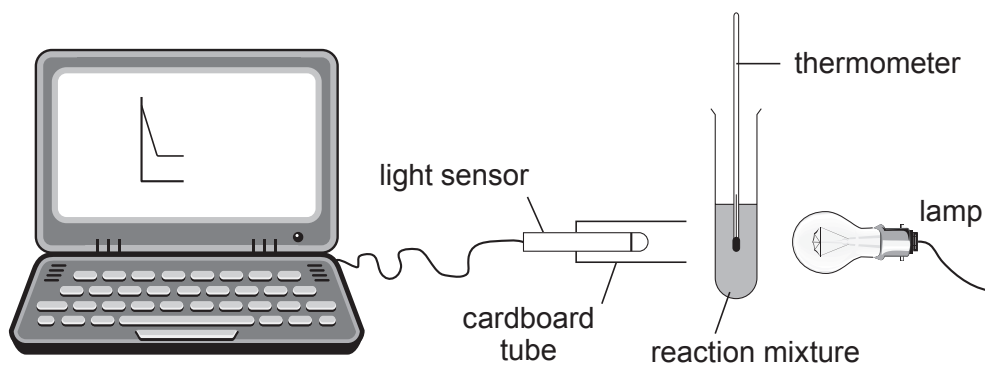
$$\text{distance moved} = R_f \times \text{distance moved by the solvent}$$

*Distance moved* = ..... cm

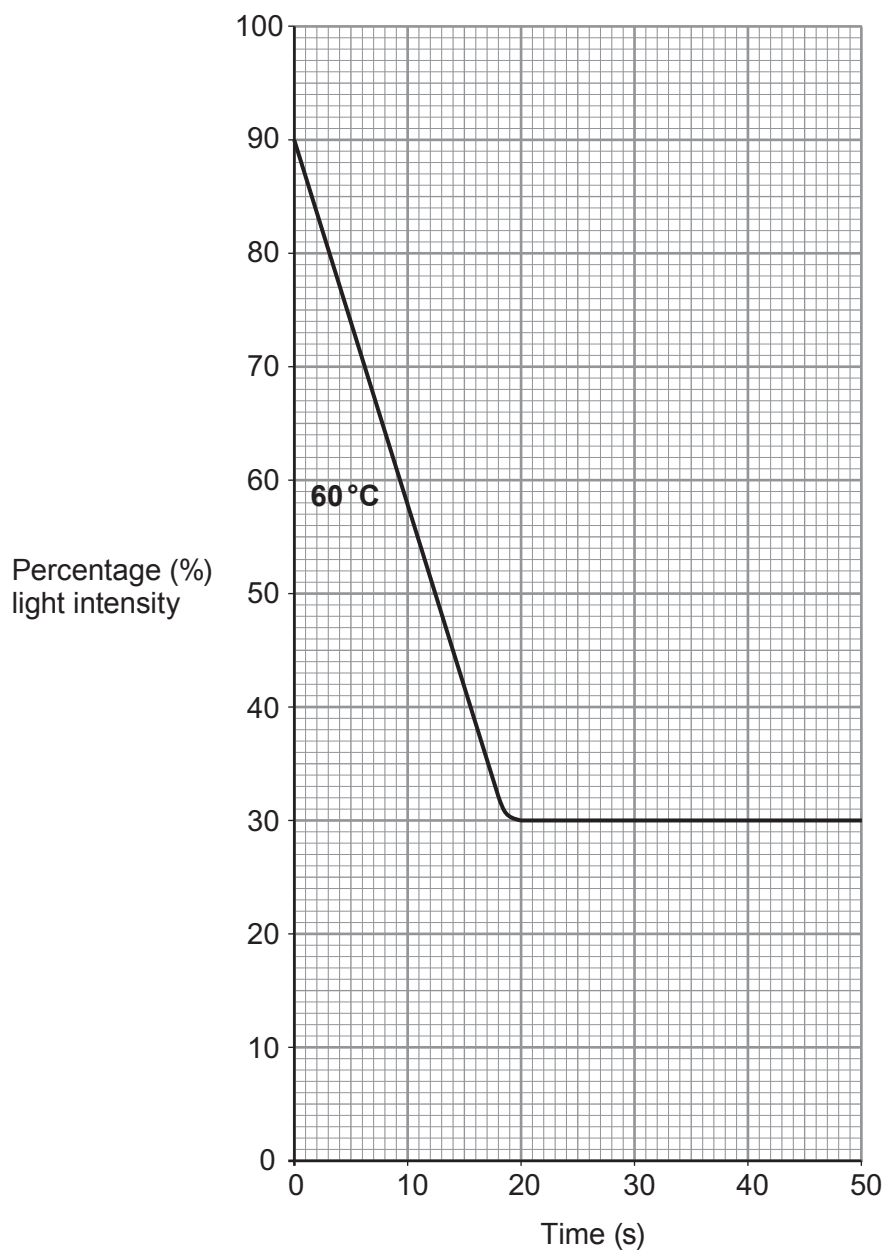
- (c) Give the reason why water is used as the solvent when obtaining this chromatogram of food colourings. [1]

.....

5. Sodium thiosulfate solution reacts with dilute hydrochloric acid forming a yellow precipitate. This reaction was investigated using the equipment below.

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5 cm<sup>3</sup> of dilute hydrochloric acid was added to 10 cm<sup>3</sup> sodium thiosulfate solution at 60 °C and the light intensity was measured over time. The results are shown on the grid below.





- (a) Use the graph to find the time taken for the reaction to stop. [1]

*Time* = ..... s

- (b) The experiment was repeated at 40 °C. The reaction stopped after 35 s. Carefully draw the graph of this experiment on the same grid. [1]

- (c) Explain why the light intensity decreases as this reaction takes place. [2]

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- (d) Suggest **one** possible reason why the light intensity does not fall to 0%. [1]

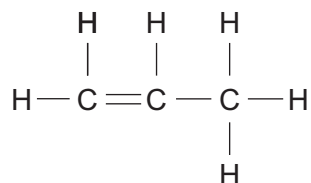
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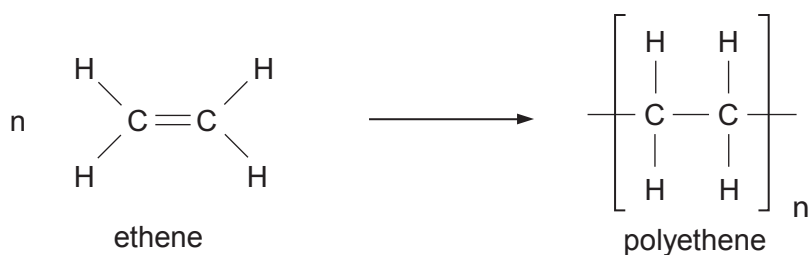
6. (a) The following diagram shows the structural formula of propene.



Give the molecular formula of propene. .... [1]

- (b) An alkane contains three carbon atoms and eight hydrogen atoms. Draw its structural formula. [1]

- (c) The equation below shows the formation of polyethene from ethene.



Describe what happens to ethene molecules during the formation of polyethene. [3]

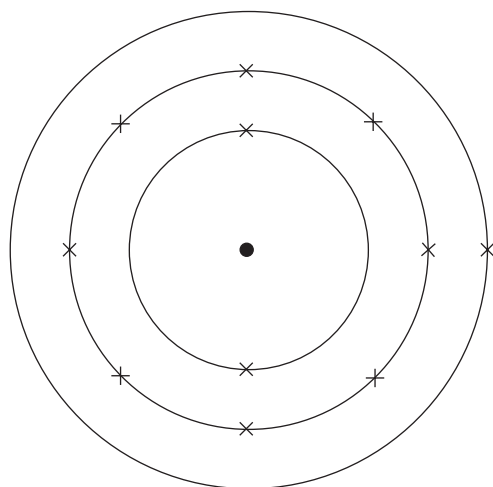
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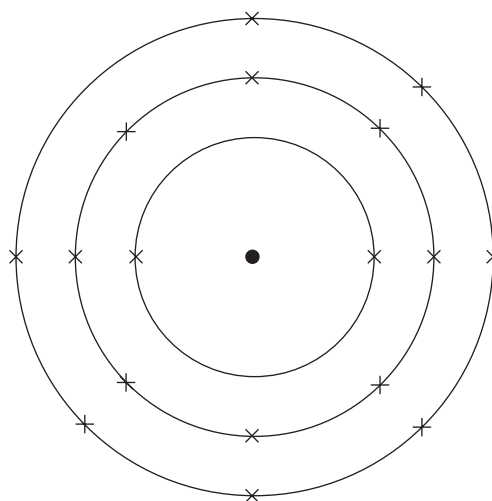
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7. (a) The diagrams below show the electronic structure of a sodium atom and a chlorine atom.



sodium atom



chlorine atom

- (i) Give the number of electrons in the **outer** shell of [1]  
 a sodium atom, .....
- a chlorine atom. ....
- (ii) Sodium reacts with chlorine to form a white solid.

I State, in terms of electrons, what happens to sodium and chlorine atoms during this reaction. [2]

.....

.....

II Complete the **word** equation for this reaction. [1]

sodium + chlorine  $\longrightarrow$  .....

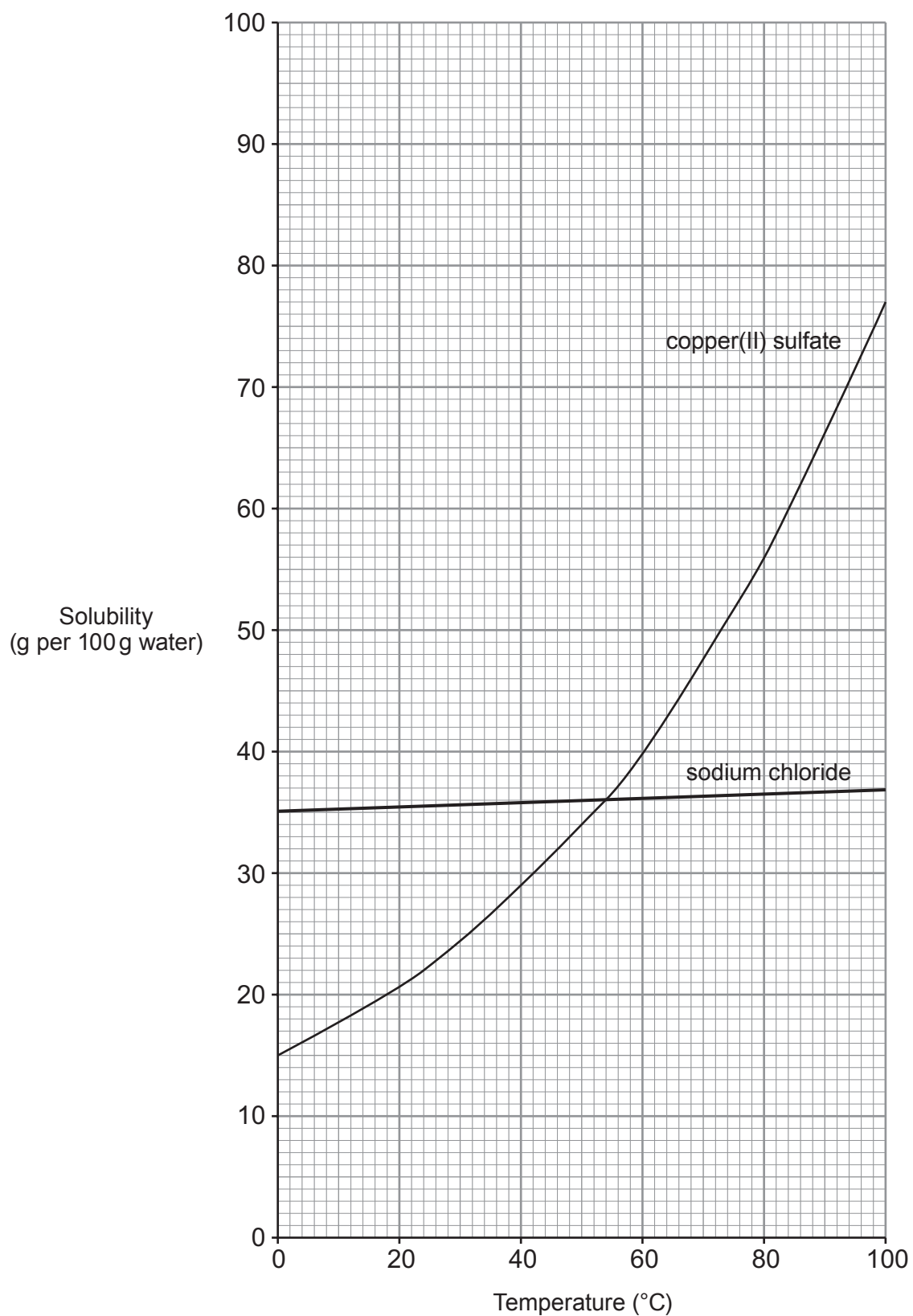
- (b) Sodium chlorate,  $\text{NaClO}_3$ , is used to bleach paper. [2]  
 Calculate the relative formula mass ( $M_r$ ) of sodium chlorate.

$$A_r(\text{O}) = 16 \quad A_r(\text{Na}) = 23 \quad A_r(\text{Cl}) = 35.5$$

$$M_r(\text{NaClO}_3) = \dots\dots\dots$$

6

8. The graphs below show the solubilities of sodium chloride and copper(II) sulfate in water at different temperatures.



- (a) Compare the solubilities of copper(II) sulfate and sodium chloride below 54 °C, at 54 °C and above 54 °C. [3]

.....

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.....

- (b) Calculate the mass of solid copper(II) sulfate that forms when a saturated solution in 50 g of water at 80 °C cools to 40 °C. [2]

*Mass of solid copper(II) sulfate = ..... g*

- (c) State why the temperature scale on a solubility graph ranges from 0 °C to 100 °C. [2]

.....

.....

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

Element	Symbol	Number of protons	Number of neutrons	Number of electrons
beryllium	${}^9_4\text{Be}$	4	5	4
fluorine	${}^{19}_9\text{F}$	9	.....	.....
calcium	.....	20	20	.....
argon	${}^{40}_{18}\text{Ar}$	.....	22	18

- (ii) Give the **names** of the elements which have the same mass number. [1]

..... and .....

- (iii) Using **X** to represent an electron, draw the electronic structure of argon. [1]

- (b) Boron has two isotopes,  ${}^{11}_5\text{B}$  and  ${}^{10}_5\text{B}$ .

Give **one** similarity and **one** difference between the nuclei of these two boron atoms. [2]

*Similarity* .....

*Difference* .....

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10. Lithium, sodium and potassium are Group 1 metals.

- (a) A teacher wanted to demonstrate the similarities and differences in how each metal reacted with water. She added a small piece of each metal separately to a trough of water.

Describe what you would **see** when each metal is added to water and state how the observations can be used to establish the trend in reactivity within the group. [6 QWC]

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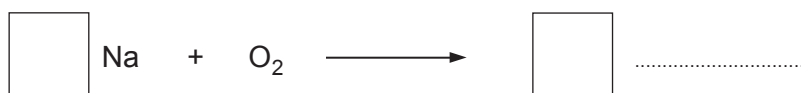
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- (b) The teacher then demonstrated the reaction of sodium with oxygen.

Complete and balance the symbol equation for this reaction.

[2]



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## FORMULAE FOR SOME COMMON IONS

POSITIVE IONS		NEGATIVE IONS	
Name	Formula	Name	Formula
Aluminium	$\text{Al}^{3+}$	Bromide	$\text{Br}^-$
Ammonium	$\text{NH}_4^+$	Carbonate	$\text{CO}_3^{2-}$
Barium	$\text{Ba}^{2+}$	Chloride	$\text{Cl}^-$
Calcium	$\text{Ca}^{2+}$	Fluoride	$\text{F}^-$
Copper(II)	$\text{Cu}^{2+}$	Hydroxide	$\text{OH}^-$
Hydrogen	$\text{H}^+$	Iodide	$\text{I}^-$
Iron(II)	$\text{Fe}^{2+}$	Nitrate	$\text{NO}_3^-$
Iron(III)	$\text{Fe}^{3+}$	Oxide	$\text{O}^{2-}$
Lithium	$\text{Li}^+$	Sulfate	$\text{SO}_4^{2-}$
Magnesium	$\text{Mg}^{2+}$		
Nickel	$\text{Ni}^{2+}$		
Potassium	$\text{K}^+$		
Silver	$\text{Ag}^+$		
Sodium	$\text{Na}^+$		
Zinc	$\text{Zn}^{2+}$		

# PERIODIC TABLE OF ELEMENTS

1      2      3      4      5      6      7      0

Group

		<div style="border: 1px solid black; padding: 2px; display: inline-block;"> <math>^1_1\text{H}</math> Hydrogen         </div>										<div style="border: 1px solid black; padding: 2px; display: inline-block;"> <math>^4_2\text{He}</math> Helium         </div>					
7 <b>Li</b> Lithium	9 <b>Be</b> Beryllium											19 <b>F</b> Fluorine	20 <b>Ne</b> Neon				
23 <b>Na</b> Sodium	24 <b>Mg</b> Magnesium											32 <b>S</b> Sulfur	35 <b>Cl</b> Chlorine	40 <b>Ar</b> Argon			
39 <b>K</b> Potassium	40 <b>Ca</b> Calcium	45 <b>Sc</b> Scandium	48 <b>Ti</b> Titanium	51 <b>V</b> Vanadium	52 <b>Cr</b> Chromium	55 <b>Mn</b> Manganese	56 <b>Fe</b> Iron	59 <b>Co</b> Cobalt	59 <b>Ni</b> Nickel	64 <b>Cu</b> Copper	65 <b>Zn</b> Zinc	70 <b>Ga</b> Gallium	73 <b>Ge</b> Germanium	75 <b>As</b> Arsenic	79 <b>Se</b> Selenium	80 <b>Br</b> Bromine	84 <b>Kr</b> Krypton
86 <b>Rb</b> Rubidium	88 <b>Sr</b> Strontium	89 <b>Y</b> Yttrium	91 <b>Zr</b> Zirconium	93 <b>Nb</b> Niobium	96 <b>Mo</b> Molybdenum	99 <b>Tc</b> Technetium	101 <b>Ru</b> Ruthenium	103 <b>Rh</b> Rhodium	106 <b>Pd</b> Palladium	108 <b>Ag</b> Silver	112 <b>Cd</b> Cadmium	115 <b>In</b> Indium	119 <b>Sn</b> Tin	122 <b>Sb</b> Antimony	128 <b>Te</b> Tellurium	127 <b>I</b> Iodine	131 <b>Xe</b> Xenon
133 <b>Cs</b> Caesium	137 <b>Ba</b> Barium	139 <b>La</b> Lanthanum	179 <b>Hf</b> Hafnium	181 <b>Ta</b> Tantalum	184 <b>W</b> Tungsten	186 <b>Re</b> Rhenium	190 <b>Os</b> Osmium	192 <b>Ir</b> Iridium	195 <b>Pt</b> Platinum	197 <b>Au</b> Gold	201 <b>Hg</b> Mercury	204 <b>Tl</b> Thallium	207 <b>Pb</b> Lead	209 <b>Bi</b> Bismuth	210 <b>Po</b> Polonium	210 <b>At</b> Astatine	222 <b>Rn</b> Radon
223 <b>Fr</b> Francium	226 <b>Ra</b> Radium	227 <b>Ac</b> Actinium											227 <b>Ac</b> Actinium	227 <b>Ac</b> Actinium	227 <b>Ac</b> Actinium	227 <b>Ac</b> Actinium	

Key:

