Surname	Centre Number	Candidate Number
Other Names		

GCSE

CHEMISTRY

UNIT 2: CHEMICAL BONDING, APPLICATION OF CHEMICAL REACTIONS AND ORGANIC CHEMISTRY
FOUNDATION TIER

SAMPLE ASSESSMENT MATERIALS

(1 hour 45 minutes)

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**5**	
2.	**6**	
3.	**8**	
4.	**8**	
5.	**9**	
6.	**6**	
7.	**6**	
8.	**6**	
9.	**6**	
10.	**10**	
11.	**10**	
Total	**80**	

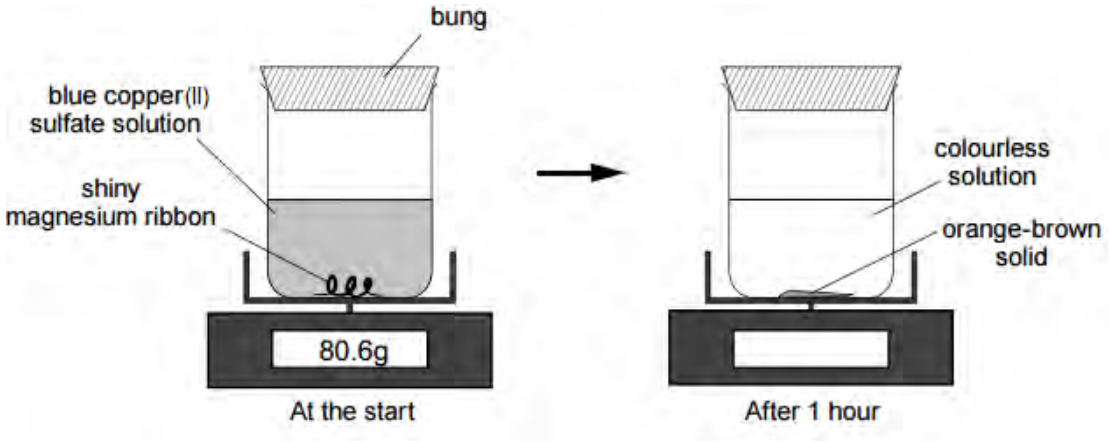
ADDITIONAL MATERIALS
In addition to this paper you will require a calculator.

INSTRUCTIONS TO CANDIDATES
Use black ink or black ball-point pen. Do not use gel pen. Do not use correction 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.

INFORMATION FOR CANDIDATES
The number of marks is given in brackets at the end of each question or part-question.
Question **9** is a quality of extended response (QER) question where your writing skills will be assessed.

Answer **all** *questions.*

1. (a) Some pupils were asked to investigate what happens when a piece of shiny magnesium ribbon is added to copper(II) sulfate solution. They set up the apparatus shown below. The mass was recorded at the start and again after one hour.



(i) **Circle** the name for the type of reaction taking place. [1]

neutralisation displacement combustion

(ii) Put a tick (✓) in the box next to the mass of the beaker and its contents after 1 hour.

more than 80.6 g ☐ equal to 80.6 g ☐ less than 80.6 g ☐

Give the reason for your choice. [1]

.....

.....

(iii) The experiment was repeated using sodium sulfate solution instead of copper(II) sulfate solution. No reaction took place.

Put the metals copper, magnesium and sodium in order of reactivity. [1]

Most reactive .....

.....

Least reactive .....

(b) Rust is iron(III) oxide, Fe_2O_3. It is formed when iron comes into contact with water and oxygen.

Some iron nails were weighed before and after being exposed to water and oxygen for 1 week. The results are given below.

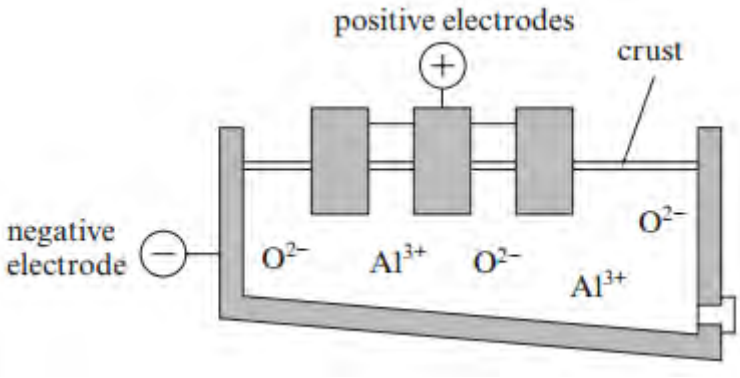
Time of weighing	**Mass of nails (g)**
before exposure to water and oxygen	28
after exposure to water and oxygen	40

Use this information to calculate the percentage increase in mass of the nails after they had been exposed to water and oxygen. [2]

percentage increase in mass = ... %

5

2. (a) Electrolysis is also used to extract aluminium from molten aluminium oxide. On melting, aluminium oxide releases aluminium ions, Al^{3+}, and oxide ions, O^{2-}.



(i) By drawing an arrow from the formula of **each ion** in the diagram, show the direction of movement of **all** the ions when the current is switched on. [1]

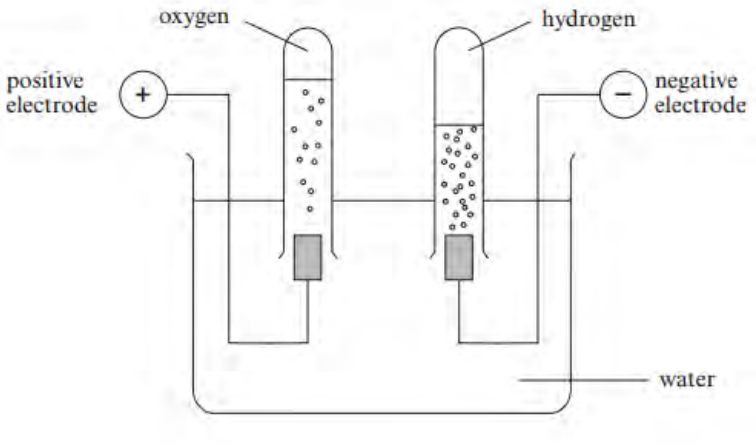
(ii) Balance the symbol equation for the overall reaction occurring. [1]

$$\boxed{2}\ Al_2O_3 \longrightarrow \boxed{\ }\ Al + \boxed{\ }\ O_2$$

(iii) Give the **main** reason why this process is expensive. [1]

.....

(b) A teacher demonstrated how water can be broken down into its elements by electrolysis. She set up the following apparatus.



(i) What name is given to the negative electrode? [1]

.....

(ii) Describe the test used to identify hydrogen gas. [1]

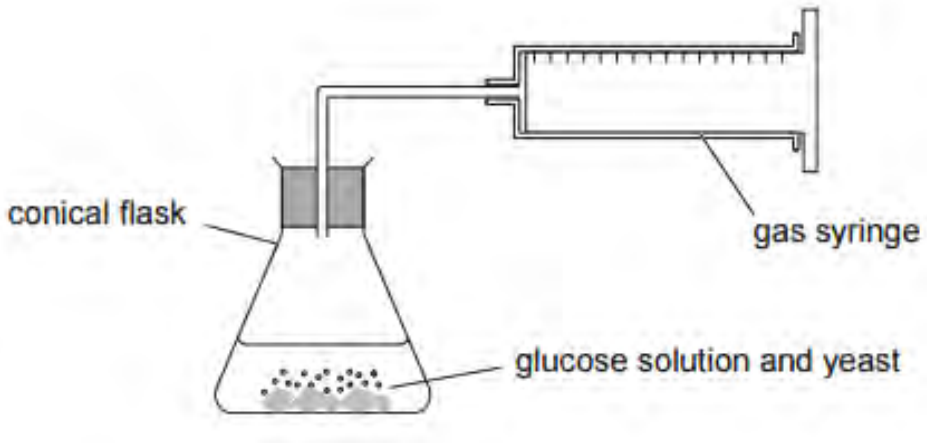
.....

(iii) When 36 g of water is broken down into its elements, 4 g of hydrogen is produced. Calculate the mass of oxygen produced. [1]

mass = ... g

6

3. A pupil investigated the effect of temperature on the rate of fermentation using the apparatus shown below.



The experiment was carried out three times at five different temperatures. The volume of gas collected after 10 minutes was recorded each time. The results are shown below.

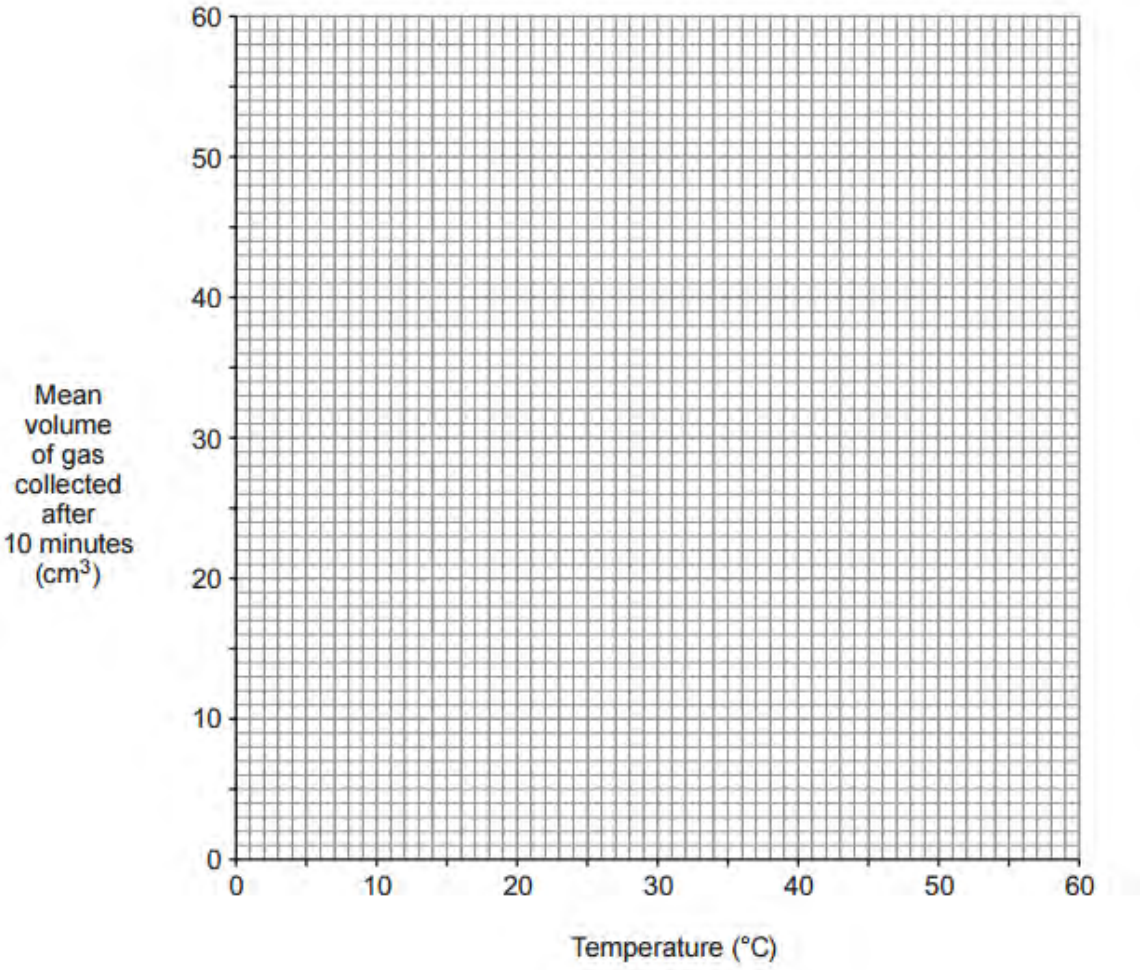
Temperature (°C)	Volume of gas collected after 10 minutes (cm^3)			
	1	**2**	**3**	**Mean**
20	9	8	7	8
30	38	40	(32)	39
40	52	53	54	53
50	35	32	33	33
60	12	11	12	12

(a) Suggest why the circled value is considered to be anomalous. [1]

……..

……..

(b) Plot a graph of the **mean** volume of gas collected against temperature on the grid below. [2]



(c) State what conclusions can be drawn from the graph. [2]

……..

……..

……..

(d) Write a **word** equation for the reaction taking place. [2]

…… $\xrightarrow{\text{yeast}}$ …… + ……

(e) Yeast produces a catalyst that allows this reaction to take place. Name the **type** of catalyst produced by yeast. [1]

……

8

4. (a) The table below shows some tests that can be carried out to identify ions.

Positive ion	Test to identify the ion	Observation
Na^+	flame test	yellow flame
K^+	flame test	lilac flame
Ca^{2+}	flame test	brick-red flame
Cu^{2+}	add sodium hydroxide solution	blue precipitate
Fe^{2+}	add sodium hydroxide solution	green precipitate
Mg^{2+}	add sodium hydroxide solution	white precipitate

Negative ion	Test to identify the ion	Observation
CO_3^{2-}	add dilute hydrochloric acid	bubbles formed
SO_4^{2-}	add barium chloride solution	white precipitate
Cl^-	add by silver nitrate solution	white precipitate

Use only the information in the tables to answer parts (i) and (ii).

(i) Caroline carried out the two tests needed to identify a compound thought to be iron(II) sulfate. Give the expected observations for the tests that were carried out. [2]

Add sodium hydroxide solution ……

Add barium chloride solution ……

(ii) Gareth carried out two different tests to identify a second compound. The observations for these tests are given below.

Flame test: yellow flame produced

Add hydrochloric acid: bubbles formed

Name the compound he identified. ..... [2]

(b) (i) A pupil was given a gas jar containing ammonia gas. Describe a test that could be carried out to prove that it was ammonia. Give the expected result for the test. [2]

.....

.....

.....

(ii) Ammonium hydroxide solution reacts with hydrochloric acid according to the following equation.

ammonium hydroxide + hydrochloric acid → ammonium chloride + water

I. Give the general name for the type of reaction taking place. [1]

……

II. Give the chemical formula of the ammonium chloride formed during the reaction. [1]

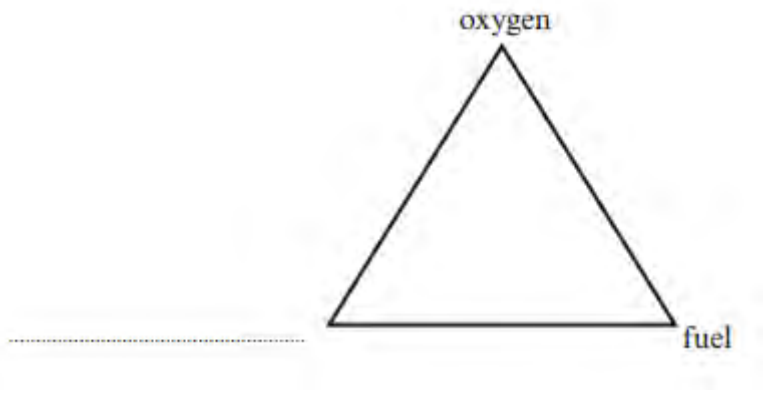
……

8

5. (a) Use your knowledge of hydrocarbons and the trends in the data to complete the following table. [3]

Hydrocarbon	methane	ethane	propane	butane	pentane
Molecular formula	CH_4	C_2H_6	.....	C_4H_{10}	C_5H_{12}
Boiling point (°C)	–164	–87	–42	.....	36
State at 20 °C	gas	gas	gas	gas	.....

(b) The fire triangle can be used to explain how fires can be extinguished.



(i) Complete the fire triangle by adding the missing factor in the diagram. [1]

(ii) A beaker of ethanol caught fire in a laboratory. Suggest how a teacher would safely extinguish the fire. Give a reason for your answer. [2]

.....

.....

(c) Methane gas is used as a fuel. It burns in oxygen giving out energy.

$$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$$

Breaking the bonds in the methane and oxygen molecules uses 2640 kJ of energy.

(i) Use the information in the equation above and the table to calculate the total amount of energy released in making the bonds in the carbon dioxide and water molecules. [2]

Bond made	**Energy released in making bond**	**Number of bonds made**
C = O	740	**?**
O—H	460	4

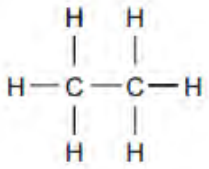
energy released = …… kJ

(ii) Calculate the overall energy released during the reaction. [1]

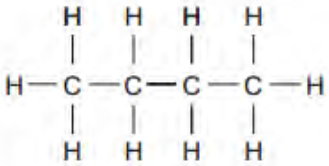
overall energy released = …… kJ

9

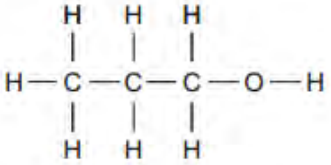
6. (a) The structural formulae of some organic compounds are shown below.



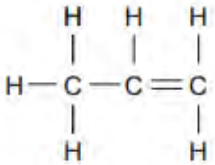
A



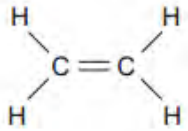
B



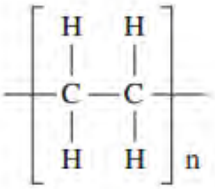
C



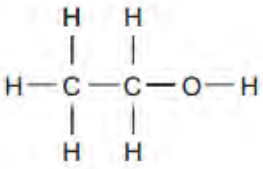
D



E



F



G

(i) Give the letters, **A**-**G**, which represent the following:

two alkenes, ... and .....

two alcohols, ... and .....

a polymer. ..... [3]

(ii) Give the letter of **one** compound that can undergo polymerisation and give a reason for your answer. [2]

.....

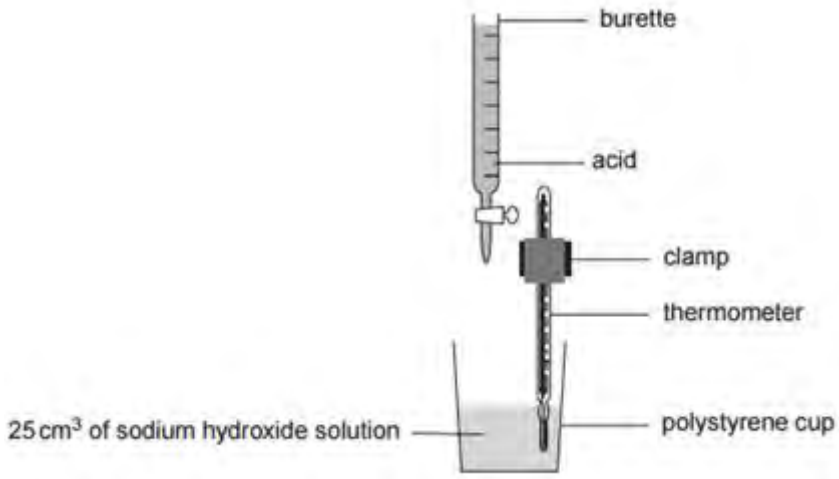
.....

(b) Dodecane is an alkane with 12 carbon atoms. Calculate the number of hydrogen atoms present in a molecule of dodecane. [1]

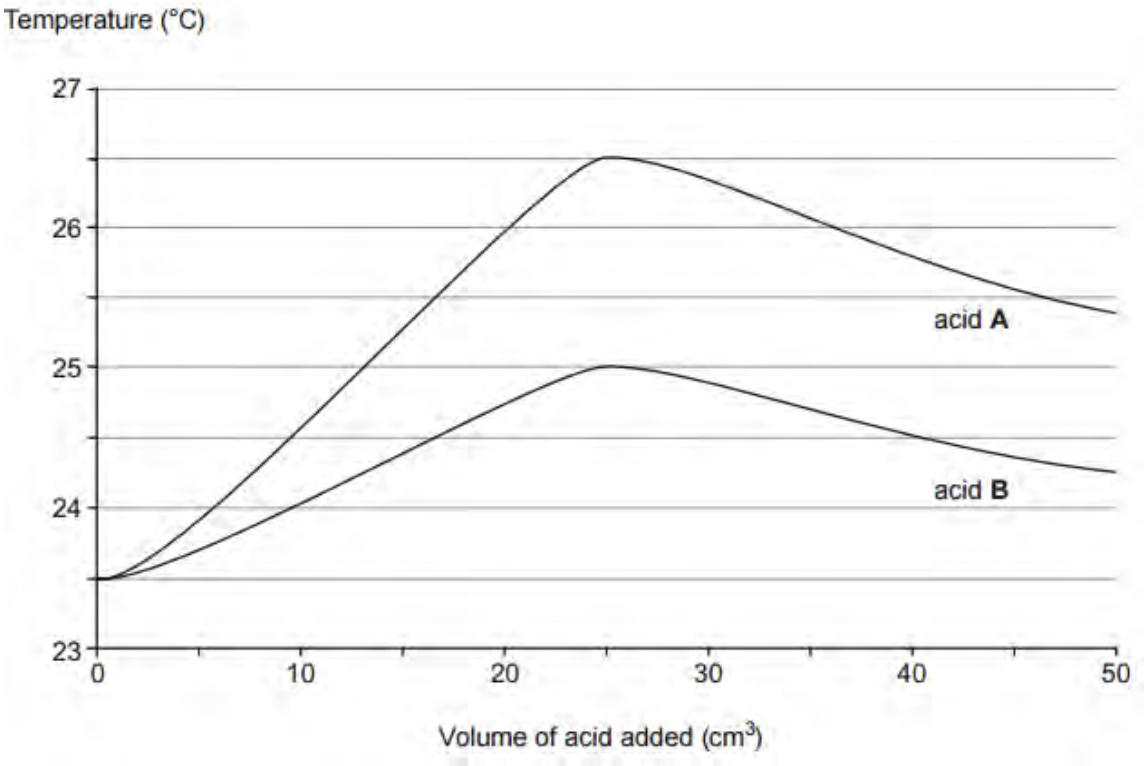
number of hydrogen atoms = ...

6

7. The apparatus below can be used to measure the temperature as a neutralisation reaction takes place.



The graphs below show how the temperature changes when acids **A** and **B** are added separately to 25 cm^3 of sodium hydroxide solution.



(a) Use the graphs opposite to find:

(i) the volume of acid required to neutralise the sodium hydroxide solution in both experiments; [1]

…… cm^3

(ii) the maximum temperature **rise** for acid **B**. [1]

…… °C

(b) State which acid, **A** or **B**, is stronger and give a reason for your answer. [1]

Stronger acid ……

Reason ……..

…….

(c) Describe how an indicator could be used to find the exact volume of acid needed for neutralisation. [3]

……..

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6

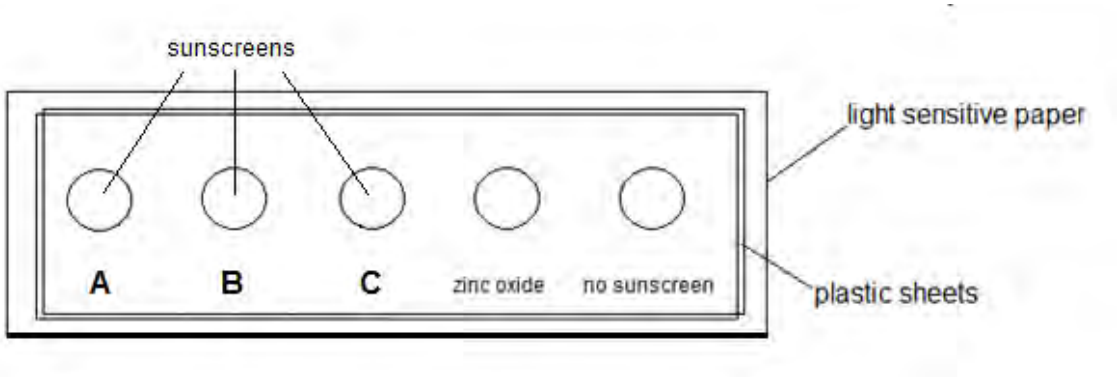
8. Nanoparticles are widely used in our everyday lives. They are used in deodorant sprays, plasters and sunscreens and in manufacturing self-cleaning windows.

Nano-sized zinc oxide particles are used in many sunscreens because they are known to block sunlight.

Rebecca and Jonathan set up an investigation to compare three sunscreens, **A**, **B** and **C**. They wanted to find out which was most effective in providing protection against UV rays.

Between two plastic sheets, they placed a sample of each of the sunscreens, as well as a sample of zinc oxide. Each of the samples was labelled. An area with no sunscreen was also labelled.

The plastic sheets were then placed on top of a sheet of light-sensitive paper and put into direct sunlight.



Light-sensitive paper changes from white to black, depending on its exposure to sunlight.

(a) Which **one** of these statements is a scientific description of the role of the 'zinc oxide' and 'no sunscreen' areas in comparing the effectiveness of the sunscreens? Tick (✓) the correct answer. [1]

'zinc oxide' and 'no sunscreen' are both factors being tested ☐

'no sunscreen' is a factor being tested and 'zinc oxide' is a reference substance ☐

'no sunscreen' is a reference substance and 'zinc oxide' is a factor being tested ☐

'no sunscreen' and 'zinc oxide' are both reference substances ☐

(b) Which **one** of these questions were Rebecca and Jonathan trying to answer? Tick (✓) the correct answer. [1]

how does the protection for each sunscreen compare with the others? ☐

how do sunscreens protect your skin from ultraviolet radiation? ☐

is there any sunscreen that gives less protection than no sunscreen? ☐

is there any sunscreen lotion that gives more protection than zinc oxide? ☐

(c) Why were the samples placed between two sheets of plastic? Tick (✓) the correct answer. [1]

to stop the samples from drying out ☐

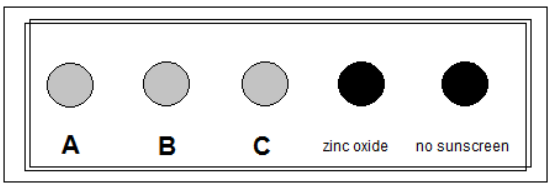
to spread the samples out as far as possible ☐

to keep the samples inside the marked circles ☐

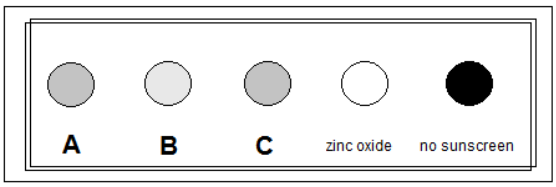
to make the samples the same thickness ☐

(d) The light-sensitive paper is white and gradually changes to grey then black, depending on its exposure to sunlight.

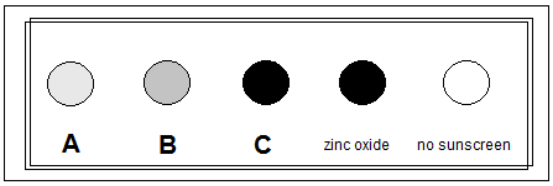
Which one of these diagrams shows the result set that might occur? Explain your choice. [3]



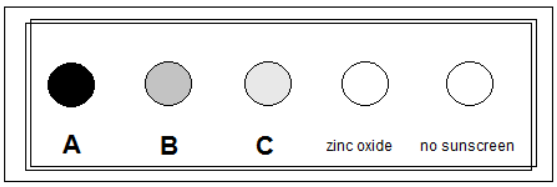
Result Set 1



Result Set 2



Result Set 3



Result Set 4

Answer .....

Explanation .....

.....

.....

.....

6

9. Explain why plastics have replaced traditional materials such as iron, glass, wood and paper for making everyday objects. [6 QER]

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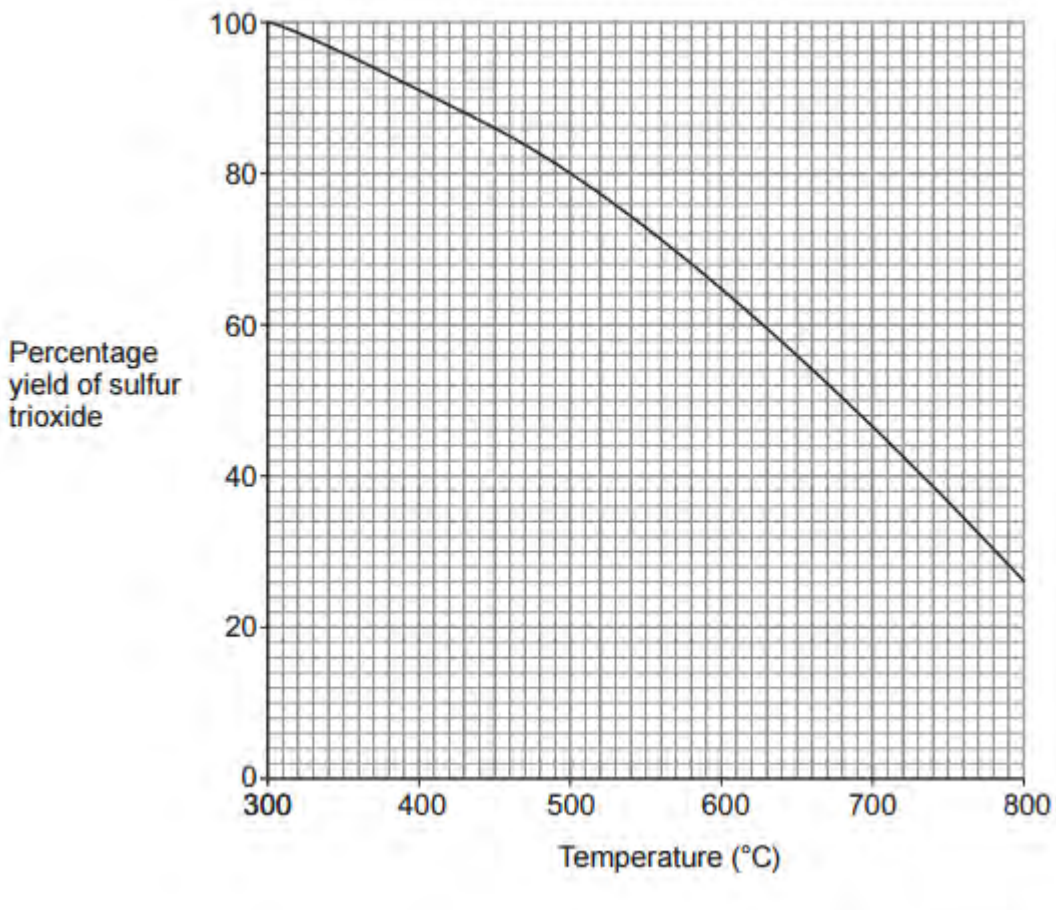
10. (a) One of the main stages in the manufacture of sulfuric acid is the reaction between sulfur dioxide and oxygen to form sulfur trioxide.

(i) Write the balanced **symbol** equation which represents this reaction.[3]

..... + ... ⇋ .....

(ii) The graph below shows how the percentage yield of sulfur trioxide changes with temperature between 300°C and 800°C.



Use the graph to find the increase in percentage yield if the temperature is reduced from 650 °C to 450 °C. [2]

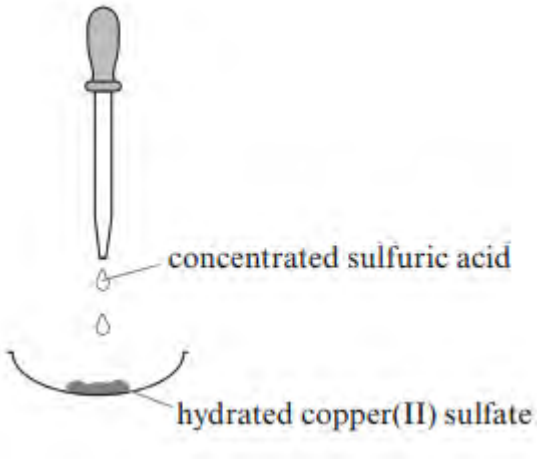
increase in percentage yield =..... %

(iii) One molecule of sulfur trioxide reacts with one molecule of sulfuric acid to form one molecule of oleum as the **only** product.

Write a balanced **symbol** equation for this reaction. [2]

..... + ... → .....

(b) A few drops of concentrated sulfuric acid were added to some crystals of hydrated copper(II) sulfate, $CuSO_4.5H_2O$.



Describe **two** changes that would be seen in the appearance of the copper(II) sulfate and state the property that the concentrated sulfuric acid displaying.

[3]

……..

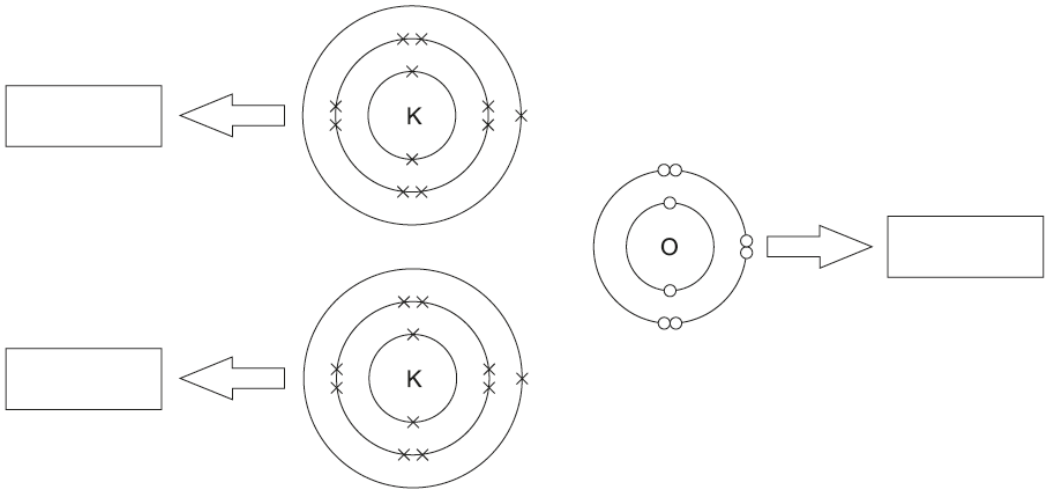
……..

……..

……..

10

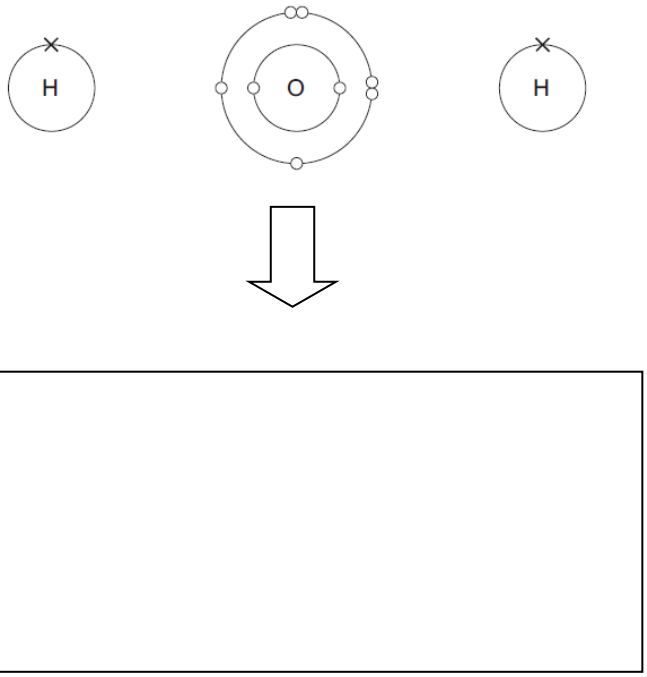
11. (a) Potassium reacts with oxygen to form potassium oxide. The diagram below can be used to show the electronic changes that take place as potassium oxide is formed.



(i) **Draw arrows on the diagram** to show the movement of electrons that leads to the formation of ions. [1]

(ii) **Write in the boxes**, the electronic configurations of the potassium and oxide **ions** formed. Include the charges on these ions. [2]

(b) Using the electronic structures shown, complete the diagram to show the covalent bonding in a molecule of water, H_2O. [2]



(c) **Table 1** shows some properties associated with three different types of structure.

Structure	Particle model	Melting point and boiling point	Electrical conductivity
giant ionic	consists of charged ions	high	only when molten or in solution
giant covalent	single molecules consisting of very many atoms	high	poor
simple covalent	small molecules, each consisting of a few atoms	low	poor

Table 1

Table 2 lists some properties of four substances, **A**, **B**, **C** and **D**.

Substance	Melting point (°C)	Boiling point (°C)	Electrical conductivity
A	–182	–161	poor
B	3550	4827	poor
C	1085	2562	good
D	801	1413	good when dissolved

Table 2

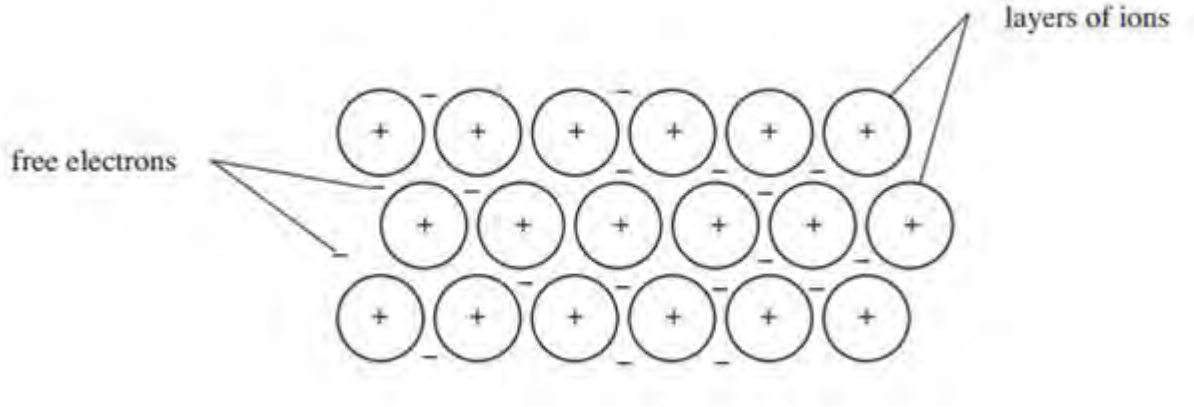
Give the letter of the substance, **A**, **B**, **C** or **D** that does not have a structure listed in **Table 1**. Give the reason for your answer. [2]

Substance .....

Reason .....

.....

(d) The diagram shows a model that can be used to represent the structure of a metal.



Use this model to explain **three** properties that are typical of metals. [3]

……..

……..

……..

……..

10

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^{+}	Sulfate	SO_4^{2-}
Magnesium	Mg^{2+}		
Nickel	Ni^{2+}		
Potassium	K^{+}		
Silver	Ag^{+}		
Sodium	Na^{+}		
Zinc	Zn^{2+}		

Avogadro's number, $L = 6 \times 10^{23}$

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: