Surname	Centre Number	Candidate Number
Other Names		0

GCSE – NEW

3430U20-1

S18-3430U20-1

SCIENCE (Double Award)

Unit 2: CHEMISTRY 1
FOUNDATION TIER

WEDNESDAY, 13 JUNE 2018 – MORNING

1 hour 15 minutes

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

3430U201 01

ADDITIONAL MATERIALS

In addition to this examination 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. 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. If you run out of space, use the additional page 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.

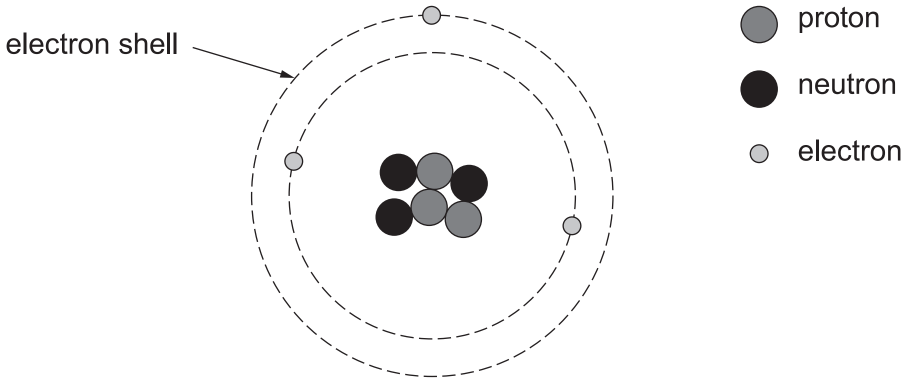
Question **6** is a quality of extended response (QER) question where your writing skills will be assessed.

The Periodic Table is printed on the back cover of this paper and the formulae for some common ions on the inside of the back cover.

Examiner only

Answer **all** *questions.*

1. *(a)* The diagram represents a lithium atom. Its nucleus contains protons and neutrons.



(i) Complete the table of information about particles in the atom. [2]

Name of particle	Charge	Mass
proton		1
neutron	0	
electron	–1	almost zero

(ii) **Use the information in the diagram** to give the mass number of this lithium atom. [1]

....

Examiner only

(b) Lithium reacts with oxygen. The word equation for this reaction is as follows.

lithium + oxygen ⟶ lithium oxide

(i) Name the **metal** in this equation. [1]

....

(ii) Name the **compound** in this equation. [1]

....

(iii) Name a **reactant** in this equation. [1]

....

(iv) Lithium oxide contains the ions Li^+ and O^{2-}.

Underline the formula of lithium oxide. [1]

LiO_2 **2LiO** **Li_2O** **Li^2O**

3430U201 03

7

Examiner only

2. Peter, Claire and David compared the hardness of three samples of water, **A**, **B** and **C**. They added soap solution to each sample until it gave a lather on shaking. They carried out a fair test.

(a) Give **two** ways they made it a fair test. [2]

....

....

....

(b) Their results are shown in the table.

Water sample	Volume of soap solution needed to give a lather (cm^3)			
	Peter	Claire	David	Mean
A	18	19	17	....
B	8	10	9	9
C	1	1	1	1

(i) Calculate the mean volume of soap solution needed for sample **A** to give a lather. **Show your working.** [2]

Mean = ... cm^3

(ii) Which of the three water samples is the **hardest**? Give a reason for your answer. [2]

....

....

....

Examiner only

(c) The box shows some advantages and some disadvantages of hard water.

strengthens bones and teeth	**forms limescale when heated**
wastes soap	**reduces heart disease**
forms a scum with soap	**tastes better**

Choose **all** the disadvantages of hard water from the box. [2]

....

....

....

....

(d) Choose from the box an ion that causes hardness in water. [1]

K^{+}	Na^{+}	Ca^{2+}	Cu^{2+}

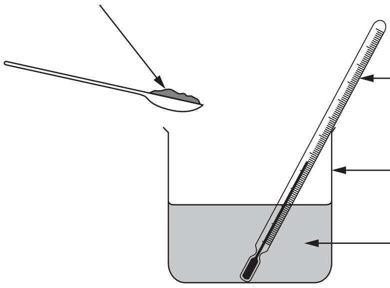
Ion ....

3430U201 05

9

Examiner only

3. Magnesium, zinc and iron powders were each added separately to 100 cm^3 of copper(II) sulfate solution, to see which gave the greatest temperature change.



The temperature was recorded before and after each reaction. The results are shown in the table.

Metal	Temperature before the reaction (°C)	Temperature after the reaction (°C)	Temperature increase (°C)
zinc	20	....	14
magnesium	19	39	20
iron	19	24	5

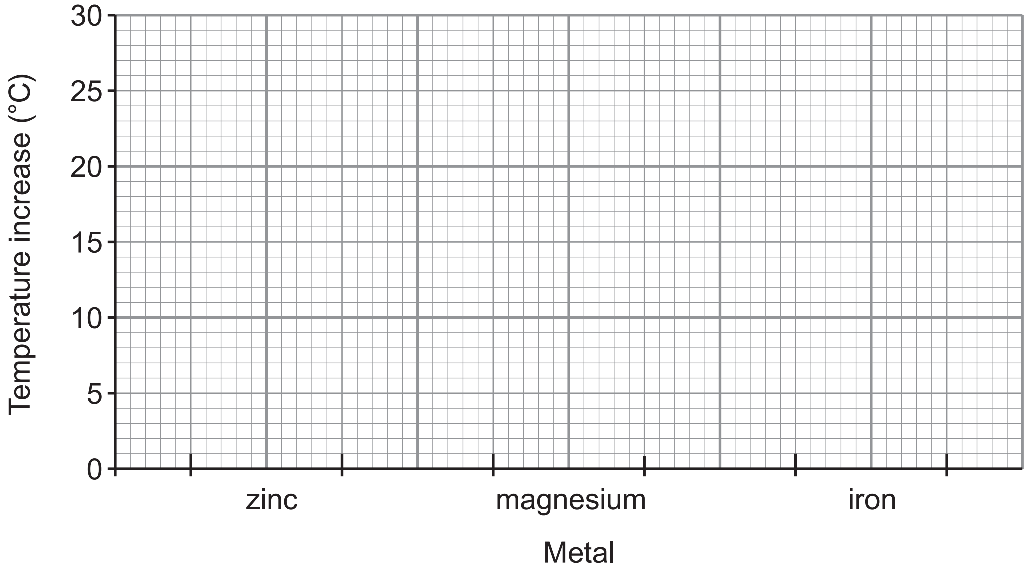
(a) Calculate the temperature after the reaction with zinc. [1]

Temperature = ... °C

 (3430U20-1)

Examiner only

(b) Plot a **bar chart** to show the temperature increase for each metal. [2]



(c) (i) Calculate the energy released in the reaction with magnesium. [2]
Use the following equation.

energy released (J) = volume of solution (cm^3) × 4.2 × temperature increase (°C)

Energy released = ... J

(ii) In this reaction magnesium sulfate, $MgSO_4$, is formed. What is the relative formula mass (M_r) of magnesium sulfate? [2]

A_r(Mg) = 24 A_r(S) = 32 A_r(O) = 16

M_r = ...

7

3430U201 07

 (3430U20-1) **Turn over.**

Examiner only

4. A student investigated changes that happened when pairs of colourless solutions were mixed. The table shows the observations made after mixing.

Pair of solutions	Appearance of the reactants	Appearance when mixed	Temperature change when mixed
A	two colourless solutions	no change	increase
B	two colourless solutions	bubbles form	increase
C	two colourless solutions	white precipitate forms	no change
D	two colourless solutions	no change	no change

(a) Which pair of solutions do **not** react? Give a reason for your answer. [2]

....

....

....

(b) (i) The gas given off when pair **B** react is carbon dioxide. Describe the test for carbon dioxide gas. [1]

....

....

(ii) One of the solutions in pair **B** is sodium carbonate. Give the formula of sodium carbonate. [1]

....

(c) (i) Which pair of solutions is silver nitrate and sodium chloride? [1]

....

(ii) What colour would sodium chloride give in a flame test? [1]

....

6

BLANK PAGE

PLEASE DO NOT WRITE ON THIS PAGE

3430U201
09

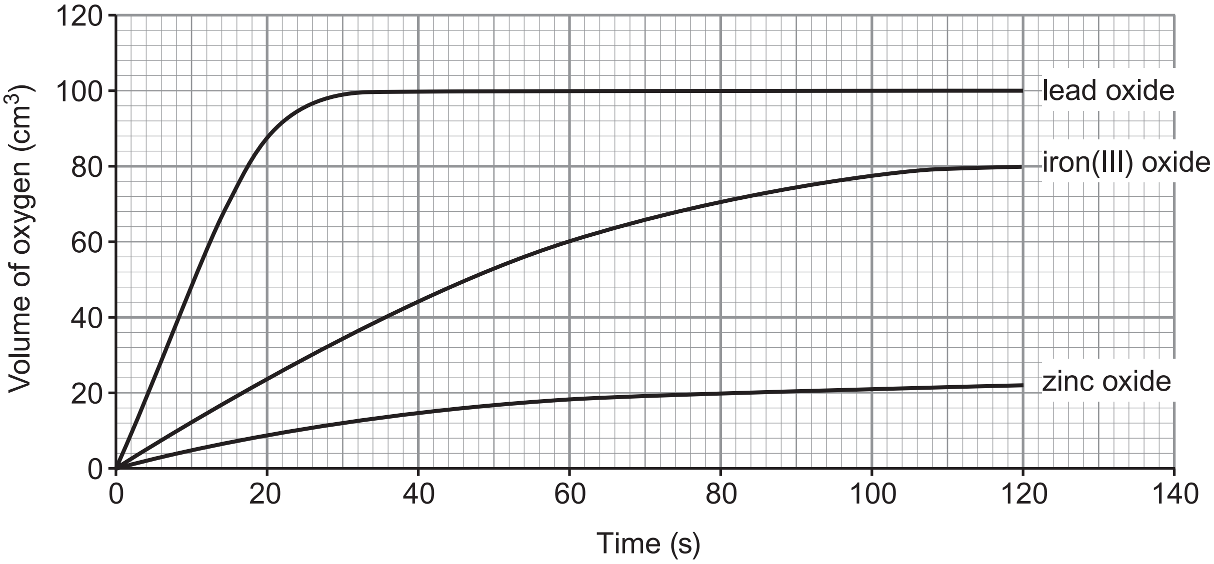
Examiner only

5. Hydrogen peroxide solution decomposes to give water and oxygen gas. Many metal oxides act as catalysts for the reaction.

(a) Use the symbol equation for the reaction to find the formula of hydrogen peroxide. [1]

$$2 \;\ldots\ldots\ldots\ldots \longrightarrow 2H_2O \;+\; O_2$$

(b) Catalysts are used to speed up the reaction. The graphs show the volume of oxygen formed over 120 seconds when 1.0 g of different metal oxides were added to 50 cm^3 of hydrogen peroxide solution.



(i) Use the graph to find the time taken to form 44 cm^3 of oxygen using iron(III) oxide as the catalyst. [1]

.... s

Examiner only

(ii) State which metal oxide is the **best** catalyst. Give a reason for your answer. [1]

....

....

....

(iii) After 120 seconds, the contents of each beaker were washed into a filter paper and funnel. The catalyst left over on each filter paper was dried and weighed.

Tick (✓) the box next to the statement which is correct. [1]

the same mass of all catalysts is left over	☐
more zinc oxide is left over than lead oxide	☐
about 80 % of the iron(III) oxide is left over	☐
no lead oxide is left over	☐

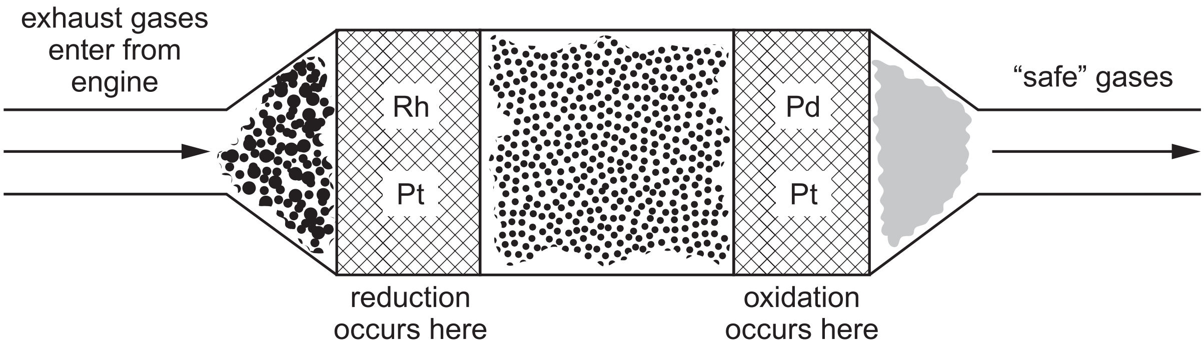
3430U201
11

(c) Exhaust gases from car engines contain harmful molecules, for example, carbon monoxide and nitrogen oxides. All cars are fitted with catalytic converters that split up these harmful molecules.

The catalysts are made from platinum (Pt) and palladium (Pd) or rhodium (Rh). A mesh structure is used that exposes the maximum surface area of catalyst to the exhaust gases, while also reducing the amount of catalyst required. Platinum, palladium and rhodium are extremely expensive.

As the exhaust gases from the engine pass over the catalysts, chemical reactions take place on their surfaces. The harmful molecules are broken up and converted into other gases that are "safe" to enter the air. These gases include carbon dioxide, nitrogen, oxygen and water.

Catalytic converter



There are two different types of catalyst, a **reduction catalyst** and an **oxidation catalyst**. The reduction catalyst removes oxygen from nitrogen oxides to make nitrogen and oxygen. The oxidation catalyst adds oxygen to carbon monoxide to make carbon dioxide.

One of the biggest drawbacks of the catalytic converter is that it only works effectively at high temperatures. The average running temperature of a car engine is between 90 and 110 °C. It takes nearly 30 minutes for these temperatures to be reached.

The table opposite shows the percentages of carbon monoxide and nitrogen oxides converted to safe gases by a catalytic converter at different temperatures.

Examiner only

Temperature (°C)	Carbon monoxide converted (%)	Nitrogen oxides converted (%)
25	16	25
50	19	28
75	26	35
100	60	72
125	91	92
150	93	94
175	95	95
200	97	98

(i) Using your knowledge of particle theory suggest why a catalyst in mesh form works better than a lump of catalyst. [2]

....

....

....

....

(ii) Tick (✓) the box that best describes the adverse effect that gases leaving the exhaust would have on the environment. [1]

they have no effect on the environment ☐

they reduce oxygen levels ☐

they deplete the ozone layer ☐

they cause global warming ☐

Examiner only

(iii) Tick (✓) the box that best describes the conversion of carbon monoxide and nitrogen oxides into "safe" gases at different temperatures. [1]

- [ ] equal amounts of carbon monoxide and nitrogen oxides are converted at every temperature
- [ ] more carbon monoxide is converted than nitrogen oxides up to 100 °C
- [ ] more nitrogen oxides are converted than carbon monoxide up to 100 °C
- [ ] 40 % more nitrogen oxides are converted than carbon monoxide up to 100 °C

(iv) In your opinion how effective are catalytic converters? Explain your answer. [2]

....

....

....

....

10

Examiner only

6. Describe how respiration and photosynthesis keep the carbon dioxide and oxygen content of the atmosphere approximately constant. Discuss how human activity is threatening this balance. [6 QER]

6

Examiner only

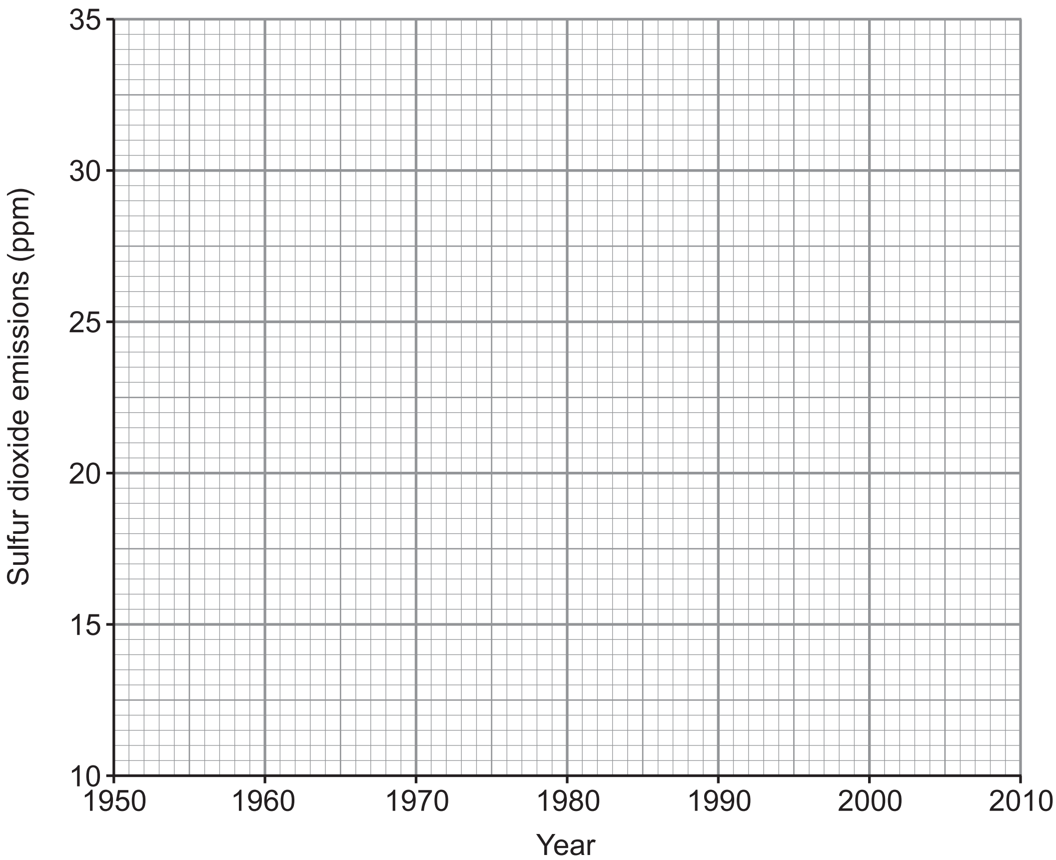
7. Burning fossil fuels containing sulfur causes sulfur dioxide, SO_2, to be released into the atmosphere.

The table shows sulfur dioxide emissions in the UK between 1950 and 2010.

Year	Sulfur dioxide emissions (ppm)
1950	12.0
1960	16.0
1970	21.5
1980	29.5
1990	29.0
2000	24.0
2010	18.5

ppm = parts per million

(a) (i) On the grid plot the sulfur dioxide emissions against the year and draw a suitable line. [3]



Examiner only

(ii) Describe how sulfur dioxide emissions changed between 1950 and 2010. [2]

....

....

....

(iii) The UK government introduced a regulation to reduce sulfur dioxide emissions in the 1980s. From your graph, state why it is difficult to decide exactly the year when the regulation came into force. [1]

....

....

....

(b) Sulfur dioxide can be converted to sulfur and water by reacting it with hydrogen sulfide, H_2S.

Complete and balance the symbol equation for this reaction. [2]

SO_2 + ☐ H_2S ⟶ ☐ S + ☐ ....

8

 (3430U20-1) **Turn over.**

Examiner only

8. The table shows some physical properties of Group 6 elements.

Element	Melting point (°C)	Boiling point (°C)	Density (g/cm^3)	Electrical conductor
oxygen	–219	–183	0.0014	no
sulfur	115	445	2.0	no
selenium	221	685	4.8	semi-conductor
tellurium	450	988	6.2	semi-conductor

(a) (i) Describe the trend in the melting points of the Group 6 elements. [1]

....

(ii) Give the physical state of selenium at 400 °C. Give a reason for your choice. [2]

....

....

(iii) Explain why it is difficult to classify selenium as either a metal or a non-metal. [1]

....

....

....

Examiner only

(b) Selenium dioxide reacts with sodium hydroxide to produce sodium selenite and water.

$$SeO_2 + 2NaOH \longrightarrow Na_2SeO_3 + H_2O$$

selenium dioxide → sodium selenite

(i) Calculate the relative formula mass (M_r) of sodium selenite, Na_2SeO_3. [1]

A_r(Na) = 23 A_r(Se) = 79 A_r(O) = 16

M_r = ...

(ii) Calculate the percentage by mass of selenium in sodium selenite. [2]

Percentage = ... %

7

END OF PAPER

BLANK PAGE

PLEASE DO NOT WRITE ON THIS PAGE

Question number	Additional page, if required. Write the question number(s) in the left-hand margin.

Examiner only

Turn over.

BLANK PAGE

PLEASE DO NOT WRITE ON THIS PAGE

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+}		

THE PERIODIC TABLE

Group

1	2											3	4	5	6	7	0
						1 H Hydrogen 1											4 He Helium 2
7 Li Lithium 3	9 Be Beryllium 4											11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10
23 Na Sodium 11	24 Mg Magnesium 12											27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulfur 16	35.5 Cl Chlorine 17	40 Ar Argon 18
39 K Potassium 19	40 Ca Calcium 20	45 Sc Scandium 21	48 Ti Titanium 22	51 V Vanadium 23	52 Cr Chromium 24	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	59 Ni Nickel 28	63.5 Cu Copper 29	65 Zn Zinc 30	70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36
86 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	99 Tc Technetium 43	101 Ru Ruthenium 44	103 Rh Rhodium 45	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54
133 Cs Caesium 55	137 Ba Barium 56	139 La Lanthanum 57	179 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	186 Re Rhenium 75	190 Os Osmium 76	192 Ir Iridium 77	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	210 Po Polonium 84	210 At Astatine 85	222 Rn Radon 86
223 Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89															

Key

A_r — relative atomic mass Symbol Name Z — atomic number