

Please check the examination details below before entering your candidate information	
Candidate surname	Other names
Centre Number	Candidate Number
Pearson Edexcel Level 1/Level 2 GCSE (9–1)	
Tuesday 13 June 2023	
Morning (Time: 1 hour 10 minutes)	Paper reference 1SC0/2CH
Combined Science	
PAPER 5	
Higher Tier	
You must have: Calculator, ruler	Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided – *there may be more space than you need.*
- Calculators may be used.
- Any diagrams may NOT be accurately drawn, unless otherwise indicated.
- You must **show all your working out** with **your answer clearly identified** at the **end of your solution**.

Information

- The total mark for this paper is 60.
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*
- In questions marked with an **asterisk** (*), marks will be awarded for your ability to structure your answer logically, showing how the points that you make are related or follow on from each other where appropriate.
- There is a periodic table on the back cover of the paper.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ►

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Answer ALL questions. Write your answers in the spaces provided.

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

- 1 A student used the apparatus shown in Figure 1 to investigate the reaction between marble chips and dilute hydrochloric acid.

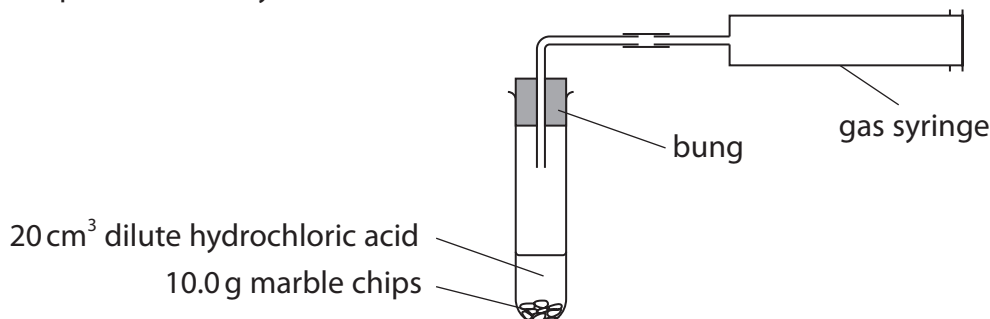


Figure 1

The student recorded the volume of gas every minute as shown in Figure 2.

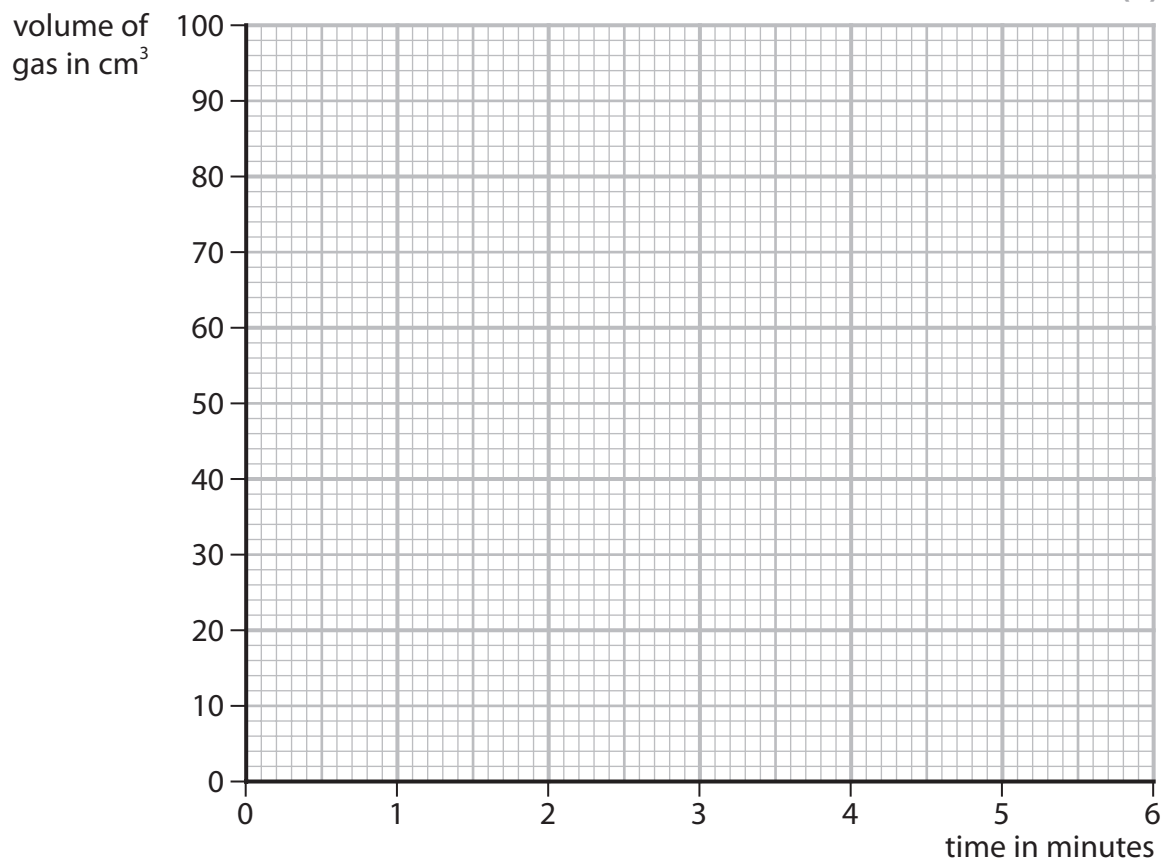
time in minutes	0	1	2	3	4	5	6
volume of gas in cm ³	0	52	78	91	97	100	100

Figure 2

- (a) On the grid, plot the results shown in Figure 2.

Draw a curve of best fit.

(3)



(b) Rate of reaction can be calculated using

$$\text{rate of reaction} = \frac{\text{volume of gas produced in 1 minute}}{1 \text{ minute}}$$

Figure 3 shows the rates of reaction calculated from the results of this experiment.

The rate of reaction for the time interval 2 to 3 minutes is missing.

time interval	0 to 1 minute	1 to 2 minutes	2 to 3 minutes	3 to 4 minutes	4 to 5 minutes
rate of reaction in $\text{cm}^3 \text{ min}^{-1}$	52	26		6	3

Figure 3

(i) Calculate the rate of reaction for the time interval 2 to 3 minutes.

(1)

rate of reaction = $\text{cm}^3 \text{ min}^{-1}$

(ii) State and explain what happens to the rate of reaction as the acid reacts with the marble chips in this experiment.

(3)

(c) The student repeated the experiment using the same volume of acid and the same mass of marble chips but used smaller marble chips.

All other conditions remained the same.

The student found that the reaction with the smaller marble chips was faster to start with but produced the same volume of gas.

Using this information, draw a line on the grid to show the results for the reaction with the smaller marble chips.

Label this line 'C'.

(2)

(Total for Question 1 = 9 marks)



2 Figure 4 shows some information about the group 1 metals.

group 1 metal	atomic number	relative atomic mass
lithium	3	7
sodium	11	23
potassium	19	39
rubidium	37	85
caesium	55	133

Figure 4

(a) Explain, in terms of their electronic configurations, why these metals are placed in group 1 of the periodic table.

(2)

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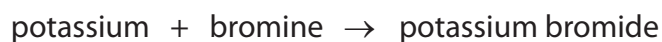
(b) Which row shows two correct properties of group 1 metals?

(1)

properties of group 1 metals		
☐ A	compounds are white in colour	high density
☐ B	low melting points	compounds are blue in colour
☐ C	soft enough to be cut by a knife	low melting points
☐ D	high density	conduct electricity

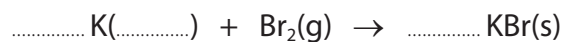


- (c) The word equation for the reaction of potassium with bromine is



Add the missing state symbol and balance the equation for this reaction.

(2)



- (d) A sample of potassium contains three isotopes, potassium-39, potassium-40 and potassium-41.

- (i) Explain the meaning of the term **isotopes**.

(2)

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- (ii) This sample of potassium contains

93.25% potassium-39

0.02% potassium-40

6.73% potassium-41

Calculate the relative atomic mass of this sample of potassium.

(2)

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relative atomic mass =

(Total for Question 2 = 9 marks)



- 3 (a) Figure 5 shows the percentage of three gases, **X**, **Y** and **Z**, in the Earth's early atmosphere.

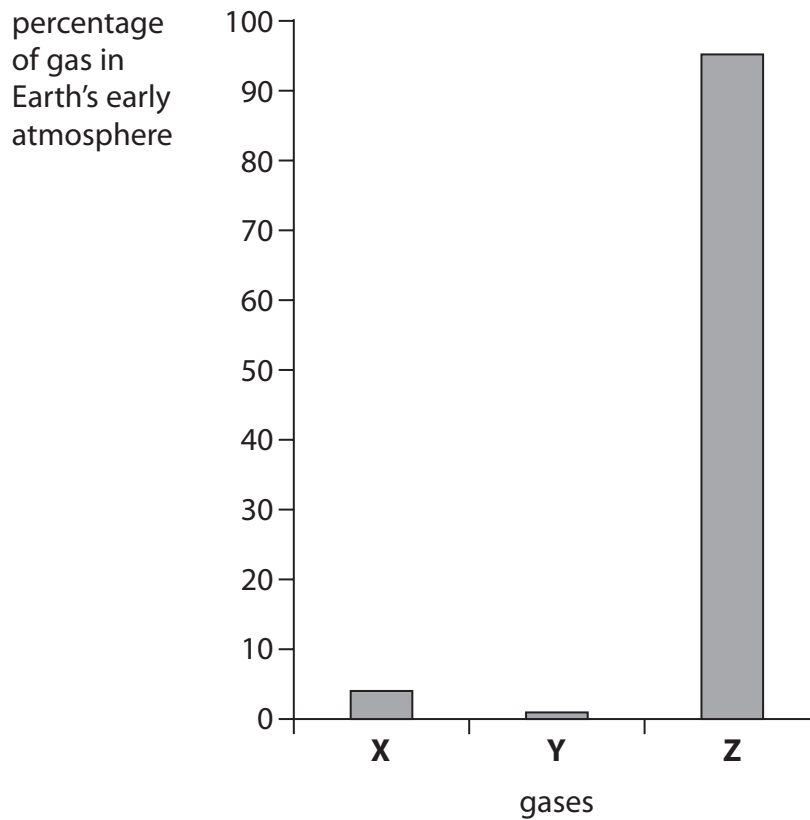


Figure 5

What is the name of gas **Z**?

(1)

- ☐ **A** argon
- ☐ **B** carbon dioxide
- ☐ **C** nitrogen
- ☐ **D** oxygen



- (b) It is thought that small quantities of hydrogen sulfide, H_2S , were also in the Earth's early atmosphere.

Draw the dot and cross diagram for a molecule of hydrogen sulfide.

Show outer electrons only.

(2)

- (c) Acid rain is caused by some pollutant gases present in the atmosphere.

Explain how impurities in fossil fuels can result in acid rain.

(3)

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(d) A student investigates the effect of acid rain on cress plants.

The student uses this method.

step 1 grow 20 cress plants in each of two dishes, **A** and **B**

step 2 water the cress plants in dish **A** with 10 cm^3 of dilute hydrochloric acid with a pH of 2

step 3 water the cress plants in dish **B** with 10 cm^3 of pure water with a pH of 7

step 4 repeat steps 2 and 3 every day for one week

step 5 count how many plants are still alive after one week.

- (i) State what piece of equipment the student could use to measure the pH of each liquid.

(1)

- (ii) Explain **one** improvement that the student could make to the method to make the results more valid.

(2)

(Total for Question 3 = 9 marks)



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- 4 Chlorine gas can be prepared by reacting concentrated hydrochloric acid with solid potassium manganate(VII).

Figure 6 shows the apparatus used.

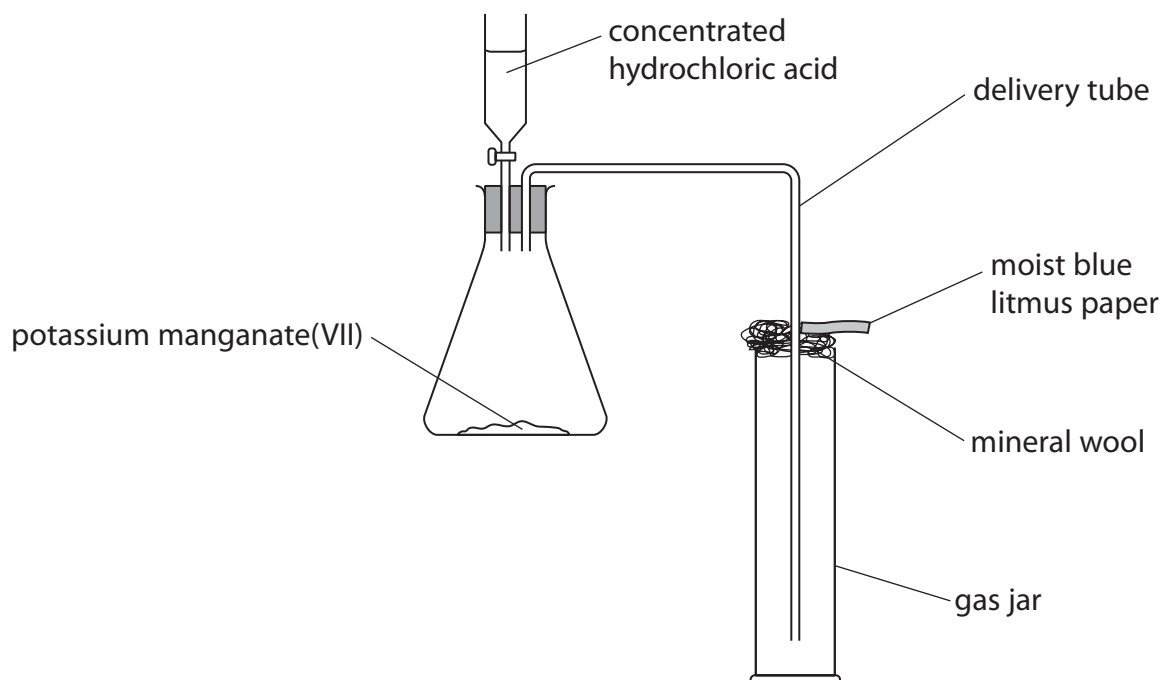


Figure 6

- (a) Figure 7 shows the hazard symbols for concentrated hydrochloric acid, potassium manganate(VII) and chlorine gas.

substance	hazard symbol
concentrated hydrochloric acid	 
potassium manganate(VII)	  
chlorine gas	  

Figure 7

Use the information in Figure 7 to help you answer (a)(i) and (a)(ii).



(i) What are the hazards associated with potassium manganate(VII)?

(1)

- ☐ A flammable, harmful and corrosive
- ☐ B flammable, toxic and hazardous to the environment
- ☐ C oxidising, harmful and hazardous to the environment
- ☐ D oxidising, toxic and corrosive

(ii) Explain **one** precaution that should be taken when preparing the sample of chlorine gas.

(2)

precaution

reason

(b) State the purpose of the delivery tube.

(1)

(c) Suggest why damp blue litmus is placed at the top of the gas jar.

(2)

(d) In the reaction, potassium manganate(VII), KMnO_4 , reacts with hydrochloric acid to form manganese chloride, MnCl_2 , potassium chloride, chlorine and water.

Write the balanced equation for the reaction.

(3)

(Total for Question 4 = 9 marks)

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5 Ammonia can be produced from the reaction of hydrogen with nitrogen.

(a) What is the percentage by mass of nitrogen in ammonia, NH_3 ?

(relative atomic masses: $\text{H} = 1.0$, $\text{N} = 14$)

(1)

- ☐ **A** 18%
- ☐ **B** 42%
- ☐ **C** 51%
- ☐ **D** 82%

(b) The reaction between hydrogen and nitrogen is exothermic.

Figure 8 shows the reaction profile of this exothermic reaction.

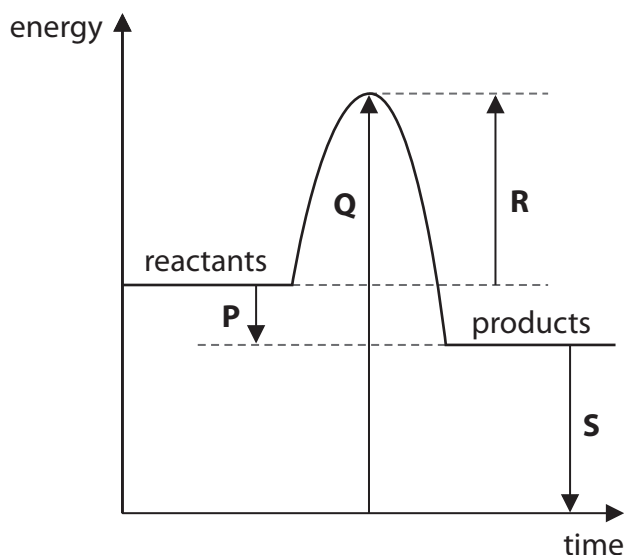


Figure 8

(i) Which arrow represents the activation energy for the reaction?

(1)

- ☐ **A** arrow **P**
- ☐ **B** arrow **Q**
- ☐ **C** arrow **R**
- ☐ **D** arrow **S**



- (ii) Describe what the reaction profile shows about the energy involved in bond breaking and bond making in this reaction.

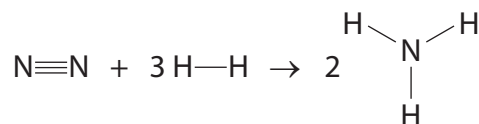
(2)

- (iii) Figure 9 shows the energies of some bonds.

bond	bond energy in kJ mol^{-1}
$\text{N}\equiv\text{N}$	944
$\text{H}-\text{H}$	436
$\text{H}-\text{N}$	388

Figure 9

The equation for the reaction between nitrogen and hydrogen to form ammonia is



Calculate the energy change, in kJ mol^{-1} , for this reaction.

(4)

energy change = kJ mol^{-1}



- (c) Ammonia, NH_3 , and silicon dioxide, SiO_2 , are both compounds that are made of two non-metallic elements.

Ammonia has a boiling point of -33°C .

Silicon dioxide has a boiling point of 2230°C .

Explain why the boiling points of ammonia and silicon dioxide are so different.

(3)

(Total for Question 5 = 11 marks)



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6 Crude oil is a mixture of hydrocarbons.

Crude oil can be separated into useful fractions by the process of fractional distillation in a fractionating column.

- (a) Figure 10 shows a fractionating column, the fractions obtained and the trend in viscosity of the fractions.

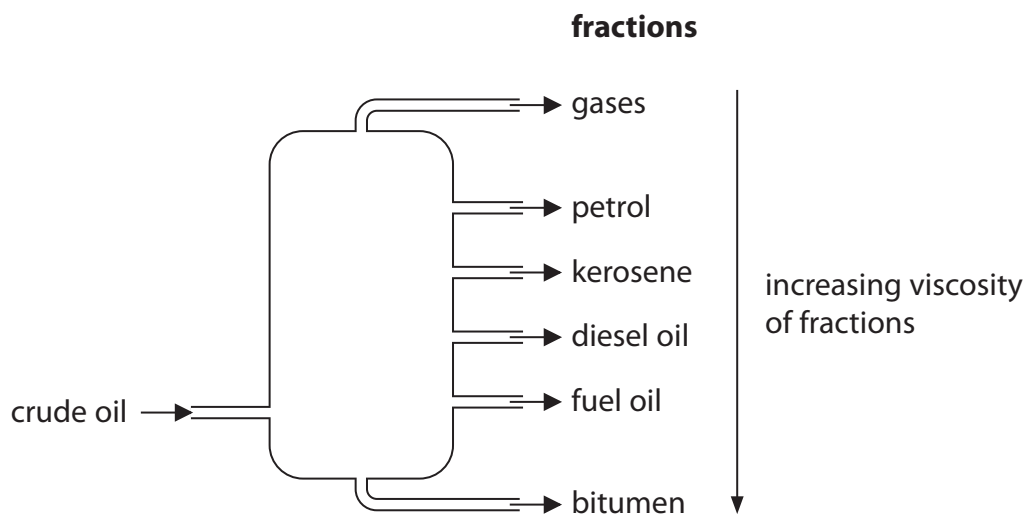


Figure 10

- (i) Which row shows the correct uses for bitumen, diesel oil and fuel oil?

(1)

	bitumen	diesel oil	fuel oil
☐ A	fuel for large ships	surfacing roads	fuel for trains
☐ B	fuel for large ships	fuel for trains	surfacing roads
☐ C	surfacing roads	fuel for trains	fuel for large ships
☐ D	surfacing roads	fuel for large ships	fuel for trains

- (ii) Explain the trend in the viscosity of the fractions.

(2)

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- (b) Hydrocarbon **X** was cracked to form one molecule of hexane, C_6H_{14} , and one molecule of alkene **Y**.



The relative formula mass of **Y** is 56.

The empirical formula of **Y** is CH_2 .

Deduce the molecular formula of hydrocarbon **X**.

Show your working.

(relative atomic masses: $H = 1.0$, $C = 12$)

(4)

molecular formula of **X** =

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*(c) Large quantities of methane are used as a fuel.

Figure 11 shows a Bunsen burner.

Methane can be used as fuel for the Bunsen burner.

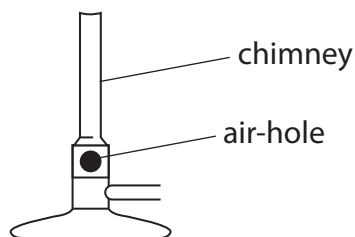


Figure 11

The air-hole on the chimney of the Bunsen burner can be opened and closed.

Explain the effect of opening and closing the air-hole of the Bunsen burner on the products of combustion of methane and the harm that using large quantities of methane as a fuel can cause.

(6)

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(Total for Question 6 = 13 marks)

TOTAL FOR PAPER = 60 MARKS



The periodic table of the elements

1	2	Key										3	4	5	6	7	0	
7 Li lithium 3	9 Be beryllium 4	relative atomic mass atomic symbol name atomic (proton) number										11 B boron 5	12 C carbon 6	14 N nitrogen 7	16 O oxygen 8	19 F fluorine 9	4 He helium 2	
		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
	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
	85 Rb rubidium 37	88 Sr strontium 38	89 Y yttrium 39	91 Zr zirconium 40	93 Nb niobium 41	96 Mo molybdenum 42	[98] 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	178 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	[209] Po polonium 84	[210] At astatine 85	[222] Rn radon 86	

* The elements with atomic numbers from 58 to 71 are omitted from this part of the periodic table.

The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number.

