**Please write clearly in block capitals.**

**H**

Centre number ☐☐☐☐☐ Candidate number ☐☐☐☐

Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

# GCSE

## CHEMISTRY

### Higher Tier Paper 1

Practice Paper Series – Set 2

**Time allowed: 1 hour 45 minutes**

### Materials

For this paper you must have:

- a ruler
- a scientific calculator
- the periodic table (printed at the back of this booklet).

### Instructions

- Use black ink or black ball-point pen.
- Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided.
- Do not write outside the box around each page or on blank pages.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Do all rough work in this book. Cross through any work you do not want to be marked.
- In all calculations, show clearly how you work out your answer.

### Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 100.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.
- When answering questions 07.3 and 09.5 you need to make sure that your answer:
  - is clear, logical, sensibly structured
  - fully developed
  - shows how the points that you make are related or follow on from each other where appropriate.

**For Examiner's Use**

| Question | Mark |
|---|---|
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| 6 | |
| 7 | |
| 8 | |
| 9 | |
| 10 | |
| **TOTAL** | |

This is an original practice paper written for sciencegcse.co.uk to match the style and demand of AQA GCSE Chemistry (8462) Paper 1 (Higher Tier). It is not an AQA examination paper and has not been produced or endorsed by AQA. It is not a prediction of a future examination.

**0 1** Cells and batteries use chemical reactions to produce electricity.

**0 1 . 1** What is a battery? [1 mark]

.....

.....

**0 1 . 2** A simple cell can be made by putting two different metals into an electrolyte. [2 marks]

Give **two** factors that affect the voltage of a cell.

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**0 1 . 3** Explain how a rechargeable battery can be used again after it has run down. [2 marks]

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**Table 1** gives information about two types of battery.

**Table 1**

| Type of battery | Cost of one battery | Number of times it can be used | Voltage in V |
|---|---|---|---|
| Alkaline (non-rechargeable) | 90p | 1 | 1.5 |
| Rechargeable | £3.60 | 400 | 1.2 |

**0 1 . 4** Explain why a non-rechargeable battery eventually stops producing a potential difference. [2 marks]

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**Question 1 continues on the next page**

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**0 1 . 5** Suggest **one** disadvantage of the rechargeable battery compared with the alkaline battery. [1 mark]

Use **Table 1**.

.....

.....

**0 2** Carbon and silicon are elements in Group 4 of the periodic table.

**0 2 . 1** Silicon has the atomic number 14 [1 mark]

Give the electronic structure of a silicon atom.

.....

**Table 2** shows the isotopes of silicon.

**Table 2**

| Isotope | Mass number | Percentage abundance |
|---|---|---|
| silicon-28 | 28 | 92 |
| silicon-29 | 29 | 5 |
| silicon-30 | 30 | 3 |

**0 2 . 2** State what is meant by **isotopes** of an element. [2 marks]

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**0 2 . 3** How many neutrons are there in an atom of silicon-30? [1 mark]

..... neutrons

**Question 2 continues on the next page**

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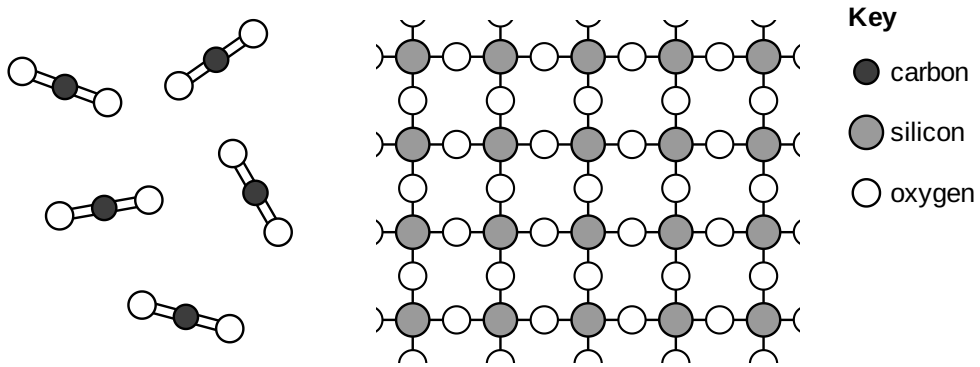


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Carbon dioxide and silicon dioxide have very different properties.

**Figure 1** represents their structures.

**Figure 1**




Carbon dioxide Silicon dioxide

**0 2 . 4** What type of bonding holds the atoms together in both substances? [1 mark]

**0 2 . 5** Solid carbon dioxide turns into a gas at −78 °C. Silicon dioxide melts at 1710 °C [4 marks]

Explain why silicon dioxide melts at a much higher temperature than the temperature at which carbon dioxide turns into a gas.

Use **Figure 1**.

**Turn over for the next question**

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**0 3** Hydrogen peroxide ($H_2O_2$) is used as a bleach.

It can be made by two different routes.

Route A

$$H_2 + O_2 \longrightarrow H_2O_2$$

Route B

$$BaO_2 + H_2SO_4 \longrightarrow BaSO_4 + H_2O_2$$

Relative formula masses ($M_r$): $BaO_2 = 169$ $H_2SO_4 = 98$ $BaSO_4 = 233$ $H_2O_2 = 34$

**0 3 . 1** Explain why the atom economy of route A is 100% [1 mark]

.....

.....

**0 3 . 2** Calculate the percentage atom economy for making hydrogen peroxide by route B. [2 marks]

Atom economy = ..... %

**0 3 . 3** A factory uses route B. The theoretical yield of hydrogen peroxide is 680 kg. The factory obtains 544 kg of hydrogen peroxide. [2 marks]

Calculate the percentage yield.

Percentage yield = ..... %

**0 3 . 4** Calculate the mass of barium peroxide ($BaO_2$) needed for a **theoretical yield** of 680 kg of hydrogen peroxide by route B. [2 marks]

Mass of barium peroxide = ..... kg

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**Question 3 continues on the next page**

**0 3 . 5** A manager says: [2 marks]

**'We should use route A because it has the higher atom economy.'**

Give **two** other factors that the factory should consider when choosing a route.

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**0 3 . 6** Manganese is a transition metal. It forms compounds containing $Mn^{2+}$ ions and compounds containing $Mn^{4+}$ ions. [2 marks]

Hydrogen peroxide decomposes quickly when manganese(IV) oxide is added, and the manganese(IV) oxide is not used up.

Give **two** typical properties of transition metals or their compounds shown by this information.

1

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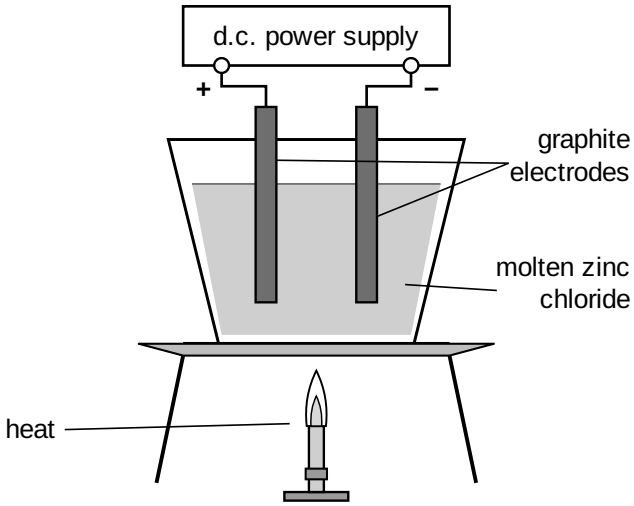
2

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**0 4** Zinc chloride is an ionic compound. Molten zinc chloride can be electrolysed.

**Figure 2** shows the apparatus.

**Figure 2**




**0 4 . 1** Why must the zinc chloride be molten for electrolysis? [1 mark]

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**Question 4 continues on the next page**

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**0 4 . 2** Name the product at each electrode. [2 marks]

Positive electrode .....

Negative electrode .....

**0 4 . 3** Write a half equation for the reaction at the positive electrode. [2 marks]

.....

.....

**0 4 . 4** Suggest why this electrolysis is done in a fume cupboard. [1 mark]

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**0 4 . 5** Give **one** reason why graphite is used for the electrodes. [1 mark]

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**0 5** Sodium hydrogencarbonate is used in baking powder.

When it is heated, sodium hydrogencarbonate decomposes:

$$2NaHCO_3(s) \longrightarrow Na_2CO_3(s) + H_2O(g) + CO_2(g)$$

**0 5 . 1** Explain how sodium hydrogencarbonate helps a cake to rise when it is baked. [2 marks]

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**0 5 . 2** The decomposition of sodium hydrogencarbonate is endothermic. [2 marks]

Explain why, in terms of breaking and making bonds.

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**Question 5 continues on the next page**

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**0 5 . 3** A student heated 4.20 g of sodium hydrogencarbonate in a test tube until its mass stopped changing. [4 marks]

$$2NaHCO_3 \longrightarrow Na_2CO_3 + H_2O + CO_2$$

Relative formula masses ($M_r$): $NaHCO_3 = 84$ $Na_2CO_3 = 106$

Calculate the mass of sodium carbonate produced.

Mass of sodium carbonate = ..... g

**0 5 . 4** Calculate the volume of carbon dioxide produced at room temperature and pressure when the 4.20 g of sodium hydrogencarbonate decomposes. [2 marks]

The volume of 1 mole of any gas at room temperature and pressure is 24 $dm^3$

Volume = ..... $dm^3$

**0 5 . 5** Why did the student heat the sodium hydrogencarbonate until its mass stopped changing? [1 mark]

.....

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**0 5 . 6** Explain why the mass of the test tube and its contents decreased. [1 mark]

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**Turn over for the next question**

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**0 6** A student investigated the reactivity of three metals, **X**, **Y** and **Z**.

The student added each metal to solutions containing ions of the other metals.

- Metal **X** forms $X^{3+}$ ions.
- Metals **Y** and **Z** form $Y^{2+}$ and $Z^{2+}$ ions.

**Table 3** shows the results.

✓ = a reaction happened ✗ = no reaction

**Table 3**

| Metal | Solution containing $X^{3+}$ ions | Solution containing $Y^{2+}$ ions | Solution containing $Z^{2+}$ ions |
|---|---|---|---|
| **X** | — | ✓ | ✓ |
| **Y** | ✗ | — | ✓ |
| **Z** | ✗ | ✗ | — |

**0 6 . 1** Give the order of reactivity of the three metals. [2 marks]

Give a reason for your answer.

Most reactive ☐ ☐ ☐ Least reactive

Reason

.....

.....

**0 6 . 2** Complete the balanced ionic equation for the reaction between metal **X** and $Y^{2+}$ ions. [2 marks]

..... X + ..... $Y^{2+}$ ⟶ ..... $X^{3+}$ + ..... Y

**0 6 . 3** Which species is oxidised in this reaction? [2 marks]

Explain your answer in terms of electrons.

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**0 6 . 4** How many electrons are transferred in the balanced equation in question 06.2? [1 mark]

..... electrons

**Question 6 continues on the next page**

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**0 6 . 5** Metal **X** is extracted by the electrolysis of its molten oxide. [2 marks]

Complete the half equation for the reaction at the negative electrode.

$X^{3+}$ + ..... ⟶ .....

**0 7** Magnesium sulfate is a soluble salt.

It can be made by reacting magnesium carbonate, an insoluble solid, with dilute sulfuric acid.

**0 7 . 1** Complete the word equation for the reaction. [1 mark]

magnesium carbonate + sulfuric acid ⟶

magnesium sulfate + ..... + .....

**0 7 . 2** How can a student tell when all of the sulfuric acid has reacted? [1 mark]

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**0 7 . 3** Describe how a student could make pure, dry crystals of magnesium sulfate from magnesium carbonate and dilute sulfuric acid. [6 marks]

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**0 8** A student found the concentration of a sulfuric acid solution by titration.

This is the method used.

1. Use a pipette to transfer 10.0 $cm^3$ of the sulfuric acid into a 250 $cm^3$ volumetric flask.
2. Add distilled water to make the volume up to 250 $cm^3$ and mix.
3. Use a pipette to transfer 25.0 $cm^3$ of the diluted acid into a conical flask.
4. Add a few drops of indicator.
5. Add 0.100 $mol/dm^3$ sodium hydroxide solution from a burette until the indicator changes colour.

**0 8 . 1** Name a suitable indicator and give its colour change at the end point. [2 marks]

Indicator .....

Colour change from ..... to .....

**0 8 . 2** Why is a volumetric flask used to dilute the acid, rather than a beaker? [1 mark]

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**0 8 . 3** Why is the conical flask placed on a white tile during the titration? [1 mark]

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**Question 8 continues on the next page**

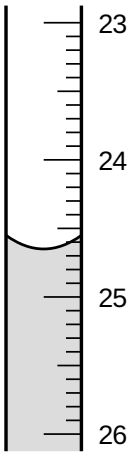
**Table 4** shows the student's results.

**Table 4**

| Titration | Initial burette reading in $cm^3$ | Final burette reading in $cm^3$ | Titre in $cm^3$ |
|---|---|---|---|
| Rough | 0.00 | 24.30 | 24.30 |
| 1 | 0.50 | 23.90 | 23.40 |
| 2 | 0.20 | 23.85 | 23.65 |
| 3 | 1.15 | | |

**Figure 3** shows the burette at the end of titration 3

**Figure 3**




**0 8 . 4** Give the final burette reading for titration 3 [1 mark]

Final burette reading = ..... $cm^3$

**0 8 . 5** Concordant titres are within 0.10 $cm^3$ of each other. [2 marks]

Calculate the mean titre using only the concordant results.

Mean titre = ..... $cm^3$

**Question 8 continues on the next page**

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**0 8 . 6** The equation for the reaction is: [4 marks]

$$H_2SO_4 + 2NaOH \longrightarrow Na_2SO_4 + 2H_2O$$

25.0 $cm^3$ of the diluted acid reacted with the mean titre of 0.100 $mol/dm^3$ sodium hydroxide solution.

The acid had been diluted from 10.0 $cm^3$ to 250 $cm^3$

Calculate the concentration of the original sulfuric acid, before it was diluted.

Use your answer to question 08.5

Give your answer in $mol/dm^3$ to 3 significant figures.

Concentration = ..... $mol/dm^3$

**0 8 . 7** Another student left some distilled water in the burette before filling it with the sodium hydroxide solution. [2 marks]

Explain how this would affect the calculated concentration of the sulfuric acid.

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**0 9** Silver kills bacteria. Some wound dressings contain silver as nanoparticles.

**0 9 . 1** Give the range of diameters of nanoparticles. [1 mark]

From ..... nm to ..... nm

**0 9 . 2** Give **one** other use of nanoparticles. [1 mark]

.....

**Question 9 continues on the next page**

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Scientists tested three dressings containing silver, **A**, **B** and **C**, and a control dressing.

The dressings had the same area. Each silver dressing contained the same mass of silver.

Each dressing was tested five times. The results were recorded after 24 hours

**Table 5** shows the results.

**Table 5**

| Dressing | Diameter of silver particles in nm | Mean percentage of bacteria killed | Range of results in % | Silver released into the wound in µg | Cost of one dressing |
|---|---|---|---|---|---|
| **A** | 20 | 99.2 | 98.8–99.6 | 120 | £4.50 |
| **B** | 60 | 97.0 | 93.5–99.4 | 75 | £3.20 |
| **C** | 2000 | 81.5 | 76.0–87.0 | 25 | £2.10 |
| Control | no silver | 4.0 | 2.5–5.5 | 0 | £0.80 |

**0 9 . 3** Why did the scientists test a control dressing without silver? [1 mark]

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**0 9 . 4** Describe and explain the relationship between the diameter of the silver particles and the mass of silver released into the wound. [2 marks]

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**Question 9 continues on the next page**

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**0 9 . 5** A hospital wants to choose one of the silver dressings. [6 marks]

Evaluate the three silver dressings, **A**, **B** and **C**.

Use **Table 5** and your knowledge of nanoparticles.

Do not write outside the box

**1 0** Aluminium nitride (AlN) is a ceramic used in electronics.

Aluminium nitride is made by heating aluminium in nitrogen gas.

Relative atomic masses ($A_r$): N = 14 Al = 27

**1 0 . 1** Calculate the relative formula mass ($M_r$) of aluminium nitride. [1 mark]

$M_r$ = .....

**1 0 . 2** In one experiment, 5.40 g of aluminium reacted with 2.80 g of nitrogen ($N_2$). [4 marks]

8.20 g of aluminium nitride was produced.

Use these masses to balance the equation for the reaction.

You must show your working.

..... Al + ..... $N_2$ ⟶ ..... AlN

**1 0 . 3** Explain why the mass of aluminium nitride produced is equal to the total mass of aluminium and nitrogen that reacted. [1 mark]

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.....

**1 0 . 4** A 2.70 g sample of impure aluminium was heated in excess nitrogen until the reaction was complete. [4 marks]

The impurities did not react. The mass of the solid increased by 1.26 g

Calculate the percentage by mass of aluminium in the sample.

Percentage of aluminium = ..... %

**Question 10 continues on the next page**

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**1 0 . 5** Some of the solid was lost from the container before it was weighed. [2 marks]

Explain how this would affect the calculated percentage of aluminium in the sample.

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**END OF QUESTIONS**

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**Additional page, if required.**

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**Additional page, if required.**

Write the question numbers in the left-hand margin.

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There are no more questions in this paper. Original practice paper © sciencegcse.co.uk – free to use for non-commercial education. Not an AQA paper.

# The Periodic Table of Elements

| 1 | 2 | | | | | | | | | | | 3 | 4 | 5 | 6 | 7 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | relative atomic mass<br>**atomic symbol**<br>name<br>atomic (proton) number<br>**Key** | | | | 1<br>**H**<br>hydrogen<br>1 | | | | | | | | | | | 4<br>**He**<br>helium<br>2 |
| 7<br>**Li**<br>lithium<br>3 | 9<br>**Be**<br>beryllium<br>4 | | | | | | | | | | | 11<br>**B**<br>boron<br>5 | 12<br>**C**<br>carbon<br>6 | 14<br>**N**<br>nitrogen<br>7 | 16<br>**O**<br>oxygen<br>8 | 19<br>**F**<br>fluorine<br>9 | 20<br>**Ne**<br>neon<br>10 |
| 23<br>**Na**<br>sodium<br>11 | 24<br>**Mg**<br>magnesium<br>12 | | | | | | | | | | | 27<br>**Al**<br>aluminium<br>13 | 28<br>**Si**<br>silicon<br>14 | 31<br>**P**<br>phosphorus<br>15 | 32<br>**S**<br>sulfur<br>16 | 35.5<br>**Cl**<br>chlorine<br>17 | 40<br>**Ar**<br>argon<br>18 |
| 39<br>**K**<br>potassium<br>19 | 40<br>**Ca**<br>calcium<br>20 | 45<br>**Sc**<br>scandium<br>21 | 48<br>**Ti**<br>titanium<br>22 | 51<br>**V**<br>vanadium<br>23 | 52<br>**Cr**<br>chromium<br>24 | 55<br>**Mn**<br>manganese<br>25 | 56<br>**Fe**<br>iron<br>26 | 59<br>**Co**<br>cobalt<br>27 | 59<br>**Ni**<br>nickel<br>28 | 63.5<br>**Cu**<br>copper<br>29 | 65<br>**Zn**<br>zinc<br>30 | 70<br>**Ga**<br>gallium<br>31 | 73<br>**Ge**<br>germanium<br>32 | 75<br>**As**<br>arsenic<br>33 | 79<br>**Se**<br>selenium<br>34 | 80<br>**Br**<br>bromine<br>35 | 84<br>**Kr**<br>krypton<br>36 |
| 85<br>**Rb**<br>rubidium<br>37 | 88<br>**Sr**<br>strontium<br>38 | 89<br>**Y**<br>yttrium<br>39 | 91<br>**Zr**<br>zirconium<br>40 | 93<br>**Nb**<br>niobium<br>41 | 96<br>**Mo**<br>molybdenum<br>42 | [98]<br>**Tc**<br>technetium<br>43 | 101<br>**Ru**<br>ruthenium<br>44 | 103<br>**Rh**<br>rhodium<br>45 | 106<br>**Pd**<br>palladium<br>46 | 108<br>**Ag**<br>silver<br>47 | 112<br>**Cd**<br>cadmium<br>48 | 115<br>**In**<br>indium<br>49 | 119<br>**Sn**<br>tin<br>50 | 122<br>**Sb**<br>antimony<br>51 | 128<br>**Te**<br>tellurium<br>52 | 127<br>**I**<br>iodine<br>53 | 131<br>**Xe**<br>xenon<br>54 |
| 133<br>**Cs**<br>caesium<br>55 | 137<br>**Ba**<br>barium<br>56 | 139<br>**La***<br>lanthanum<br>57 | 178<br>**Hf**<br>hafnium<br>72 | 181<br>**Ta**<br>tantalum<br>73 | 184<br>**W**<br>tungsten<br>74 | 186<br>**Re**<br>rhenium<br>75 | 190<br>**Os**<br>osmium<br>76 | 192<br>**Ir**<br>iridium<br>77 | 195<br>**Pt**<br>platinum<br>78 | 197<br>**Au**<br>gold<br>79 | 201<br>**Hg**<br>mercury<br>80 | 204<br>**Tl**<br>thallium<br>81 | 207<br>**Pb**<br>lead<br>82 | 209<br>**Bi**<br>bismuth<br>83 | [209]<br>**Po**<br>polonium<br>84 | [210]<br>**At**<br>astatine<br>85 | [222]<br>**Rn**<br>radon<br>86 |
| [223]<br>**Fr**<br>francium<br>87 | [226]<br>**Ra**<br>radium<br>88 | [227]<br>**Ac***<br>actinium<br>89 | [261]<br>**Rf**<br>rutherfordium<br>104 | [262]<br>**Db**<br>dubnium<br>105 | [266]<br>**Sg**<br>seaborgium<br>106 | [264]<br>**Bh**<br>bohrium<br>107 | [277]<br>**Hs**<br>hassium<br>108 | [268]<br>**Mt**<br>meitnerium<br>109 | [271]<br>**Ds**<br>darmstadtium<br>110 | [272]<br>**Rg**<br>roentgenium<br>111 | [285]<br>**Cn**<br>copernicium<br>112 | [286]<br>**Nh**<br>nihonium<br>113 | [289]<br>**Fl**<br>flerovium<br>114 | [289]<br>**Mc**<br>moscovium<br>115 | [293]<br>**Lv**<br>livermorium<br>116 | [294]<br>**Ts**<br>tennessine<br>117 | [294]<br>**Og**<br>oganesson<br>118 |

* The lanthanides (atomic numbers 58–71) and the actinides (atomic numbers 90–103) have been omitted. Relative atomic masses for Cu and Cl have not been rounded to the nearest whole number.