

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 1

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 06.1 and 07.5 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           |      |
| 11           |      |
| <b>TOTAL</b> |      |

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sciencegcse.co.uk | Practice Paper Series – Set 1 | SGC/S1/SC/1H

**0 1** Sodium is in Group 1 of the periodic table. Iron is a transition metal.

**Table 1** shows some properties of sodium and iron.

**Table 1**

| Property                     | Sodium                                 | Iron              |
|------------------------------|----------------------------------------|-------------------|
| Melting point in °C          | 98                                     | 1538              |
| Density in g/cm <sup>3</sup> | 0.97                                   | 7.9               |
| Hardness                     | soft – can be cut with a knife         | hard              |
| Reaction with water          | fizzes and moves around on the surface | very slow (rusts) |

**0 1 . 1** Give the electronic structure of a sodium atom. [1 mark]

Electronic structure .....

**0 1 . 2** Explain, in terms of electrons, why sodium reacts vigorously with water. [2 marks]

.....  
 .....  
 .....

**0 1 . 3** Use **Table 1** to give **two** ways in which the properties of transition metals differ from the properties of Group 1 metals. [2 marks]

1  
 .....  
 2  
 .....

**0 1 . 4** Iron forms two different chlorides, FeCl<sub>2</sub> and FeCl<sub>3</sub>. [2 marks]  
 Give the charge on the iron ion in each compound.

FeCl<sub>2</sub> .....  
 FeCl<sub>3</sub> .....

**Question 1 continues on the next page**

- 0 1 . 5** Compounds of transition metals are often coloured. [1 mark]  
Give **one** other typical property of transition metals that is **not** shown in **Table 1**.

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- 0 2** Titanium dioxide is used in sunscreens. Some sunscreens contain nanoparticles of titanium dioxide.

- 0 2 . 1** Which of these could be the diameter of a nanoparticle? [1 mark]  
Tick (✓) **one** box.

- |                               |                          |
|-------------------------------|--------------------------|
| $1 \times 10^{-10} \text{ m}$ | <input type="checkbox"/> |
| $5 \times 10^{-8} \text{ m}$  | <input type="checkbox"/> |
| $2 \times 10^{-6} \text{ m}$  | <input type="checkbox"/> |
| $3 \times 10^{-4} \text{ m}$  | <input type="checkbox"/> |

- 0 2 . 2** A nanoparticle can be modelled as a cube with sides of 10 nm. [2 marks]  
Calculate the surface area to volume ratio of this cube.

Surface area to volume ratio = \_\_\_\_\_

- 0 2 . 3** A cube with sides of 100 nm has a surface area to volume ratio of 0.06. [1 mark]  
Describe how the surface area to volume ratio changes when the side of a cube decreases by a factor of 10.

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- 0 2 . 4** Explain why a sunscreen containing nanoparticles of titanium dioxide may need **less** titanium dioxide than a sunscreen containing larger particles. [2 marks]

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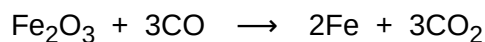
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**0 2 . 5** Suggest **one** possible risk of using nanoparticles in sunscreens. [1 mark]

.....

.....

**0 3** Iron is extracted from iron(III) oxide in a blast furnace.



Relative atomic masses ( $A_r$ ): C = 12 O = 16 Fe = 56

**0 3 . 1** Calculate the relative formula mass ( $M_r$ ) of iron(III) oxide,  $\text{Fe}_2\text{O}_3$ . [1 mark]

Relative formula mass = .....

**0 3 . 2** Calculate the maximum mass of iron that can be produced from 800 g of iron(III) oxide. [3 marks]

Maximum mass of iron = ..... g

**0 3 . 3** In one experiment, 800 g of iron(III) oxide produced 476 g of iron. [2 marks]

Calculate the percentage yield of iron.

If you could not answer **03.2**, use 550 g as the maximum mass of iron.

This is **not** the correct answer to **03.2**.

Percentage yield = ..... %

**Question 3 continues on the next page**

**0 3 . 4** Give **two** reasons why the percentage yield of a reaction is usually less than 100%. [2 marks]

1

.....

2

.....

**0 3 . 5** Calculate the atom economy for the production of iron in this reaction. [2 marks]  
Use the equation:

$$\text{atom economy} = \frac{\text{relative formula mass of desired product}}{\text{sum of relative formula masses of reactants}} \times 100$$

Atom economy = ..... %

**0 3 . 6** Give **one** reason why it is important for industry to use reactions with a high atom economy. [1 mark]

.....

.....

**0 4** Copper is a metal.

**0 4 . 1** Describe the bonding in copper. [2 marks]

.....

.....

.....

**0 4 . 2** Explain why copper conducts electricity. [1 mark]

.....

.....

**Question 4 continues on the next page**

0 4 . 3 Explain why pure copper is soft.

[1 mark]

Brass is an alloy of copper and zinc.

**Table 2** shows the hardness of copper and of two types of brass.

**Table 2**

| Metal   | Percentage of zinc | Hardness in arbitrary units |
|---------|--------------------|-----------------------------|
| Copper  | 0                  | 40                          |
| Brass A | 15                 | 80                          |
| Brass B | 30                 | 110                         |

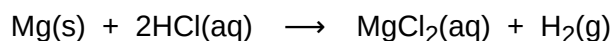
0 4 . 4 Explain why brass is harder than pure copper.

[2 marks]

0 4 . 5 Suggest which metal in **Table 2** would be best for making a door handle that must not scratch easily. [1 mark]

Give a reason for your answer.

0 5 A student reacted magnesium with dilute hydrochloric acid.



Relative atomic masses ( $A_r$ ): H = 1 Mg = 24 Cl = 35.5

0 5 . 1 Calculate the relative formula mass ( $M_r$ ) of magnesium chloride,  $\text{MgCl}_2$ . [1 mark]

Relative formula mass = .....

Do not write outside the box

- 05.2** The student used 2.4 g of magnesium. [1 mark]  
Calculate the number of moles of magnesium in 2.4 g.

Number of moles = ..... mol

- 05.3** Calculate the maximum mass of magnesium chloride that could be made from 2.4 g of magnesium. [2 marks]

Mass of magnesium chloride = ..... g

- 05.4** The student used 0.15 mol of hydrochloric acid. [2 marks]  
Show that hydrochloric acid is the limiting reactant.

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.....  
.....

- 05.5** Calculate the mass of magnesium chloride made from 0.15 mol of hydrochloric acid. [2 marks]  
Give your answer to 2 significant figures.

Mass of magnesium chloride = ..... g

- 05.6** The student obtained less magnesium chloride than the mass calculated in **05.5**. [1 mark]  
Suggest **one** reason why.

.....  
.....

Question 5 continues on the next page

05.7

The volume of 1 mol of any gas at room temperature and pressure (r.t.p.) is  $24 \text{ dm}^3$ . [2 marks]

Calculate the volume of hydrogen gas produced at r.t.p. when 0.15 mol of hydrochloric acid reacts with excess magnesium.

Volume of hydrogen = .....  $\text{dm}^3$

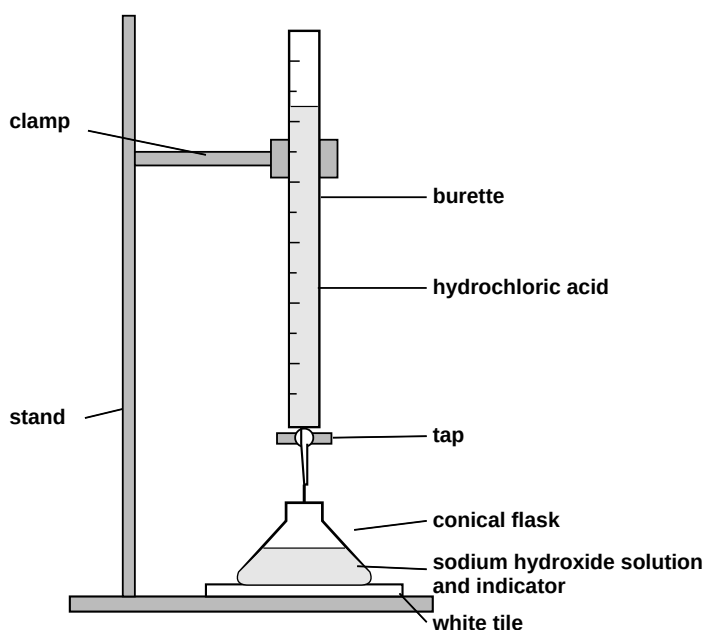
06

A student used a titration to find the concentration of a sodium hydroxide solution.

The student used  $25.0 \text{ cm}^3$  of the sodium hydroxide solution and hydrochloric acid with a concentration of  $0.100 \text{ mol/dm}^3$ .

Figure 1 shows the apparatus.

Figure 1



06.1

Describe how the student should carry out the titration to obtain an accurate value for the volume of hydrochloric acid needed to neutralise the sodium hydroxide solution. [6 marks]

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Handwriting practice area with 20 sets of three horizontal lines (top solid, middle dashed, bottom solid).

**Question 6 continues on the next page**

The student repeated the titration several times.

**Table 3** shows the results.

**Table 3**

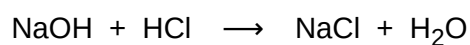
|                                                      | <b>Rough</b> | <b>Titration<br/>1</b> | <b>Titration<br/>2</b> | <b>Titration<br/>3</b> |
|------------------------------------------------------|--------------|------------------------|------------------------|------------------------|
| Volume of<br>hydrochloric acid<br>in cm <sup>3</sup> | 22.50        | 21.90                  | 21.80                  | 22.20                  |

**0 6 . 2** Calculate the mean volume of hydrochloric acid used. [2 marks]

Use only the concordant results (results within 0.10 cm<sup>3</sup> of each other).

Mean volume = ..... cm<sup>3</sup>

**0 6 . 3** Sodium hydroxide reacts with hydrochloric acid. [3 marks]



Calculate the concentration of the sodium hydroxide solution in mol/dm<sup>3</sup>.

Use your answer to **06.2**.

Give your answer to 3 significant figures.

Concentration = ..... mol/dm<sup>3</sup>

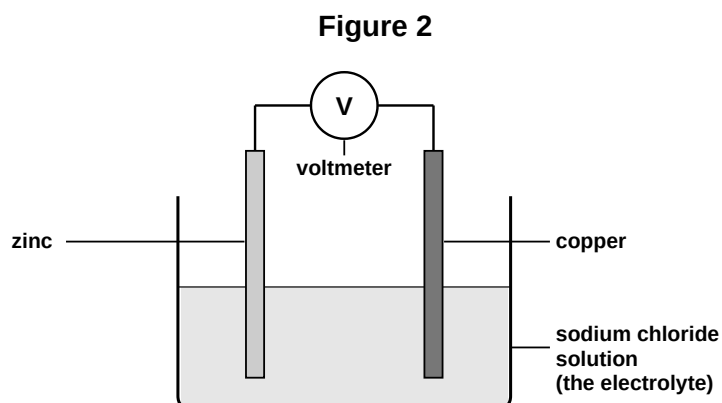
**0 6 . 4** Calculate the concentration of the sodium hydroxide solution in g/dm<sup>3</sup>. [2 marks]

Relative formula mass ( $M_r$ ) of NaOH = 40

Concentration = ..... g/dm<sup>3</sup>

Do not write outside the box

**0 7** Figure 2 shows a simple cell.



A student made cells using different metals with copper. The same electrolyte was used each time.

**Table 4** shows the results.

**Table 4**

| Metal used with copper | Voltage in V |
|------------------------|--------------|
| Magnesium              | 2.7          |
| Zinc                   | 1.1          |
| Iron                   | 0.8          |
| Copper                 | 0.0          |

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**0 7 . 1** Explain the pattern shown in **Table 4**. [2 marks]

.....

.....

.....

.....

**0 7 . 2** Tin is less reactive than iron but more reactive than copper. [1 mark]

Predict the voltage of a cell made from tin and copper.

Voltage = ..... V

**Question 7 continues on the next page**

[2 marks]

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[2 marks]

$$2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$$

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[6 marks]

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

0 8 Hydrogen burns in oxygen to form water.

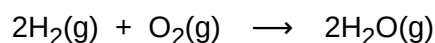


**Table 5** shows some bond energies.

**Table 5**

| Bond | Bond energy<br>in kJ/mol |
|------|--------------------------|
| H–H  | 436                      |
| O=O  | 498                      |
| O–H  | 464                      |

0 8 . 1 Calculate the overall energy change for this reaction.

[3 marks]

Use **Table 5**.

Overall energy change = ..... kJ/mol

**Question 8 continues on the next page**

**08.2** Explain how your answer to **08.1** shows that the reaction is exothermic. [1 mark]

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**08.3** A mixture of hydrogen and oxygen does not react until a spark is added. [2 marks]

Explain why.

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**09** A student electrolysed three different solutions using inert electrodes.  
**Table 6** shows the products.

**Table 6**

| Solution                   | Product at the negative electrode | Product at the positive electrode |
|----------------------------|-----------------------------------|-----------------------------------|
| Sodium chloride solution   | hydrogen                          | chlorine                          |
| Potassium bromide solution |                                   |                                   |
| Copper sulfate solution    |                                   |                                   |

**09.1** Complete **Table 6**. [2 marks]

**09.2** Explain why copper, and **not** hydrogen, is produced at the negative electrode when copper sulfate solution is electrolysed. [1 mark]

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**Question 9 continues on the next page**

**09.3** Write the half equation for the reaction at the negative electrode when copper sulfate solution is electrolysed. [3 marks]

State whether this reaction is oxidation or reduction. Give a reason for your answer.

.....  
Oxidation or reduction .....

**09.4** Oxygen is produced at the positive electrode from hydroxide ions. [2 marks]  
Write the half equation for this reaction.

**09.5** The copper sulfate solution became paler blue during the electrolysis. [1 mark]  
Explain why.

**10** A student added zinc powder to copper sulfate solution in a beaker.  
A reaction took place.

**10.1** Give **two** observations the student would make. [2 marks]

1

2

**10.2** Write the ionic equation for the reaction between zinc and copper ions. [2 marks]

Question 10 continues on the next page

- 1 0 . 3** Explain, in terms of electrons, why zinc is oxidised **and** copper ions are reduced in this reaction. [2 marks]

.....

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- 1 0 . 4** Silver is less reactive than copper. [1 mark]  
Explain why silver does **not** react with copper sulfate solution.

.....

.....

- 1 0 . 5** Zinc also reacts with dilute sulfuric acid. [1 mark]  
Name the salt produced.

.....

- 1 1** Table 7 shows some properties of four substances, **A**, **B**, **C** and **D**.

**Table 7**

| Substance | Melting point<br>in °C | Conducts electricity<br>when solid | Conducts electricity<br>when molten |
|-----------|------------------------|------------------------------------|-------------------------------------|
| <b>A</b>  | 801                    | no                                 | yes                                 |
| <b>B</b>  | -101                   | no                                 | no                                  |
| <b>C</b>  | 1610                   | no                                 | no                                  |
| <b>D</b>  | 1085                   | yes                                | yes                                 |

- 1 1 . 1** Which substance is a metal? [2 marks]  
Give a reason for your answer.

Substance .....

.....

.....

**Question 11 continues on the next page**

- 1 1 . 2** Which substance consists of small molecules? [2 marks]  
Give a reason for your answer.

Substance .....

.....

.....

- 1 1 . 3** Explain why substance **A** conducts electricity when molten but **not** [2 marks]  
when solid.

.....

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.....

- 1 1 . 4** Substance **C** is silicon dioxide. [1 mark]  
What type of structure does silicon dioxide have?

.....

**END OF QUESTIONS**

**Additional page, if required.**

Write the question numbers in the left-hand margin.

[illegible]

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Write the question numbers in the left-hand margin.

[illegible]

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

\* 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.