

Please write clearly in block capitals.

F

Centre number

Candidate  
number

Surname

Forename(s)

Candidate signature

I declare this is my own work.

# GCSE

## COMBINED SCIENCE: TRILOGY

### Foundation Tier Chemistry Paper 2

Practice Paper Series – Set 1

Time allowed: 1 hour 15 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 70.
- 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 question 08.2 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            |      |
| <b>TOTAL</b> |      |

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sciencegcse.co.uk | Practice Paper Series – Set 1 | SGC/S1/C/2F

**0 1** The Earth's atmosphere today is mostly a mixture of two gases.

**0 1 . 1** Which gas makes up about four-fifths (80%) of the atmosphere? [1 mark]

Tick (✓) **one** box.

Argon

☐

Carbon dioxide

☐

Nitrogen

☐

Oxygen

☐

**0 1 . 2** Scientists think that the Earth's early atmosphere was very different. [3 marks]

Complete the sentences.

Use words from the box.

|                |           |            |        |           |
|----------------|-----------|------------|--------|-----------|
| carbon dioxide | condensed | evaporated | oxygen | volcanoes |
|----------------|-----------|------------|--------|-----------|

The early atmosphere was mostly .....

The gases in the early atmosphere came from .....

The oceans formed when water vapour .....

**0 1 . 3** The amount of carbon dioxide in the atmosphere decreased over billions of years. [2 marks]

Give **two** reasons why.

1

.....

.....

2

.....

.....

**0 1 . 4** Name the process by which algae and plants produced the oxygen in the atmosphere. [1 mark]

.....

**Turn over for the next question**

**0 2** Crude oil is a mixture of many different hydrocarbons. Most of the hydrocarbons are alkanes.

**0 2 . 1** What is a hydrocarbon? [1 mark]

Tick (✓) **one** box.

A compound of hydrogen and carbon only

☐

A compound of hydrogen, carbon and oxygen

☐

A mixture of hydrogen and carbon

☐

An element that contains carbon

☐

**0 2 . 2** Which of these is the formula of an alkane? [1 mark]

Tick (✓) **one** box.

$C_2H_4$

☐

$C_3H_6$

☐

$C_3H_8$

☐

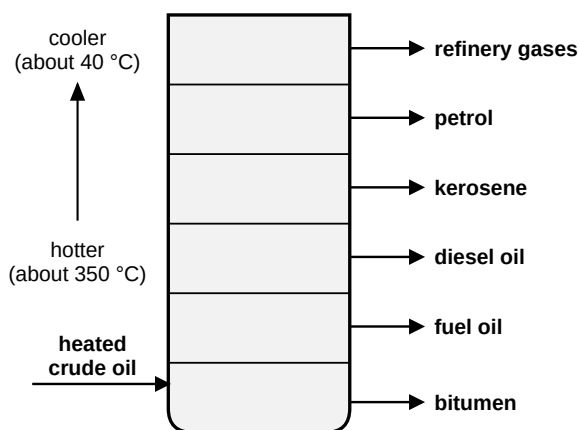
$C_4H_8$

☐

Crude oil is separated into fractions by fractional distillation.

**Figure 1** shows a fractionating column.

**Figure 1**



**0 2 . 3** Describe how the fractions are separated in the fractionating column. [2 marks]

.....

.....

.....

.....

Do not write outside the box

**Table 1** shows some information about three of the fractions.

**Table 1**

| Fraction   | Number of carbon atoms in each molecule | Boiling point range in °C |
|------------|-----------------------------------------|---------------------------|
| Petrol     | 5 to 10                                 | 40 to 180                 |
| Kerosene   | 10 to 16                                | 180 to 250                |
| Diesel oil | 16 to 20                                | 250 to 350                |

- 0 2 . 4** Describe the relationship between the number of carbon atoms in the molecules and the boiling point of the fraction. [1 mark]

.....

.....

- 0 2 . 5** Which of the three fractions in **Table 1** is the easiest to ignite? [1 mark]

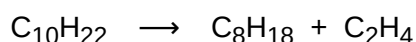
.....

- 0 2 . 6** Petrol burns completely in a car engine. [2 marks]
- Complete the word equation for the complete combustion of a hydrocarbon.

hydrocarbon + oxygen → ..... + .....

- 0 3** Large alkane molecules from crude oil can be broken down into smaller, more useful molecules by cracking.

The equation shows one example.



- 0 3 . 1** Describe how cracking is carried out. [2 marks]

.....

.....

.....

- 0 3 . 2** Give **one** reason why cracking is useful. [1 mark]

.....

.....

Do not write outside the box

**0 3 . 3** C<sub>2</sub>H<sub>4</sub> is an alkene. [2 marks]

Describe a test to show that a substance is an alkene.

Give the result of the test.

Test .....

Result .....

**0 3 . 4** Alkenes are more reactive than alkanes. [1 mark]

Give the reason why.

.....  
.....

**0 4** A student used paper chromatography to find out which dyes are in a brown food colouring.

The student put spots of the brown food colouring and of four known dyes, **A**, **B**, **C** and **D**, on a start line drawn in pencil.

**0 4 . 1** Give **one** reason why the start line is drawn in pencil and **not** in ink. [1 mark]

.....  
.....

**0 4 . 2** The start line must be above the level of the solvent in the beaker. [1 mark]

Give the reason why.

.....  
.....

**0 4 . 3** Food colourings are formulations. [1 mark]

What is a formulation?

Tick (✓) **one** box.

A mixture made in a fixed proportion for a purpose

☐

A pure compound with a fixed formula

☐

A single element

☐

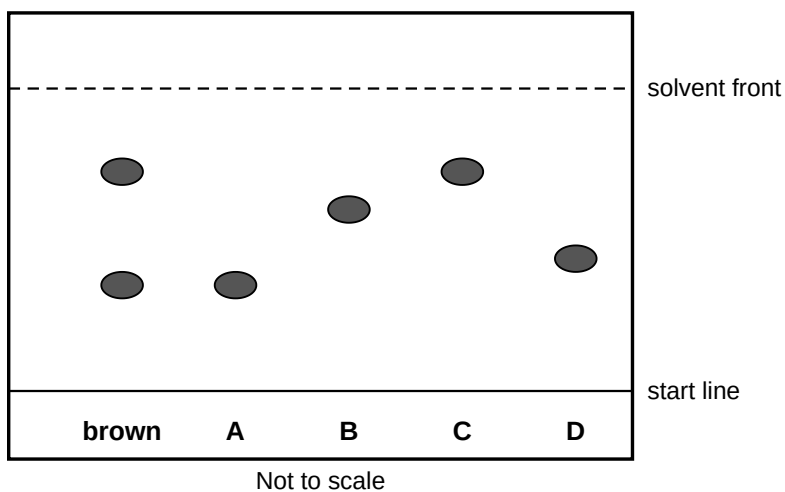
A solution that has been filtered

☐

**Question 4 continues on the next page**

Figure 2 shows the chromatogram.

Figure 2



- 0 4 . 4** Which two dyes are in the brown food colouring? [2 marks]  
Use **Figure 2**.

Dye ..... Dye .....

- 0 4 . 5** On the chromatogram, the solvent front moved 8.0 cm from the start line. The spot of dye **B** moved 4.8 cm from the start line. [2 marks]  
Calculate the  $R_f$  value of dye **B**.

Use the equation:

$$R_f = \frac{\text{distance moved by substance}}{\text{distance moved by solvent}}$$

$R_f =$  .....

- 0 4 . 6** The chromatogram shows that dye **D** is a pure substance. [1 mark]  
How does the chromatogram show this?

.....  
.....

Turn over for the next question

Do not write outside the box

**0 5** In the UK most drinking water is produced from rain water that collects in rivers, lakes and the ground.

**0 5 . 1** Complete the sentences. [2 marks]  
Use words from the box.

chlorine    distilled    filter beds    salt    sterilised

The water is passed through ..... to remove solid particles.

The water is then ..... to kill microbes.

**0 5 . 2** Water that is safe to drink is called potable water. [1 mark]  
Potable water is **not** pure water.  
Explain why.

.....  
.....  
A student tested samples of water from three different sources.

The student measured the pH of each sample, and found the mass of dissolved solids in 100 cm<sup>3</sup> of each sample.

**Table 2** shows the results.

**Table 2**

| Water sample | pH | Mass of dissolved solids<br>in 100 cm <sup>3</sup> of water in g |
|--------------|----|------------------------------------------------------------------|
| Rain water   | 6  | 0.01                                                             |
| River water  | 7  | 0.05                                                             |
| Sea water    | 8  | 3.50                                                             |

**0 5 . 3** Describe how the student could find the mass of dissolved solids in 100 cm<sup>3</sup> of a water sample. [2 marks]

**Question 5 continues on the next page**

**0 5 . 4** Calculate the mass of dissolved solids in 1 dm<sup>3</sup> of sea water. [1 mark]

$$1 \text{ dm}^3 = 1000 \text{ cm}^3$$

Mass = ..... g

**0 5 . 5** In some countries with little rain, drinking water is produced from sea water by distillation. [2 marks]

Describe how distillation produces drinking water from sea water.

.....

.....

.....

.....

**0 6** The amount of carbon dioxide in the atmosphere is increasing.

**Table 3** shows the concentration of carbon dioxide in the atmosphere in 1960 and in 2020.

**Table 3**

| Year | Concentration of carbon dioxide<br>in parts per million |
|------|---------------------------------------------------------|
| 1960 | 317                                                     |
| 2020 | 414                                                     |

**0 6 . 1** Calculate the percentage increase in the concentration of carbon dioxide between 1960 and 2020. [2 marks]

Percentage increase = ..... %

**Question 6 continues on the next page**

**0 6 . 2** Give **two** human activities that increase the amount of carbon dioxide in the atmosphere. [2 marks]

1

.....

2

.....

**0 6 . 3** Carbon dioxide is a greenhouse gas. [1 mark]

Which other gas is a greenhouse gas?

Tick (✓) **one** box.

Argon

☐

Methane

☐

Nitrogen

☐

Oxygen

☐

**0 6 . 4** An increase in greenhouse gases in the atmosphere is causing global climate change. [2 marks]

Give **two** possible effects of global climate change.

1

.....

2

.....

**0 6 . 5** Some fuels contain sulfur. [2 marks]

Name the gas that is produced from the sulfur when these fuels burn **and** give **one** problem this gas causes.

Gas .....

Problem

.....

.....

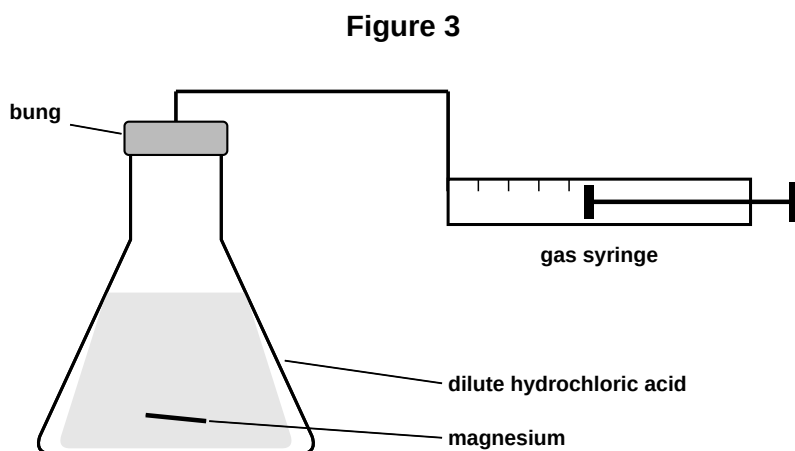
**Turn over for the next question**

07

A student investigated the rate of reaction between magnesium and dilute hydrochloric acid.

Hydrogen gas is produced in the reaction.

**Figure 3** shows the apparatus.



07.1

Describe a test to show that the gas produced is hydrogen.

[2 marks]

Give the result of the test.

Test .....

Result .....

The student measured the volume of hydrogen produced every 20 seconds, using acid with a concentration of  $1.0 \text{ mol/dm}^3$ .

**Table 4** shows the results.

**Table 4**

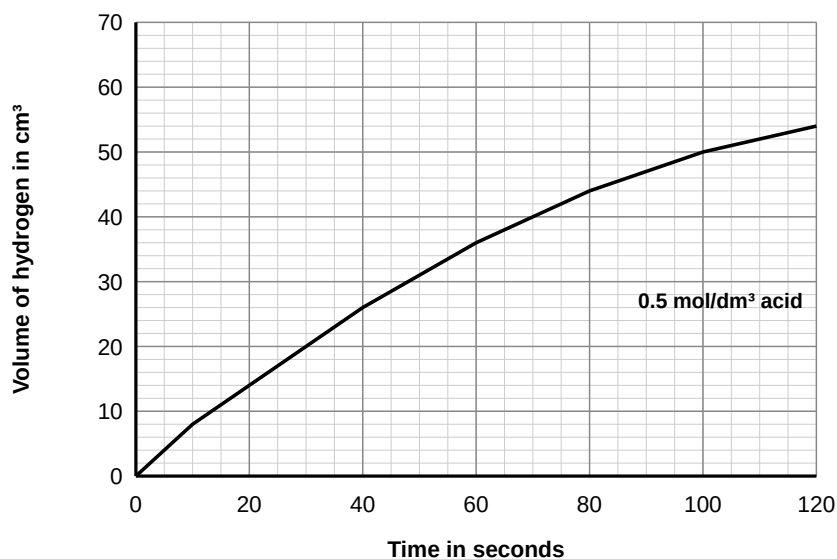
| Time in seconds                     | 0 | 20 | 40 | 60 | 80 | 100 | 120 |
|-------------------------------------|---|----|----|----|----|-----|-----|
| Volume of hydrogen in $\text{cm}^3$ | 0 | 24 | 40 | 50 | 56 | 60  | 60  |

The student then repeated the investigation with acid with a concentration of  $0.5 \text{ mol/dm}^3$ .

The results for the  $0.5 \text{ mol/dm}^3$  acid have been plotted on **Figure 4**.

**Question 7 continues on the next page**

Figure 4



Do not write outside the box

**0 7 . 2** Plot the results from **Table 4** on **Figure 4**. [2 marks]

**0 7 . 3** Draw a line of best fit through your points. [1 mark]

**0 7 . 4** Calculate the mean rate of reaction in the first 20 seconds with the 1.0 mol/dm<sup>3</sup> acid. [2 marks]

Use **Table 4**.

Use the equation:

$$\text{mean rate of reaction} = \frac{\text{volume of gas produced}}{\text{time taken}}$$

Mean rate of reaction = ..... cm<sup>3</sup>/s

**0 7 . 5** How does **Table 4** show that the reaction with the 1.0 mol/dm<sup>3</sup> acid had finished after 100 seconds? [1 mark]

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Question 7 continues on the next page

**07.6** The reaction was slower with the 0.5 mol/dm<sup>3</sup> acid. [2 marks]

Explain why, in terms of particles.

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.....

**08** Shopping bags can be made from plastic (poly(ethene)) or from paper.  
Scientists carried out a life cycle assessment (LCA) of the two types of bag.

**08.1** What is a life cycle assessment? [1 mark]

.....

.....

**Table 5** shows some of the information the scientists collected. The values are for 1000 bags of each type.

**Table 5**

|                                                  | Plastic bags      | Paper bags   |
|--------------------------------------------------|-------------------|--------------|
| Raw material                                     | crude oil         | trees (wood) |
| Energy used to make the bags in MJ               | 500               | 2600         |
| Water used to make the bags in dm <sup>3</sup>   | 60                | 1100         |
| Mass of 1000 bags in kg                          | 7                 | 55           |
| Number of times each bag is used before disposal | 2 to 4            | 1 to 2       |
| Time taken to break down in landfill             | hundreds of years | a few months |

**08.2** Evaluate the environmental impact of plastic bags compared with paper bags. [6 marks]

Use **Table 5** and your own knowledge.

.....

.....

.....

.....

Do not write outside the box

[illegible]

09

$$\text{hydrated copper sulfate (blue)} \rightleftharpoons \text{anhydrous copper sulfate (white)} + \text{water}$$

|   |   |   |   |
|---|---|---|---|
| 0 | 9 | . | 1 |
|---|---|---|---|

.....

**0 9 . 2** The reaction that takes place when the crystals are heated is endothermic. [2 marks]

Water is then added to the white anhydrous copper sulfate.

Compare the energy change for this reverse reaction with the energy change when the crystals are heated.

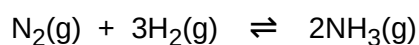
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Ammonia is made from nitrogen and hydrogen in a reversible reaction.



The reaction is carried out in a closed container and reaches equilibrium.

**0 9 . 3** What is meant by **equilibrium**? [2 marks]

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**0 9 . 4** A catalyst is used in the reaction. [2 marks]

Explain how a catalyst increases the rate of a reaction.

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**END OF QUESTIONS**

**Additional page, if required.**

Write the question numbers in the left-hand margin.

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**Additional page, if required.**

Write the question numbers in the left-hand margin.

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**There are no questions printed on this page**

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.