

Name: ..... ( ) Class: Sec 4 SG 5 / 6

# Queenstown Secondary School



**Preliminary Examination 2024**  
**Secondary Four Normal (Academic)**  
**Science (Chemistry)**  
**5105/03**

**30 July 2024**  
**Tuesday**

**Time: 1015 – 1130h**  
**Papers 3 and 4: 1 hour 15 minutes**

**Setter: Ms Nancy Ng LK**

**Additional Materials:** Multiple Choice Answer Sheet

## READ THESE INSTRUCTIONS FIRST

Write in soft pencil.  
 Do not use staples, paper clips, glue or correction fluid.  
 Write your name, class and index number on the Answer Sheet in the spaces provided.

There are **twenty** questions on this paper. Answer **all** questions. For each question there are four possible answers A, B, C and D.  
 Choose the one you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

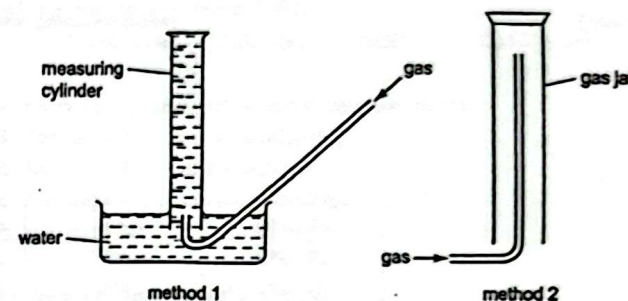
**Read the instructions on the Answer Sheet very carefully.**

Answers to Paper 3 and Paper 4 must be handed in separately.  
 Each correct answer will score one mark. A mark will not be deducted for a wrong answer.  
 You are advised to spend no more than **30 minutes** on Paper 3.  
 You may proceed to answer Paper 4 as soon as you have completed Paper 3.  
 Any rough working should be done in this booklet.  
 A copy of the Periodic Table is printed on page 11.  
 The use of an approved scientific calculator is expected, where appropriate.

This document consists of 11 printed pages.

2

1 The diagrams show two methods of collecting gases.



Which row gives the properties of a gas that can be collected by both methods?

|   | property 1         | property 2          |
|---|--------------------|---------------------|
| A | insoluble in water | denser than air     |
| B | insoluble in water | less dense than air |
| C | soluble in water   | denser than air     |
| D | soluble in water   | less dense than air |

2 Three separations are listed.

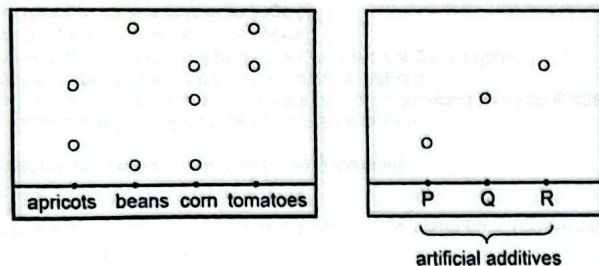
- obtaining water from sodium chloride solution
- obtaining solid copper(II) sulfate from copper(II) sulfate solution
- obtaining sand from a mixture of sand and sodium chloride solution

|   | 1            | 2               | 3           |
|---|--------------|-----------------|-------------|
| A | distillation | crystallisation | filtration  |
| B | distillation | evaporation     | sublimation |
| C | filtration   | crystallisation | sublimation |
| D | filtration   | evaporation     | filtration  |

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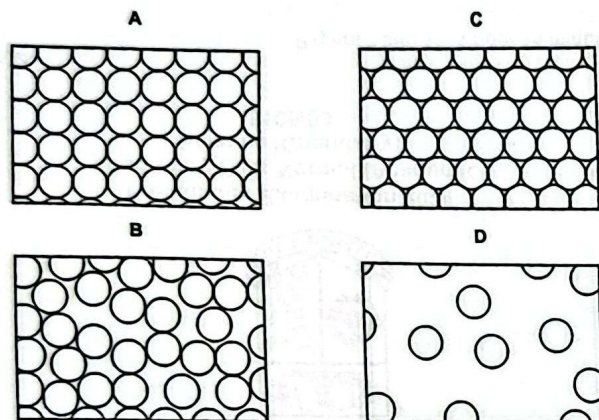
[Turn over

- 3 Samples of tinned apricots, beans, corn and tomatoes are tested for additives by using chromatography.
- The chromatograms are compared with those of three artificial additives, P, Q and R. The results are as follows.



Which tinned food does not contain any artificial additives?

- A apricots      B beans      C corn      D tomatoes
- 4 Substance X has a melting point of  $-7^{\circ}\text{C}$  and a boiling point of  $79^{\circ}\text{C}$ .
- Which diagram shows the correct arrangement of particles of substance X under room conditions?



- 5 An atom of fluorine is represented by  $^{19}_{9}\text{F}$ .
- What is the electron arrangement of the fluorine atom?

- A 2,7      B 2,8      C 2,8,8      D 2,8,8,1

- 6 The atomic structures of four different particles are shown.

| particle               | number of protons | number of neutrons | number of electrons |
|------------------------|-------------------|--------------------|---------------------|
| A/                     | W                 | 14                 | 13                  |
| $\text{A}^{\text{P}+}$ | 13                | 14                 | X                   |
| S                      | 16                | Y                  | 16                  |
| $\text{S}^{2-}$        | 16                | 16                 | Z                   |

What are the values for W, X, Y and Z?

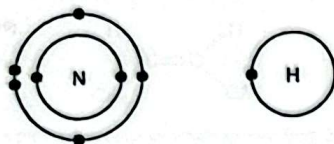
|   | W  | X  | Y  | Z  |
|---|----|----|----|----|
| A | 10 | 16 | 14 | 16 |
| B | 13 | 10 | 16 | 18 |
| C | 13 | 16 | 18 | 10 |
| D | 14 | 13 | 18 | 14 |

- 7 Gallium combines with sulfur to make an ionic compound gallium sulfide. The formula of gallium sulfide is  $\text{Ga}_2\text{S}_3$ .

Which row describes the melting point of gallium sulfide and the formulae of the ions in the compound?

|   | melting point | ions present                     |
|---|---------------|----------------------------------|
| A | high          | $\text{Ga}^{2+}$ $\text{S}^{3-}$ |
| B | high          | $\text{Ga}^{3+}$ $\text{S}^{2-}$ |
| C | low           | $\text{Ga}^{2+}$ $\text{S}^{3-}$ |
| D | low           | $\text{Ga}^{3+}$ $\text{S}^{2-}$ |

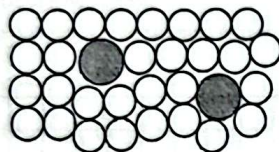
- 8 The electronic structures of an atom of nitrogen and an atom of hydrogen are shown.



Which row describes what happens to the electrons in the valence shells and the type of bonding when atoms of N and H form a compound?

|   | electrons   | type of bond |
|---|-------------|--------------|
| A | transferred | covalent     |
| B | shared      | covalent     |
| C | transferred | ionic        |
| D | shared      | ionic        |

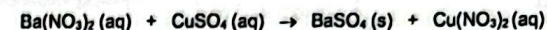
- 9 The diagram shows the arrangement of particles in substance Z.



Which statement is correct?

- A Z is hard and strong.
- B Z is soluble in water.
- C Z has a fixed melting point.
- D Z conducts electricity in the aqueous state.

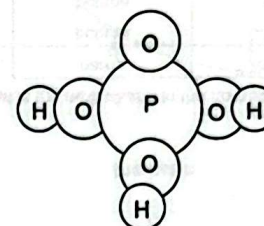
- 10 The chemical equation below represents the reaction between barium nitrate,  $\text{Ba}(\text{NO}_3)_2$ , and copper(II) sulfate,  $\text{CuSO}_4$ .



What is the ionic equation that represents the above reaction?

- A  $\text{Ba}^{2+}(\text{aq}) + 2\text{NO}_3^-(\text{aq}) \rightarrow \text{Ba}(\text{NO}_3)_2(\text{aq})$
- B  $\text{Ba}^{2+}(\text{aq}) + \text{SO}_4^{2-}(\text{aq}) \rightarrow \text{BaSO}_4(\text{s})$
- C  $\text{Cu}^{2+}(\text{aq}) + 2\text{NO}_3^-(\text{aq}) \rightarrow \text{Cu}(\text{NO}_3)_2(\text{aq})$
- D  $\text{Cu}^{2+}(\text{aq}) + \text{SO}_4^{2-}(\text{aq}) \rightarrow \text{CuSO}_4(\text{aq})$

- 11 The diagram shows a model of a molecule.



What is the relative molecular mass,  $M_r$ , of this molecule?

- A 50
- B 82
- C 98
- D 106

- 12 Why is calcium hydroxide added to soil?

- A to decrease pH and neutralise acidity
- B to decrease pH and neutralise alkalinity
- C to increase pH and neutralise acidity
- D to increase pH and neutralise alkalinity

- 13 An amphoteric oxide was added separately to dilute hydrochloric acid and aqueous sodium hydroxide.

Which of the following is correct?

|   | hydrochloric acid | sodium hydroxide |
|---|-------------------|------------------|
| A | salt formed       | no reaction      |
| B | salt formed       | salt formed      |
| C | no reaction       | salt formed      |
| D | no reaction       | no reaction      |

- 14 Iodine, I, has a lower nucleon (mass) number than tellurium, Te, but is placed after it in the Periodic Table.

Which statement explains why iodine is placed after tellurium in the Periodic Table?

- A Iodine has fewer neutrons than tellurium.  
 B Iodine has fewer protons than tellurium.  
 C Iodine has more neutrons than tellurium.  
 D Iodine has more protons than tellurium.
- 15 Which statement about bromine and iodine is correct?
- A Bromine is a red-brown gas that reacts with sodium chloride solution.  
 B Bromine is a red-brown liquid that reacts with potassium iodide solution.  
 C Iodine is a grey solid that reacts with potassium bromide solution.  
 D Iodine is a purple vapour that reacts with sodium chloride solution.

- 16 W, X, Y and Z are four different metals.

W does not react with acids.

X reacts with steam and acids but not with cold water.

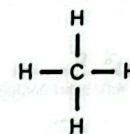
Y reacts with cold water.

Z reacts slowly with acids but not with steam.

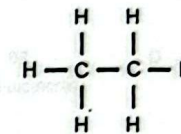
Which row shows the ease with which the metals can be extracted from their ores?

|   | easiest to extract |   |   | most difficult to extract |
|---|--------------------|---|---|---------------------------|
| A | W                  | X | Z | Y                         |
| B | W                  | Z | X | Y                         |
| C | Y                  | X | Z | W                         |
| D | Y                  | Z | X | W                         |

- 17 The names and molecular structure of two alkanes are shown.



methane

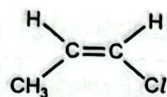


ethane

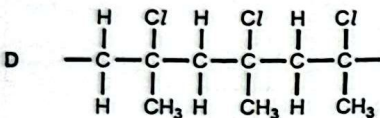
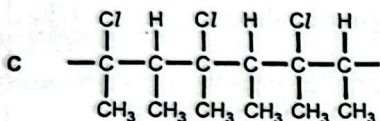
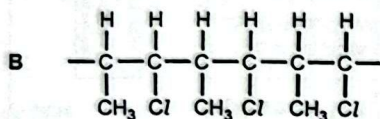
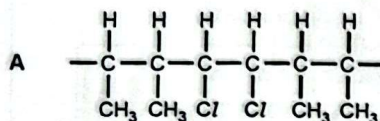
What is the next alkane in the homologous series?

|   | name    | formula                |
|---|---------|------------------------|
| A | butane  | $\text{C}_3\text{H}_6$ |
| B | butane  | $\text{C}_3\text{H}_8$ |
| C | propane | $\text{C}_3\text{H}_6$ |
| D | propane | $\text{C}_3\text{H}_8$ |

18 The following formula represents a monomer.



Which formula shows a part of the polymer chain formed from 3 molecules of the monomer?



19 Which atmospheric pollutants are responsible for damage to buildings?

- 1 nitrogen dioxide
- 2 sulfur dioxide
- 3 carbon monoxide
- 4 methane

A 1 and 2

B 1 and 4

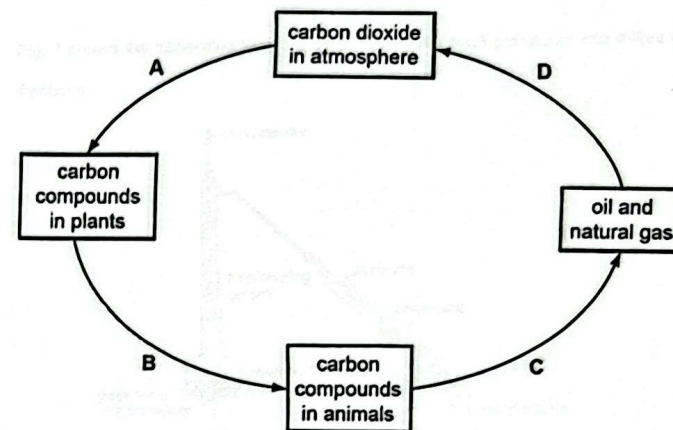
C 2 and 3

D 3 and 4

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20 Which step in the diagram shows the process of combustion?



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Name: ..... ( ) Class: Sec 4 SG 5 / 6

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**Preliminary Examination 2024**  
**Secondary Four Normal (Academic)**  
**Science (Chemistry)**  
**5105/04**

**30 July 2024**  
**Tuesday**

**Time: 1015 – 1130h**  
**Papers 3 and 4: 1 hour 15 minutes**

**Setter: Ms Nancy Ng LK**

**Additional Materials:** Candidates answer on the Question Paper.  
No Additional Materials are required.

### READ THESE INSTRUCTIONS FIRST

Write your name, class and index number on all the work you hand in.  
Write in dark blue or black pen.  
You may use an HB pencil for any diagrams or graphs.  
Do not use staples, paper clips, glue or correction fluid.

#### Section A

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

#### Section B

Answer one question. Write your answers in the spaces provided.

The use of an approved scientific calculator is expected, where appropriate.  
In calculations, you should show all the steps in your working, giving your answer at each stage.  
You are advised to spend no longer than 30 minutes on Paper 3.  
You may proceed to answer Paper 4 as soon as you have completed Paper 3.  
A copy of the Periodic Table is printed on page 9.

At the end of the examination hand in your answers to Paper 3 and Paper 4 separately.  
The number of marks is given in brackets [ ] at the end of each question or part question.

| Examiner's Use |     |
|----------------|-----|
| Section A      | /22 |
| Section B      | /8  |
| TOTAL          | /30 |

This document consists of 9 printed pages.

### Section A

Answer all questions.

- 1 Fig. 1 shows the apparatus that is used to fractionally distill petroleum into different fractions.

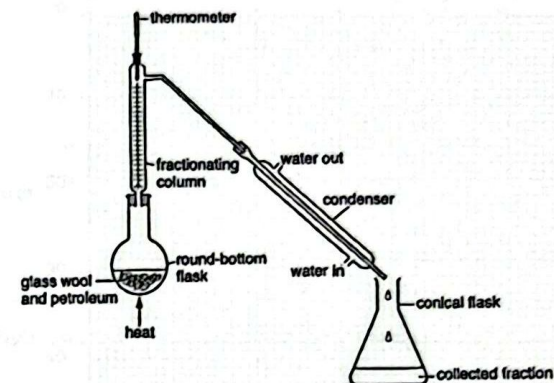


Fig. 1

- (a) (i) Name the physical property that allows the fractions to be separated. [1]  
.....
- (ii) State why the fractions condense in the condenser. [1]  
.....
- (b) The petrol fraction has a boiling point range of 35°C to 70°C.
- (i) Explain why the petrol fraction is collected over a range of temperatures rather than at a single temperature. [1]  
.....  
.....

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[Turn over

- (ii) Explain what happens when a liquid boils. Your answer should explain boiling in terms of the kinetic particle theory and of the energy changes involved.

.....

.....

.....

.....

.....

[3]

[Total: 6]

- 2 A student carries out an experiment to study the reaction between dilute hydrochloric acid, HCl, and excess magnesium carbonate,  $\text{MgCO}_3$ . The carbon dioxide gas produced in this experiment is collected and its volume is measured at one-minute intervals.

The results obtained from the experiment are shown in the table below.

Table 2

| time / min                               | 0 | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  |
|------------------------------------------|---|----|----|----|----|----|----|----|----|----|
| volume of carbon dioxide / $\text{cm}^3$ | 0 | 15 | 20 | 29 | 33 | 37 | 39 | 40 | 40 | 40 |

- (a) (i) Name the apparatus used to measure the volume of gas collected.  
..... [1]
- (ii) Describe a positive test to identify the gas.  
test .....  
result ..... [1]

- (iii) Write a balanced chemical equation for the reaction between dilute hydrochloric acid and magnesium carbonate.

..... [1]

- (b) At the start of the experiment there is 29.4 g of magnesium carbonate.

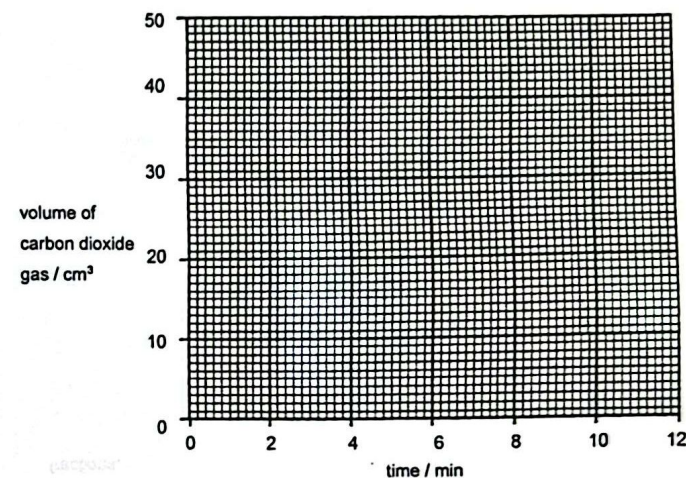
Calculate the amount of magnesium carbonate, in moles.

[relative atomic masses,  $A_r$ : Mg, 24; C, 12; O, 16]

amount of magnesium carbonate = ..... mol [1]

- (c) Plot a graph of these results, marking each point with a cross (\*).

Draw a best-fit curve taking into account all the plotted points.



[2]

(d) Suggest why the volume of gas stops increasing after 7 minutes.

..... [1]

[Total: 7]

- 3 The table shows some information about the elements in Group 1 of the Periodic Table.

Table 3

| element   | atomic number | melting point / °C | density in g / cm <sup>3</sup> |
|-----------|---------------|--------------------|--------------------------------|
| lithium   | 3             | 180                | 0.53                           |
| sodium    | 11            | 98                 | 0.97                           |
| potassium | 19            | 63                 | 0.89                           |
| rubidium  | 37            | 39                 | 1.53                           |
| caesium   | 55            |                    |                                |

- (a) (i) Explain why the elements are in Group 1 of the Periodic Table.  
..... [1]
- (ii) Explain why potassium is in period 4 of the Periodic Table.  
..... [1]
- (b) (i) Describe one observation when a piece of sodium is added to water.  
..... [1]
- (ii) Describe what you would observe when a few drops of Universal Indicator are added to the reaction mixture.  
..... [1]
- (iii) Write a balanced chemical equation for the reaction between sodium and water.  
..... [1]

[Total: 5]

- 4 Vegetable oil can be converted to margarine in the industries.

There are several types of polyunsaturated fatty acids in vegetable oils that can be made into margarine.

The structure shown below is linoleic acid, a common acid found in vegetable oils.

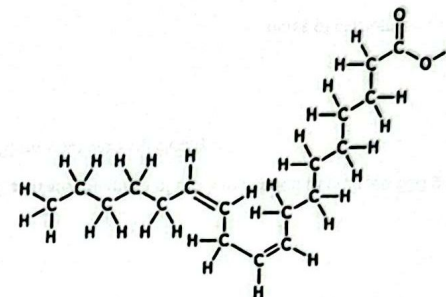


Fig. 4

- (a) Explain, with reference to its structure, why linoleic acid is *polyunsaturated*.  
..... [1]
- (b) (i) Name the reagent required to convert vegetable oil to margarine.  
..... [1]
- (ii) Describe a simple test to distinguish between a sample of polyunsaturated vegetable oil and a sample of saturated margarine.  
test .....  
result with vegetable oil .....  
result with margarine ..... [2]

[Total: 4]

## Section B

Answer one question from this section.

- 1 The most common isotope of carbon in carbon dioxide is  $^{12}_6\text{C}$ .

(a) Define the term *isotopes*.

..... [1]

(b) Another isotope of carbon has the symbol  $^{13}_6\text{C}$ .

Determine the number of sub-atomic particles in one atom of  $^{13}_6\text{C}$ .

number of protons = ..... [1]  
number of neutrons = .....

(c) Ethene burns completely in oxygen to produce carbon dioxide,  $\text{CO}_2$ .

(i) Complete and balance the equation for the complete combustion of ethene.



(ii) Draw a 'dot and cross' diagram to show the bonding in one molecule of carbon dioxide,  $\text{CO}_2$ . Show only outer shell electrons.

(d) Carbon monoxide,  $\text{CO}$ , is an atmospheric pollutant.

(i) Explain how carbon monoxide is formed.

..... [1]

(ii) Describe the effect of carbon monoxide on health.

..... [1]

[Total: 8]

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[Turn over]

- 2 Calcium is an element found in Group 2 of the Periodic Table.

(a) Calcium and steam are reacted.

The incomplete equation for the reaction is shown.



(i) Name solid X.

..... [1]

(ii) State and explain whether solid X is an acidic or basic compound.

type of compound ..... [1]  
explanation .....

(b) Calcium reacts with dilute hydrochloric acid to form calcium chloride,  $\text{CaCl}_2$ .



(i) Draw a 'dot and cross' diagram to show the arrangement of electrons in calcium chloride. Show only outer shell electrons.

[2]

(ii) Explain, in terms of bonding and structure, why solid calcium chloride cannot conduct electricity but aqueous calcium chloride can conduct electricity.

..... [2]  
.....  
.....

(iii) Calculate the mass of calcium needed to produce 500 g of  $\text{CaCl}_2$ .

Show your working clearly.

mass of calcium = ..... g [2]

[Total: 8]

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[Turn over]

# The Periodic Table of Elements

| Group                                                                                                                                                                                               |                             |                            |                             |                           |                              |                             |                              |                            |                              |                           |                            |                             |                             |                               |                              |                              |                           |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|----------------------------|-----------------------------|---------------------------|------------------------------|-----------------------------|------------------------------|----------------------------|------------------------------|---------------------------|----------------------------|-----------------------------|-----------------------------|-------------------------------|------------------------------|------------------------------|---------------------------|
| I                                                                                                                                                                                                   | II                          |                            |                             |                           |                              |                             |                              |                            |                              |                           |                            | III                         | IV                          | V                             | VI                           | VII                          | 0                         |
| <div><div>Key</div><div>proton (atomic) number</div><div>atomic symbol</div><div>name</div><div>relative atomic mass</div></div> <div><div>1</div><div>H</div><div>hydrogen</div><div>1</div></div> |                             |                            |                             |                           |                              |                             |                              |                            |                              |                           |                            |                             |                             |                               |                              |                              |                           |
| 3<br>Li<br>lithium<br>7                                                                                                                                                                             | 4<br>Be<br>beryllium<br>9   |                            |                             |                           |                              |                             |                              |                            |                              |                           |                            | 5<br>B<br>boron<br>11       | 6<br>C<br>carbon<br>12      | 7<br>N<br>nitrogen<br>14      | 8<br>O<br>oxygen<br>16       | 9<br>F<br>fluorine<br>19     | 10<br>Ne<br>neon<br>20    |
| 11<br>Na<br>sodium<br>23                                                                                                                                                                            | 12<br>Mg<br>magnesium<br>24 |                            |                             |                           |                              |                             |                              |                            |                              |                           |                            | 13<br>Al<br>aluminium<br>27 | 14<br>Si<br>silicon<br>28   | 15<br>P<br>phosphorus<br>31   | 16<br>S<br>sulphur<br>32     | 17<br>Cl<br>chlorine<br>35.5 | 18<br>Ar<br>argon<br>40   |
| 19<br>K<br>potassium<br>39                                                                                                                                                                          | 20<br>Ca<br>calcium<br>40   | 21<br>Sc<br>scandium<br>45 | 22<br>Ti<br>titanium<br>48  | 23<br>V<br>vanadium<br>51 | 24<br>Cr<br>chromium<br>52   | 25<br>Mn<br>manganese<br>55 | 26<br>Fe<br>iron<br>56       | 27<br>Co<br>cobalt<br>59   | 28<br>Ni<br>nickel<br>59     | 29<br>Cu<br>copper<br>64  | 30<br>Zn<br>zinc<br>65     | 31<br>Ga<br>gallium<br>70   | 32<br>Ge<br>germanium<br>73 | 33<br>As<br>arsenic<br>75     | 34<br>Se<br>selenium<br>79   | 35<br>Br<br>bromine<br>80    | 36<br>Kr<br>krypton<br>84 |
| 37<br>Rb<br>rubidium<br>85                                                                                                                                                                          | 38<br>Sr<br>strontium<br>88 | 39<br>Y<br>yttrium<br>89   | 40<br>Zr<br>zirconium<br>91 | 41<br>Nb<br>niobium<br>93 | 42<br>Mo<br>molybdenum<br>96 | 43<br>Tc<br>technetium<br>- | 44<br>Ru<br>ruthenium<br>101 | 45<br>Rh<br>rhodium<br>103 | 46<br>Pd<br>palladium<br>106 | 47<br>Ag<br>silver<br>108 | 48<br>Cd<br>cadmium<br>112 | 49<br>In<br>indium<br>115   | 50<br>Sn<br>tin<br>119      | 51<br>Sb<br>antimony<br>122   | 52<br>Te<br>tellurium<br>128 | 53<br>I<br>iodine<br>127     | 54<br>Xe<br>xenon<br>131  |
| 55<br>Cs<br>caesium<br>133                                                                                                                                                                          | 56<br>Ba<br>barium<br>137   | 57 - 71<br>lanthanoids     |                             |                           |                              |                             |                              |                            |                              |                           |                            | 81<br>Tl<br>thallium<br>204 | 82<br>Pb<br>lead<br>207     | 83<br>Bi<br>bismuth<br>209    | 84<br>Po<br>polonium<br>-    | 85<br>At<br>astatine<br>-    | 86<br>Rn<br>radon<br>-    |
| 87<br>Fr<br>francium<br>-                                                                                                                                                                           | 88<br>Ra<br>radium<br>-     | 89 - 103<br>actinoids      |                             |                           |                              |                             |                              |                            |                              |                           |                            | 114<br>Fl<br>flerovium<br>- | 115<br>Mc<br>moscovium<br>- | 116<br>Lv<br>livermorium<br>- | 117<br>Ts<br>tennessine<br>- | 118<br>Og<br>oganeson<br>-   |                           |

lanthanoids

|                              |                            |                                 |                              |                             |                             |                             |                               |                            |                               |                              |                           |                               |                              |                              |
|------------------------------|----------------------------|---------------------------------|------------------------------|-----------------------------|-----------------------------|-----------------------------|-------------------------------|----------------------------|-------------------------------|------------------------------|---------------------------|-------------------------------|------------------------------|------------------------------|
| 57<br>La<br>lanthanum<br>139 | 58<br>Ce<br>cerium<br>140  | 59<br>Pr<br>praseodymium<br>141 | 60<br>Nd<br>neodymium<br>144 | 61<br>Pm<br>promethium<br>- | 62<br>Sm<br>samarium<br>150 | 63<br>Eu<br>europium<br>152 | 64<br>Gd<br>gadolinium<br>157 | 65<br>Tb<br>terbium<br>159 | 66<br>Dy<br>dysprosium<br>163 | 67<br>Ho<br>holmium<br>165   | 68<br>Er<br>erbium<br>167 | 69<br>Tm<br>thulium<br>169    | 70<br>Yb<br>ytterbium<br>173 | 71<br>Lu<br>lutetium<br>175  |
| 89<br>Ac<br>actinium<br>-    | 90<br>Th<br>thorium<br>232 | 91<br>Pa<br>protactinium<br>231 | 92<br>U<br>uranium<br>238    | 93<br>Np<br>neptunium<br>-  | 94<br>Pu<br>plutonium<br>-  | 95<br>Am<br>americium<br>-  | 96<br>Cm<br>curium<br>-       | 97<br>Bk<br>berkelium<br>- | 98<br>Cf<br>californium<br>-  | 99<br>Es<br>einsteinium<br>- | 100<br>Fm<br>fermium<br>- | 101<br>Md<br>mendelevium<br>- | 102<br>No<br>nobelium<br>-   | 103<br>Lr<br>lawrencium<br>- |

actinoids

The volume of one mole of any gas is 24 dm<sup>3</sup> at room temperature and pressure (r.t.p.).