



**Cambridge International Examinations**  
Cambridge International General Certificate of Secondary Education

CANDIDATE  
NAME

CENTRE  
NUMBER

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NUMBER

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**CHEMISTRY**

**0620/22**

Paper 2

**October/November 2015**

**1 hour 15 minutes**

Candidates answer on the Question Paper.

No Additional Materials are required.

**READ THESE INSTRUCTIONS FIRST**

Write your Centre number, candidate number and name in the spaces at the top of this page.

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.

**DO NOT WRITE IN ANY BARCODES.**

Answer **all** questions.

Electronic calculators may be used.

A copy of the Periodic Table is printed on page 16.

You may lose marks if you do not show your working or if you do not use appropriate units.

At the end of the examination, fasten all your work securely together.

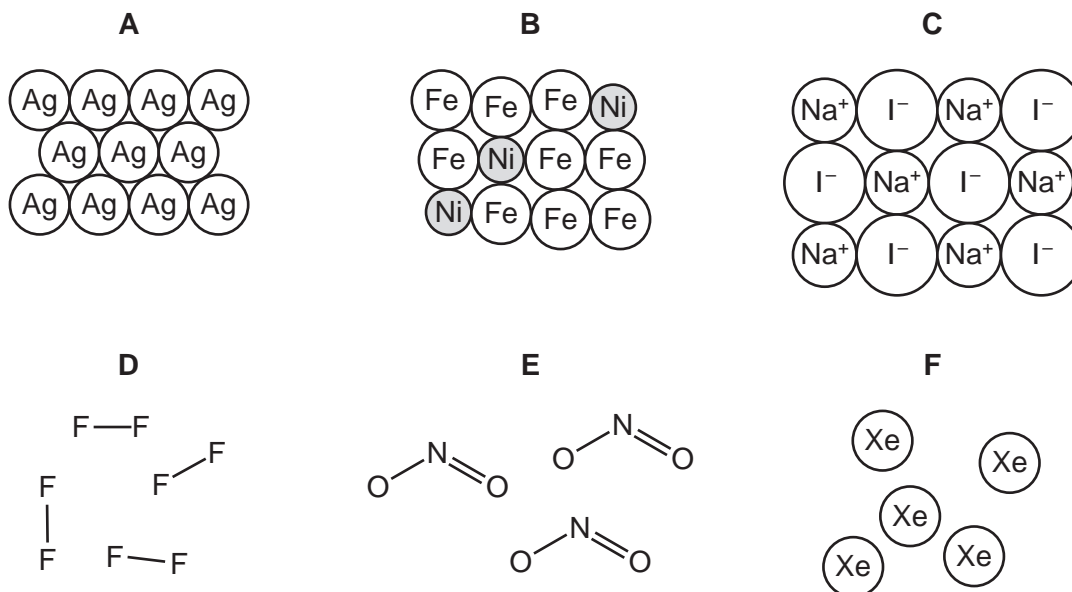
The number of marks is given in brackets [ ] at the end of each question or part question.

The syllabus is approved for use in England, Wales and Northern Ireland as a Cambridge International Level 1/Level 2 Certificate.

This document consists of **14** printed pages and **2** blank pages.



1 The structures of six substances are shown below.



Answer the following questions about these substances.  
Each substance may be used once, more than once or not at all.

(a) Which substance, **A**, **B**, **C**, **D**, **E** or **F**,

- (i) is a simple molecular compound, ..... [1]
- (ii) is an alloy, ..... [1]
- (iii) is a compound, whose aqueous solution gives a yellow precipitate on addition of aqueous silver nitrate, ..... [1]
- (iv) is an atmospheric pollutant arising from reactions taking place in car engines, ..... [1]
- (v) is a diatomic molecule, ..... [1]
- (vi) conducts electricity when molten but not when solid? ..... [1]

(b) Substance **A** is an element.

What is meant by the term *element*?

.....  
..... [1]

(c) Substance **D** oxidises water to oxygen.

Complete the symbol equation for this reaction.

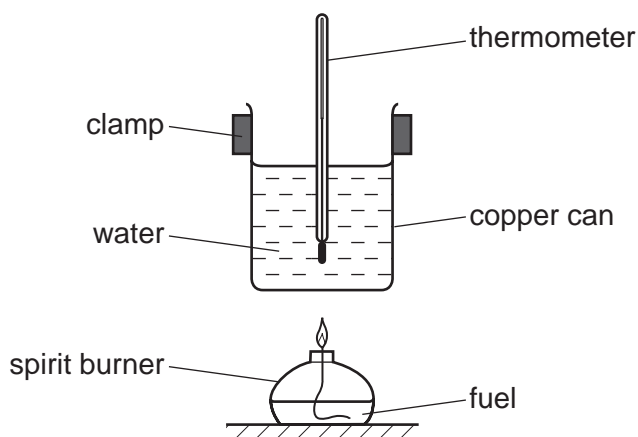


[2]

[Total: 9]

## 3

- 2 A student measured the highest temperature reached when four different fuels were burned. He used the apparatus shown below.



- (a) The same amount of each fuel was burned.

Suggest **two** other things which the student should keep constant to make the experiment a fair test.

1. ....

2. ....

[2]

- (b) Is burning an exothermic or an endothermic reaction?  
Give a reason for your answer.

..... [1]

- (c) The table below shows the results.

| fuel     | molecular formula               | initial temperature/°C | final temperature/°C |
|----------|---------------------------------|------------------------|----------------------|
| ethanol  | C <sub>2</sub> H <sub>6</sub> O | 23                     | 44                   |
| hexane   | C <sub>6</sub> H <sub>14</sub>  | 17                     | 46                   |
| pentane  | C <sub>5</sub> H <sub>12</sub>  | 22                     | 48                   |
| propanol | C <sub>3</sub> H <sub>8</sub> O | 21                     | 45                   |

- (i) Which fuel gave the highest temperature change?

..... [1]

- (ii) Which fuel has the highest relative molecular mass?  
You are not expected to do any calculations.

..... [1]

(d) Methane is a fuel.

(i) Draw the structure of methane showing all atoms and all bonds.

[1]

(ii) Which **one** of the following fuels is largely methane?  
Tick **one** box.

|             |                          |
|-------------|--------------------------|
| coal        | <input type="checkbox"/> |
| fuel oil    | <input type="checkbox"/> |
| gasoline    | <input type="checkbox"/> |
| natural gas | <input type="checkbox"/> |

[1]

(e) Pentane and hexane belong to the same homologous series.

(i) How can you tell this from their names?

..... [1]

(ii) Complete the following sentence about a homologous series using words from the list below.

|                 |                   |                  |                   |                  |
|-----------------|-------------------|------------------|-------------------|------------------|
| <b>acidic</b>   | <b>alcohol</b>    | <b>compounds</b> | <b>density</b>    | <b>different</b> |
| <b>elements</b> | <b>functional</b> | <b>masses</b>    | <b>properties</b> | <b>solid</b>     |

A homologous series is a family of similar ..... with similar .....  
due to the presence of the same ..... group.

[3]

[Total: 11]

- 3 The order of reactivity of zinc, magnesium, calcium and barium is shown below.

zinc → magnesium → calcium → barium

least reactive  $\longrightarrow$  most reactive

- (a) Equal-sized pieces of zinc, magnesium, calcium and barium are placed in water. Some observations from these reactions are shown in the table.

- (i) Complete the box for barium.

| metal     | observations  |
|-----------|---|
| zinc      | no reaction with cold water                                     |
| magnesium | gives a few bubbles with hot water, does not disappear          |
| calcium   | gives off bubbles steadily with cold water, gets smaller slowly |
| barium    |   |

[2]

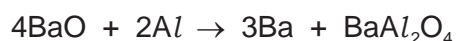
- (ii) Give the name of a metal in the above table which is extracted by heating with carbon.

..... [1]

- (iii) Suggest why barium cannot be extracted using carbon.

..... [1]

- (b) Barium can be extracted by heating barium oxide with aluminium.



How does this equation show that barium oxide gets reduced?

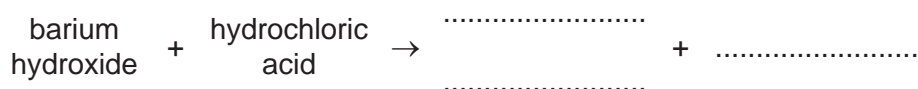
..... [1]

- (c) A solution of barium hydroxide is alkaline.

- (i) Describe how you would show that barium hydroxide solution is alkaline.

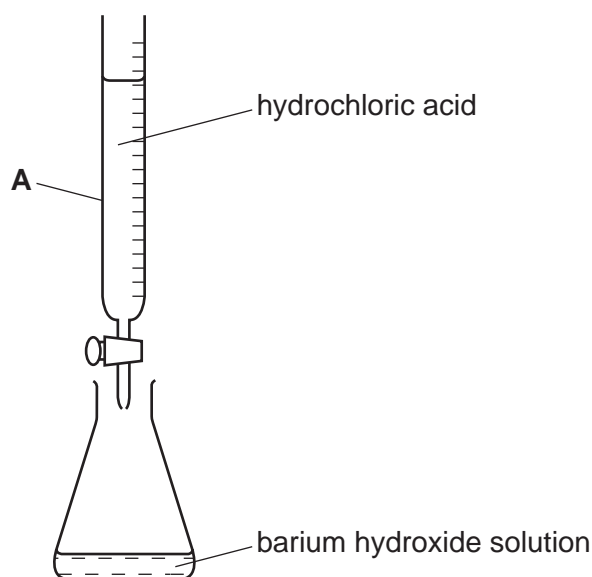
..... [1]

- (ii) Complete the word equation for the reaction of barium hydroxide with hydrochloric acid.



[2]

- (d) A student used the apparatus shown below to calculate the concentration of barium hydroxide solution.



- (i) Give the name of the piece of apparatus labelled **A**.

..... [1]

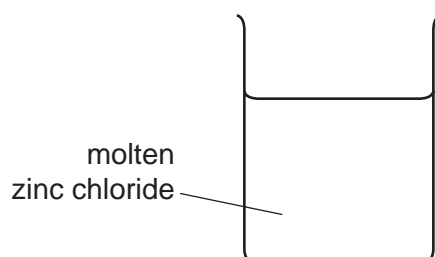
- (ii) The hydrochloric acid is added to the barium hydroxide solution in the flask until the acid is in excess.

Describe how the pH of the solution changes as the acid is added.

.....

..... [2]

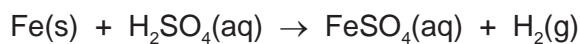
- (e) Complete the diagram below for the electrolysis of molten zinc chloride. Label the electrodes and the power source.



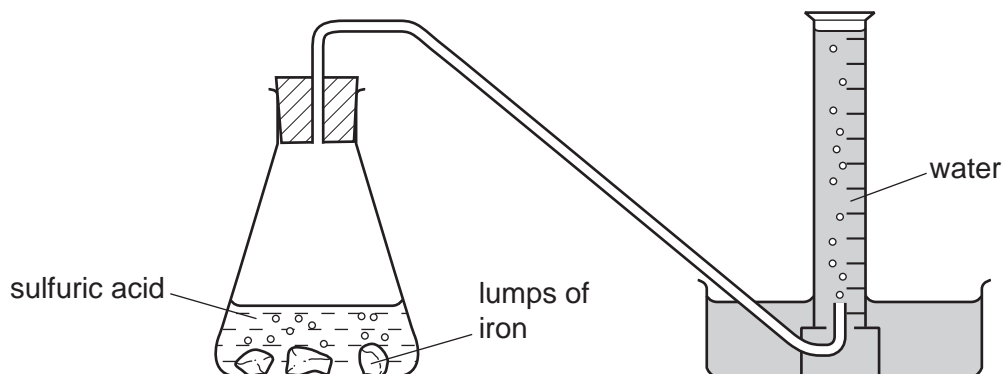
[3]

[Total: 14]

- 4 A student investigated the reaction of lumps of iron with sulfuric acid.



She used the apparatus shown below.



- (a) (i) Describe how this apparatus can be used to investigate the rate of this reaction.

.....  
 .....  
 ..... [3]

- (ii) Describe how the rate of reaction would differ if smaller lumps of iron were used. All other conditions remain the same.

..... [1]

- (b) The student investigated the effect of temperature on the reaction rate.

- (i) State **three** factors which the student should keep the same in each experiment.

1. ....  
 2. ....  
 3. .... [3]

## 8

(ii) The table shows how the rate of reaction changed with temperature.

| temperature /°C | rate of reaction in cm <sup>3</sup> /s |
|-----------------|--|
| 20              | 2.2                                    |
| 30              | 4.4                                    |
| 40              | 8.8                                    |
| 50              | 17.6                                   |

Use the information in the table to describe how the rate of reaction changed with temperature.

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

(c) Iron(II) sulfate can be prepared by adding excess iron to sulfuric acid.

Describe how you could obtain pure dry crystals of iron(II) sulfate from the reaction mixture in the conical flask.

.....  
.....  
.....  
..... [3]

[Total: 12]



5 A crystal of sulfur melts when heated.

- (a) Explain, using the kinetic particle theory, the differences between the arrangement and motion of the particles in sulfur crystals and liquid sulfur.

.....  
 .....  
 .....  
 .....  
 ..... [4]

(b) Sulfur dioxide is an atmospheric pollutant.

- (i) Describe how sulfur dioxide is formed and how it gets into the atmosphere.

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

- (ii) What type of oxide is sulfur dioxide?

..... [1]

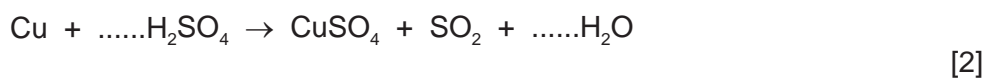
- (iii) Flue gas desulfurisation removes sulfur dioxide from exhaust gases in factories.

Describe the process of flue gas desulfurisation.

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

- (iv) Sulfur dioxide is also formed when copper is reduced by hot concentrated sulfuric acid.

Complete the symbol equation for this reaction.



(c) Copper is a metal.

Give **two** physical properties which are characteristic of all metals.

1. ....  
 2. ....  
 [2]

- (d) The table below gives some properties of some metals that are used to make electrical cables and wires.

| metal     | strength           | electrical conductivity | melting point /°C | price \$/kg |
|-----------|--------------------|-------------------------|-------------------|-------------|
| aluminium | comparatively weak | good                    | 660               | 1.5         |
| copper    | strong             | very good               | 1093              | 29          |
| steel     | strong             | fairly good             | 1535              | 2.1         |
| silver    | fairly strong      | very good               | 962               | 635         |

- (i) Suggest why aluminium with a steel core is used for overhead power cables.

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

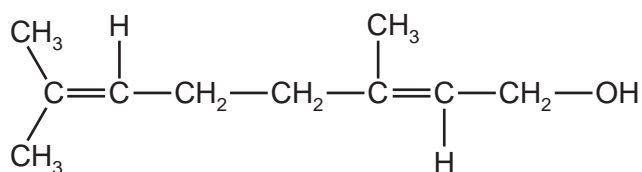
- (ii) Copper is used in electrical wiring in the home rather than silver.

Suggest why.

..... [1]

[Total: 16]

- 6 Geraniol is a chemical found in rose petals.  
The structure of geraniol is shown below.

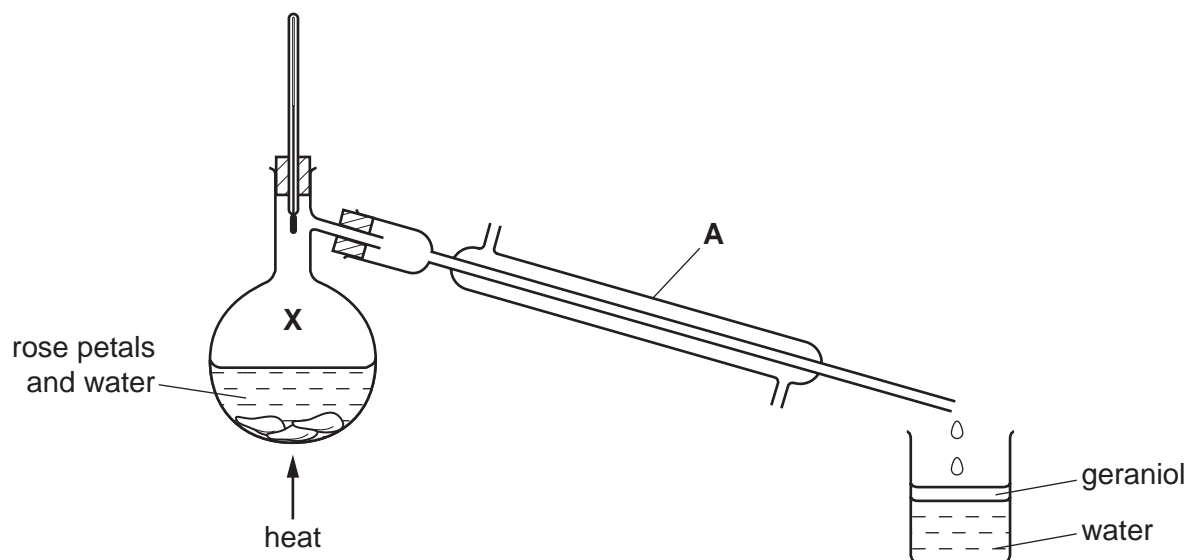


- (a) (i) On the structure above, put a ring around the alcohol functional group. [1]

- (ii) Is geraniol a saturated or an unsaturated compound?  
Give a reason for your answer.

..... [1]

- (b) Geraniol can be extracted from rose petals by steam distillation using the apparatus shown below. The geraniol is carried off in small droplets with the steam.



- (i) Give the name of the piece of apparatus labelled A.

..... [1]

- (ii) The vapour at point X is a mixture of geraniol and steam.

Give **one** property of a mixture which distinguishes it from a compound.

.....  
..... [1]

- (iii) The geraniol and water are collected in the beaker.

What information in the diagram above shows that geraniol is less dense than water?

..... [1]

(c) Geraniol can also be extracted from rose petals by grinding the petals in ethanol.

(i) Draw the structure of ethanol showing all atoms and all bonds.

[1]

(ii) Complete the word equation for the complete combustion of ethanol.

ethanol + oxygen → ..... + .....

[2]

(d) What is the percentage by volume of oxygen in the air?

..... [1]

[Total: 9]

7 Beryllium is in Group II and Period 2 of the Periodic Table.

(a) Describe the structure of a beryllium atom.

In your answer, refer to

- the type and number of each subatomic particle present,
- the charges on each type of subatomic particle,
- the position of each type of subatomic particle in the atom.

.....

.....

.....

.....

.....

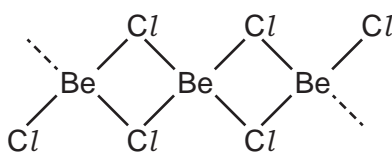
.....

.....

.....

..... [5]

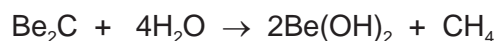
(b) Part of the structure of beryllium chloride is shown below.



Deduce the simplest formula for beryllium chloride.

..... [1]

(c) Beryllium carbide,  $\text{Be}_2\text{C}$ , reacts with water. Beryllium hydroxide and methane are formed.



(i) Calculate the relative formula mass of beryllium hydroxide.

[2]

(ii) Describe **one** adverse effect of methane on the environment.

..... [1]

[Total: 9]





**DATA SHEET**  
**The Periodic Table of the Elements**

|                             |                              | Group  |    |   |    |     |   |                          |                                 |                           |  |  |  |  |  |   |                          |  |
|-----------------------------|------------------------------|--|----|---|----|-----|---|--------------------------|---------------------------------|---------------------------|--|--|--|--|--|---|--------------------------|--|
| I                           | II                           | III  | IV | V | VI | VII | 0 |                          |                                 |                           |  |  |  |  |  |   |                          |  |
|                             |                              | <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10%; text-align: center;">1</td> <td style="width: 10%; text-align: center;"><b>H</b><br/>Hydrogen<br/>1</td> <td colspan="5"></td> <td style="width: 10%; text-align: center;">2</td> <td style="width: 10%; text-align: center;"><b>He</b><br/>Helium<br/>2</td> </tr> </table> |    |   |    |     |   |                          | 1                               | <b>H</b><br>Hydrogen<br>1 |  |  |  |  |  | 2 | <b>He</b><br>Helium<br>2 |  |
| 1                           | <b>H</b><br>Hydrogen<br>1    |  |    |   |    |     | 2 | <b>He</b><br>Helium<br>2 |                                 |                           |  |  |  |  |  |   |                          |  |
| 7                           | 9                            |  |    |   |    |     |   |                          | 4                               |                           |  |  |  |  |  |   |                          |  |
| <b>Li</b><br>Lithium<br>3   | <b>Be</b><br>Beryllium<br>4  |  |    |   |    |     |   |                          | <b>Ne</b><br>Neon<br>10         |                           |  |  |  |  |  |   |                          |  |
| 23                          | 24                           |  |    |   |    |     |   |                          | 35.5                            |                           |  |  |  |  |  |   |                          |  |
| <b>Na</b><br>Sodium<br>11   | <b>Mg</b><br>Magnesium<br>12 |  |    |   |    |     |   |                          | <b>Cl</b><br>Chlorine<br>17     |                           |  |  |  |  |  |   |                          |  |
| 39                          | 40                           |  |    |   |    |     |   |                          | 79                              |                           |  |  |  |  |  |   |                          |  |
| <b>K</b><br>Potassium<br>19 | <b>Ca</b><br>Calcium<br>20   |  |    |   |    |     |   |                          | <b>Br</b><br>Bromine<br>35      |                           |  |  |  |  |  |   |                          |  |
| 85                          | 88                           |  |    |   |    |     |   |                          | 127                             |                           |  |  |  |  |  |   |                          |  |
| <b>Rb</b><br>Rubidium<br>37 | <b>Sr</b><br>Strontium<br>38 |  |    |   |    |     |   |                          | <b>I</b><br>Iodine<br>53        |                           |  |  |  |  |  |   |                          |  |
| 133                         | 137                          |  |    |   |    |     |   |                          | 209                             |                           |  |  |  |  |  |   |                          |  |
| <b>Cs</b><br>Caesium<br>55  | <b>Ba</b><br>Barium<br>56    |  |    |   |    |     |   |                          | <b>At</b><br>Astatine<br>85     |                           |  |  |  |  |  |   |                          |  |
| 226                         | 227                          |  |    |   |    |     |   |                          | 86                              |                           |  |  |  |  |  |   |                          |  |
| <b>Fr</b><br>Francium<br>87 | <b>Ra</b><br>Radium<br>88    |  |    |   |    |     |   |                          | <b>Rn</b><br>Radon<br>86        |                           |  |  |  |  |  |   |                          |  |
|                             |                              |  |    |   |    |     |   |                          | 175                             |                           |  |  |  |  |  |   |                          |  |
|                             |                              |  |    |   |    |     |   |                          | <b>Lu</b><br>Lutetium<br>71     |                           |  |  |  |  |  |   |                          |  |
|                             |                              |  |    |   |    |     |   |                          | 173                             |                           |  |  |  |  |  |   |                          |  |
|                             |                              |  |    |   |    |     |   |                          | <b>Yb</b><br>Ytterbium<br>70    |                           |  |  |  |  |  |   |                          |  |
|                             |                              |  |    |   |    |     |   |                          | 169                             |                           |  |  |  |  |  |   |                          |  |
|                             |                              |  |    |   |    |     |   |                          | <b>Tm</b><br>Thulium<br>69      |                           |  |  |  |  |  |   |                          |  |
|                             |                              |  |    |   |    |     |   |                          | 167                             |                           |  |  |  |  |  |   |                          |  |
|                             |                              |  |    |   |    |     |   |                          | <b>Er</b><br>Erbium<br>68       |                           |  |  |  |  |  |   |                          |  |
|                             |                              |  |    |   |    |     |   |                          | 166                             |                           |  |  |  |  |  |   |                          |  |
|                             |                              |  |    |   |    |     |   |                          | <b>Dy</b><br>Dysprosium<br>66   |                           |  |  |  |  |  |   |                          |  |
|                             |                              |  |    |   |    |     |   |                          | 165                             |                           |  |  |  |  |  |   |                          |  |
|                             |                              |  |    |   |    |     |   |                          | <b>Ho</b><br>Holmium<br>67      |                           |  |  |  |  |  |   |                          |  |
|                             |                              |  |    |   |    |     |   |                          | 162                             |                           |  |  |  |  |  |   |                          |  |
|                             |                              |  |    |   |    |     |   |                          | <b>Dy</b><br>Dysprosium<br>66   |                           |  |  |  |  |  |   |                          |  |
|                             |                              |  |    |   |    |     |   |                          | 159                             |                           |  |  |  |  |  |   |                          |  |
|                             |                              |  |    |   |    |     |   |                          | <b>Tb</b><br>Terbium<br>65      |                           |  |  |  |  |  |   |                          |  |
|                             |                              |  |    |   |    |     |   |                          | 157                             |                           |  |  |  |  |  |   |                          |  |
|                             |                              |  |    |   |    |     |   |                          | <b>Gd</b><br>Gadolinium<br>64   |                           |  |  |  |  |  |   |                          |  |
|                             |                              |  |    |   |    |     |   |                          | 152                             |                           |  |  |  |  |  |   |                          |  |
|                             |                              |  |    |   |    |     |   |                          | <b>Eu</b><br>Europium<br>63     |                           |  |  |  |  |  |   |                          |  |
|                             |                              |  |    |   |    |     |   |                          | 150                             |                           |  |  |  |  |  |   |                          |  |
|                             |                              |  |    |   |    |     |   |                          | <b>Sm</b><br>Samarium<br>62     |                           |  |  |  |  |  |   |                          |  |
|                             |                              |  |    |   |    |     |   |                          | 144                             |                           |  |  |  |  |  |   |                          |  |
|                             |                              |  |    |   |    |     |   |                          | <b>Nd</b><br>Neodymium<br>60    |                           |  |  |  |  |  |   |                          |  |
|                             |                              |  |    |   |    |     |   |                          | 141                             |                           |  |  |  |  |  |   |                          |  |
|                             |                              |  |    |   |    |     |   |                          | <b>Pr</b><br>Praseodymium<br>59 |                           |  |  |  |  |  |   |                          |  |
|                             |                              |  |    |   |    |     |   |                          | 140                             |                           |  |  |  |  |  |   |                          |  |
|                             |                              |  |    |   |    |     |   |                          | <b>Ce</b><br>Cerium<br>58       |                           |  |  |  |  |  |   |                          |  |
|                             |                              |  |    |   |    |     |   |                          | 238                             |                           |  |  |  |  |  |   |                          |  |
|                             |                              |  |    |   |    |     |   |                          | <b>U</b><br>Uranium<br>92       |                           |  |  |  |  |  |   |                          |  |
|                             |                              |  |    |   |    |     |   |                          | 232                             |                           |  |  |  |  |  |   |                          |  |
|                             |                              |  |    |   |    |     |   |                          | <b>Th</b><br>Thorium<br>90      |                           |  |  |  |  |  |   |                          |  |
|                             |                              |  |    |   |    |     |   |                          | 98                              |                           |  |  |  |  |  |   |                          |  |
|                             |                              |  |    |   |    |     |   |                          | <b>Cf</b><br>Californium<br>98  |                           |  |  |  |  |  |   |                          |  |
|                             |                              |  |    |   |    |     |   |                          | 99                              |                           |  |  |  |  |  |   |                          |  |
|                             |                              |  |    |   |    |     |   |                          | <b>Es</b><br>Einsteinium<br>99  |                           |  |  |  |  |  |   |                          |  |
|                             |                              |  |    |   |    |     |   |                          | 100                             |                           |  |  |  |  |  |   |                          |  |
|                             |                              |  |    |   |    |     |   |                          | <b>Fm</b><br>Fermium<br>100     |                           |  |  |  |  |  |   |                          |  |
|                             |                              |  |    |   |    |     |   |                          | 101                             |                           |  |  |  |  |  |   |                          |  |
|                             |                              |  |    |   |    |     |   |                          | <b>Md</b><br>Mendelevium<br>101 |                           |  |  |  |  |  |   |                          |  |
|                             |                              |  |    |   |    |     |   |                          | 102                             |                           |  |  |  |  |  |   |                          |  |
|                             |                              |  |    |   |    |     |   |                          | <b>No</b><br>Nobelium<br>102    |                           |  |  |  |  |  |   |                          |  |
|                             |                              |  |    |   |    |     |   |                          | 103                             |                           |  |  |  |  |  |   |                          |  |
|                             |                              |  |    |   |    |     |   |                          | <b>Lr</b><br>Lawrencium<br>103  |                           |  |  |  |  |  |   |                          |  |

\*58-71 Lanthanoid series  
†90-103 Actinoid series

a = relative atomic mass

X = atomic symbol

b = proton (atomic) number

Key

|   |          |
|---|----------|
| a | <b>X</b> |
| b | †        |

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