



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS  
International General Certificate of Secondary Education

**CHEMISTRY**

**0620/13**

Paper 1 Multiple Choice

**May/June 2013**

**45 Minutes**

Additional Materials:      Multiple Choice Answer Sheet  
   Soft clean eraser  
   Soft pencil (type B or HB is recommended)



**READ THESE INSTRUCTIONS FIRST**

Write in soft pencil.

Do not use staples, paper clips, highlighters, glue or correction fluid.

Write your name, Centre number and candidate number on the Answer Sheet in the spaces provided unless this has been done for you.

**DO NOT WRITE IN ANY BARCODES.**

There are **forty** 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.**

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done in this booklet.

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

Electronic calculators may be used.

This document consists of **15** printed pages and **1** blank page.



## 2

1 The diagram shows a cup of tea.



Which row describes the water particles in the air above the cup compared with the water particles in the cup?

|          | moving faster | closer together |
|----------|---------------|-----------------|
| <b>A</b> | ✓             | ✓               |
| <b>B</b> | ✓             | ✗               |
| <b>C</b> | ✗             | ✓               |
| <b>D</b> | ✗             | ✗               |

2 Crystals of sodium chloride were prepared by the following method.

- 1 25.0 cm<sup>3</sup> of dilute hydrochloric acid was accurately measured into a conical flask.
- 2 Aqueous sodium hydroxide was added until the solution was neutral. The volume of sodium hydroxide added was measured.
- 3 The solution was evaporated and the crystals washed with approximately 15 cm<sup>3</sup> of water.

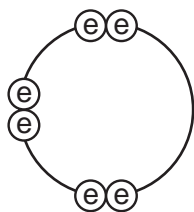
Which row shows the pieces of apparatus used to measure the 25.0 cm<sup>3</sup> of hydrochloric acid, the volume of aqueous sodium hydroxide and the 15 cm<sup>3</sup> of water?

|          | 25.0 cm <sup>3</sup> of hydrochloric acid accurately | the volume of aqueous sodium hydroxide added | 15 cm <sup>3</sup> of water approximately |
|----------|--|--|---|
| <b>A</b> | burette  | pipette                                      | measuring cylinder                        |
| <b>B</b> | measuring cylinder                                   | burette                                      | pipette                                   |
| <b>C</b> | pipette  | burette                                      | measuring cylinder                        |
| <b>D</b> | pipette  | measuring cylinder                           | burette                                   |



4

- 6 Element X has six electrons in its outer shell.



key  
 ⊕ = electron

How could the element react?

- A** by gaining two electrons to form a positive ion  
**B** by losing six electrons to form a negative ion  
**C** by sharing two electrons with two electrons from another element to form two covalent bonds  
**D** by sharing two electrons with two electrons from another element to form four covalent bonds
- 7 For which substance is the type of bonding **not** correct?

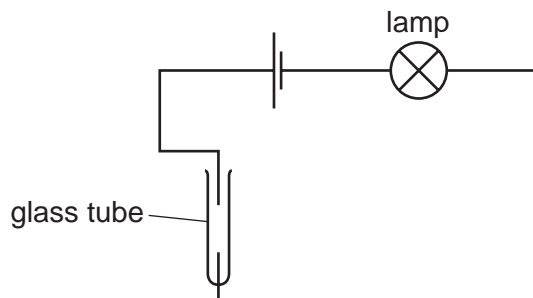
|          | substance         | type of bonding |          |          |
|----------|-------------------|-----------------|----------|----------|
|          |                   | ionic           | covalent | metallic |
| <b>A</b> | chlorine          |                 | ✓        |          |
| <b>B</b> | potassium bromide | ✓               |          |          |
| <b>C</b> | sodium            |                 |          | ✓        |
| <b>D</b> | sodium chloride   |                 | ✓        |          |

- 8 A compound with the formula  $\text{XF}_2$  has a relative formula mass of 78.

What is element X?

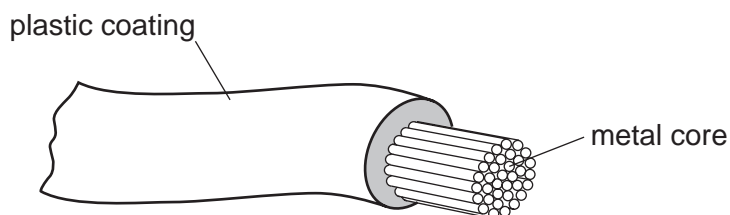
- A** argon  
**B** calcium  
**C** neon  
**D** zirconium

- 9 The diagram shows an incomplete circuit.



Which substance causes the lamp to light when added to the glass tube?

- A aqueous sodium chloride
  - B aqueous sugar
  - C solid sodium chloride
  - D solid sugar
- 10 The diagram shows an electrical cable.



Which statement about the substances used is correct?

- A The coating is plastic because it conducts electricity well.
  - B The core is copper because it conducts electricity well.
  - C The core is copper because it is cheap and strong.
  - D The core is iron because it is cheap and strong.
- 11 What is the balanced chemical equation for the reaction between calcium and water?
- A  $\text{Ca} + \text{H}_2\text{O} \rightarrow \text{CaOH} + \text{H}_2$
  - B  $\text{Ca} + \text{H}_2\text{O} \rightarrow \text{Ca(OH)}_2 + \text{H}_2$
  - C  $\text{Ca} + 2\text{H}_2\text{O} \rightarrow \text{CaOH} + \text{H}_2$
  - D  $\text{Ca} + 2\text{H}_2\text{O} \rightarrow \text{Ca(OH)}_2 + \text{H}_2$

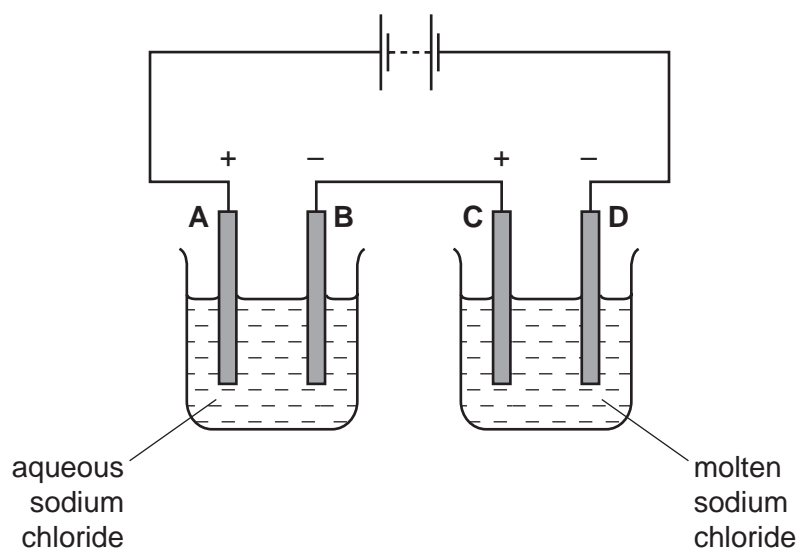
12 Some white anhydrous copper(II) sulfate powder is put into a beaker of water and stirred.

What would show that the process was exothermic?

- A A blue solution is formed.
- B The beaker feels cooler.
- C The beaker feels warmer.
- D The powder dissolves in the water.

13 The diagram shows an electrolysis circuit.

At which electrode is hydrogen formed?



14 Which substance does **not** require oxygen in order to produce energy?

- A coal
- B hydrogen
- C natural gas
- D  $^{235}\text{U}$

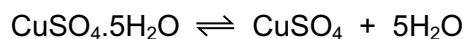
15 Calcium carbonate reacts with hydrochloric acid to form carbon dioxide.

Which changes would slow this reaction down?

- 1 decreasing the concentration of hydrochloric acid
- 2 decreasing the particle size of calcium carbonate
- 3 decreasing the temperature

- A 1 and 2 only
- B 1 and 3 only
- C 2 and 3 only
- D 1, 2 and 3

- 16 The equation shows the formation of anhydrous copper(II) sulfate from hydrated copper(II) sulfate.



Statements 1, 2 and 3 refer to this reaction.

- 1 Hydrated copper(II) sulfate is reduced to anhydrous copper(II) sulfate.
- 2 The (II) in the name copper(II) sulfate refers to the oxidation state of the metal.
- 3 The reaction is reversible.

Which statements are correct?

- A** 1 only      **B** 1 and 2      **C** 2 and 3      **D** 3 only

- 17 Ant stings hurt because of the methanoic acid produced by the ant.

Which substance could, **most safely**, be used to neutralise the acid?

|          | substance        | pH |
|----------|------------------|----|
| <b>A</b> | baking soda      | 8  |
| <b>B</b> | car battery acid | 1  |
| <b>C</b> | lemon juice      | 3  |
| <b>D</b> | oven cleaner     | 14 |

- 18 In which equation is the underlined substance acting as a reducing agent?

- A** 3CO + Fe<sub>2</sub>O<sub>3</sub> → 2Fe + 3CO<sub>2</sub>
- B** CO<sub>2</sub> + C → 2CO
- C** CuO + H<sub>2</sub> → Cu + H<sub>2</sub>O
- D** CaO + H<sub>2</sub>O → Ca(OH)<sub>2</sub>

- 19 Two indicators, bromophenol blue and Congo red, show the following colours in acidic solutions and in alkaline solutions.

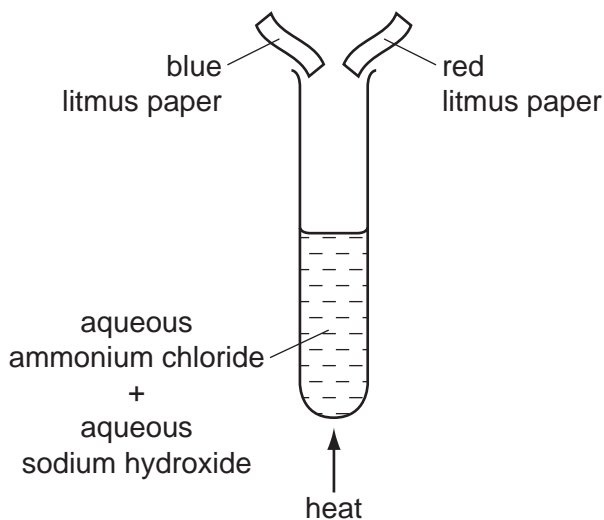
| indicator        | acid   | alkali |
|------------------|--------|--------|
| bromophenol blue | yellow | blue   |
| Congo red        | violet | red    |

A few drops of each indicator are added to separate samples of a solution of pH 2.

What are the colours of the indicators in this solution?

|          | in a solution of pH 2 |              |
|----------|-----------------------|--------------|
|          | bromophenol blue is   | Congo red is |
| <b>A</b> | blue                  | red          |
| <b>B</b> | blue                  | violet       |
| <b>C</b> | yellow                | red          |
| <b>D</b> | yellow                | violet       |

- 20 The diagram shows an experiment.



What happens to the pieces of litmus paper?

|          | blue litmus paper | red litmus paper |
|----------|-------------------|------------------|
| <b>A</b> | changes colour    | changes colour   |
| <b>B</b> | changes colour    | no colour change |
| <b>C</b> | no colour change  | changes colour   |
| <b>D</b> | no colour change  | no colour change |



21 The diagram shows one period of the Periodic Table.

|    |    |   |   |   |   |   |    |
|----|----|---|---|---|---|---|----|
| Li | Be | B | C | N | O | F | Ne |
|----|----|---|---|---|---|---|----|

Which two elements form acidic oxides?

- A carbon and lithium
- B carbon and neon
- C carbon and nitrogen
- D nitrogen and neon

22 Which element is a transition metal?

|   | colour of chloride | melting point of element / °C |
|---|--------------------|-------------------------------|
| A | white              | 113                           |
| B | white              | 1495                          |
| C | yellow             | 113                           |
| D | yellow             | 1495                          |

23 Which property of elements increases across a period of the Periodic Table?

- A metallic character
- B number of electron shells
- C number of outer shell electrons
- D tendency to form positive ions

24 Which property makes aluminium ideal for making food containers?

- A conducts electricity
- B conducts heat
- C mechanical strength
- D resistance to corrosion

25 Fluorine is at the top of Group VII in the Periodic Table.

Which row shows the properties of fluorine?

|          | colour | state at room temperature | reaction with aqueous potassium iodide |
|----------|--------|---------------------------|--|
| <b>A</b> | brown  | gas                       | no reaction                            |
| <b>B</b> | brown  | liquid                    | iodine displaced                       |
| <b>C</b> | yellow | gas                       | iodine displaced                       |
| <b>D</b> | yellow | liquid                    | no reaction                            |

26 Which element is a metal?

|          | charge on element ion | electrical conductivity |
|----------|-----------------------|-------------------------|
| <b>A</b> | negative              | low                     |
| <b>B</b> | positive              | high                    |
| <b>C</b> | negative              | high                    |
| <b>D</b> | positive              | low                     |

27 Group I metals are also known as the Alkali Metals.

Which statement about the metals in Group I is **not** correct?

- A** In their reactions they lose electrons.
- B** Their atoms all have one electron in their outer shell.
- C** They form +1 ions in their reactions with non-metals.
- D** They form covalent compounds by sharing electrons.

28 Below are some metals in decreasing order of reactivity.

magnesium

zinc

iron

copper

Titanium reacts with acid and cannot be extracted from its ore by heating with carbon.

Where should titanium be placed in this list?

- A below copper
- B between iron and copper
- C between magnesium and zinc
- D between zinc and iron

29 Which substance is **not** involved in the extraction of iron from hematite?

- A carbon
- B carbon monoxide
- C calcium carbonate
- D nitrogen

30 Pure metals conduct electricity and can be hammered into different shapes.

Why are metals sometimes used as alloys?

- A Alloys are cheaper than the metals they are made from.
- B Alloys are easier to hammer into different shapes.
- C Alloys are harder and keep their shape better.
- D Alloys conduct electricity better.

31 Water has been contaminated with sea-water.

Which substances can be removed by chlorination and filtration?

- A bacteria, sand and sodium chloride
- B bacteria and sand only
- C bacteria and sodium chloride only
- D sand and sodium chloride only

32 Which information about carbon dioxide and methane is correct?

|          |                                   | carbon dioxide | methane |
|----------|-----------------------------------|----------------|---------|
| <b>A</b> | formed when vegetation decomposes | ✓              | ✗       |
| <b>B</b> | greenhouse gas                    | ✓              | ✓       |
| <b>C</b> | present in unpolluted air         | ✗              | ✗       |
| <b>D</b> | produced during respiration       | ✗              | ✓       |

key  
 ✓ = true  
 ✗ = false

33 Iron rusts when it reacts with .....1.....

Rusting can be prevented by covering the iron with a more reactive metal, such as .....2.....

Which words correctly complete gaps 1 and 2?

|          | 1                | 2         |
|----------|------------------|-----------|
| <b>A</b> | oxygen           | copper    |
| <b>B</b> | oxygen           | magnesium |
| <b>C</b> | oxygen and water | copper    |
| <b>D</b> | oxygen and water | magnesium |

34 Nitrogen, phosphorus and potassium are essential elements for plant growth.

Which mixture provides all three essential elements?

|          | mixture                                       | formula   |
|----------|---|---|
| <b>A</b> | ammonium phosphate<br>+<br>potassium chloride | $(\text{NH}_4)_3\text{PO}_4$<br>+<br>$\text{KCl}$             |
| <b>B</b> | ammonium phosphate<br>+<br>ammonium nitrate   | $(\text{NH}_4)_3\text{PO}_4$<br>+<br>$\text{NH}_4\text{NO}_3$ |
| <b>C</b> | ammonium phosphate<br>+<br>ammonium chloride  | $(\text{NH}_4)_3\text{PO}_4$<br>+<br>$\text{NH}_4\text{Cl}$   |
| <b>D</b> | ammonium nitrate<br>+<br>potassium chloride   | $\text{NH}_4\text{NO}_3$<br>+<br>$\text{KCl}$                 |

35 Organic compounds may have names ending in -ane, -ene, -ol or -oic acid.

How many of these endings indicate the compounds contain double bonds in their molecules?

- A 1                      B 2                      C 3                      D 4

36 The list shows four methods that were suggested for the formation of carbon dioxide.

- 1 action of an alkali on a carbonate
- 2 action of heat on a carbonate
- 3 complete combustion of methane
- 4 reaction of a carbonate with oxygen

Which methods would result in the production of carbon dioxide?

- A 1 and 2              B 1 and 4              C 2 and 3              D 3 and 4

37 The table shows the boiling points of four members of the homologous series of alcohols.

| compound |                                  | boiling point<br>/°C |
|----------|----------------------------------|----------------------|
| name     | formula                          |                      |
| methanol | CH <sub>3</sub> OH               | 65                   |
| ethanol  | C <sub>2</sub> H <sub>5</sub> OH | 78                   |
| propanol | C <sub>3</sub> H <sub>7</sub> OH | X                    |
| butanol  | C <sub>4</sub> H <sub>9</sub> OH | 117                  |

What is the value of X?

- A 55°C              B 82°C              C 98°C              D 115°C

38 Which columns describe the hydrocarbons ethane and ethene?

|                               | 1           | 2                    | 3           | 4                    |
|-------------------------------|-------------|----------------------|-------------|----------------------|
| state at room temperature     | gas         | gas                  | liquid      | liquid               |
| reaction with oxygen          | burns       | burns                | burns       | burns                |
| reaction with aqueous bromine | no reaction | decolourises bromine | no reaction | decolourises bromine |

- A 1 (ethane) and 2 (ethene)  
 B 1 (ethane) and 4 (ethene)  
 C 2 (ethene) and 3 (ethane)  
 D 3 (ethane) and 4 (ethene)

- 39 The table shows some fractions that are obtained from petroleum by fractional distillation, together with some of their uses.

| fraction     | use              |
|--------------|------------------|
| refinery gas | cooking          |
| gasoline     | fuel for cars    |
| 1            | making chemicals |
| 2            | jet fuel         |
| 3            | fuel for ships   |
| bitumen      | making roads     |

Which row correctly identifies fractions 1, 2 and 3?

|          | 1          | 2          | 3                    |
|----------|------------|------------|----------------------|
| <b>A</b> | diesel oil | fuel oil   | lubricating fraction |
| <b>B</b> | fuel oil   | diesel oil | kerosene             |
| <b>C</b> | kerosene   | naphtha    | diesel oil           |
| <b>D</b> | naphtha    | kerosene   | fuel oil             |

- 40 Which of the statements about ethanol are correct?

- 1 Ethanol can be formed by an addition reaction.
- 2 Ethanol can be formed by fermentation.
- 3 When ethanol burns in air, it forms carbon dioxide and water.

- A** 1, 2 and 3      **B** 1 and 2      **C** 1 and 3      **D** 2 and 3



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

|                       |                        | Group   |                        |                           |                         |                         |                        |                        |                        |                        |                          |                          |                      |                          |                        |                         |                      |                       |                       |                        |                       |                           |                        |                         |                       |                       |                         |                      |                         |                      |                       |                      |                        |                       |                       |                     |                       |                      |                           |                     |                        |                        |                        |                     |                        |                          |                          |                      |                          |                       |                         |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
|-----------------------|------------------------|---|------------------------|---------------------------|-------------------------|-------------------------|------------------------|------------------------|------------------------|------------------------|--------------------------|--------------------------|----------------------|--------------------------|------------------------|-------------------------|----------------------|-----------------------|-----------------------|------------------------|-----------------------|---------------------------|------------------------|-------------------------|-----------------------|-----------------------|-------------------------|----------------------|-------------------------|----------------------|-----------------------|----------------------|------------------------|-----------------------|-----------------------|---------------------|-----------------------|----------------------|---------------------------|---------------------|------------------------|------------------------|------------------------|---------------------|------------------------|--------------------------|--------------------------|----------------------|--------------------------|-----------------------|-------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
|                       |                        | I   | II                     | III                       | IV                      | V                       | VI                     | VII                    | VIII                   | IX                     | X                        |                          |                      |                          |                        |                         |                      |                       |                       |                        |                       |                           |                        |                         |                       |                       |                         |                      |                         |                      |                       |                      |                        |                       |                       |                     |                       |                      |                           |                     |                        |                        |                        |                     |                        |                          |                          |                      |                          |                       |                         |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
|                       |                        | 1<br><b>H</b><br>Hydrogen<br>1                      |                        |                           |                         |                         |                        |                        |                        |                        |                          |                          |                      |                          |                        |                         |                      |                       |                       |                        |                       |                           |                        |                         |                       |                       |                         |                      |                         |                      |                       |                      |                        |                       |                       |                     |                       |                      |                           |                     |                        |                        |                        |                     |                        |                          |                          |                      |                          |                       |                         |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
|                       |                        | 4<br><b>He</b><br>Helium<br>2                       |                        |                           |                         |                         |                        |                        |                        |                        |                          |                          |                      |                          |                        |                         |                      |                       |                       |                        |                       |                           |                        |                         |                       |                       |                         |                      |                         |                      |                       |                      |                        |                       |                       |                     |                       |                      |                           |                     |                        |                        |                        |                     |                        |                          |                          |                      |                          |                       |                         |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 7                     | 9                      | 3   | 4                      | 5                         | 6                       | 7                       | 8                      | 9                      | 10                     | 11                     | 12                       | 13                       | 14                   | 15                       | 16                     | 17                      | 18                   | 19                    | 20                    |                        |                       |                           |                        |                         |                       |                       |                         |                      |                         |                      |                       |                      |                        |                       |                       |                     |                       |                      |                           |                     |                        |                        |                        |                     |                        |                          |                          |                      |                          |                       |                         |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| <b>Li</b><br>Lithium  | <b>Be</b><br>Beryllium | <b>B</b><br>Boron                                   | <b>C</b><br>Carbon     | <b>N</b><br>Nitrogen      | <b>O</b><br>Oxygen      | <b>F</b><br>Fluorine    | <b>Ne</b><br>Neon      | <b>Na</b><br>Sodium    | <b>Mg</b><br>Magnesium | <b>Al</b><br>Aluminium | <b>Si</b><br>Silicon     | <b>P</b><br>Phosphorus   | <b>S</b><br>Sulfur   | <b>Cl</b><br>Chlorine    | <b>Ar</b><br>Argon     | <b>K</b><br>Potassium   | <b>Ca</b><br>Calcium | <b>Sc</b><br>Scandium | <b>Ti</b><br>Titanium | <b>V</b><br>Vanadium   | <b>Cr</b><br>Chromium | <b>Mn</b><br>Manganese    | <b>Fe</b><br>Iron      | <b>Co</b><br>Cobalt     | <b>Ni</b><br>Nickel   | <b>Cu</b><br>Copper   | <b>Zn</b><br>Zinc       | <b>Ga</b><br>Gallium | <b>Ge</b><br>Germanium  | <b>As</b><br>Arsenic | <b>Se</b><br>Selenium | <b>Br</b><br>Bromine | <b>Kr</b><br>Krypton   |                       |                       |                     |                       |                      |                           |                     |                        |                        |                        |                     |                        |                          |                          |                      |                          |                       |                         |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 19                    | 37                     | 38  | 39                     | 40                        | 41                      | 42                      | 43                     | 44                     | 45                     | 46                     | 47                       | 48                       | 49                   | 50                       | 51                     | 52                      | 53                   | 54                    | 55                    | 56                     | 57                    | 58                        | 59                     | 60                      | 61                    | 62                    | 63                      | 64                   | 65                      | 66                   | 67                    | 68                   | 69                     | 70                    | 71                    | 72                  | 73                    | 74                   | 75                        | 76                  | 77                     | 78                     | 79                     | 80                  | 81                     | 82                       | 83                       | 84                   | 85                       | 86                    |                         |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| <b>Rb</b><br>Rubidium | <b>Sr</b><br>Strontium | <b>Y</b><br>Yttrium                                 | <b>Zr</b><br>Zirconium | <b>Nb</b><br>Niobium      | <b>Mo</b><br>Molybdenum | <b>Tc</b><br>Technetium | <b>Ru</b><br>Ruthenium | <b>Rh</b><br>Rhodium   | <b>Pd</b><br>Palladium | <b>Ag</b><br>Silver    | <b>Cd</b><br>Cadmium     | <b>In</b><br>Indium      | <b>Sn</b><br>Tin     | <b>Sb</b><br>Antimony    | <b>Te</b><br>Tellurium | <b>I</b><br>Iodine      | <b>Xe</b><br>Xenon   | <b>Cs</b><br>Caesium  | <b>Ba</b><br>Barium   | <b>La</b><br>Lanthanum | <b>Ce</b><br>Cerium   | <b>Pr</b><br>Praseodymium | <b>Nd</b><br>Neodymium | <b>Pm</b><br>Promethium | <b>Sm</b><br>Samarium | <b>Eu</b><br>Europium | <b>Gd</b><br>Gadolinium | <b>Tb</b><br>Terbium | <b>Dy</b><br>Dysprosium | <b>Ho</b><br>Holmium | <b>Er</b><br>Erbium   | <b>Tm</b><br>Thulium | <b>Yb</b><br>Ytterbium | <b>Lu</b><br>Lutetium | <b>Fr</b><br>Francium | <b>Ra</b><br>Radium | <b>Ac</b><br>Actinium | <b>Th</b><br>Thorium | <b>Pa</b><br>Protactinium | <b>U</b><br>Uranium | <b>Np</b><br>Neptunium | <b>Pu</b><br>Plutonium | <b>Am</b><br>Americium | <b>Cm</b><br>Curium | <b>Bk</b><br>Berkelium | <b>Cf</b><br>Californium | <b>Es</b><br>Einsteinium | <b>Fm</b><br>Fermium | <b>Md</b><br>Mendelevium | <b>No</b><br>Nobelium | <b>Lr</b><br>Lawrencium |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 55                    | 87                     | 88  | 89                     | 90                        | 91                      | 92                      | 93                     | 94                     | 95                     | 96                     | 97                       | 98                       | 99                   | 100                      | 101                    | 102                     | 103                  | 104                   | 105                   | 106                    | 107                   | 108                       | 109                    | 110                     | 111                   | 112                   | 113                     | 114                  | 115                     | 116                  | 117                   | 118                  | 119                    | 120                   | 121                   | 122                 | 123                   | 124                  | 125                       | 126                 | 127                    | 128                    | 129                    | 130                 | 131                    | 132                      | 133                      | 134                  | 135                      | 136                   | 137                     | 138 | 139 | 140 | 141 | 142 | 143 | 144 | 145 | 146 | 147 | 148 | 149 | 150 | 151 | 152 | 153 | 154 | 155 | 156 | 157 | 158 | 159 | 160 | 161 | 162 | 163 | 164 | 165 | 166 | 167 | 168 | 169 | 170 | 171 | 172 | 173 | 174 | 175 |
| <b>Fr</b><br>Francium | <b>Ra</b><br>Radium    | <b>Ac</b><br>Actinium                               | <b>Th</b><br>Thorium   | <b>Pa</b><br>Protactinium | <b>U</b><br>Uranium     | <b>Np</b><br>Neptunium  | <b>Pu</b><br>Plutonium | <b>Am</b><br>Americium | <b>Cm</b><br>Curium    | <b>Bk</b><br>Berkelium | <b>Cf</b><br>Californium | <b>Es</b><br>Einsteinium | <b>Fm</b><br>Fermium | <b>Md</b><br>Mendelevium | <b>No</b><br>Nobelium  | <b>Lr</b><br>Lawrencium |                      |                       |                       |                        |                       |                           |                        |                         |                       |                       |                         |                      |                         |                      |                       |                      |                        |                       |                       |                     |                       |                      |                           |                     |                        |                        |                        |                     |                        |                          |                          |                      |                          |                       |                         |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
|                       |                        | *58-71 Lanthanoid series<br>†90-103 Actinoid series |                        |                           |                         |                         |                        |                        |                        |                        |                          |                          |                      |                          |                        |                         |                      |                       |                       |                        |                       |                           |                        |                         |                       |                       |                         |                      |                         |                      |                       |                      |                        |                       |                       |                     |                       |                      |                           |                     |                        |                        |                        |                     |                        |                          |                          |                      |                          |                       |                         |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |

Key

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

a = relative atomic mass  
X = atomic symbol  
b = proton (atomic) number

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

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