



# Cambridge IGCSE™

## CHEMISTRY

Paper 2 Multiple Choice (Extended)

0620/23

May/June 2020

45 minutes

You must answer on the multiple choice answer sheet.

You will need: Multiple choice answer sheet  
Soft clean eraser  
Soft pencil (type B or HB is recommended)

## INSTRUCTIONS

- 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 multiple choice answer sheet.
- Follow the instructions on the multiple choice answer sheet.
- Write in soft pencil.
- Write your name, centre number and candidate number on the multiple choice answer sheet in the spaces provided unless this has been done for you.
- Do **not** use correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.

## INFORMATION

- The total mark for this paper is 40.
- Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
- Any rough working should be done on this question paper.
- The Periodic Table is printed in the question paper.

This document has **16** pages. Blank pages are indicated.



- 1 A mixture of ice and water is left to stand and the ice melts.

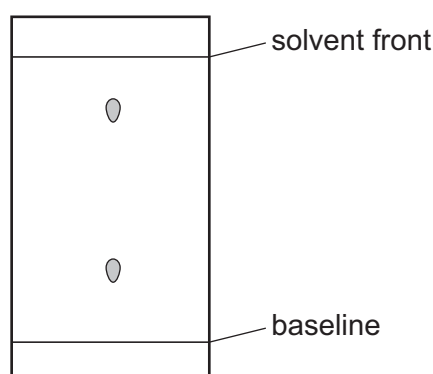
Which row describes what happens as the ice is melting?

|          | temperature of mixture | energy changes                                |
|----------|------------------------|-----------------------------------------------|
| <b>A</b> | increases              | average kinetic energy of particles increases |
| <b>B</b> | increases              | energy is used to overcome attractive forces  |
| <b>C</b> | stays the same         | average kinetic energy of particles increases |
| <b>D</b> | stays the same         | energy is used to overcome attractive forces  |

- 2 Which piece of apparatus is used to measure  $13.7 \text{ cm}^3$  of dilute hydrochloric acid?

- A** balance  
**B** burette  
**C** conical flask  
**D** pipette

- 3 Chromatography is carried out on a mixture of three substances. The chromatogram is sprayed with a locating agent. The result is shown.

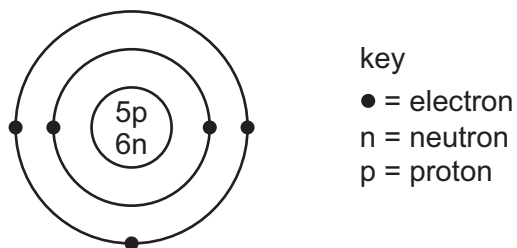


What are possible reasons why the chromatogram shows only two spots?

- 1 One of the substances in the mixture is insoluble in the solvent.
- 2 The locating agent did not react with one of the substances in the mixture.
- 3 Two of the substances in the mixture have the same  $R_f$  values.
- 4 The  $R_f$  value of one of the substances is too small.

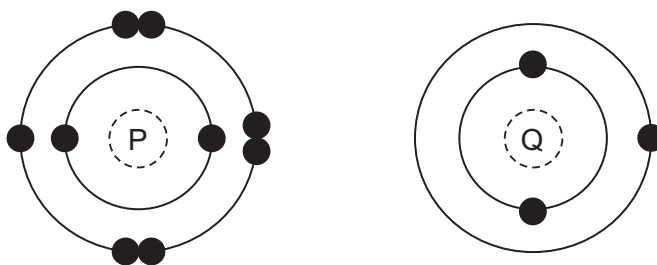
- A** 1 and 2      **B** 1 and 4      **C** 2 and 3      **D** 3 and 4

- 4 The structure of an atom of element X is shown.



What is element X?

- A** boron  
**B** carbon  
**C** sodium  
**D** sulfur
- 5 The electronic structures of two atoms, P and Q, are shown.



P and Q combine together to form a compound.

What is the type of bonding in the compound and what is the formula of the compound?

|          | type of bonding | formula         |
|----------|-----------------|-----------------|
| <b>A</b> | ionic           | PQ              |
| <b>B</b> | ionic           | PQ <sub>2</sub> |
| <b>C</b> | covalent        | PQ <sub>2</sub> |
| <b>D</b> | covalent        | PQ              |

- 6 Caesium is a metal in Group I of the Periodic Table.

Which description of the bonding in caesium is correct?

- A** electrostatic attraction between oppositely charged ions  
**B** electrostatic attraction between positive metal ions and mobile electrons  
**C** neighbouring metal atoms sharing pairs of electrons  
**D** strong attractive forces between atoms

7 Why does magnesium oxide, MgO, have a very high melting point?

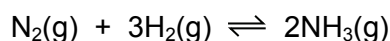
- A There is a very strong double bond between magnesium and oxygen.
- B There is a very strong attractive force between the magnesium oxide molecules.
- C The oxide ions are strongly attracted to positive ions.
- D The magnesium ions are strongly attracted to a sea of electrons.

8 Aluminium metal reacts with iron(III) oxide to form aluminium oxide and iron.

Which chemical equation for the reaction between aluminium and iron(III) oxide is correct?

- A  $\text{FeO} + \text{Al} \rightarrow \text{AlO} + \text{Fe}$
- B  $\text{Fe}_2\text{O} + 2\text{Al} \rightarrow \text{Al}_2\text{O} + 2\text{Fe}$
- C  $\text{Fe}_2\text{O}_3 + \text{Al} \rightarrow \text{Al}_2\text{O}_3 + \text{Fe}$
- D  $\text{Fe}_2\text{O}_3 + 2\text{Al} \rightarrow \text{Al}_2\text{O}_3 + 2\text{Fe}$

9 The Haber process is a reversible reaction.



The reaction has a 30% yield of ammonia.

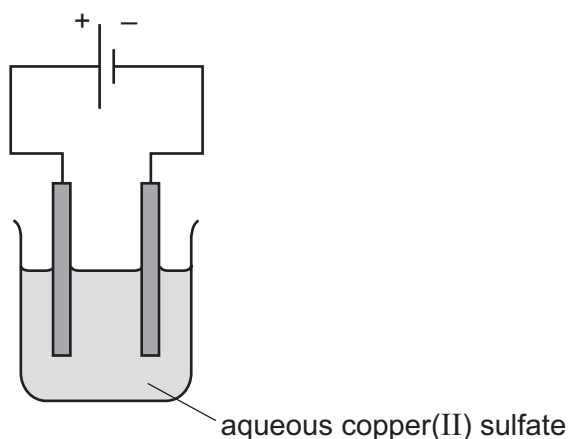
Which volume of ammonia gas,  $\text{NH}_3$ , measured at room temperature and pressure, is obtained by reacting 0.75 moles of hydrogen with excess nitrogen?

- A  $3600\text{ cm}^3$
- B  $5400\text{ cm}^3$
- C  $12\,000\text{ cm}^3$
- D  $18\,000\text{ cm}^3$

10 Which row describes the reactions during the electrolysis of dilute aqueous sodium chloride?

|   | anode (+) reaction                                                        | cathode (–) reaction                                                      |
|---|---------------------------------------------------------------------------|---------------------------------------------------------------------------|
| A | $\text{H}_2 \rightarrow 2\text{H}^+ + 2\text{e}^-$                        | $2\text{H}_2\text{O} + \text{O}_2 + 4\text{e}^- \rightarrow 4\text{OH}^-$ |
| B | $2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$                        | $4\text{OH}^- \rightarrow 2\text{H}_2\text{O} + \text{O}_2 + 4\text{e}^-$ |
| C | $2\text{H}_2\text{O} + \text{O}_2 + 4\text{e}^- \rightarrow 4\text{OH}^-$ | $\text{H}_2 \rightarrow 2\text{H}^+ + 2\text{e}^-$                        |
| D | $4\text{OH}^- \rightarrow 2\text{H}_2\text{O} + \text{O}_2 + 4\text{e}^-$ | $2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$                        |

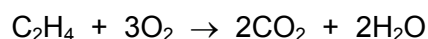
- 11 The electrolysis of aqueous copper(II) sulfate, using inert electrodes, is shown.



Which statement about a reaction at an electrode is correct?

- A Copper ions gain electrons at the negative electrode.
  - B Copper ions gain electrons at the positive electrode.
  - C Hydrogen ions gain electrons at the negative electrode.
  - D Hydrogen ions gain electrons at the positive electrode.
- 12 Ethene gas,  $C_2H_4$ , is completely burned in excess oxygen to form carbon dioxide and water.

The equation for this exothermic reaction is shown.



The table shows the bond energies involved in the reaction.

| bond | bond energy<br>(kJ/mol) |
|------|-------------------------|
| C=C  | 614                     |
| C-H  | 413                     |
| O=O  | 495                     |
| C=O  | 799                     |
| O-H  | 467                     |

What is the total energy change in this reaction?

- A -954 kJ/mol
- B -1010 kJ/mol
- C -1313 kJ/mol
- D -1369 kJ/mol

**13** Which statements about hydrogen fuel cells are correct?

- 1 Water is formed as the only waste product.
- 2 Both water and carbon dioxide are formed as waste products.
- 3 The overall reaction is  $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$ .
- 4 The overall reaction is endothermic.

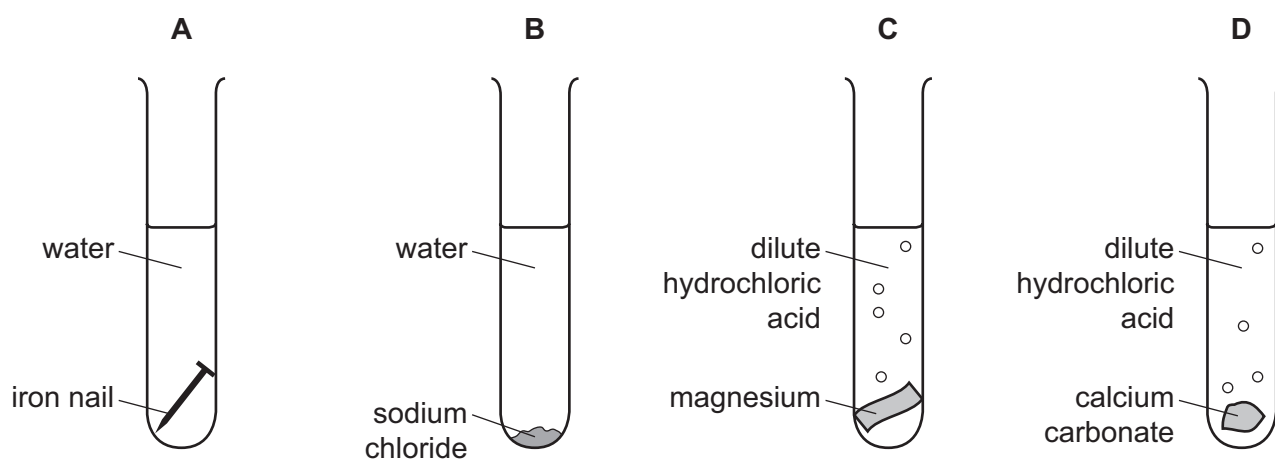
**A** 1 and 3

**B** 1 and 4

**C** 2 and 3

**D** 2 and 4

**14** In which tube is a physical change taking place?

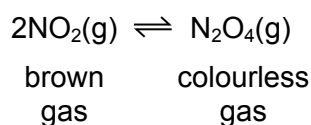


**15** A chemical reaction occurs when the reacting particles collide.

Which reaction conditions would produce the greatest rate of particle collisions?

|          | concentration of acid | reaction temperature |
|----------|-----------------------|----------------------|
| <b>A</b> | decrease              | decrease             |
| <b>B</b> | no change             | increase             |
| <b>C</b> | increase              | increase             |
| <b>D</b> | increase              | no change            |

- 16 At room temperature, the conversion of nitrogen dioxide,  $\text{NO}_2$ , into dinitrogen tetroxide,  $\text{N}_2\text{O}_4$ , is reversible.

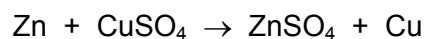


The forward reaction is exothermic.

Which changes cause the equilibrium to shift to the left?

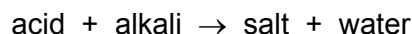
|          | pressure | temperature |
|----------|----------|-------------|
| <b>A</b> | decrease | decrease    |
| <b>B</b> | decrease | increase    |
| <b>C</b> | increase | decrease    |
| <b>D</b> | increase | increase    |

- 17 The equation for the reaction between zinc and aqueous copper(II) sulfate is shown.

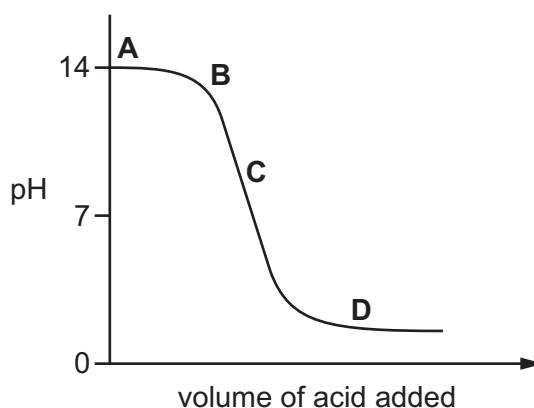


Which statement is correct?

- A** The oxidation state of the oxidising agent has changed from 0 to +2.  
**B** The oxidation state of the reducing agent has changed from 0 to +2.  
**C** The oxidation state of the reducing agent has changed from +2 to 0.  
**D** This is not a redox reaction. The solution changes from colourless to blue.
- 18 The graph shows how the pH of a solution changes as an acid is added to an alkali.



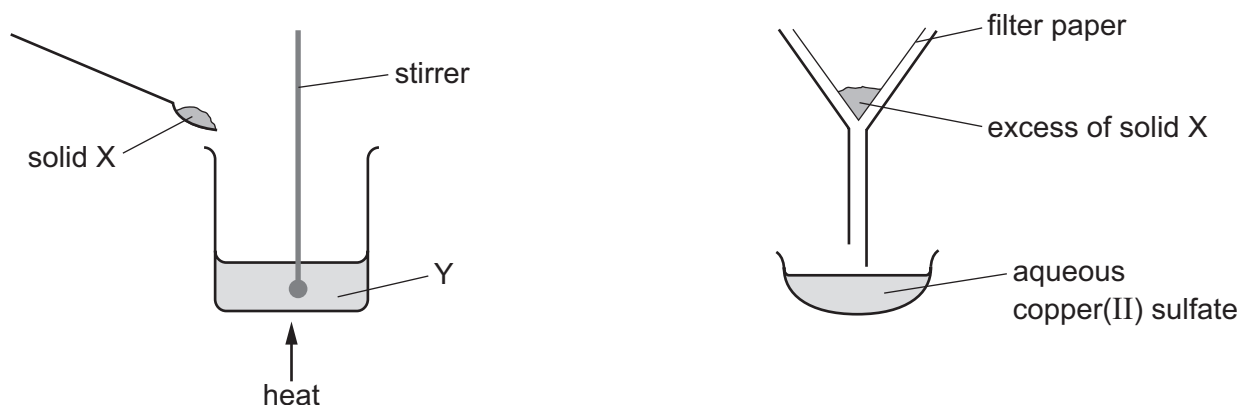
Which letter represents the area of the graph where both acid and salt are present?



19 Which statement describes a weak acid?

- A It is a proton acceptor and is fully ionised in aqueous solution.
- B It is a proton acceptor and is partially ionised in aqueous solution.
- C It is a proton donor and is fully ionised in aqueous solution.
- D It is a proton donor and is partially ionised in aqueous solution.

20 The apparatus shown is used to prepare aqueous copper(II) sulfate.



What are X and Y?

|   | X                   | Y                           |
|---|---------------------|-----------------------------|
| A | copper              | aqueous iron(II) sulfate    |
| B | copper(II) chloride | dilute sulfuric acid        |
| C | copper(II) oxide    | dilute sulfuric acid        |
| D | sulfur              | aqueous copper(II) chloride |

21 Which two compounds would react together to form the insoluble salt lead(II) chloride?

|   | compound         | solubility in water |
|---|------------------|---------------------|
| 1 | lead(II) nitrate | yes                 |
| 2 | lead(II) sulfate | no                  |
| 3 | silver chloride  | no                  |
| 4 | sodium chloride  | yes                 |

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

**22** The elements in Group I include lithium, sodium and potassium.

Which statements about these elements are correct?

- 1 Sodium is denser than lithium.
- 2 Lithium has a lower melting point than potassium.
- 3 Potassium is a relatively soft metal.
- 4 Sodium is less reactive than lithium but more reactive than potassium.

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

**23** The properties of the element titanium, Ti, can be predicted from its position in the Periodic Table.

Which row identifies the properties of titanium?

|          | can be used<br>as a catalyst | conducts electricity<br>when solid | has low density | forms coloured<br>compounds |
|----------|------------------------------|------------------------------------|-----------------|-----------------------------|
| <b>A</b> | ✓                            | ✓                                  | ✓               | x                           |
| <b>B</b> | ✓                            | ✓                                  | x               | ✓                           |
| <b>C</b> | ✓                            | x                                  | ✓               | ✓                           |
| <b>D</b> | x                            | ✓                                  | ✓               | ✓                           |

**24** Which statement about the noble gases is correct?

- A** Argon is used in light bulbs and balloons.
- B** Helium reacts with oxygen in the air.
- C** They all have full outer electron shells.
- D** They are all diatomic molecules.

**25** Which property is shown by **all** metals?

- A** They are extracted from their ores by heating with carbon.
- B** They conduct electricity.
- C** They form acidic oxides.
- D** They react with hydrochloric acid to form hydrogen.

- 26** A salt is heated strongly. The only products are a white solid and a colourless gas.

What is the salt?

- A** copper(II) carbonate
- B** potassium carbonate
- C** calcium nitrate
- D** sodium nitrate

- 27** Molten iron from the blast furnace contains impurities.

The process of turning the impure iron into steel involves blowing oxygen into the molten iron and adding calcium oxide.

What are the reasons for blowing in oxygen and adding calcium oxide?

|          | blowing in oxygen                         | adding calcium oxide                      |
|----------|-------------------------------------------|-------------------------------------------|
| <b>A</b> | carbon is removed by reacting with oxygen | reacts with acidic impurities making slag |
| <b>B</b> | carbon is removed by reacting with oxygen | reacts with slag and so removes it        |
| <b>C</b> | iron reacts with the oxygen               | reacts with acidic impurities making slag |
| <b>D</b> | iron reacts with the oxygen               | reacts with slag and so removes it        |

- 28** P, Q, R and S are four metals.

P displaces Q from a solution of its sulfate.

Q reacts with hydrochloric acid and can be extracted from its ore using carbon.

R does not react with hydrochloric acid.

The carbonate of S does not decompose when heated strongly.

What is the order of reactivity of the metals, starting with the most reactive?

|          | <div style="display: flex; align-items: center; justify-content: space-between;"> <div>most reactive</div> <div>→</div> <div>least reactive</div> </div> |   |   |   |
|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|---|
| <b>A</b> | R                                                                                                                                                        | P | Q | S |
| <b>B</b> | R                                                                                                                                                        | Q | P | S |
| <b>C</b> | S                                                                                                                                                        | P | Q | R |
| <b>D</b> | S                                                                                                                                                        | Q | P | R |

**29** Which substances can be used to detect the presence of water?

- 1 cobalt(II) chloride
- 2 copper(II) sulfate
- 3 litmus
- 4 methyl orange

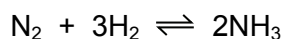
**A** 1 and 2      **B** 1 and 3      **C** 2 and 4      **D** 3 and 4

**30** Which processes increase the amount of carbon dioxide in the atmosphere?

- 1 burning ethanol
- 2 farming cattle
- 3 growing trees

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

**31** Hydrogen and nitrogen react to form ammonia in the Haber process.



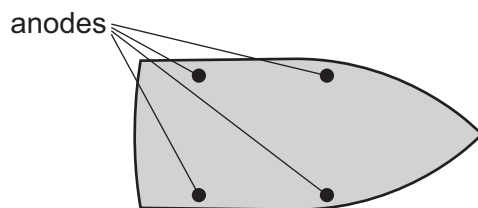
The forward reaction is exothermic.

Which statements about the process are correct?

- 1 Nitrogen is obtained from the air.
- 2 Increasing the temperature of the reaction increases the yield of ammonia.
- 3 Increasing the reaction pressure increases the yield of ammonia.
- 4 Vanadium(V) oxide is used as a catalyst.

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

32 The diagram shows the positions of sacrificial anodes on the steel hull of a yacht.



Which metal is used to make the anodes?

- A calcium
- B copper
- C sodium
- D zinc

33 A student suggests three uses of calcium carbonate (limestone).

- 1 manufacture of cement
- 2 manufacture of iron
- 3 treating alkaline soils

Which suggestions are correct?

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

34 Which reaction in the Contact process is catalysed by vanadium(V) oxide?

- A  $\text{S(s)} + \text{O}_2\text{(g)} \rightarrow \text{SO}_2\text{(g)}$
- B  $2\text{SO}_2\text{(g)} + \text{O}_2\text{(g)} \rightarrow 2\text{SO}_3\text{(g)}$
- C  $\text{SO}_3\text{(g)} + \text{H}_2\text{SO}_4\text{(l)} \rightarrow \text{H}_2\text{S}_2\text{O}_7\text{(l)}$
- D  $\text{H}_2\text{S}_2\text{O}_7\text{(l)} + \text{H}_2\text{O(l)} \rightarrow 2\text{H}_2\text{SO}_4\text{(l)}$

35 Ethanol is produced by:

- 1 the catalytic addition of steam to ethene
- 2 fermentation.

Which statement is correct?

- A Both processes require similar amounts of energy.
- B Both processes use a catalyst.
- C Process 1 uses a renewable resource.
- D Process 2 produces the purest ethanol.

36 Which statement about a homologous series is correct?

- A All members have the same general formula.
- B All members have the same molecular formula.
- C All members have similar physical properties.
- D Members show a trend in their chemical properties.

37 Increasing the number of atoms in one molecule of a hydrocarbon increases the amount of energy released when it burns.

What is the correct order?

|   | less energy<br>released | —————→  | more energy<br>released |
|---|-------------------------|---------|-------------------------|
| A | ethene                  | ethane  | methane                 |
| B | ethene                  | methane | ethane                  |
| C | methane                 | ethane  | ethene                  |
| D | methane                 | ethene  | ethane                  |

38 A small quantity of a solid chemical is added to a large excess of aqueous ethanoic acid.

No bubbles of gas are seen and the solid dissolves to give a colourless solution.

What was the solid chemical?

- A calcium hydroxide
- B copper(II) oxide
- C magnesium
- D sodium carbonate

39 Alkanes undergo substitution reactions with chlorine in the presence of ultraviolet light.

Which equation shows a reaction of this type?

- A  $\text{C}_3\text{H}_6 + \text{Cl}_2 \rightarrow \text{C}_3\text{H}_6\text{Cl}_2$
- B  $\text{C}_3\text{H}_8 + \text{Cl}_2 \rightarrow \text{C}_3\text{H}_7\text{Cl} + \text{H}_2$
- C  $\text{C}_3\text{H}_8 + 2\text{Cl}_2 \rightarrow \text{C}_3\text{H}_6\text{Cl}_2 + 2\text{HCl}$
- D  $\text{C}_3\text{H}_6 + \text{Cl}_2 \rightarrow \text{C}_3\text{H}_5\text{Cl} + \text{HCl}$

**40** Which statement about carbohydrates and proteins is correct?

- A** Carbohydrates and proteins are constituents of food.
- B** Carbohydrates and proteins are natural polymers used to make larger molecules called monomers.
- C** Carbohydrates and proteins are synthetic polymers.
- D** Carbohydrates and proteins cause pollution as they are non-biodegradable.

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The Periodic Table of Elements

| Group                      |                             |                                                                                             |                                 |                             |                              |                             |                              |                              |                                |                               |                               |                             |                             |                             |                               |                             |                           |                              |                         |
|----------------------------|-----------------------------|---------------------------------------------------------------------------------------------|---------------------------------|-----------------------------|------------------------------|-----------------------------|------------------------------|------------------------------|--------------------------------|-------------------------------|-------------------------------|-----------------------------|-----------------------------|-----------------------------|-------------------------------|-----------------------------|---------------------------|------------------------------|-------------------------|
| I                          | II                          |                                                                                             |                                 |                             |                              |                             |                              |                              |                                |                               |                               | III                         | IV                          | V                           | VI                            | VII                         | VIII                      |                              |                         |
|                            |                             | <div>1<br/>H<br/>hydrogen<br/>1</div>                                                       |                                 |                             |                              |                             |                              |                              |                                |                               |                               |                             |                             |                             |                               |                             |                           |                              |                         |
|                            |                             | <div>Key</div> <div>atomic number<br/>atomic symbol<br/>name<br/>relative atomic mass</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>sulfur<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                                                                        | 72<br>Hf<br>hafnium<br>178      | 73<br>Ta<br>tantalum<br>181 | 74<br>W<br>tungsten<br>184   | 75<br>Re<br>rhenium<br>186  | 76<br>Os<br>osmium<br>190    | 77<br>Ir<br>iridium<br>192   | 78<br>Pt<br>platinum<br>195    | 79<br>Au<br>gold<br>197       | 80<br>Hg<br>mercury<br>201    | 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                                                                         | 104<br>Rf<br>rutherfordium<br>— | 105<br>Db<br>dubnium<br>—   | 106<br>Sg<br>seaborgium<br>— | 107<br>Bh<br>bohrium<br>—   | 108<br>Hs<br>hassium<br>—    | 109<br>Mt<br>meitnerium<br>— | 110<br>Ds<br>darmstadtium<br>— | 111<br>Rg<br>roentgenium<br>— | 112<br>Cn<br>copernicium<br>— |                             | 114<br>Fl<br>flerovium<br>— |                             | 116<br>Lv<br>livermorium<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         | 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       | 94<br>Pu<br>plutonium       | 95<br>Am<br>americium       | 96<br>Cm<br>curium            | 97<br>Bk<br>berkelium      | 98<br>Cf<br>californium       | 99<br>Es<br>einsteinium    | 100<br>Fm<br>fermium      | 101<br>Md<br>mendelevium   | 102<br>No<br>nobelium        | 103<br>Lr<br>lawrencium     |

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