Cambridge Assessment International Education

# Cambridge IGCSE™

**CHEMISTRY** **0620/22**

Paper 2 Multiple Choice (Extended) **February/March 2023**

**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.
- Any rough working should be done on this question paper.
- The Periodic Table is printed in the question paper.

This document has **16** pages. Any blank pages are indicated.

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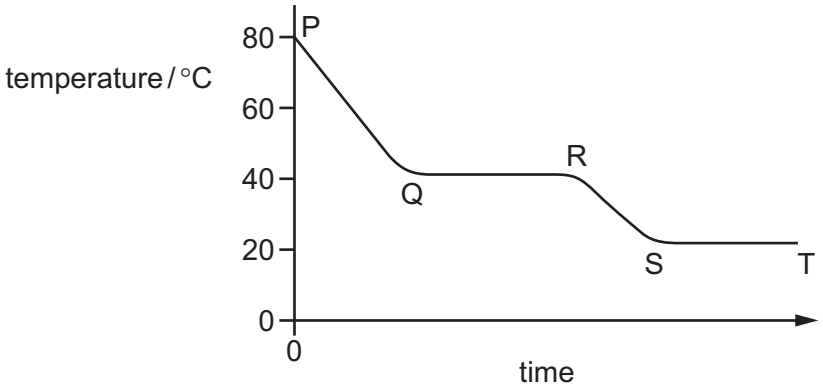
**1** Substance M is a solid at 30 °C.

The substance is heated to 80 °C and its temperature measured as it cools down to room temperature.

The cooling curve is shown.




Between which times is substance M freezing?

**A** P to Q **B** Q to R **C** R to S **D** S to T

**2** Which gas has the fastest rate of diffusion?

**A** Ar **B** $C_2H_6$ **C** $HCl$ **D** $H_2S$

**3** There are two stable isotopes of bromine.

The mass number of isotope 1 is 79.

The mass number of isotope 2 is 81.

Which statement is correct?

**A** The isotopes have the same number of neutrons.

**B** The isotopes have different chemical properties.

**C** The isotopes have different numbers of protons.

**D** The isotopes have the same number of outer electrons.

**4** Which statement about ions and ionic bonds is correct?

**A** Bromine atoms form negatively charged bromide ions.

**B** Ionic bonds form between elements in Group VII of the Periodic Table.

**C** Positive ions are formed when atoms lose protons.

**D** Potassium iodide contains negatively charged potassium ions.

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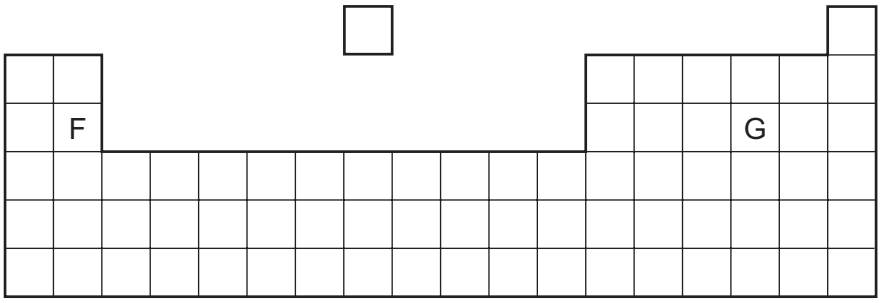
**5** Part of the Periodic Table is shown.




Which type of chemical bonding is present in the oxide of F and in the oxide of G?

| | oxide of F | oxide of G |
|---|---|---|
| **A** | covalent | covalent |
| **B** | covalent | ionic |
| **C** | ionic | covalent |
| **D** | ionic | ionic |

**6** Elements X and Y react to form a compound.

Element X loses two electrons and element Y gains one electron.

What is the charge on the ions of elements X and Y and what is the formula of the compound?

| | charge on X | charge on Y | formula of compound |
|---|---|---|---|
| **A** | 2+ | – | $X_2Y$ |
| **B** | 2+ | – | $XY_2$ |
| **C** | 2– | + | $X_2Y$ |
| **D** | 2– | + | $XY_2$ |

**7** Which statement about graphite explains why it is used as an electrode?

**A** It contains ions.

**B** It has a giant covalent structure.

**C** It is a metal.

**D** It has mobile electrons.

**8** Methane, $CH_4$, burns in air to form carbon dioxide and water.

What is the balanced equation for this reaction?

**A** $CH_4(g) + O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$

**B** $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$

**C** $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + H_2O(g)$

**D** $CH_4(g) + 3O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$

**9** The equation for the thermal decomposition of sodium hydrogencarbonate is shown.

$$2NaHCO_3 \rightarrow Na_2CO_3 + H_2O + CO_2$$

The $M_r$ of sodium hydrogencarbonate, $NaHCO_3$, is 84.

The $M_r$ of sodium carbonate, $Na_2CO_3$, is 106.

In an experiment, 2.1 g of sodium hydrogencarbonate is heated but not all of it decomposes. All of the carbon dioxide is collected and measured at room temperature and pressure. The total volume of carbon dioxide produced is 0.21 $dm^3$.

The volume of 1 mole of a gas at room temperature and pressure is 24 $dm^3$.

Which statement is correct?

**A** The mass of sodium carbonate produced is 0.93 g.

**B** The mass of sodium carbonate produced is 1.33 g.

**C** The percentage yield of carbon dioxide is 10%.

**D** The percentage yield of carbon dioxide is 35%.

**10** An electrolysis experiment is done using carbon electrodes.

Hydrogen and oxygen are formed at the electrodes.

What is the electrolyte?

**A** aqueous copper(II) sulfate

**B** concentrated hydrochloric acid

**C** dilute aqueous sodium chloride

**D** molten potassium oxide

**11** Concentrated aqueous copper(II) sulfate is electrolysed using copper electrodes.

Which ionic half-equation describes the reaction taking place at the cathode?

**A** $2H^+ + 2e^- \rightarrow H_2$

**B** $4OH^- \rightarrow O_2 + 2H_2O + 4e^-$

**C** $Cu \rightarrow Cu^{2+} + 2e^-$

**D** $Cu^{2+} + 2e^- \rightarrow Cu$

**12** When powdered sodium carbonate and aqueous ethanoic acid are mixed, the temperature of the mixture falls.

Which statement about this reaction is correct?

**A** The reaction is endothermic and $\Delta H$ is negative.

**B** The reaction is endothermic and $\Delta H$ is positive.

**C** The reaction is exothermic and $\Delta H$ is negative.

**D** The reaction is exothermic and $\Delta H$ is positive.

**13** Magnesium powder reacts with an excess of dilute hydrochloric acid to produce hydrogen gas.

Which statements about this reaction are correct?

1 The smaller the particles of magnesium powder, the more slowly the hydrogen is produced.

2 The higher the temperature, the faster the magnesium powder disappears.

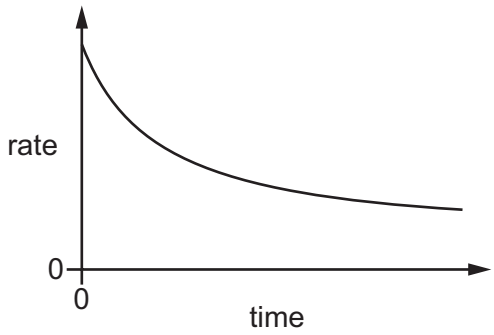
3 The lower the concentration of dilute hydrochloric acid, the faster the rate of reaction.

4 The faster the magnesium powder disappears, the faster the rate of reaction.

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

**14** The reaction between two aqueous compounds, X and Y, is slow and exothermic.

The graph shows how the rate of this reaction changes with time.




A student suggests that the rate of reaction decreases with time because:

1 the activation energy decreases

2 the speed of the molecules of X and Y decreases

3 the concentration of both X and Y decreases with time.

Which suggestions are correct?

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

**15** Hydrogen reacts with iodine to form hydrogen iodide.

$$H_2(g) + I_2(g) \rightarrow 2HI(g)$$

Which statements explain why the reaction is faster when the pressure is increased, at constant temperature?

1 At higher pressure, the molecules are moving faster.

2 At higher pressure, more of the molecules have the required activation energy.

3 At higher pressure, the molecules are closer together.

4 At higher pressure, the molecules collide more frequently.

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

**16** Ammonium sulfate is used as a fertiliser.

It is made from ammonia and sulfuric acid.

The .....1..... is made by the .....2..... process in which .....3..... is used as a catalyst.

Which words complete gaps 1, 2 and 3?

| | 1 | 2 | 3 |
|---|---|---|---|
| **A** | ammonia | Contact | iron |
| **B** | ammonia | Haber | vanadium(V) oxide |
| **C** | sulfuric acid | Contact | vanadium(V) oxide |
| **D** | sulfuric acid | Haber | iron |

**17** The reversible reaction shown takes place in a closed system at constant temperature.

$$P(g) + Q(g) + R(g) \rightleftharpoons S(g) + T(g)$$

When the reaction has reached equilibrium, more T is added.

After the addition of T, which other substances increase in concentration?

**A** P, Q, R and S

**B** P and Q only

**C** P, Q and R only

**D** S only

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

**A** $3\underline{CO} + Fe_2O_3 \rightarrow 2Fe + 3CO_2$

**B** $\underline{CO_2} + C \rightarrow 2CO$

**C** $\underline{CuO} + H_2 \rightarrow Cu + H_2O$

**D** $\underline{CaO} + H_2O \rightarrow Ca(OH)_2$

**19** An aqueous solution reacts with a solid. The products are an alkaline gas, a salt and water.

What are the aqueous solution and the solid?

| | aqueous solution | solid |
|---|---|---|
| **A** | sodium hydroxide | magnesium carbonate |
| **B** | hydrochloric acid | magnesium carbonate |
| **C** | hydrochloric acid | ammonium chloride |
| **D** | sodium hydroxide | ammonium chloride |

**20** Butanoic acid partially dissociates in aqueous solution.

Which row about butanoic acid is correct?

| | pH | effect on thymolphthalein |
|---|---|---|
| **A** | 3 | turns blue |
| **B** | 5 | turns colourless |
| **C** | 8 | turns blue |
| **D** | 10 | turns colourless |

**21** Copper(II) sulfate is prepared by adding excess copper(II) carbonate to sulfuric acid.

Why is an **excess** of copper(II) carbonate added?

**A** to ensure all the copper(II) carbonate has reacted

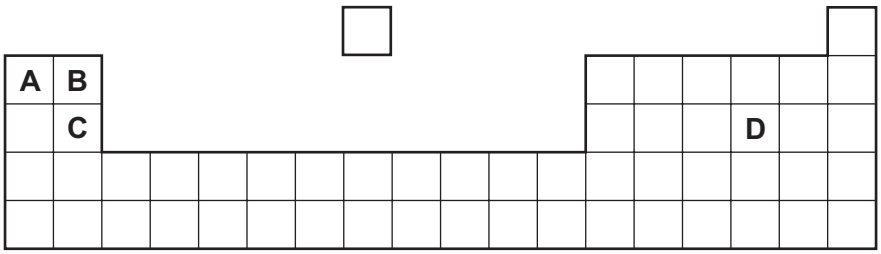
**B** to ensure all the sulfuric acid has reacted

**C** to increase the rate of reaction

**D** to increase the amount of copper(II) sulfate produced

**22** Part of the Periodic Table is shown.

Which element has two electrons in its outer shell and three electron shells?



**23** Elements in Group I and Group II show the same trends in their reactions with water and in their density.

Which row shows how the properties of barium compare with calcium?

| | reaction with water | density |
|---|---|---|
| **A** | faster | higher |
| **B** | faster | lower |
| **C** | slower | higher |
| **D** | slower | lower |

**24** Which pair of compounds shows a transition element in two different oxidation states?

**A** $Cr_2O_3$ and $Cr_2(SO_4)_3$

**B** $Cu_2O$ and $CuCO_3$

**C** ZnS and $ZnSO_4$

**D** NiO and $Ni(NO_3)_2$

**25** Which description of brass is correct?

**A** a compound of copper and zinc

**B** a compound of copper and tin

**C** a mixture of copper and zinc

**D** a mixture of copper and tin

**26** What is the symbol of the metal used in the manufacture of aircraft because of its low density?

**A** A*l* **B** Cu **C** Fe **D** Zn

**27** Which substances react to form hydrogen gas?

1 calcium and water

2 silver and dilute hydrochloric acid

3 magnesium and steam

4 zinc and dilute hydrochloric acid

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

**28** Coke (carbon) and limestone are two raw materials used in the extraction of iron from hematite.

Which type of reaction occurs when each substance is heated during the process?

| | coke | limestone |
|---|---|---|
| **A** | redox | redox |
| **B** | redox | thermal decomposition |
| **C** | thermal decomposition | redox |
| **D** | thermal decomposition | thermal decomposition |

**29** Some combustion reactions produce pollutant gases.

Which reactions produce a pollutant gas that is **not** present in clean air?

1 $2CH_4 + 3O_2 \rightarrow 2CO + 4H_2O$

2 $2H_2 + O_2 \rightarrow 2H_2O$

3 $C + O_2 \rightarrow CO_2$

4 $N_2 + O_2 \rightarrow 2NO$

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

**30** One mole of alkane Y produces 72 $dm^3$ of carbon dioxide when burned in excess oxygen, measured at room temperature and pressure.

What is Y?

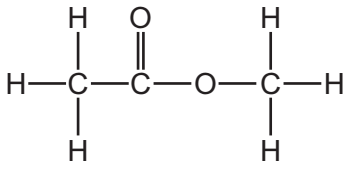
**A** butane

**B** ethane

**C** methane

**D** propane

**31** The structure of organic compound X is shown.



What is X?

**A** ethyl ethanoate

**B** ethyl methanoate

**C** methyl ethanoate

**D** methyl methanoate

**32** What is the structural formula of the compound formed in the addition reaction of propene with bromine?

**A** $CH_3CHBrCH_2Br$

**B** $CH_2BrCH_2CH_2Br$

**C** $CHBr_2CH_2CH_3$

**D** $CH_3CBr_2CH_3$

**33** Ethanol is produced industrially by fermentation and also by a catalysed addition reaction involving steam.

Which row describes one advantage of each process?

| | fermentation | catalysed addition reaction involving steam |
|---|---|---|
| **A** | the reactant used is renewable | it is a continuous process |
| **B** | the reactant used is renewable | it requires little energy |
| **C** | it is a very rapid reaction | it is a continuous process |
| **D** | it is a very rapid reaction | it requires little energy |

**34** Carboxylic acids react with alcohols when warmed with an acid catalyst.

Which type of substance is formed in this reaction?

**A** an alkene

**B** an ester

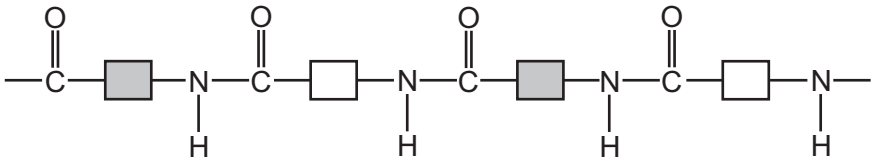
**C** a salt

**D** a polymer

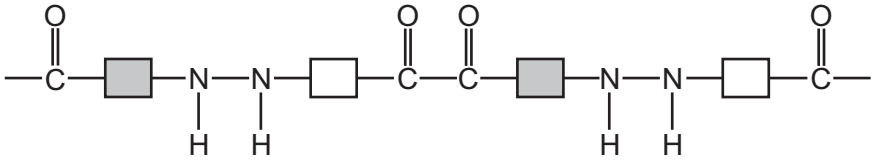
**35** Nylon is formed by condensation polymerisation.

Which structure represents nylon?

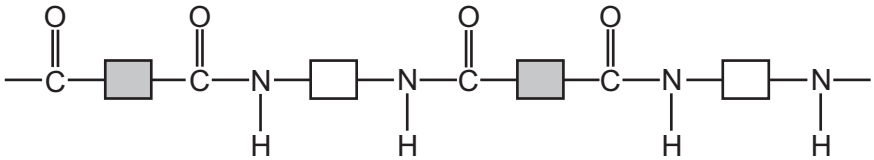
**A**



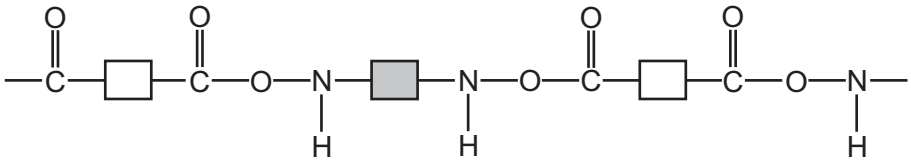
**B**



**C**

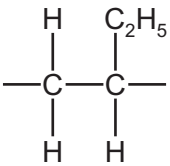


**D**

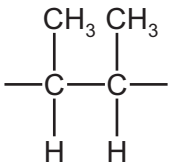


**36** Which structure represents the repeat unit of the addition polymer formed from but-1-ene?

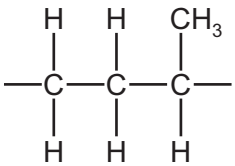
**A**



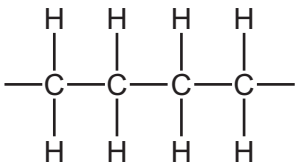
**B**



**C**



**D**

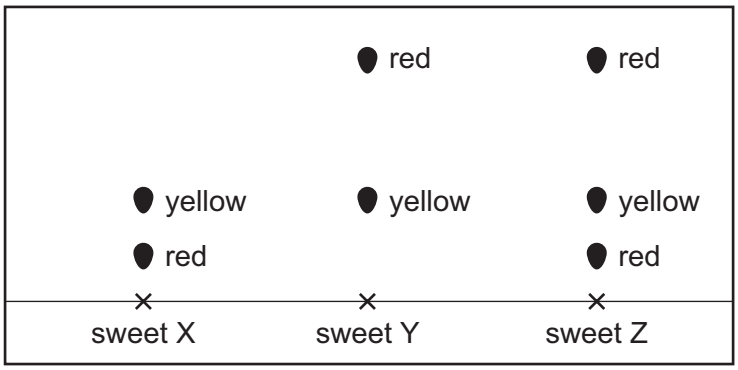


**37** 2.00 g of powdered calcium carbonate is added to 50.0 $cm^3$ of hydrochloric acid.

Which apparatus is used to measure these quantities of calcium carbonate and hydrochloric acid?

| | calcium carbonate | hydrochloric acid |
|---|---|---|
| **A** | balance | burette |
| **B** | balance | thermometer |
| **C** | pipette | burette |
| **D** | pipette | thermometer |

**38** The diagram shows a chromatogram obtained from the colours of three different sweets, X, Y and Z.




How many different **red** dyes are present in the sweets?

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

**39** A mixture contains sand and an aqueous solution of sodium chloride.

Which processes are used to obtain a sample of solid sand **and** a sample of solid sodium chloride from the mixture?

**A** crystallisation followed by filtration

**B** evaporation followed by filtration

**C** filtration followed by crystallisation

**D** simple distillation followed by crystallisation

**40** A student tests an unknown compound M.

The compound:

- produces a lilac flame using a flame test
- produces a gas which turns limewater cloudy when dilute hydrochloric acid is added.

What is M?

**A** sodium sulfate

**B** sodium carbonate

**C** potassium sulfate

**D** potassium carbonate

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## The Periodic Table of Elements

**Key**

| atomic number |
|---|
| **atomic symbol** |
| name |
| relative atomic mass |

| Group | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I | II | | | | | | | | | | | III | IV | V | VI | VII | VIII |
| | | | | | | | 1<br>H<br>hydrogen<br>1 | | | | | | | | | | 2<br>He<br>helium<br>4 |
| 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>– | 113<br>Nh<br>nihonium<br>– | 114<br>Fl<br>flerovium<br>– | 115<br>Mc<br>moscovium<br>– | 116<br>Lv<br>livermorium<br>– | 117<br>Ts<br>tennessine<br>– | 118<br>Og<br>oganesson<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 |
| actinoids | 89<br>Ac<br>actinium<br>– | 90<br>Th<br>thorium<br>232 | 91<br>Pa<br>protactinium<br>231 | 92<br>U<br>uranium<br>238 | 93<br>Np<br>neptunium<br>– | 94<br>Pu<br>plutonium<br>– | 95<br>Am<br>americium<br>– | 96<br>Cm<br>curium<br>– | 97<br>Bk<br>berkelium<br>– | 98<br>Cf<br>californium<br>– | 99<br>Es<br>einsteinium<br>– | 100<br>Fm<br>fermium<br>– | 101<br>Md<br>mendelevium<br>– | 102<br>No<br>nobelium<br>– | 103<br>Lr<br>lawrencium<br>– |

The volume of one mole of any gas is 24 $dm^3$ at room temperature and pressure (r.t.p.).



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