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

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

Paper 2 Multiple Choice (Extended) **February/March 2019**

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

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


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**1** Pure water boils at 100 °C.

What happens to the water particles when water boils?

**A** They gain energy and move further apart.

**B** They gain energy and stay close together.

**C** They lose energy and move further apart.

**D** They lose energy and stay close together.

**2** Which method should be used to separate a mixture of two liquids?

**A** crystallisation

**B** electrolysis

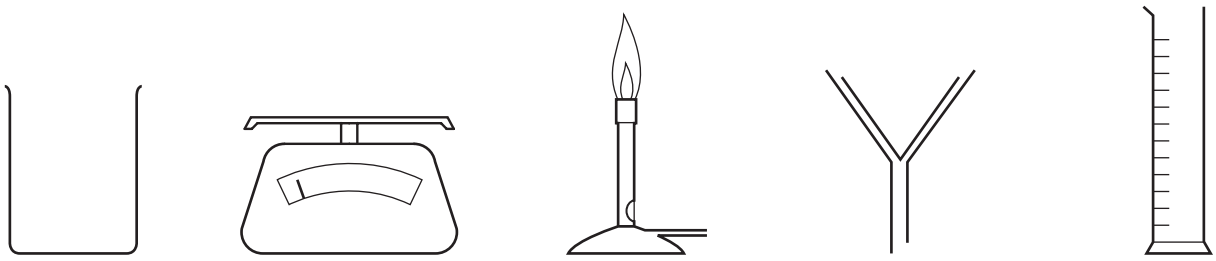
**C** filtration

**D** fractional distillation

**3** Lead(II) iodide is insoluble in water.

Lead(II) iodide is made by adding aqueous lead(II) nitrate to aqueous potassium iodide.

Which pieces of apparatus are needed to obtain solid lead(II) iodide from 20 $cm^3$ of aqueous lead(II) nitrate?

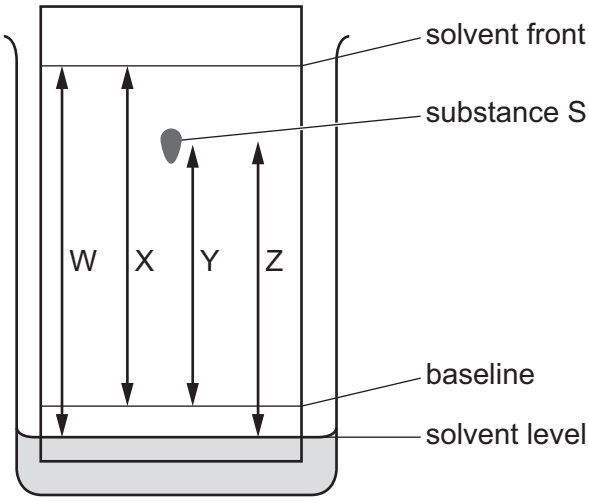


1 2 3 4 5

**A** 1, 2 and 4 **B** 1, 3 and 5 **C** 1, 4 and 5 **D** 2, 4 and 5

**4** The chromatogram of substance S is shown.

Some distances, W, X, Y and Z, are labelled on the diagram.




How is the $R_f$ value of substance S calculated?

**A** $\frac{X}{Y}$ **B** $\frac{W}{Z}$ **C** $\frac{Y}{X}$ **D** $\frac{Y}{W}$

**5** Which row describes isotopes of the same element?

| | number of protons | number of neutrons |
|---|---|---|
| **A** | different | different |
| **B** | different | same |
| **C** | same | different |
| **D** | same | same |

**6** Which row describes the structure of the positive ion in sodium chloride?

| | protons | electrons | neutrons |
|---|---|---|---|
| **A** | 11 | 11 | 12 |
| **B** | 11 | 10 | 12 |
| **C** | 17 | 17 | 18 |
| **D** | 17 | 18 | 18 |

**7** Which statement about copper, diamond and silicon(IV) oxide is correct?

**A** Copper and silicon(IV) oxide have similar electrical conductivity.

**B** In diamond the carbon atoms are covalently bonded as flat sheets.

**C** In silicon(IV) oxide the silicon and oxygen atoms are covalently bonded as flat sheets.

**D** The structure of copper includes a lattice of positive ions.

**8** An oxide of nitrogen has the following composition by mass: N, 30.4%; O, 69.6%.

It has a relative molecular mass of 92.

What is the molecular formula of the oxide of nitrogen?

**A** NO **B** $NO_2$ **C** $NO_4$ **D** $N_2O_4$

**9** Calcium carbonate reacts with dilute hydrochloric acid according to the equation shown.

$$CaCO_3 + 2HCl \rightarrow CaCl_2 + CO_2 + H_2O$$

10 g of calcium carbonate is reacted with 100 $cm^3$ of 1 mol / $dm^3$ hydrochloric acid.

The following statements are made.

1 1.2 $dm^3$ of carbon dioxide is formed.

2 5.6 g of calcium chloride is formed.

3 4.8 g of carbon dioxide is formed.

4 No calcium carbonate is left when the reaction is completed.

Which statements about the reaction are correct?

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

**10** Which substance is **not** produced during the electrolysis of concentrated aqueous sodium chloride?

**A** chlorine

**B** hydrogen

**C** sodium

**D** sodium hydroxide

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

What are the ionic half-equations for the reactions that occur at each electrode?

| | anode | cathode |
|---|---|---|
| **A** | $Cu \rightarrow Cu^{2+} + 2e^-$ | $Cu^{2+} + 2e^- \rightarrow Cu$ |
| **B** | $Cu^{2+} + 2e^- \rightarrow Cu$ | $Cu \rightarrow Cu^{2+} + 2e^-$ |
| **C** | $4OH^- \rightarrow 2H_2O + O_2 + 4e^-$ | $Cu^{2+} + 2e^- \rightarrow Cu$ |
| **D** | $4OH^- \rightarrow 2H_2O + O_2 + 4e^-$ | $2H^+ + 2e^- \rightarrow H_2$ |

**12** 10 g of ammonium nitrate is added to water at 25 °C and the mixture stirred.

The ammonium nitrate dissolves and, after one minute, the temperature of the solution is 10 °C.

Which word describes this change?

**A** endothermic

**B** exothermic

**C** neutralisation

**D** reduction

**13** Hydrogen reacts with chlorine according to the following equation.

$$H_2(g) + Cl_2(g) \rightarrow 2HCl(g)$$

The reaction is exothermic.

Which statement about this reaction is correct?

**A** Energy absorbed for bond breaking is greater than the energy released in bond making.

**B** Energy absorbed for bond breaking is less than the energy released in bond making.

**C** Energy released in bond breaking is greater than the energy absorbed in bond making.

**D** Energy released in bond breaking is less than the energy absorbed in bond making.

**14** Hydrogen-oxygen fuel cells can be used to power cars. Platinum is used as a catalyst.

The amount of energy produced per gram is shown for three fuels.

| fuel | energy produced per g of fuel / kJ |
|---|---|
| hydrogen | 143 |
| methane | 55 |
| petrol | 44 |

Which statement is correct and is an advantage of a hydrogen-oxygen fuel cell?

**A** Hydrogen is difficult to store.

**B** Hydrogen produces less energy per gram than methane or petrol.

**C** Platinum is rare and expensive.

**D** The only product is water.

**15** A student adds dilute hydrochloric acid at two different temperatures to two different lumps of limestone. The lumps of limestone have the same mass.

The carbon dioxide gas produced is collected in a gas syringe.

The volume of carbon dioxide collected in 1 minute at each temperature is shown.

| temperature / °C | volume of carbon dioxide produced in 1 minute / $cm^3$ |
|---|---|
| 25 | 10 |
| 50 | 40 |

Which row describes and explains the results obtained at 50 °C compared with 25 °C?

| | reaction rate | energy of collisions |
|---|---|---|
| **A** | higher | lower |
| **B** | higher | higher |
| **C** | lower | lower |
| **D** | lower | higher |

**16** Which reaction is reversible?

**A** $Cu + ZnSO_4 \rightarrow CuSO_4 + Zn$

**B** $CuO + H_2SO_4 \rightarrow CuSO_4 + H_2O$

**C** $CuO + H_2 \rightarrow Cu + H_2O$

**D** $CuSO_4{\bullet}5H_2O \rightarrow CuSO_4 + 5H_2O$

**17** Some nitrogen dioxide gas was put in a gas syringe. The end of the gas syringe is sealed.

A reversible reaction occurs. The reaction reaches equilibrium.

$$\underset{\text{dark brown}}{2NO_2(g)} \rightleftharpoons \underset{\text{light yellow}}{N_2O_4(g)}$$

The forward reaction is exothermic.

Which statement about the reaction is correct?

**A** If the gas syringe is placed in a cold water bath, the colour becomes darker.

**B** If the gas syringe is placed in a hot water bath, the colour becomes lighter.

**C** If the volume in the gas syringe is increased, the colour becomes lighter.

**D** If the volume in the gas syringe is decreased, the colour becomes lighter.

**18** The reaction between magnesium and carbon dioxide is shown in the equation.

$$2Mg + CO_2 \rightarrow 2MgO + C$$

Which statement describes what happens in this reaction?

**A** Carbon is oxidised.

**B** Magnesium is reduced.

**C** Neither oxidation nor reduction happens.

**D** The carbon in carbon dioxide is reduced.

**19** Which changes involve reduction?

1 $2I^- \rightarrow I_2 + 2e^-$

2 $CuO + H_2 \rightarrow Cu + H_2O$

3 $Al^{3+} + 3e^- \rightarrow Al$

4 $Pb^{2+} + SO_4^{2-} \rightarrow PbSO_4$

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

**20** Barium hydroxide is an alkali. It reacts with hydrochloric acid.

How does the pH of the hydrochloric acid change as an excess of aqueous barium hydroxide is added?

**A** The pH decreases from pH 14 and becomes constant at pH 7.

**B** The pH decreases from pH 14 to about pH 1.

**C** The pH increases from pH 1 and becomes constant at pH 7.

**D** The pH increases from pH 1 to about pH 14.

**21** Which statement describes a chemical property of aluminium oxide, $Al_2O_3$?

**A** It reacts with acids but not with bases.

**B** It reacts with acids and bases.

**C** It reacts with bases but not with acids.

**D** It reacts with water.

**22** The results of two tests on an aqueous solution of X are shown.

| test | observation |
|---|---|
| aqueous sodium hydroxide added | green precipitate formed |
| acidified aqueous silver nitrate added | yellow precipitate formed |

What is X?

**A** copper(II) chloride

**B** copper(II) iodide

**C** iron(II) chloride

**D** iron(II) iodide

**23** Four stages used to prepare an insoluble salt are listed.

1 drying

2 filtration

3 precipitation

4 washing

In which order are the stages done?

**A** $2 \rightarrow 1 \rightarrow 3 \rightarrow 4$

**B** $3 \rightarrow 2 \rightarrow 4 \rightarrow 1$

**C** $3 \rightarrow 4 \rightarrow 1 \rightarrow 2$

**D** $4 \rightarrow 3 \rightarrow 2 \rightarrow 1$

**24** The elements sodium to argon form Period 3 of the Periodic Table.

Which row describes the trend across Period 3 from left to right?

| | number of outer shell electrons | metallic character | group number |
|---|---|---|---|
| **A** | decreases | decreases | decreases |
| **B** | decreases | increases | decreases |
| **C** | increases | decreases | increases |
| **D** | increases | increases | increases |

**25** Astatine is below iodine in Group VII in the Periodic Table.

Which row describes the properties of astatine?

| | state at room temperature | reactivity |
|---|---|---|
| **A** | gas | displaces chlorine, bromine and iodine |
| **B** | gas | displaces iodine but does not displace chlorine or bromine |
| **C** | solid | displaces iodine but does not displace chlorine or bromine |
| **D** | solid | does not displace chlorine, bromine or iodine |

**26** Which statement explains why elements in Group VIII of the Periodic Table are unreactive?

**A** They are monatomic gases.

**B** They form stable diatomic molecules.

**C** They have a full outer shell of electrons.

**D** They share electrons with each other.

**27** In which reaction does Fe(s) form ions when the mixture is heated?

**A** Fe(s) + CaO(s)

**B** Fe(s) + MgO(s)

**C** Fe(s) + ZnO(s)

**D** Fe(s) + CuO(s)

**28** The list gives the order of some metals and hydrogen in the reactivity series.

Metal X is also included.

| | |
|---|---|
| most reactive | K |
| | Mg |
| | Zn |
| | H |
| | X |
| least reactive | Cu |

Which row correctly shows the properties of metal X?

| | reacts with dilute acids | oxide reduced by carbon |
|---|---|---|
| **A** | no | no |
| **B** | no | yes |
| **C** | yes | no |
| **D** | yes | yes |

**29** Which metal carbonate does **not** produce carbon dioxide when it is heated?

**A** copper(II) carbonate

**B** iron(II) carbonate

**C** potassium carbonate

**D** zinc carbonate

**30** Which statement about the extraction of metals is correct?

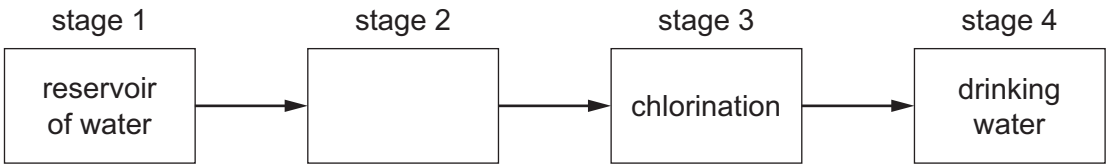
**A** Aluminium is extracted by the electrolysis of hematite.

**B** Cryolite acts as a reducing agent in the extraction of aluminium.

**C** Zinc is extracted by the electrolysis of zinc blende.

**D** Zinc is obtained by heating zinc oxide with coke.

**31** The diagram shows how water is treated to make it suitable for drinking.




What happens in stage 2?

**A** condensation

**B** sublimation

**C** evaporation

**D** filtration

**32** What are the main substances produced by the fractional distillation of liquid air?

**A** oxygen and carbon dioxide

**B** oxygen and nitrogen

**C** helium and nitrogen

**D** hydrogen and oxygen

**33** The raw materials for the Haber process are hydrogen and nitrogen.

What are the sources of the hydrogen and nitrogen?

**A** hydrogen from ethanol and nitrogen from NPK fertilisers

**B** hydrogen from methane and nitrogen from air

**C** hydrogen from sulfuric acid and nitrogen from air

**D** hydrogen from water and nitrogen from ammonium nitrate

**34** Which process removes carbon dioxide from the Earth's atmosphere?

**A** combustion

**B** heating limestone

**C** photosynthesis

**D** respiration

**35** The Contact process is used to make sulfuric acid.

The steps in the process are listed.

1 Dissolve sulfur trioxide in 98% concentrated sulfuric acid.

2 Heat sulfur strongly in air.

3 Add oleum to water.

4 Pass sulfur dioxide over a vanadium(V) oxide catalyst.

Which sequence of steps is correct?

**A** $4 \rightarrow 1 \rightarrow 2 \rightarrow 3$

**B** $4 \rightarrow 2 \rightarrow 3 \rightarrow 1$

**C** $2 \rightarrow 1 \rightarrow 4 \rightarrow 3$

**D** $2 \rightarrow 4 \rightarrow 1 \rightarrow 3$

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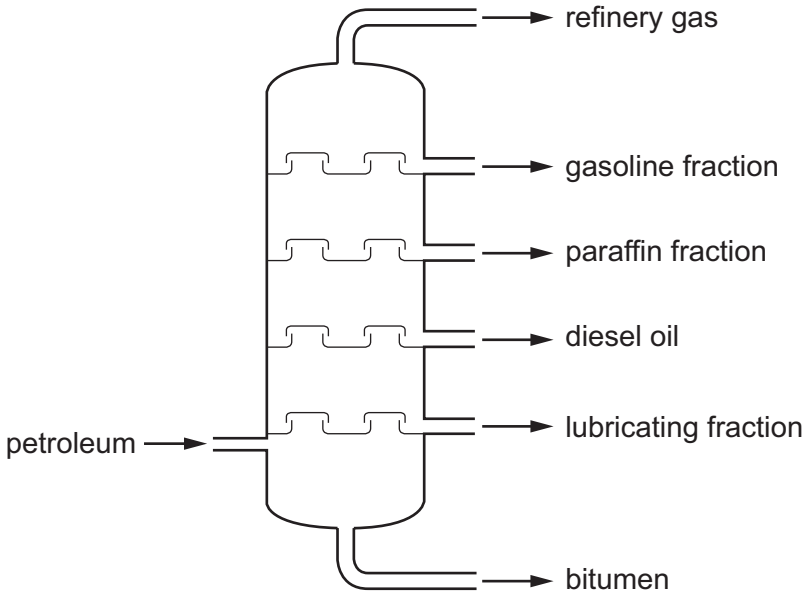
**36** The fractional distillation of petroleum is shown.




Which fraction is the least volatile?

**A** bitumen

**B** diesel oil

**C** gasoline fraction

**D** refinery gas

**37** Which statement about members of a homologous series is correct?

**A** Successive members differ by $CH_3$.

**B** Successive members have a molecular mass that differs by 14.

**C** They have the same molecular formula.

**D** They have identical physical properties.

**38** Ethanol is manufactured on a large scale by fermentation.

Which statement about fermentation is correct?

**A** It is a continuous process.

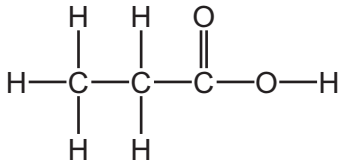
**B** A renewable raw material is used.

**C** It is a very fast reaction.

**D** The ethanol produced is pure.

**39** The structure of a compound, G, is shown.

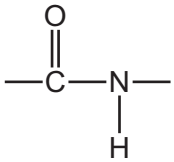
G is in the same homologous series as ethanoic acid.



Which row describes some of the properties of an aqueous solution of G?

| | produces a gas with magnesium | turns methyl orange yellow |
|---|---|---|
| **A** | no | yes |
| **B** | no | no |
| **C** | yes | no |
| **D** | yes | yes |

**40** Which statement about polymers is correct?

**A** Nylon contains the  linkage.

**B** Nylon is a polyester.

**C** Propane can be polymerised by addition polymerisation.

**D** The linkage in *Terylene* contains a carbon-carbon double bond.

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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>– | | 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 |
| 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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