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

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

Paper 2 Multiple Choice (Extended) **May/June 2017**

**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.**

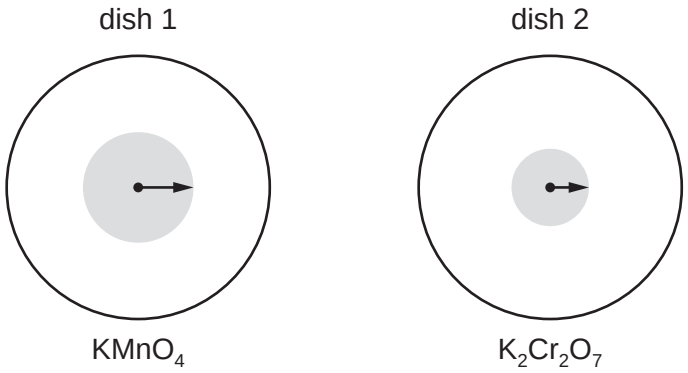
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
A copy of the Periodic Table is printed on page 16.
Electronic calculators may be used.

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

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

**1** Small crystals of purple $KMnO_4$ ($M_r$ = 158) and orange $K_2Cr_2O_7$ ($M_r$ = 294) were placed at the centres of separate petri dishes filled with agar jelly. They were left to stand under the same physical conditions.

After some time, the colour of each substance had spread out as shown.




The lengths of the arrows indicate the relative distances travelled by particles of each substance.

Which statement is correct?

**A** Diffusion is faster in dish 1 because the mass of the particles is greater.

**B** Diffusion is faster in dish 2 because the mass of the particles is greater.

**C** Diffusion is slower in dish 1 because the mass of the particles is smaller.

**D** Diffusion is slower in dish 2 because the mass of the particles is greater.

**2** Impurities change the melting and boiling points of substances.

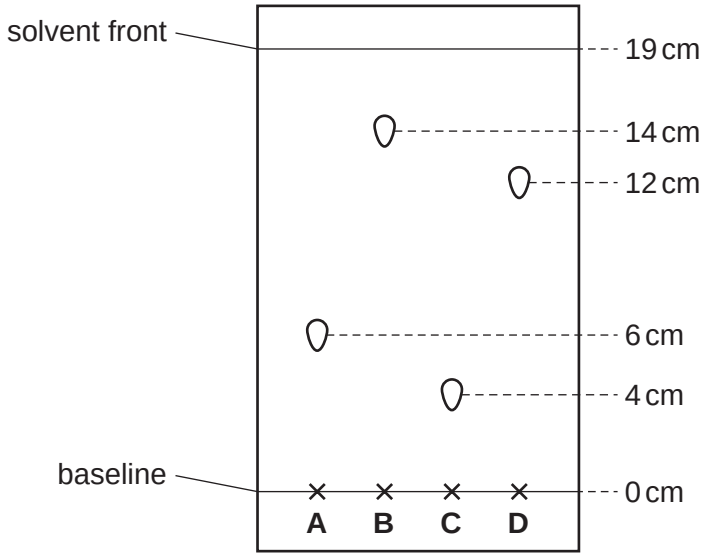
Sodium chloride is added to a sample of pure water.

How does the addition of sodium chloride affect the melting point and boiling point of the water?

| | melting point | boiling point |
|---|---|---|
| **A** | increases | increases |
| **B** | increases | decreases |
| **C** | decreases | increases |
| **D** | decreases | decreases |

**3** The diagram shows a chromatogram of four substances.

Which substance has an $R_f$ value of approximately 0.32?




**4** Which element does **not** form a stable ion with the same electronic structure as argon?

**A** aluminium

**B** chlorine

**C** phosphorus

**D** potassium

**5** Graphite and diamond are both forms of the element carbon.

Which row shows the number of other carbon atoms that each carbon atom is covalently bonded to in graphite and diamond?

| | graphite | diamond |
|---|---|---|
| **A** | 3 | 3 |
| **B** | 3 | 4 |
| **C** | 4 | 3 |
| **D** | 4 | 4 |

**6** Which statement describes metallic bonding?

**A** The attraction between a lattice of negative ions and delocalised protons.

**B** The attraction between a lattice of positive ions and delocalised electrons.

**C** The attraction between delocalised protons and electrons.

**D** The attraction between oppositely charged ions.

**7** Which equations are balanced?

1 $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$

2 $ZnCO_3 + 2HCl \rightarrow ZnCl_2 + CO_2 + 2H_2O$

3 $Mg(NO_3)_2 + NaOH \rightarrow Mg(OH)_2 + 2NaNO_3$

4 $CaCO_3 + H_2SO_4 \rightarrow CaSO_4 + H_2O + CO_2$

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

**8** Calcium carbide, $CaC_2$, reacts with water to form ethyne, $C_2H_2$, and calcium hydroxide.

The equation for the reaction is shown.

$$CaC_2(s) + 2H_2O(l) \rightarrow C_2H_2(g) + Ca(OH)_2(s)$$

Which volume of ethyne is produced when 6 g of water react completely with calcium carbide?

**A** 4 $dm^3$ **B** 8 $dm^3$ **C** 36 $dm^3$ **D** 72 $dm^3$

**9** Which statement about electrolysis is correct?

**A** Electrons move through the electrolyte from the cathode to the anode.

**B** Electrons move towards the cathode in the external circuit.

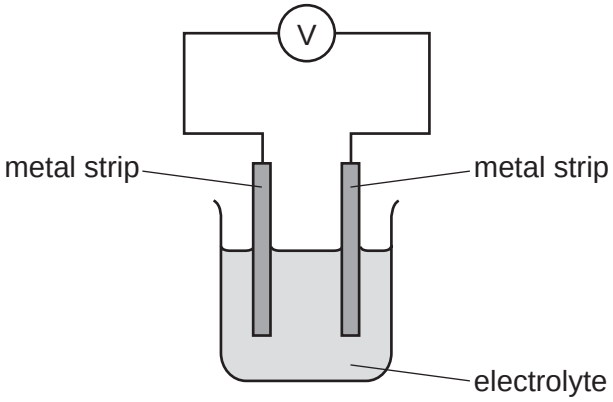
**C** Negative ions move towards the anode in the external circuit.

**D** Positive ions move through the electrolyte towards the anode during electrolysis.

**10** The reactivity series for a number of different metals is shown.

| most reactive → | | | | | least reactive |
|---|---|---|---|---|---|
| magnesium | zinc | iron | copper | silver | platinum |

The diagram shows different metal strips dipped into an electrolyte.




Which pair of metals produces the highest voltage?

**A** copper and magnesium

**B** magnesium and platinum

**C** magnesium and zinc

**D** silver and platinum

**11** Which statement about fuels is correct?

**A** Heat energy can only be produced by burning fuels.

**B** Hydrogen is used as a fuel although it is difficult to store.

**C** Methane is a good fuel because it produces only water when burned.

**D** Uranium is burned in air to produce energy.

**12** Which statements about exothermic and endothermic reactions are correct?

1 During an exothermic reaction, heat is given out.

2 The temperature of an endothermic reaction goes up because heat is taken in.

3 Burning methane in the air is an exothermic reaction.

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

**13** The equation for the reaction between hydrogen and chlorine is shown.

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

The reaction is exothermic.

The bond energies are shown in the table.

| bond | bond energy in kJ / mol |
|---|---|
| Cl–Cl | +240 |
| H–Cl | +430 |
| H–H | +436 |

What is the energy change for the reaction?

**A** –1536 kJ / mol

**B** –184 kJ / mol

**C** +184 kJ / mol

**D** +246 kJ / mol

**14** A gas is produced when calcium carbonate is heated.

Which type of change is this?

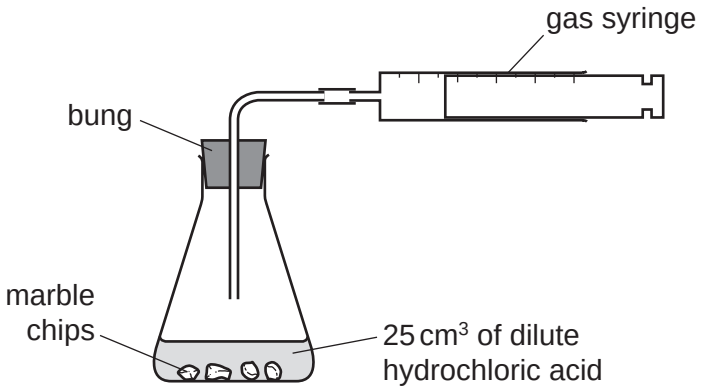
**A** chemical

**B** exothermic

**C** physical

**D** separation

**15** A student was investigating the reaction between marble chips and dilute hydrochloric acid.




Which changes slow down the rate of reaction?

| | temperature of acid | concentration of acid | surface area of marble chips |
|---|---|---|---|
| **A** | decrease | decrease | decrease |
| **B** | decrease | decrease | increase |
| **C** | increase | decrease | decrease |
| **D** | increase | increase | increase |

**16** The reaction used to manufacture ammonia from nitrogen and hydrogen is reversible.

An equilibrium can be established between ammonia, nitrogen and hydrogen.

Which statement describes the equilibrium?

**A** Both the forward reaction and the backward reaction have the same rate.

**B** The rate of the backward reaction is greater than the rate of the forward reaction.

**C** The rate of the forward reaction is greater than the rate of the backward reaction.

**D** The forward and backward reactions have both stopped.

**17** An example of a redox reaction is shown.

$$Zn + Cu^{2+} \rightarrow Zn^{2+} + Cu$$

Which statement about the reaction is correct?

**A** Zn is the oxidising agent and it oxidises $Cu^{2+}$.

**B** Zn is the oxidising agent and it reduces $Cu^{2+}$.

**C** Zn is the reducing agent and it oxidises $Cu^{2+}$.

**D** Zn is the reducing agent and it reduces $Cu^{2+}$.

**18** Which type of oxide is aluminium oxide?

**A** acidic

**B** amphoteric

**C** basic

**D** neutral

**19** Which statements about a weak acid, such as ethanoic acid, are correct?

1 It reacts with a carbonate.

2 It does not neutralise aqueous sodium hydroxide solution.

3 It turns red litmus blue.

4 It is only partially ionised in aqueous solution.

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

**20** Silver chloride is a white solid which is insoluble in water.

Which statement describes how a sample of pure silver chloride can be made?

**A** Add aqueous silver nitrate to aqueous sodium chloride and then filter.

**B** Add aqueous silver nitrate to dilute hydrochloric acid, evaporate and then crystallise.

**C** Add silver carbonate to dilute hydrochloric acid, evaporate and then crystallise.

**D** Add silver to dilute hydrochloric acid, filter and then wash the residue.

**21** Dilute sulfuric acid is added to two separate aqueous solutions, X and Y. The observations are shown.

| | |
|---|---|
| solution X | white precipitate |
| solution Y | bubbles of a colourless gas |

Which row shows the ions present in the solutions?

| | solution X | solution Y |
|---|---|---|
| **A** | $Ba^{2+}$ | $CO_3^{2-}$ |
| **B** | $Ca^{2+}$ | $Cl^-$ |
| **C** | $Cu^{2+}$ | $CO_3^{2-}$ |
| **D** | $Fe^{2+}$ | $NO_3^-$ |

**22** Which element is less reactive than the other members of its group in the Periodic Table?

**A** astatine

**B** caesium

**C** fluorine

**D** rubidium

**23** The elements oxygen and sulfur are in the same group of the Periodic Table.

Which statement about oxygen and sulfur is **not** correct?

**A** They are non-metals.

**B** They have giant covalent structures.

**C** They have six electrons in their outer shells.

**D** They react together to form an acidic oxide.

**24** Why are weather balloons sometimes filled with helium rather than hydrogen?

**A** Helium is found in air.

**B** Helium is less dense than hydrogen.

**C** Helium is more dense than hydrogen.

**D** Helium is unreactive.

**25** Which process is involved in the extraction of zinc from zinc blende?

**A** Cryolite is added to lower the melting point of zinc blende.

**B** Molten zinc blende is electrolysed.

**C** Zinc blende is heated with carbon.

**D** Zinc blende is roasted in air.

**26** Element E:

- forms an alloy
- has a basic oxide
- is below hydrogen in the reactivity series.

What is E?

**A** carbon

**B** copper

**C** sulfur

**D** zinc

**27** A list of metals is shown.

aluminium

copper

iron

magnesium

silver

zinc

Which metal will displace all of the other metals from aqueous solutions of their salts?

**A** aluminium

**B** iron

**C** magnesium

**D** zinc

**28** Stainless steel is an alloy of iron and other metals. It is strong and does not rust but it costs much more than normal steel.

What is **not** made from stainless steel?

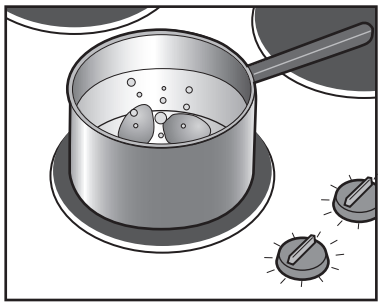
**A** cutlery

**B** pipes in a chemical factory

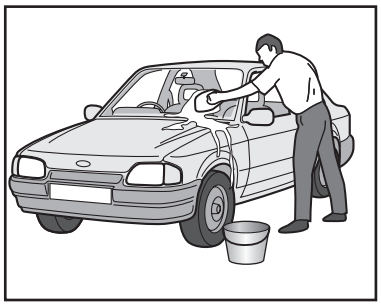
**C** railway lines

**D** saucepans

**29** The diagram shows some uses of water in the home.



1



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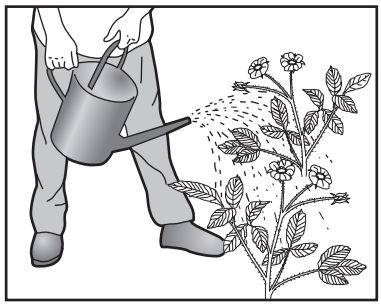


3

For which uses is it important for the water to have been treated?

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

**30** The carbon cycle includes the processes combustion, photosynthesis and respiration.

Which row shows how each process changes the amount of carbon dioxide in the atmosphere?

| | combustion | photosynthesis | respiration |
|---|---|---|---|
| **A** | decreases | decreases | increases |
| **B** | decreases | increases | decreases |
| **C** | increases | decreases | increases |
| **D** | increases | increases | decreases |

**31** Which statement about the conditions used in the Haber process is **not** correct?

**A** A high temperature is used because the forward reaction is exothermic.

**B** A high pressure is used because there are fewer moles of gas in the products than in the reactants.

**C** An iron catalyst is used to increase the rate of the forward reaction.

**D** The unreacted hydrogen and nitrogen are recycled to increase the amount of ammonia produced.

**32** Which chemical reaction decreases pollution in the air?

**A** $S + O_2 \rightarrow SO_2$

**B** $N_2 + O_2 \rightarrow 2NO$

**C** $2CH_4 + 3O_2 \rightarrow 2CO + 4H_2O$

**D** $2NO + 2CO \rightarrow 2CO_2 + N_2$

**33** Which statement about sulfuric acid is correct?

**A** It is made by the Haber process.

**B** It is made in the atmosphere by the action of lightning.

**C** It reacts with ammonia to produce a fertiliser.

**D** It reacts with copper metal to produce hydrogen gas.

**34** Statements about methods of manufacture and uses of calcium oxide are shown.

1 It is manufactured by reacting acids with calcium carbonate.

2 It is manufactured by heating calcium carbonate.

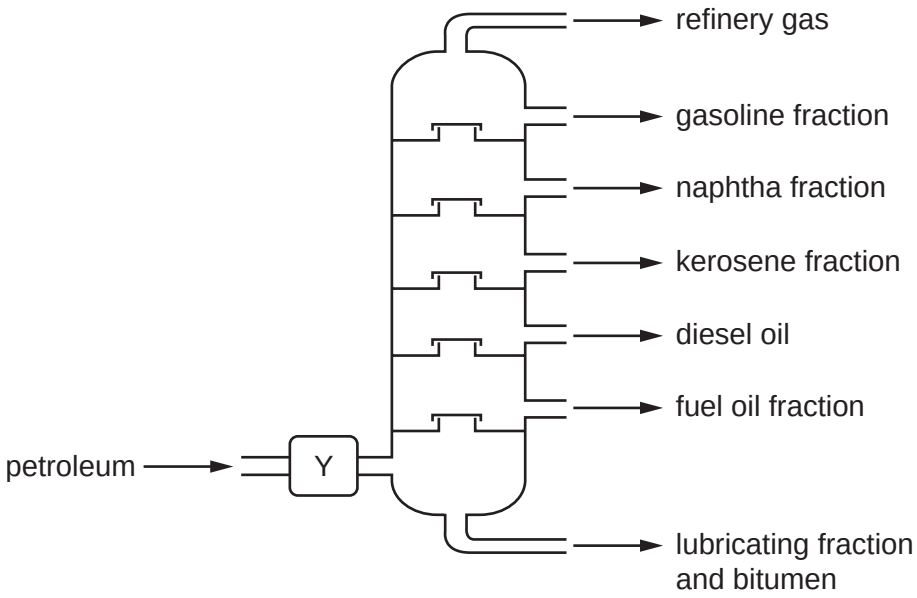
3 It is used to desulfurise flue gases.

4 It is used to treat alkaline soil.

Which statements are correct?

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

**35** The industrial fractional distillation of petroleum is shown.




Which process happens at Y?

**A** burning

**B** condensation

**C** cracking

**D** evaporation

**36** Which statement about homologous series is **not** correct?

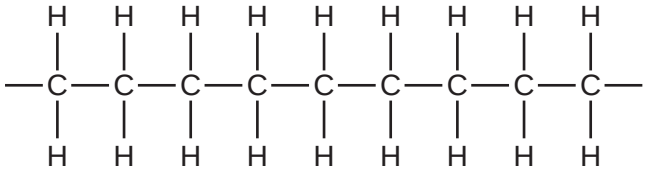
**A** Alkenes have the same general formula, $C_nH_{2n+2}$.

**B** Each member of the homologous series of alkanes differs from the next by $CH_2$.

**C** The members of a homologous series all have similar chemical properties.

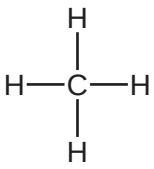
**D** The members of a homologous series all have the same functional group.

**37** The diagram shows part of the molecule of a polymer.

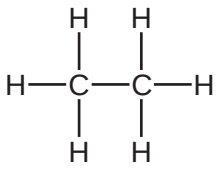


Which diagram shows the monomer from which this polymer could be manufactured?

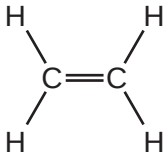
**A**



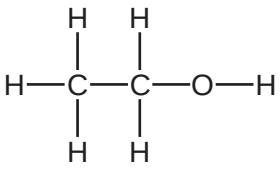
**B**



**C**



**D**



**38** Ethanol is manufactured by fermentation or by the catalytic addition of steam to ethene.

What is an advantage of ethanol manufacture by fermentation instead of by the catalytic addition of steam to ethene?

**A** Ethanol manufactured by fermentation is purified by distillation.

**B** Ethanol manufacture by fermentation produces purer ethanol.

**C** Ethanol manufacture by fermentation uses large areas of land.

**D** Ethanol manufacture by fermentation uses renewable resources.

**39** The formula of an ester is $CH_3CH_2CH_2COOCH_2CH_2CH_3$.

Which acid and alcohol react together to make the ester?

| | acid | alcohol |
|---|---|---|
| **A** | butanoic acid | butanol |
| **B** | butanoic acid | propanol |
| **C** | propanoic acid | butanol |
| **D** | propanoic acid | propanol |

**40** Polyesters and polyamides are types of synthetic polymer.

Which statements are correct?

1 They are made by addition polymerisation.

2 They are made by condensation polymerisation.

3 The monomers from which they are made are unsaturated hydrocarbons.

4 The monomers from which they are made contain reactive functional groups at their ends.

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

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## The Periodic Table of Elements

| Group | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I | II | | | | | | | | | | | III | IV | V | VI | VII | VIII |
| | | | | | | | 1 H hydrogen 1 | | | | | | | | | | 2 He helium 4 |
| 3 Li lithium 7 | 4 Be beryllium 9 | | | | | | | | | | | 5 B boron 11 | 6 C carbon 12 | 7 N nitrogen 14 | 8 O oxygen 16 | 9 F fluorine 19 | 10 Ne neon 20 |
| 11 Na sodium 23 | 12 Mg magnesium 24 | | | | | | | | | | | 13 Al aluminium 27 | 14 Si silicon 28 | 15 P phosphorus 31 | 16 S sulfur 32 | 17 Cl chlorine 35.5 | 18 Ar argon 40 |
| 19 K potassium 39 | 20 Ca calcium 40 | 21 Sc scandium 45 | 22 Ti titanium 48 | 23 V vanadium 51 | 24 Cr chromium 52 | 25 Mn manganese 55 | 26 Fe iron 56 | 27 Co cobalt 59 | 28 Ni nickel 59 | 29 Cu copper 64 | 30 Zn zinc 65 | 31 Ga gallium 70 | 32 Ge germanium 73 | 33 As arsenic 75 | 34 Se selenium 79 | 35 Br bromine 80 | 36 Kr krypton 84 |
| 37 Rb rubidium 85 | 38 Sr strontium 88 | 39 Y yttrium 89 | 40 Zr zirconium 91 | 41 Nb niobium 93 | 42 Mo molybdenum 96 | 43 Tc technetium – | 44 Ru ruthenium 101 | 45 Rh rhodium 103 | 46 Pd palladium 106 | 47 Ag silver 108 | 48 Cd cadmium 112 | 49 In indium 115 | 50 Sn tin 119 | 51 Sb antimony 122 | 52 Te tellurium 128 | 53 I iodine 127 | 54 Xe xenon 131 |
| 55 Cs caesium 133 | 56 Ba barium 137 | 57–71 lanthanoids | 72 Hf hafnium 178 | 73 Ta tantalum 181 | 74 W tungsten 184 | 75 Re rhenium 186 | 76 Os osmium 190 | 77 Ir iridium 192 | 78 Pt platinum 195 | 79 Au gold 197 | 80 Hg mercury 201 | 81 Tl thallium 204 | 82 Pb lead 207 | 83 Bi bismuth 209 | 84 Po polonium – | 85 At astatine – | 86 Rn radon – |
| 87 Fr francium – | 88 Ra radium – | 89–103 actinoids | 104 Rf rutherfordium – | 105 Db dubnium – | 106 Sg seaborgium – | 107 Bh bohrium – | 108 Hs hassium – | 109 Mt meitnerium – | 110 Ds darmstadtium – | 111 Rg roentgenium – | 112 Cn copernicium – | | 114 Fl flerovium – | | 116 Lv livermorium – | | |

**Key**

atomic number
atomic symbol
name
relative atomic mass

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| lanthanoids | 57 La lanthanum 139 | 58 Ce cerium 140 | 59 Pr praseodymium 141 | 60 Nd neodymium 144 | 61 Pm promethium – | 62 Sm samarium 150 | 63 Eu europium 152 | 64 Gd gadolinium 157 | 65 Tb terbium 159 | 66 Dy dysprosium 163 | 67 Ho holmium 165 | 68 Er erbium 167 | 69 Tm thulium 169 | 70 Yb ytterbium 173 | 71 Lu lutetium 175 |
| actinoids | 89 Ac actinium – | 90 Th thorium 232 | 91 Pa protactinium 231 | 92 U uranium 238 | 93 Np neptunium – | 94 Pu plutonium – | 95 Am americium – | 96 Cm curium – | 97 Bk berkelium – | 98 Cf californium – | 99 Es einsteinium – | 100 Fm fermium – | 101 Md mendelevium – | 102 No nobelium – | 103 Lr lawrencium – |

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