



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

**CHEMISTRY**

**0620/22**

Paper 2 Multiple Choice (Extended)

**October/November 2016**

**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 20.

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 **17** printed pages and **3** blank pages.



- 1 'Particles moving **very slowly** from an area of higher concentration to an area of lower concentration.'

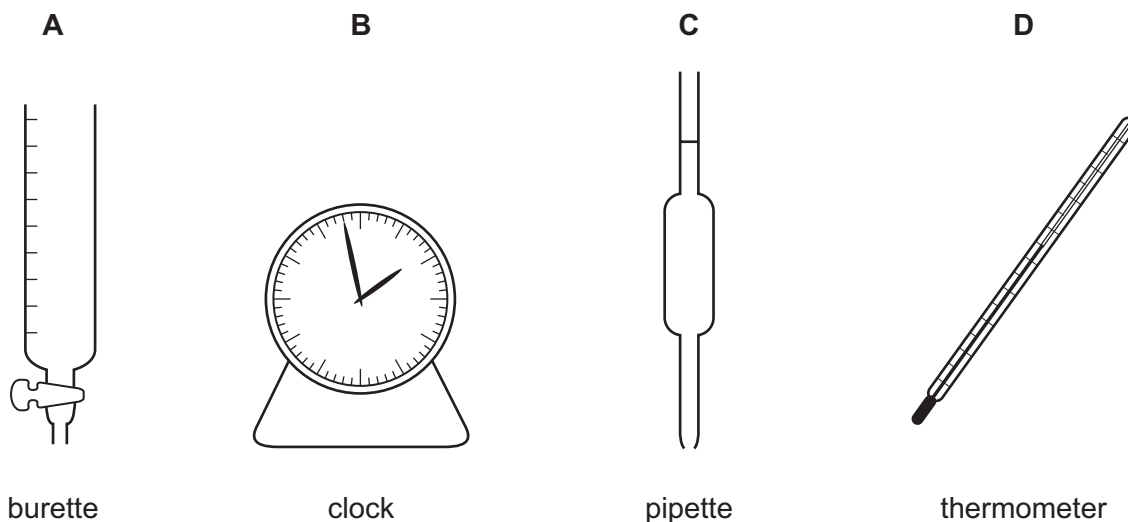
Which process is being described?

- A a liquid being frozen
- B a solid melting
- C a substance diffusing through a liquid
- D a substance diffusing through the air

- 2 A student mixes  $25\text{cm}^3$  samples of dilute hydrochloric acid with different volumes of aqueous sodium hydroxide.

In each case, the student measures the change in temperature to test if the reaction is exothermic.

Which piece of apparatus is **not** needed?



- 3 A sample contains a mixture of powdered limestone (calcium carbonate), sugar and wax.

What is the correct way to obtain a pure sample of sugar?

- A Dissolve the mixture in dilute hydrochloric acid, filter and wash the residue.
- B Dissolve the mixture in hexane, filter and evaporate the filtrate.
- C Dissolve the mixture in water, filter and evaporate the filtrate.
- D Dissolve the mixture in water, filter and wash the residue.

- 4 The table shows information about four different particles.

| particle        | proton number | nucleon number | number of protons | number of neutrons | number of electrons |
|-----------------|---------------|----------------|-------------------|--------------------|---------------------|
| Na              | 11            | 23             | 11                | W                  | 11                  |
| Na <sup>+</sup> | 11            | 23             | 11                | 12                 | X                   |
| O               | 8             | 16             | 8                 | Y                  | 8                   |
| O <sup>2-</sup> | 8             | 16             | 8                 | 8                  | Z                   |

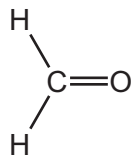
What are the values of W, X, Y and Z?

|          | W  | X  | Y  | Z  |
|----------|----|----|----|----|
| <b>A</b> | 11 | 10 | 10 | 8  |
| <b>B</b> | 11 | 11 | 8  | 10 |
| <b>C</b> | 12 | 10 | 8  | 10 |
| <b>D</b> | 12 | 11 | 10 | 8  |

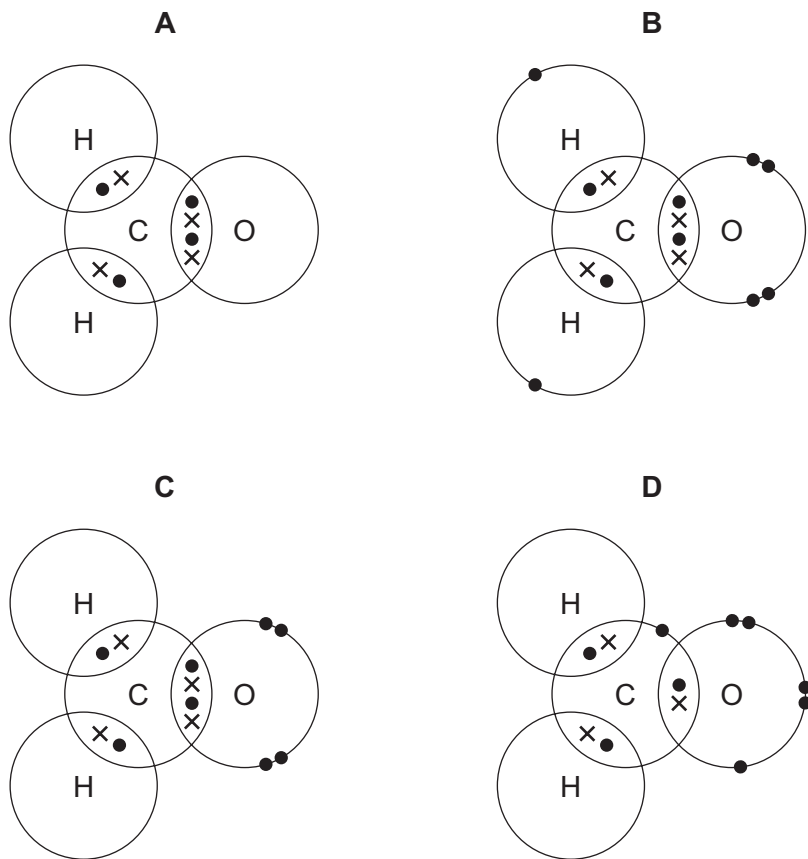
- 5 In which ionic compound do the metal ion and the non-metal ion have the same electronic structure?

**A** CaO                      **B** KBr                      **C** MgO                      **D** NaCl

6 The structure of methanal is shown.



Which diagram shows the arrangement of outer shell electrons in a molecule of methanal?



7 Iron is a metal. Its structure consists of a giant lattice of positive ions in a 'sea of electrons'.

Which statements about solid iron are correct?

- 1 Iron conducts electricity because the electrons are free to move.
- 2 Iron conducts heat because the positive ions are free to move.
- 3 Iron has a high melting point due to the strong covalent bonds.
- 4 Iron is malleable because the layers of ions can slide over one another.

**A** 1 and 3

**B** 1 and 4

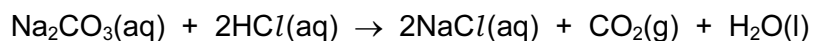
**C** 1 only

**D** 2, 3 and 4

8 Which sample contains the greatest number of molecules?

- A 4 g of hydrogen
- B 18 g of water
- C 24 dm<sup>3</sup> of oxygen
- D 66 g of carbon dioxide

9 Sodium carbonate solution reacts with dilute hydrochloric acid. The equation for the reaction is shown.

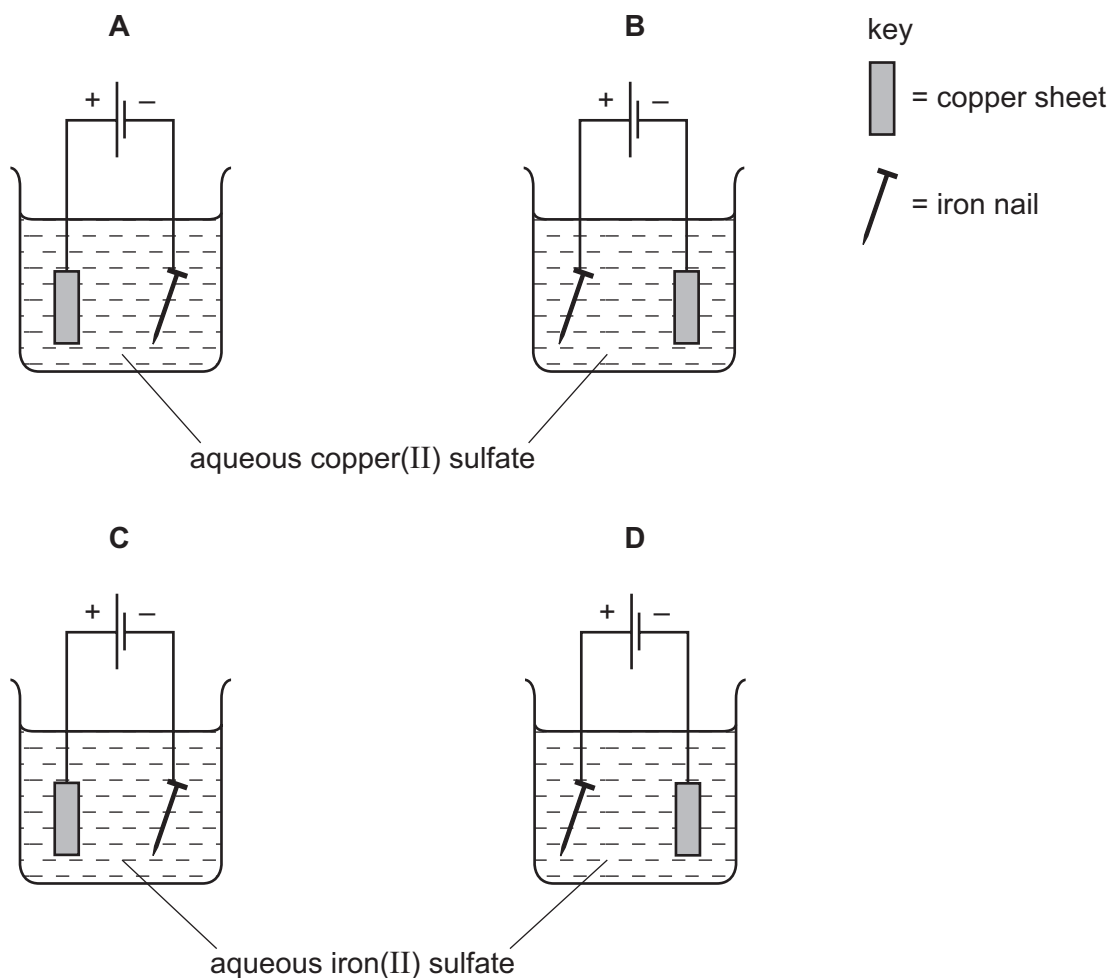


Excess sodium carbonate is added to 10.0 cm<sup>3</sup> of 0.10 mol/dm<sup>3</sup> hydrochloric acid.

Which volume of carbon dioxide gas is made?

- A 12 cm<sup>3</sup>
- B 24 cm<sup>3</sup>
- C 12 000 cm<sup>3</sup>
- D 24 000 cm<sup>3</sup>

10 Which apparatus could be used to electroplate an iron nail with copper?



- 11 A student sets up a number of simple cells by putting strips of two different metals into dilute sulfuric acid.

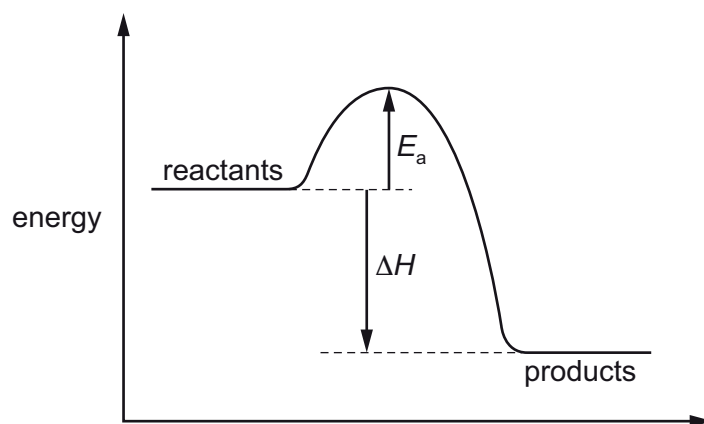
Which cell produces the highest voltage?

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

- 12 Which experiment is the most exothermic?

|   | initial temperature / °C | final temperature / °C |
|---|--------------------------|------------------------|
| A | 20                       | 5                      |
| B | 20                       | 32                     |
| C | 25                       | 12                     |
| D | 25                       | 34                     |

- 13 The energy level diagram for a reaction is shown.



Which row is correct?

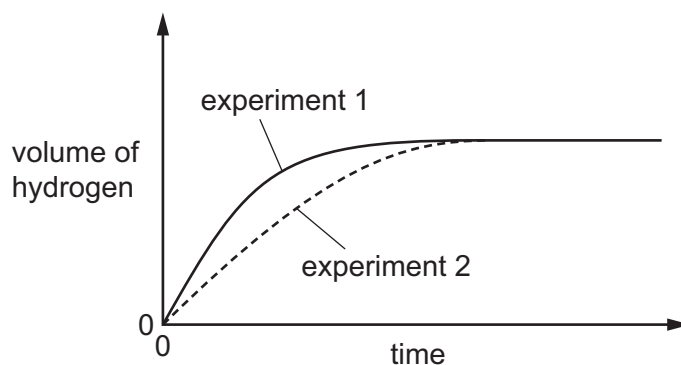
|   | sign of $\Delta H$ | overall energy change | sign of $E_a$ |
|---|--------------------|-----------------------|---------------|
| A | –                  | exothermic            | –             |
| B | +                  | endothermic           | +             |
| C | +                  | endothermic           | –             |
| D | –                  | exothermic            | +             |

- 14** Zinc granules are reacted with excess dilute hydrochloric acid.

The volume of hydrogen given off is measured at different times.

The results are shown on the graph, labelled experiment 1.

The results for a second experiment are also shown on the graph, labelled experiment 2.



Which change to the conditions was made in experiment 2?

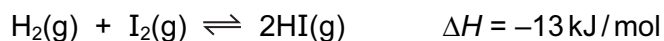
- A** The concentration of the hydrochloric acid was decreased.
  - B** The size of the zinc granules was decreased.
  - C** The surface area of the zinc granules was increased.
  - D** The temperature was increased.
- 15** In an experiment nitric acid is added to excess marble chips and the volume of carbon dioxide formed is measured.

The experiment is repeated using smaller marble chips. All other conditions remain the same.

Which statement about the second experiment is correct?

- A** The collisions are more frequent and higher energy.
- B** The collisions are more frequent and the same energy.
- C** The collisions are the same frequency and the same energy.
- D** The collisions are the same frequency and higher energy.

- 16 At 400°C the reaction between hydrogen and iodine reaches an equilibrium. The reaction is exothermic.



Which change in conditions would increase the percentage of hydrogen iodide in the equilibrium mixture?

- A a decrease in pressure
  - B a decrease in temperature
  - C an increase in pressure
  - D an increase in temperature
- 17 Chromium forms the compound chromium(III) sulfate.

What does the (III) represent?

- A the charge on a sulfate ion
  - B the number of chromium ions combined with one sulfate ion
  - C the number of sulfate ions combined with one chromium ion
  - D the oxidation state of chromium
- 18 Germanium oxide is a white powder.

Germanium oxide reacts with concentrated hydrochloric acid.

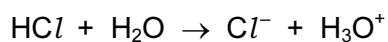
Germanium oxide reacts with concentrated aqueous sodium hydroxide.

Germanium oxide does not dissolve when added to water.

Which type of oxide is germanium oxide?

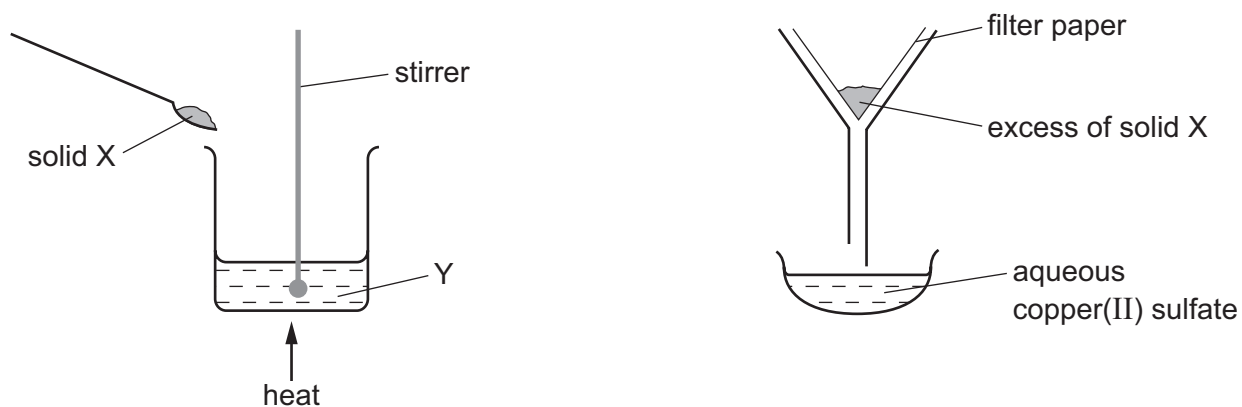
- A acidic
- B amphoteric
- C basic
- D neutral

- 19 Hydrogen chloride gas reacts with water to produce an acidic solution. The equation for the reaction is shown.



Which statement describes what happens during the reaction?

- A The chloride ion is formed by accepting an electron from the water.
  - B The hydrogen chloride loses an electron to form the chloride ion.
  - C The water accepts a proton from the hydrogen chloride.
  - D The water donates a proton to the hydrogen chloride.
- 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 | sulfuric acid               |
| C | copper(II) oxide    | sulfuric acid               |
| D | sulfur              | aqueous copper(II) chloride |

21 Information about some silver compounds is shown in the table.

| compound         | formula                  | solubility in water |
|------------------|--------------------------|---------------------|
| silver carbonate | $\text{Ag}_2\text{CO}_3$ | insoluble           |
| silver chloride  | $\text{AgCl}$            | insoluble           |
| silver nitrate   | $\text{AgNO}_3$          | soluble             |
| silver oxide     | $\text{Ag}_2\text{O}$    | insoluble           |

Which equation shows a reaction which **cannot** be used to make a silver salt?

- A  $\text{AgNO}_3(\text{aq}) + \text{HCl}(\text{aq}) \rightarrow \text{AgCl}(\text{s}) + \text{HNO}_3(\text{aq})$
- B  $\text{Ag}_2\text{O}(\text{s}) + 2\text{HNO}_3(\text{aq}) \rightarrow 2\text{AgNO}_3(\text{aq}) + \text{H}_2\text{O}(\text{l})$
- C  $\text{Ag}_2\text{CO}_3(\text{s}) + 2\text{HNO}_3(\text{aq}) \rightarrow 2\text{AgNO}_3(\text{aq}) + \text{H}_2\text{O}(\text{l}) + \text{CO}_2(\text{g})$
- D  $2\text{Ag}(\text{s}) + 2\text{HCl}(\text{aq}) \rightarrow 2\text{AgCl}(\text{s}) + \text{H}_2(\text{g})$

22 What is **not** a property of Group I metals?

- A They are soft and can be cut with a knife.
- B They react when exposed to oxygen in the air.
- C They produce an acidic solution when they react with water.
- D They react rapidly with water producing hydrogen gas.

- 23** Aqueous sodium hydroxide was added slowly, until in excess, to separate solutions of W, X, Y and Z.

The results are shown.

| solution | initial observation with aqueous sodium hydroxide | final observation with excess aqueous sodium hydroxide |
|----------|---------------------------------------------------|--------------------------------------------------------|
| W        | white precipitate formed                          | precipitate dissolves                                  |
| X        | white precipitate formed                          | no change                                              |
| Y        | pale blue precipitate formed                      | no change                                              |
| Z        | green precipitate formed                          | no change                                              |

Which row identifies the metal ions in the solutions?

|          | metal ion in solution W | metal ion in solution X | metal ion in solution Y | metal ion in solution Z |
|----------|-------------------------|-------------------------|-------------------------|-------------------------|
| <b>A</b> | aluminium               | calcium                 | copper(II)              | iron(II)                |
| <b>B</b> | aluminium               | calcium                 | iron(II)                | copper(II)              |
| <b>C</b> | aluminium               | iron(II)                | calcium                 | copper(II)              |
| <b>D</b> | calcium                 | aluminium               | copper(II)              | iron(II)                |

- 24** Part of the Periodic Table is shown.

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

[illegible]

- 25** Impurities in iron obtained from the blast furnace include carbon, phosphorus and silicon.

Which impurities are removed from the molten iron as gases when it is made into steel?

- A** carbon and phosphorus  
**B** carbon and silicon  
**C** carbon only  
**D** phosphorus and silicon

26 Y displaces X from its aqueous sulfate.

X does not displace W from its aqueous sulfate.

X displaces Z from its aqueous sulfate.

What is the order of reactivity of elements W, X, Y and Z?

|          | most<br>reactive |  |   |   | least<br>reactive |
|----------|------------------|-----------------------------------------------------------------------------------|---|---|-------------------|
| <b>A</b> | W                | X                                                                                 | Y | Z |                   |
| <b>B</b> | W                | Y                                                                                 | X | Z |                   |
| <b>C</b> | Z                | X                                                                                 | Y | W |                   |
| <b>D</b> | Z                | W                                                                                 | Y | X |                   |

27 Which statement about the industrial extraction of aluminium from aluminium oxide is correct?

- A** Aluminium is extracted by heating its oxide with carbon.
- B** Aluminium is extracted using electrolysis and is collected at the anode.
- C** Aluminium is extracted using platinum electrodes and direct current.
- D** Molten cryolite is used as a solvent for aluminium oxide.

28 The alloy brass is a mixture of copper and another metal.

Brass is used to make the pins of electrical plugs.

Copper is used to make electrical wiring.

Which row about brass is correct?

|          | hardness           | electrical<br>conductivity | other metal |
|----------|--------------------|----------------------------|-------------|
| <b>A</b> | harder than copper | better than copper         | tin         |
| <b>B</b> | harder than copper | worse than copper          | zinc        |
| <b>C</b> | softer than copper | better than copper         | tin         |
| <b>D</b> | softer than copper | worse than copper          | zinc        |

29 Air is a mixture of gases.

Which gas is present in the largest amount?

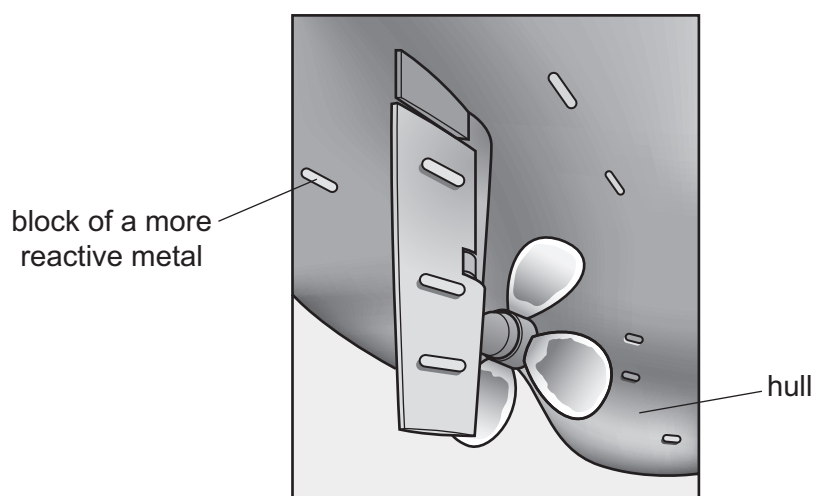
- A argon
- B carbon dioxide
- C nitrogen
- D oxygen

30 Which information about carbon dioxide and methane is correct?

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

key  
 ✓ = true  
 ✗ = false

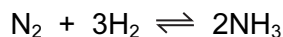
31 Boats made from steel can be protected from rusting by attaching blocks of a more reactive metal to the hull of the boat.



Which statement is correct?

- A Copper is used for the blocks because it does not react with water.
- B Magnesium is not used for the blocks because it reacts with steel.
- C The metal used for the blocks loses electrons more easily than steel.
- D This form of protection from rusting is called galvanising.

- 32 Ammonia is manufactured by the Haber process, using an iron catalyst.



It is not possible to obtain 100% yield.

What is the reason for this?

- A A high pressure is used.
  - B Ammonia decomposes at high temperature.
  - C Some of the ammonia is recycled.
  - D The ammonia reacts with the catalyst.
- 33 Sulfuric acid is manufactured by a series of chemical reactions, one of which is catalysed by vanadium(V) oxide.

What is the equation for the reaction catalysed by vanadium(V) oxide?

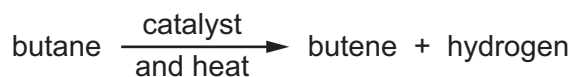
- A  $\text{S} + \text{O}_2 \rightarrow \text{SO}_2$
  - B  $2\text{S} + 3\text{O}_2 \rightarrow 2\text{SO}_3$
  - C  $2\text{SO}_2 + \text{O}_2 \rightarrow 2\text{SO}_3$
  - D  $\text{SO}_3 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{SO}_4$
- 34 Which substance gives off carbon dioxide on heating?
- A lime
  - B limestone
  - C limewater
  - D slaked lime

- 35 Petroleum is separated into fractions.

Which statement is **not** correct?

- A Each fraction contains a mixture of hydrocarbon molecules.
- B Fuel oil burns easily and is used as fuel in cars.
- C Refinery gas is the fraction containing the smallest molecules.
- D The fractions are separated depending on their boiling point range.

36 Butane reacts as shown.



What is this type of reaction?

- A combustion
- B cracking
- C polymerisation
- D reduction

37 Substance Z has the following characteristics.

- 1 It burns in an excess of oxygen to form carbon dioxide and water.
- 2 It is oxidised by air to form a liquid smelling of vinegar.
- 3 It reacts with carboxylic acids to form esters.

What is substance Z?

- A ethane
- B ethanoic acid
- C ethanol
- D ethyl ethanoate

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

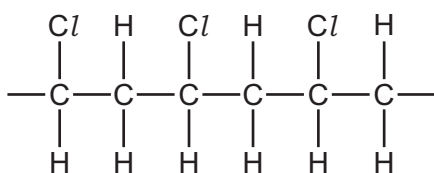
Which row shows an advantage and a disadvantage of using the catalytic addition of steam to ethene compared to fermentation?

|   | advantage                | disadvantage                 |
|---|--------------------------|------------------------------|
| A | fast                     | the product is impure        |
| B | fast                     | uses non-renewable materials |
| C | the product is pure      | slow                         |
| D | uses renewable materials | slow                         |

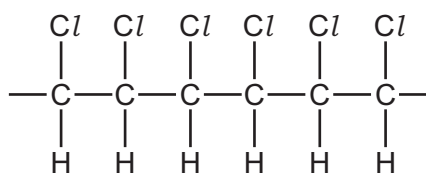
39 Chloroethene,  $\text{CH}_2=\text{CHCl}$ , can be polymerised.

Which diagram represents a section of the polymer?

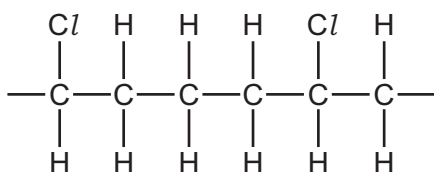
**A**



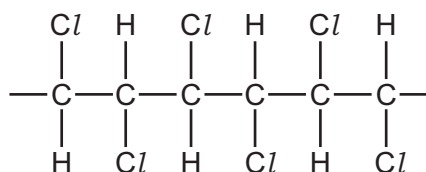
**B**



**C**



**D**



40 *Terylene* is a synthetic polymer.

Which statement about *Terylene* is **not** correct?

- A** It contains amide linkages.
- B** It contains carbon and oxygen atoms.
- C** It is made from small units called monomers.
- D** It is formed by condensation polymerisation.



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The Periodic Table of Elements

| Group                      |                             |                                                                                             |                             |                                 |                              |                              |                              |                            |                              |                                |                               |                                       |                             |                               |                              |                           |                           |                        |
|----------------------------|-----------------------------|---------------------------------------------------------------------------------------------|-----------------------------|---------------------------------|------------------------------|------------------------------|------------------------------|----------------------------|------------------------------|--------------------------------|-------------------------------|---------------------------------------|-----------------------------|-------------------------------|------------------------------|---------------------------|---------------------------|------------------------|
| I                          | II                          |                                                                                             |                             |                                 |                              |                              |                              |                            |                              |                                |                               | III                                   | IV                          | V                             | VI                           | VII                       | VIII                      |                        |
|                            |                             | <div>Key</div> <div>atomic number<br/>atomic symbol<br/>name<br/>relative atomic mass</div> |                             |                                 |                              |                              |                              |                            |                              |                                |                               | <div>1<br/>H<br/>hydrogen<br/>1</div> |                             |                               |                              |                           |                           |                        |
|                            |                             |                                                                                             |                             |                                 |                              |                              |                              |                            |                              |                                |                               |                                       |                             |                               |                              |                           |                           |                        |
| 3<br>Li<br>lithium<br>7    | 4<br>Be<br>beryllium<br>9   |                                                                                             |                             |                                 |                              |                              |                              |                            |                              |                                |                               |                                       |                             |                               |                              |                           |                           |                        |
| 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

actinoids

|                              |                            |                                 |                              |                             |                             |                             |                               |                            |                               |                              |                           |                               |                              |                              |
|------------------------------|----------------------------|---------------------------------|------------------------------|-----------------------------|-----------------------------|-----------------------------|-------------------------------|----------------------------|-------------------------------|------------------------------|---------------------------|-------------------------------|------------------------------|------------------------------|
| 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<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<sup>3</sup> at room temperature and pressure (r.t.p.)