

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS  
International General Certificate of Secondary Education

**CHEMISTRY**

**0620/01**

Paper 1 Multiple Choice

October/November 2004

**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, highlighters, 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.

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.

You may use a calculator.

This document consists of **16** printed pages.

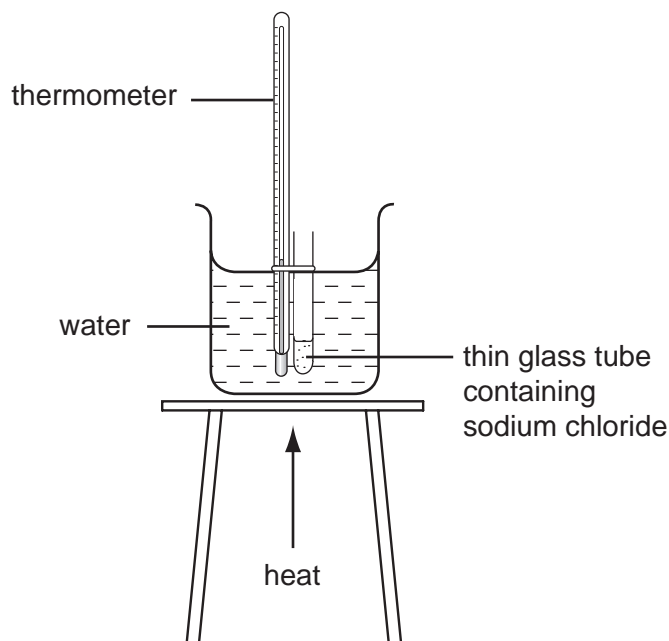


- 1 When steam at  $100^{\circ}\text{C}$  condenses to water at  $25^{\circ}\text{C}$ , what happens to the water molecules?
- A They move faster and closer together.
  - B They move faster and further apart.
  - C They move slower and closer together.
  - D They move slower and further apart.
- 2 The melting points and boiling points of four substances are shown.

Which substance is liquid at  $100^{\circ}\text{C}$ ?

| substance | melting point/ $^{\circ}\text{C}$ | boiling point/ $^{\circ}\text{C}$ |
|-----------|-----------------------------------|-----------------------------------|
| <b>A</b>  | -203                              | -17                               |
| <b>B</b>  | -25                               | 50                                |
| <b>C</b>  | 11                                | 181                               |
| <b>D</b>  | 463                               | 972                               |

- 3 The apparatus shown **cannot** be used to determine the melting point of sodium chloride,  $\text{Na}^+\text{Cl}^-$ .



Why is this?

|          | melting point of sodium chloride is greater than $100^\circ\text{C}$ | sodium chloride dissolves in the water |
|----------|--|--|
| <b>A</b> | ✓  | ✓                                      |
| <b>B</b> | ✓  | x                                      |
| <b>C</b> | x  | ✓                                      |
| <b>D</b> | x  | x                                      |

- 4 A student wishes to extract a coloured solution from some berries to make an indicator solution.

Which of the listed instructions should the student follow?

|   |                     |
|---|---------------------|
| 1 | crush the berries   |
| 2 | add acid            |
| 3 | add a solvent       |
| 4 | filter the mixture  |
| 5 | distil the filtrate |

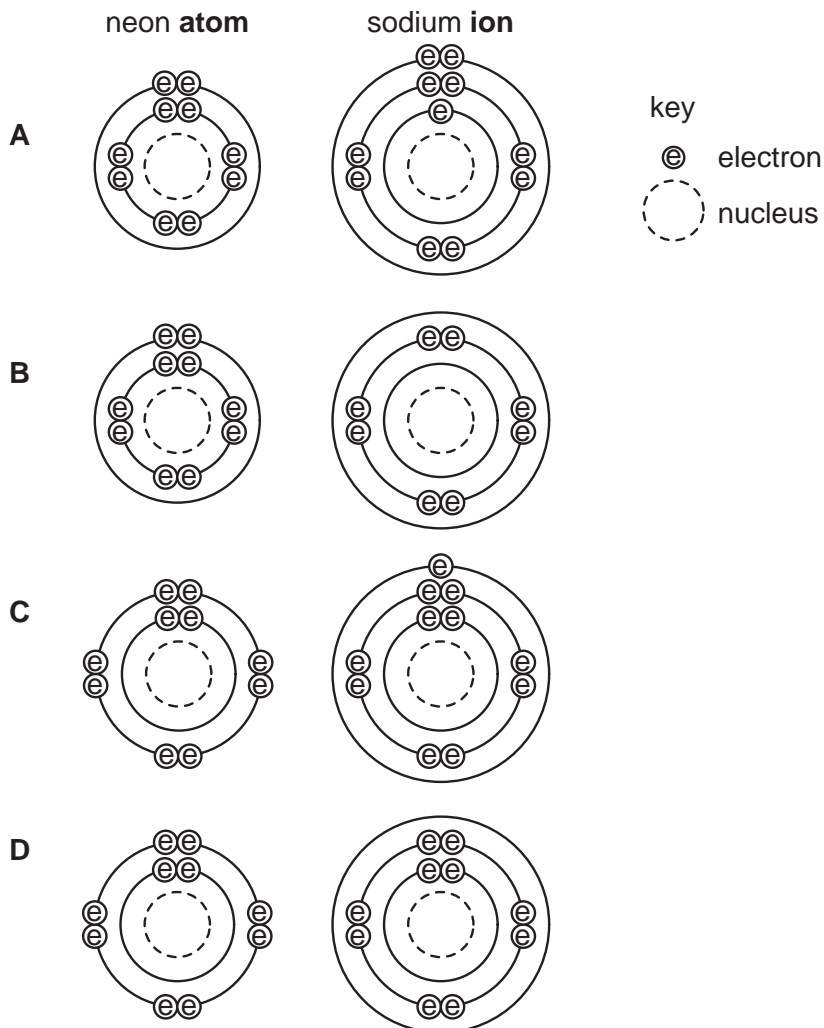
- A** 1, 2 and 4  
**B** 1, 3 and 4  
**C** 2, 3 and 5  
**D** 2, 4 and 5

5 Hydrogen and helium have isotopes, as shown.

In which of these isotopes does the nucleus have twice as many neutrons as protons?

- A  ${}^2_1\text{H}$
- B  ${}^3_1\text{H}$
- C  ${}^3_2\text{He}$
- D  ${}^4_2\text{He}$

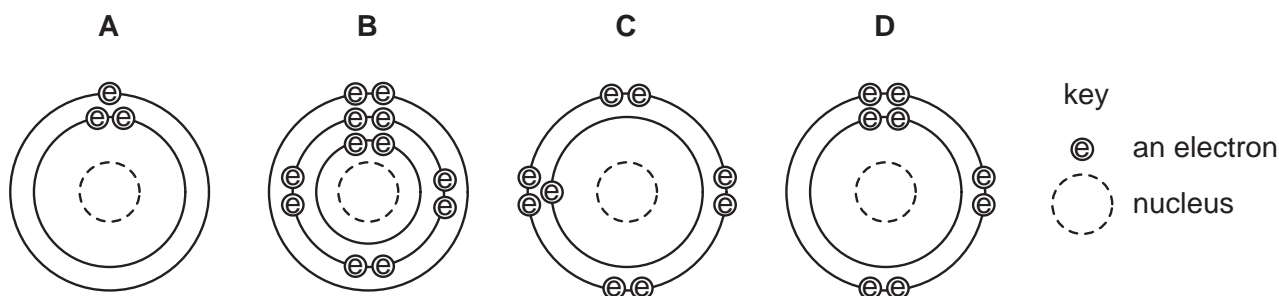
6 How are the electrons arranged in a neon **atom**, Ne, and a sodium **ion**,  $\text{Na}^+$ ?



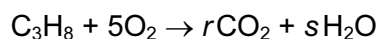
7 Which compound has ionic bonds?

- A hydrogen chloride
- B methane
- C sodium chloride
- D water

8 Which diagram shows an atom in the same group of the Periodic Table as sodium?



9 When propane is burned, carbon dioxide and water are formed, as shown.



Which values of  $r$  and  $s$  balance the equation?

|          | $r$ | $s$ |
|----------|-----|-----|
| <b>A</b> | 1   | 3   |
| <b>B</b> | 1   | 5   |
| <b>C</b> | 3   | 4   |
| <b>D</b> | 3   | 8   |

10 Which formula represents a compound containing three atoms?

- A**  $\text{HNO}_3$       **B**  $\text{H}_2\text{O}$       **C**  $\text{LiF}$       **D**  $\text{ZnSO}_4$

11 A substance **X** is heated in an evaporating basin until there is no further change.

|                | mass of basin and contents |
|----------------|----------------------------|
| before heating | 25.52 g                    |
| after heating  | 26.63 g                    |

What could **X** be?

- A** copper  
**B** copper(II) carbonate  
**C** copper(II) oxide  
**D** hydrated copper(II) sulphate

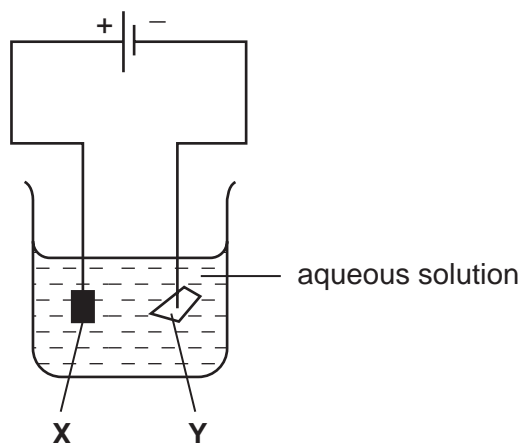
12 Aluminium is extracted from its oxide by electrolysis.

Which words correctly complete the spaces?

The oxide is dissolved in .....1..... cryolite and aluminium is deposited at the .....2.....

|          | space 1 | space 2          |
|----------|---------|------------------|
| <b>A</b> | aqueous | negative cathode |
| <b>B</b> | aqueous | positive anode   |
| <b>C</b> | molten  | negative cathode |
| <b>D</b> | molten  | positive anode   |

13 The diagram shows an electrolysis experiment using metals **X** and **Y** as electrodes.



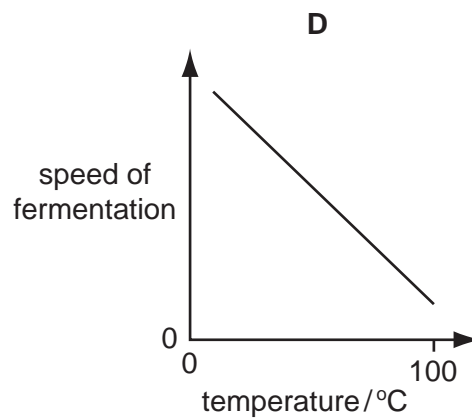
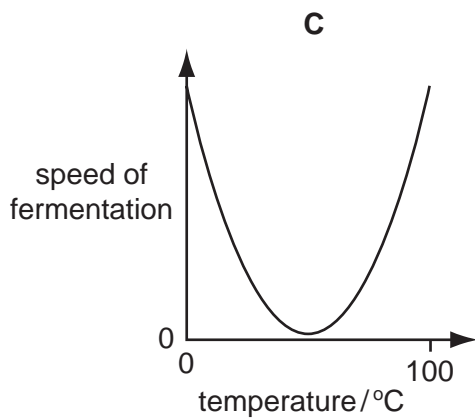
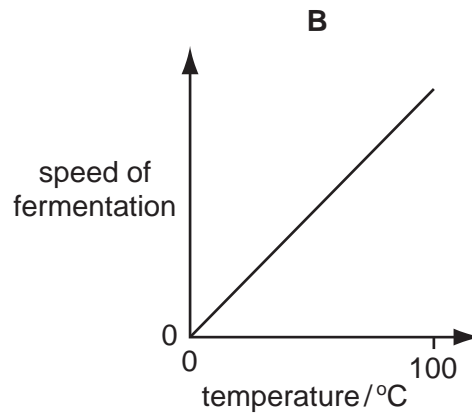
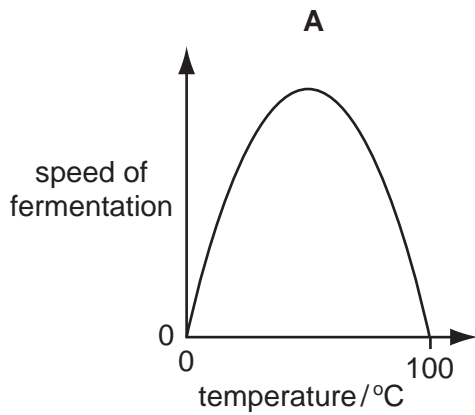
One of the metals becomes coated with copper.

Which metal becomes coated and which aqueous solution is used?

|          | metal    | aqueous solution |
|----------|----------|------------------|
| <b>A</b> | <b>X</b> | $\text{CrCl}_3$  |
| <b>B</b> | <b>X</b> | $\text{CuCl}_2$  |
| <b>C</b> | <b>Y</b> | $\text{CrCl}_3$  |
| <b>D</b> | <b>Y</b> | $\text{CuCl}_2$  |

14 The solvent ethanol is produced by the fermentation of sugar, using yeast.

Which graph correctly shows how the speed of fermentation changes with temperature?



15 In which process does an endothermic change take place?

- A combustion
- B evaporation
- C filtration
- D neutralisation

16 The sign  $\rightleftharpoons$  is used in some equations to show that a reaction can be reversed.

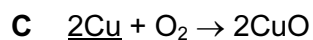
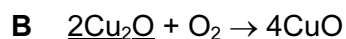
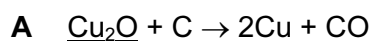
Two incomplete equations are given.

|          | reagents                              | products                                  |
|----------|---------------------------------------|---|
| <b>P</b> | $\text{CoCl}_2 + 2\text{H}_2\text{O}$ | $\text{CoCl}_2 \cdot 2\text{H}_2\text{O}$ |
| <b>Q</b> | $\text{C} + \text{O}_2$               | $\text{CO}_2$                             |

For which of these reactions can a  $\rightleftharpoons$  sign be correctly used to complete the equation?

|          | <b>P</b> | <b>Q</b> |
|----------|----------|----------|
| <b>A</b> | ✓        | ✓        |
| <b>B</b> | ✓        | x        |
| <b>C</b> | x        | ✓        |
| <b>D</b> | x        | x        |

17 In which reaction does reduction of the underlined substance take place?



18 In which experiment is the rate of reaction between hydrochloric acid and calcium carbonate **slowest**?

**A**

water at 30°C

dilute hydrochloric acid

lumps of calcium carbonate

**B**

water at 60°C

dilute hydrochloric acid

powdered calcium carbonate

**C**

water at 30°C

concentrated hydrochloric acid

lumps of calcium carbonate

**D**

water at 60°C

concentrated hydrochloric acid

powdered calcium carbonate



19 Aqueous ammonia is added to a solution of a metal sulphate.

A green precipitate that is insoluble in excess of the aqueous ammonia forms.

Which metal ion is present?

- A  $\text{Ca}^{2+}$       B  $\text{Cu}^{2+}$       C  $\text{Fe}^{3+}$       D  $\text{Fe}^{2+}$

20 The chart shows the colour ranges of four different indicators.

Which indicator is blue in an acidic solution?

| indicator | pH value            |   |        |   |   |   |   |               |   |              |               |    |      |    |
|-----------|---------------------|---|--------|---|---|---|---|---------------|---|--------------|---------------|----|------|----|
|           | 1                   | 2 | 3      | 4 | 5 | 6 | 7 | 8             | 9 | 10           | 11            | 12 | 13   | 14 |
| A         | yellow              |   | ←————→ |   |   |   |   |               |   |              |               |    | blue |    |
| B         | — red —————→        |   |        |   |   |   |   | blue ←—       |   | yellow ————— |               |    |      |    |
| C         | — red —————→        |   |        |   |   |   |   | ←— blue ————— |   | —————        |               |    |      |    |
| D         | — colourless —————→ |   |        |   |   |   |   |               |   |              | ←— blue ————— |    |      |    |

21 An ion X in solution is identified as shown.

The diagram shows two test tubes being heated. In the first test tube, the solution is labeled 'solution X + NaOH(aq)' and the damp red litmus paper remains red. In the second test tube, the solution is also labeled 'solution X + NaOH(aq)', but the damp red litmus paper turns blue, and there is a layer of 'metal powder' at the bottom of the test tube.

What is ion X?

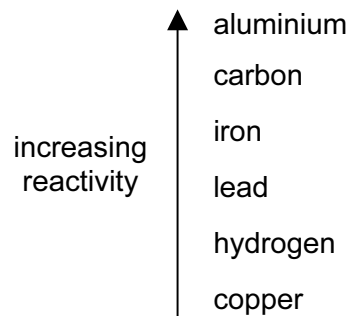
- A  $\text{Al}^{3+}(\text{aq})$       B  $\text{NH}_4^+(\text{aq})$       C  $\text{NO}_3^-(\text{aq})$       D  $\text{SO}_4^{2-}(\text{aq})$

22 Metals can be joined together by welding them at a high temperature.

Why is an argon atmosphere often used?

- A Argon has a low density.
- B Argon is colourless.
- C Argon is inexpensive.
- D Argon is unreactive.

23 Part of the reactivity series is outlined below.

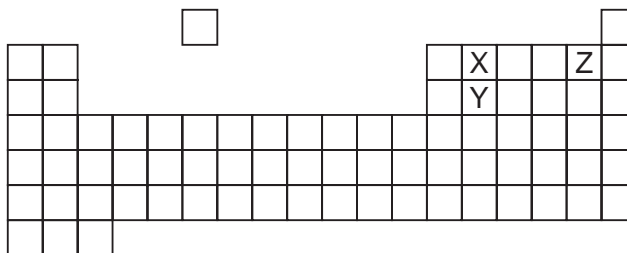


Electrolysis is an expensive way of extraction.

Which metal has to be extracted from its ore by electrolysis?

- A aluminium
- B copper
- C lead
- D iron

24 The diagram shows part of the Periodic Table.



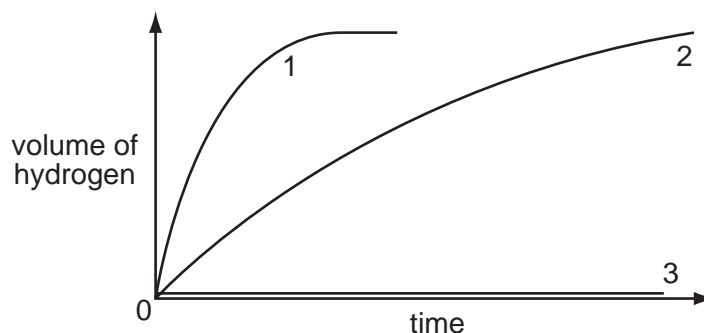
Which statement about elements X, Y and Z is correct?

The proton number of X is

- A seven less than that of Z.
- B three less than that of Z.
- C one less than that of Y.
- D sixteen less than that of Y.

25 Three different metals, Cu, Fe and Mg, are each added to an excess of dilute hydrochloric acid.

The graph shows how rapidly hydrogen is given off.



Which metal gives which curve?

|          | 1  | 2  | 3  |
|----------|----|----|----|
| <b>A</b> | Fe | Cu | Mg |
| <b>B</b> | Fe | Mg | Cu |
| <b>C</b> | Mg | Cu | Fe |
| <b>D</b> | Mg | Fe | Cu |

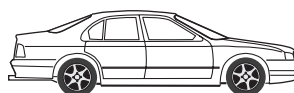
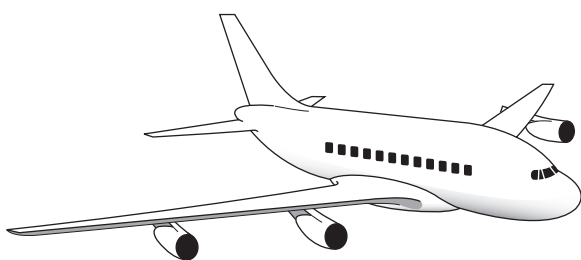
26 Which substance is a metal?

|          | electrical conductivity (solid) | electrical conductivity (molten) |
|----------|---------------------------------|----------------------------------|
| <b>A</b> | high                            | high                             |
| <b>B</b> | high                            | low                              |
| <b>C</b> | low                             | high                             |
| <b>D</b> | low                             | low                              |

27 Which changes occur when impure iron is made into stainless steel?

|          | carbon  | chromium |
|----------|---------|----------|
| <b>A</b> | added   | added    |
| <b>B</b> | added   | removed  |
| <b>C</b> | removed | added    |
| <b>D</b> | removed | removed  |

28 The bodies of an aeroplane, a car and a wheelbarrow are made of metal.



Which metal is used for which body?

|          | aeroplane | car       | wheelbarrow |
|----------|-----------|-----------|-------------|
| <b>A</b> | aluminium | iron      | steel       |
| <b>B</b> | aluminium | steel     | iron        |
| <b>C</b> | steel     | aluminium | iron        |
| <b>D</b> | steel     | iron      | aluminium   |

29 What is used to test for the presence of water?

- A** anhydrous copper(II) sulphate
- B** aqueous barium chloride
- C** aqueous sodium hydroxide
- D** Universal indicator paper

30 A candle is burned in a fixed volume of air.

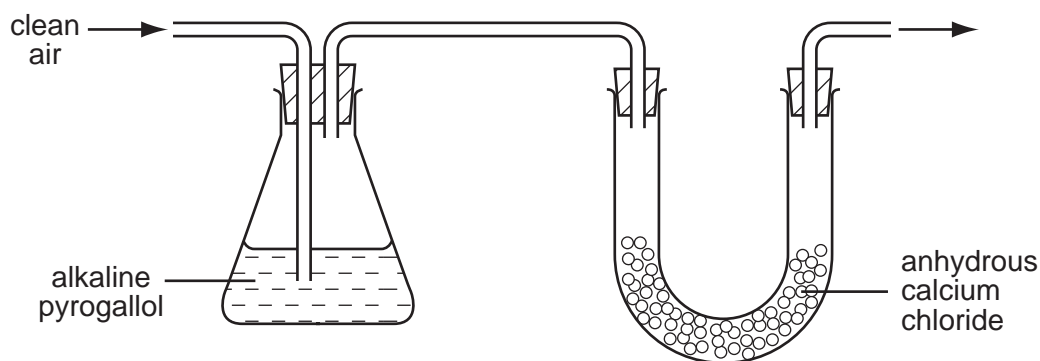
How do the percentages (%) of carbon dioxide and oxygen change?

|          | carbon dioxide | oxygen |
|----------|----------------|--------|
| <b>A</b> | fall           | fall   |
| <b>B</b> | fall           | rise   |
| <b>C</b> | rise           | fall   |
| <b>D</b> | rise           | rise   |

31 Anhydrous calcium chloride is used as a drying agent.

An alkaline solution of pyrogallol absorbs oxygen and carbon dioxide.

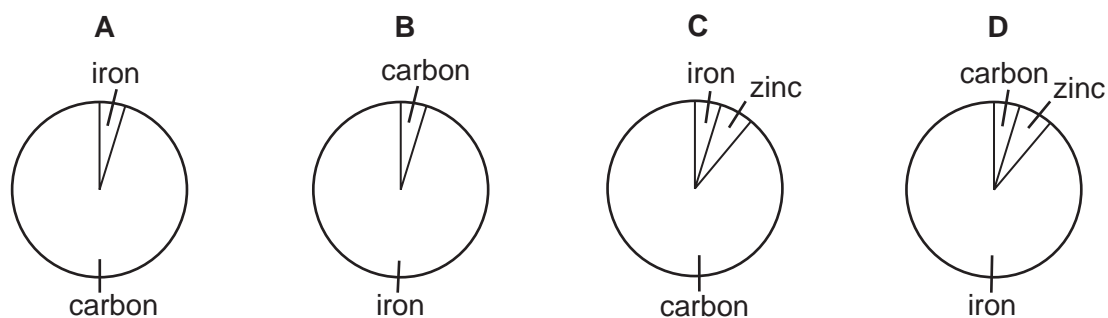
Clean air is passed through the apparatus shown.



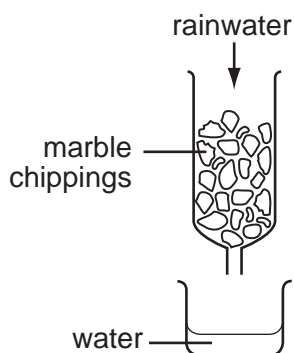
Which gases are present in the air leaving the apparatus?

|          | argon | nitrogen | hydrogen |
|----------|-------|----------|----------|
| <b>A</b> | ✓     | ✓        | ✓        |
| <b>B</b> | ✓     | x        | ✓        |
| <b>C</b> | x     | ✓        | ✓        |
| <b>D</b> | ✓     | ✓        | x        |

32 Which chart could represent the composition of a galvanised roof?

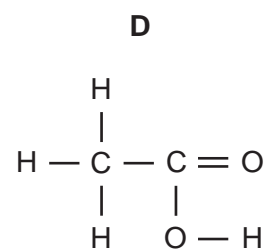
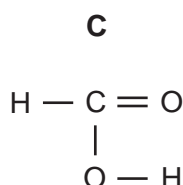
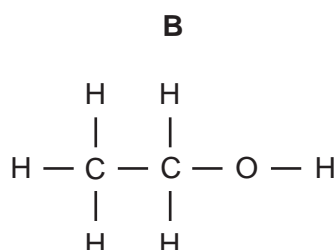
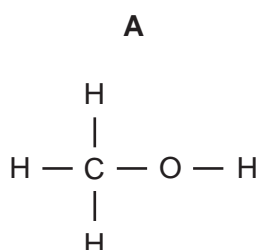


- 33 Which statement explains why iron is used as the catalyst in the manufacture of ammonia?
- A More ammonia is produced in a given time.  
 B The catalyst is unchanged at the end of the reaction.  
 C The catalyst neutralises the ammonia.  
 D The purity of the ammonia is improved.
- 34 A sample of acid rainwater (pH = 4) is passed down a glass column packed with marble chippings (calcium carbonate). The water coming from the bottom of the column is collected in a beaker. The pH is now 6.



What causes the change in pH?

- A The acid has been filtered.  
 B The acid has been neutralised.  
 C The acid is made more concentrated.  
 D The acid is precipitated.
- 35 What are the products when limestone (calcium carbonate) is strongly heated?
- A calcium hydroxide and carbon dioxide  
 B calcium hydroxide and carbon monoxide  
 C calcium oxide and carbon dioxide  
 D calcium oxide and carbon monoxide
- 36 Which compound is ethanol?



37 What is petroleum?

- A an aircraft fuel
- B a central heating fuel
- C a mixture of carbohydrates
- D a mixture of hydrocarbons

38 Methanol and ethanol belong to the same homologous series.

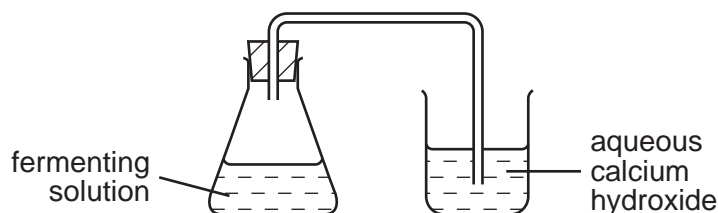
What does this mean?

- A Their molecules contain atoms only of carbon and hydrogen.
- B Their molecules have the same number of carbon atoms.
- C They have the same functional group.
- D They have the same relative molecular mass.

39 Which substances can be obtained by cracking hydrocarbons?

- A ethanol and ethene
- B ethanol and hydrogen
- C ethene and hydrogen
- D ethene and poly(ethene)

40 The apparatus shown may be used to study the products of fermentation.



What is the purpose of the aqueous calcium hydroxide?

- A to absorb any excess of yeast
- B to condense the ethanol produced
- C to prevent air entering the system
- D to show that carbon dioxide is produced

**DATA SHEET**  
**The Periodic Table of the Elements**

|                       |                        | Group                  |                        |                        |                        |                       |                         |                         |                        |                        |                        |
|-----------------------|------------------------|------------------------|------------------------|------------------------|------------------------|-----------------------|-------------------------|-------------------------|------------------------|------------------------|------------------------|
|                       |                        | I                      | II                     | III                    | IV                     | V                     | VI                      | VII                     | VIII                   | IX                     | X                      |
| 7                     | 3                      | 9                      | 4                      | 5                      | 6                      | 7                     | 8                       | 9                       | 10                     | 11                     | 12                     |
| <b>Li</b><br>Lithium  | <b>Be</b><br>Beryllium | <b>B</b><br>Boron      | <b>C</b><br>Carbon     | <b>N</b><br>Nitrogen   | <b>O</b><br>Oxygen     | <b>F</b><br>Fluorine  | <b>Ne</b><br>Neon       | <b>Na</b><br>Sodium     | <b>Mg</b><br>Magnesium | <b>Al</b><br>Aluminium | <b>Si</b><br>Silicon   |
| 23                    | 11                     | 19                     | 20                     | 27                     | 24                     | 25                    | 26                      | 29                      | 30                     | 31                     | 32                     |
| <b>Na</b><br>Sodium   | <b>Mg</b><br>Magnesium | <b>K</b><br>Potassium  | <b>Ca</b><br>Calcium   | <b>Sc</b><br>Scandium  | <b>Ti</b><br>Titanium  | <b>V</b><br>Vanadium  | <b>Cr</b><br>Chromium   | <b>Mn</b><br>Manganese  | <b>Fe</b><br>Iron      | <b>Co</b><br>Cobalt    | <b>Ni</b><br>Nickel    |
| 39                    | 19                     | 47                     | 38                     | 45                     | 40                     | 41                    | 42                      | 43                      | 44                     | 45                     | 46                     |
| <b>K</b><br>Potassium | <b>Ca</b><br>Calcium   | <b>Sr</b><br>Strontium | <b>Rb</b><br>Rubidium  | <b>Y</b><br>Yttrium    | <b>Zr</b><br>Zirconium | <b>Nb</b><br>Niobium  | <b>Mo</b><br>Molybdenum | <b>Tc</b><br>Technetium | <b>Ru</b><br>Ruthenium | <b>Rh</b><br>Rhodium   | <b>Pd</b><br>Palladium |
| 85                    | 37                     | 88                     | 55                     | 89                     | 40                     | 41                    | 42                      | 43                      | 44                     | 45                     | 46                     |
| <b>Rb</b><br>Rubidium | <b>Sr</b><br>Strontium | <b>Ba</b><br>Barium    | <b>Cs</b><br>Caesium   | <b>La</b><br>Lanthanum | <b>Hf</b><br>Hafnium   | <b>Ta</b><br>Tantalum | <b>W</b><br>Tungsten    | <b>Re</b><br>Rhenium    | <b>Os</b><br>Osmium    | <b>Ir</b><br>Iridium   | <b>Pt</b><br>Platinum  |
| 133                   | 55                     | 137                    | 55                     | 139                    | 72                     | 73                    | 74                      | 75                      | 76                     | 77                     | 78                     |
| <b>Fr</b><br>Francium | <b>Ra</b><br>Radium    | <b>Ac</b><br>Actinium  | <b>La</b><br>Lanthanum | <b>Hf</b><br>Hafnium   | <b>Ta</b><br>Tantalum  | <b>W</b><br>Tungsten  | <b>Re</b><br>Rhenium    | <b>Os</b><br>Osmium     | <b>Ir</b><br>Iridium   | <b>Pt</b><br>Platinum  | <b>Au</b><br>Gold      |
| 226                   | 88                     | 227                    | 87                     | 89                     | 72                     | 73                    | 74                      | 75                      | 76                     | 77                     | 78                     |
| <b>Fr</b><br>Francium | <b>Ra</b><br>Radium    | <b>Ac</b><br>Actinium  | <b>La</b><br>Lanthanum | <b>Hf</b><br>Hafnium   | <b>Ta</b><br>Tantalum  | <b>W</b><br>Tungsten  | <b>Re</b><br>Rhenium    | <b>Os</b><br>Osmium     | <b>Ir</b><br>Iridium   | <b>Pt</b><br>Platinum  | <b>Au</b><br>Gold      |
| 227                   | 89                     | 227                    | 89                     | 89                     | 72                     | 73                    | 74                      | 75                      | 76                     | 77                     | 78                     |
| <b>Fr</b><br>Francium | <b>Ra</b><br>Radium    | <b>Ac</b><br>Actinium  | <b>La</b><br>Lanthanum | <b>Hf</b><br>Hafnium   | <b>Ta</b><br>Tantalum  | <b>W</b><br>Tungsten  | <b>Re</b><br>Rhenium    | <b>Os</b><br>Osmium     | <b>Ir</b><br>Iridium   | <b>Pt</b><br>Platinum  | <b>Au</b><br>Gold      |
| 227                   | 89                     | 227                    | 89                     | 89                     | 72                     | 73                    | 74                      | 75                      | 76                     | 77                     | 78                     |
| <b>Fr</b><br>Francium | <b>Ra</b><br>Radium    | <b>Ac</b><br>Actinium  | <b>La</b><br>Lanthanum | <b>Hf</b><br>Hafnium   | <b>Ta</b><br>Tantalum  | <b>W</b><br>Tungsten  | <b>Re</b><br>Rhenium    | <b>Os</b><br>Osmium     | <b>Ir</b><br>Iridium   | <b>Pt</b><br>Platinum  | <b>Au</b><br>Gold      |
| 227                   | 89                     | 227                    | 89                     | 89                     | 72                     | 73                    | 74                      | 75                      | 76                     | 77                     | 78                     |
| <b>Fr</b><br>Francium | <b>Ra</b><br>Radium    | <b>Ac</b><br>Actinium  | <b>La</b><br>Lanthanum | <b>Hf</b><br>Hafnium   | <b>Ta</b><br>Tantalum  | <b>W</b><br>Tungsten  | <b>Re</b><br>Rhenium    | <b>Os</b><br>Osmium     | <b>Ir</b><br>Iridium   | <b>Pt</b><br>Platinum  | <b>Au</b><br>Gold      |
| 227                   | 89                     | 227                    | 89                     | 89                     | 72                     | 73                    | 74                      | 75                      | 76                     | 77                     | 78                     |
| <b>Fr</b><br>Francium | <b>Ra</b><br>Radium    | <b>Ac</b><br>Actinium  | <b>La</b><br>Lanthanum | <b>Hf</b><br>Hafnium   | <b>Ta</b><br>Tantalum  | <b>W</b><br>Tungsten  | <b>Re</b><br>Rhenium    | <b>Os</b><br>Osmium     | <b>Ir</b><br>Iridium   | <b>Pt</b><br>Platinum  | <b>Au</b><br>Gold      |
| 227                   | 89                     | 227                    | 89                     | 89                     | 72                     | 73                    | 74                      | 75                      | 76                     | 77                     | 78                     |
| <b>Fr</b><br>Francium | <b>Ra</b><br>Radium    | <b>Ac</b><br>Actinium  | <b>La</b><br>Lanthanum | <b>Hf</b><br>Hafnium   | <b>Ta</b><br>Tantalum  | <b>W</b><br>Tungsten  | <b>Re</b><br>Rhenium    | <b>Os</b><br>Osmium     | <b>Ir</b><br>Iridium   | <b>Pt</b><br>Platinum  | <b>Au</b><br>Gold      |
| 227                   | 89                     | 227                    | 89                     | 89                     | 72                     | 73                    | 74                      | 75                      | 76                     | 77                     | 78                     |
| <b>Fr</b><br>Francium | <b>Ra</b><br>Radium    | <b>Ac</b><br>Actinium  | <b>La</b><br>Lanthanum | <b>Hf</b><br>Hafnium   | <b>Ta</b><br>Tantalum  | <b>W</b><br>Tungsten  | <b>Re</b><br>Rhenium    | <b>Os</b><br>Osmium     | <b>Ir</b><br>Iridium   | <b>Pt</b><br>Platinum  | <b>Au</b><br>Gold      |
| 227                   | 89                     | 227                    | 89                     | 89                     | 72                     | 73                    | 74                      | 75                      | 76                     | 77                     | 78                     |
| <b>Fr</b><br>Francium | <b>Ra</b><br>Radium    | <b>Ac</b><br>Actinium  | <b>La</b><br>Lanthanum | <b>Hf</b><br>Hafnium   | <b>Ta</b><br>Tantalum  | <b>W</b><br>Tungsten  | <b>Re</b><br>Rhenium    | <b>Os</b><br>Osmium     | <b>Ir</b><br>Iridium   | <b>Pt</b><br>Platinum  | <b>Au</b><br>Gold      |
| 227                   | 89                     | 227                    | 89                     | 89                     | 72                     | 73                    | 74                      | 75                      | 76                     | 77                     | 78                     |
| <b>Fr</b><br>Francium | <b>Ra</b><br>Radium    | <b>Ac</b><br>Actinium  | <b>La</b><br>Lanthanum | <b>Hf</b><br>Hafnium   | <b>Ta</b><br>Tantalum  | <b>W</b><br>Tungsten  | <b>Re</b><br>Rhenium    | <b>Os</b><br>Osmium     | <b>Ir</b><br>Iridium   | <b>Pt</b><br>Platinum  | <b>Au</b><br>Gold      |
| 227                   | 89                     | 227                    | 89                     | 89                     | 72                     | 73                    | 74                      | 75                      | 76                     | 77                     | 78                     |
| <b>Fr</b><br>Francium | <b>Ra</b><br>Radium    | <b>Ac</b><br>Actinium  | <b>La</b><br>Lanthanum | <b>Hf</b><br>Hafnium   | <b>Ta</b><br>Tantalum  | <b>W</b><br>Tungsten  | <b>Re</b><br>Rhenium    | <b>Os</b><br>Osmium     | <b>Ir</b><br>Iridium   | <b>Pt</b><br>Platinum  | <b>Au</b><br>Gold      |
| 227                   | 89                     | 227                    | 89                     | 89                     | 72                     | 73                    | 74                      | 75                      | 76                     | 77                     | 78                     |
| <b>Fr</b><br>Francium | <b>Ra</b><br>Radium    | <b>Ac</b><br>Actinium  | <b>La</b><br>Lanthanum | <b>Hf</b><br>Hafnium   | <b>Ta</b><br>Tantalum  | <b>W</b><br>Tungsten  | <b>Re</b><br>Rhenium    | <b>Os</b><br>Osmium     | <b>Ir</b><br>Iridium   | <b>Pt</b><br>Platinum  | <b>Au</b><br>Gold      |
| 227                   | 89                     | 227                    | 89                     | 89                     | 72                     | 73                    | 74                      | 75                      | 76                     | 77                     | 78                     |
| <b>Fr</b><br>Francium | <b>Ra</b><br>Radium    | <b>Ac</b><br>Actinium  | <b>La</b><br>Lanthanum | <b>Hf</b><br>Hafnium   | <b>Ta</b><br>Tantalum  | <b>W</b><br>Tungsten  | <b>Re</b><br>Rhenium    | <b>Os</b><br>Osmium     | <b>Ir</b><br>Iridium   | <b>Pt</b><br>Platinum  | <b>Au</b><br>Gold      |
| 227                   | 89                     | 227                    | 89                     | 89                     | 72                     | 73                    | 74                      | 75                      | 76                     | 77                     | 78                     |
| <b>Fr</b><br>Francium | <b>Ra</b><br>Radium    | <b>Ac</b><br>Actinium  | <b>La</b><br>Lanthanum | <b>Hf</b><br>Hafnium   | <b>Ta</b><br>Tantalum  | <b>W</b><br>Tungsten  | <b>Re</b><br>Rhenium    | <b>Os</b><br>Osmium     | <b>Ir</b><br>Iridium   | <b>Pt</b><br>Platinum  | <b>Au</b><br>Gold      |
| 227                   | 89                     | 227                    | 89                     | 89                     | 72                     | 73                    | 74                      | 75                      | 76                     | 77                     | 78                     |
| <b>Fr</b><br>Francium | <b>Ra</b><br>Radium    | <b>Ac</b><br>Actinium  | <b>La</b><br>Lanthanum | <b>Hf</b><br>Hafnium   | <b>Ta</b><br>Tantalum  | <b>W</b><br>Tungsten  | <b>Re</b><br>Rhenium    | <b>Os</b><br>Osmium     | <b>Ir</b><br>Iridium   | <b>Pt</b><br>Platinum  | <b>Au</b><br>Gold      |
| 227                   | 89                     | 227                    | 89                     | 89                     | 72                     | 73                    | 74                      | 75                      | 76                     | 77                     | 78                     |
| <b>Fr</b><br>Francium | <b>Ra</b><br>Radium    | <b>Ac</b><br>Actinium  | <b>La</b><br>Lanthanum | <b>Hf</b><br>Hafnium   | <b>Ta</b><br>Tantalum  | <b>W</b><br>Tungsten  | <b>Re</b><br>Rhenium    | <b>Os</b><br>Osmium     | <b>Ir</b><br>Iridium   | <b>Pt</b><br>Platinum  | <b>Au</b><br>Gold      |
| 227                   | 89                     | 227                    | 89                     | 89                     | 72                     | 73                    | 74                      | 75                      | 76                     | 77                     | 78                     |
| <b>Fr</b><br>Francium | <b>Ra</b><br>Radium    | <b>Ac</b><br>Actinium  | <b>La</b><br>Lanthanum | <b>Hf</b><br>Hafnium   | <b>Ta</b><br>Tantalum  | <b>W</b><br>Tungsten  | <b>Re</b><br>Rhenium    | <b>Os</b><br>Osmium     | <b>Ir</b><br>Iridium   | <b>Pt</b><br>Platinum  | <b>Au</b><br>Gold      |
| 227                   | 89                     | 227                    | 89                     | 89                     | 72                     | 73                    | 74                      | 75                      | 76                     | 77                     | 78                     |
| <b>Fr</b><br>Francium | <b>Ra</b><br>Radium    | <b>Ac</b><br>Actinium  | <b>La</b><br>Lanthanum | <b>Hf</b><br>Hafnium   | <b>Ta</b><br>Tantalum  | <b>W</b><br>Tungsten  | <b>Re</b><br>Rhenium    | <b>Os</b><br>Osmium     | <b>Ir</b><br>Iridium   | <b>Pt</b><br>Platinum  | <b>Au</b><br>Gold      |
| 227                   | 89                     | 227                    | 89                     | 89                     | 72                     | 73                    | 74                      | 75                      | 76                     | 77                     | 78                     |
| <b>Fr</b><br>Francium | <b>Ra</b><br>Radium    | <b>Ac</b><br>Actinium  | <b>La</b><br>Lanthanum | <b>Hf</b><br>Hafnium   | <b>Ta</b><br>Tantalum  | <b>W</b><br>Tungsten  | <b>Re</b><br>Rhenium    | <b>Os</b><br>Osmium     | <b>Ir</b><br>Iridium   | <b>Pt</b><br>Platinum  | <b>Au</b><br>Gold      |
| 227                   | 89                     | 227                    | 89                     | 89                     | 72                     | 73                    | 74                      | 75                      | 76                     | 77                     | 78                     |
| <b>Fr</b><br>Francium | <b>Ra</b><br>Radium    | <b>Ac</b><br>Actinium  | <b>La</b><br>Lanthanum | <b>Hf</b><br>Hafnium   | <b>Ta</b><br>Tantalum  | <b>W</b><br>Tungsten  | <b>Re</b><br>Rhenium    | <b>Os</b><br>Osmium     | <b>Ir</b><br>Iridium   | <b>Pt</b><br>Platinum  | <b>Au</b><br>Gold      |
| 227                   | 89                     | 227                    | 89                     | 89                     | 72                     | 73                    | 74                      | 75                      | 76                     | 77                     | 78                     |
| <b>Fr</b><br>Francium | <b>Ra</b><br>Radium    | <b>Ac</b><br>Actinium  | <b>La</b><br>Lanthanum | <b>Hf</b><br>Hafnium   | <b>Ta</b><br>Tantalum  | <b>W</b><br>Tungsten  | <b>Re</b><br>Rhenium    | <b>Os</b><br>Osmium     | <b>Ir</b><br>Iridium   | <b>Pt</b><br>Platinum  | <b>Au</b><br>Gold      |
| 227                   | 89                     | 227                    | 89                     | 89                     | 72                     | 73                    | 74                      | 75                      | 76                     | 77                     | 78                     |
| <b>Fr</b><br>Francium | <b>Ra</b><br>Radium    | <b>Ac</b><br>Actinium  | <b>La</b><br>Lanthanum | <b>Hf</b><br>Hafnium   | <b>Ta</b><br>Tantalum  | <b>W</b><br>Tungsten  | <b>Re</b><br>Rhenium    | <b>Os</b><br>Osmium     | <b>Ir</b><br>Iridium   | <b>Pt</b><br>Platinum  | <b>Au</b><br>Gold      |
| 227                   | 89                     | 227                    | 89                     | 89                     | 72                     | 73                    | 74                      | 75                      | 76                     | 77                     | 78                     |
| <b>Fr</b>             |                        |                        |                        |                        |                        |                       |                         |                         |                        |                        |                        |