



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

**CHEMISTRY**

**0620/11**

Paper 1 Multiple Choice (Core)

**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.

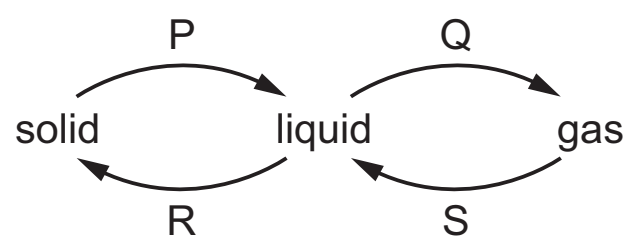
Electronic calculators may be used.

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 **14** printed pages and **2** blank pages.



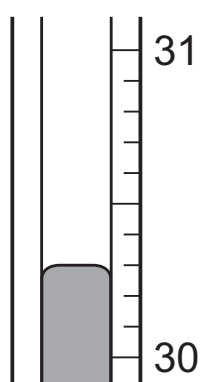
- 1 The diagram shows some changes of state.



Which words describe the changes of state, P, Q, R and S?

|          | P           | Q           | R        | S            |
|----------|-------------|-------------|----------|--------------|
| <b>A</b> | freezing    | boiling     | melting  | evaporation  |
| <b>B</b> | melting     | evaporation | freezing | condensation |
| <b>C</b> | melting     | sublimation | freezing | evaporation  |
| <b>D</b> | sublimation | evaporation | melting  | condensation |

- 2 The diagram shows part of a thermometer.



What is the reading on the thermometer?

- A** 30.2      **B** 30.3      **C** 31.7      **D** 31.8

- 3 Pure water has a boiling point of 100 °C and a freezing point of 0 °C.

What is the boiling point and freezing point of a sample of aqueous sodium chloride?

|          | boiling point/°C | freezing point/°C |
|----------|------------------|-------------------|
| <b>A</b> | 98               | −2                |
| <b>B</b> | 98               | 2                 |
| <b>C</b> | 102              | −2                |
| <b>D</b> | 102              | 2                 |

- 4 Pure copper(II) sulfate crystals can be made by adding copper(II) oxide to hot dilute sulfuric acid.

The copper(II) oxide is added until it .....1..... .

The solution is .....2..... and then .....3..... to obtain the pure crystals.

Which words complete gaps 1, 2 and 3?

|          | 1              | 2        | 3        |
|----------|----------------|----------|----------|
| <b>A</b> | is in excess   | cooled   | filtered |
| <b>B</b> | is in excess   | filtered | cooled   |
| <b>C</b> | changes colour | cooled   | filtered |
| <b>D</b> | changes colour | filtered | cooled   |

- 5 Which part of an atom has a relative mass of 1 and a relative charge of 0?

- A** electron  
**B** neutron  
**C** nucleus  
**D** proton

- 6 Which molecule contains exactly two single covalent bonds?

- A**  $Cl_2$                       **B**  $CH_4$                       **C**  $H_2O$                       **D**  $HCl$

- 7 Sodium reacts with chlorine to form sodium chloride.

Which statements describe what happens to the sodium atoms in this reaction?

- 1 Sodium atoms form positive ions.  
 2 Sodium atoms form negative ions.  
 3 Sodium atoms gain electrons.  
 4 Sodium atoms lose electrons.

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

- 8 Diamond is extremely hard and does not conduct electricity.

Which statement explains these properties?

- A** It has a lattice of positive carbon ions in a 'sea of electrons'.
- B** It has delocalised electrons and each carbon atom forms three covalent bonds with other carbon atoms.
- C** It has no delocalised electrons and each carbon atom forms four covalent bonds with other carbon atoms.
- D** It has strong ionic bonds between each carbon atom.

- 9 What is the relative formula mass of ammonium nitrate,  $\text{NH}_4\text{NO}_3$ ?

- A** 80                      **B** 108                      **C** 122                      **D** 150

- 10 Concentrated aqueous sodium chloride is electrolysed.

What is the main product formed at the positive electrode (anode)?

- A** chlorine
- B** hydrogen
- C** oxygen
- D** sodium

- 11 Some properties of four fuels are shown in the table.

Which fuel is a gas at room temperature and makes two products when it burns in a plentiful supply of air?

|          | fuel     | formula                      | melting point<br>/ $^{\circ}\text{C}$ | boiling point<br>/ $^{\circ}\text{C}$ |
|----------|----------|------------------------------|---------------------------------------|---------------------------------------|
| <b>A</b> | hydrogen | $\text{H}_2$                 | -259                                  | -253                                  |
| <b>B</b> | methane  | $\text{CH}_4$                | -182                                  | -164                                  |
| <b>C</b> | octane   | $\text{C}_8\text{H}_{18}$    | -57                                   | 126                                   |
| <b>D</b> | wax      | $\text{C}_{31}\text{H}_{64}$ | 60                                    | 400                                   |

**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** When sulfur is heated it undergoes a .....1..... change as it melts.

Further heating causes the sulfur to undergo a .....2..... change and form sulfur dioxide.

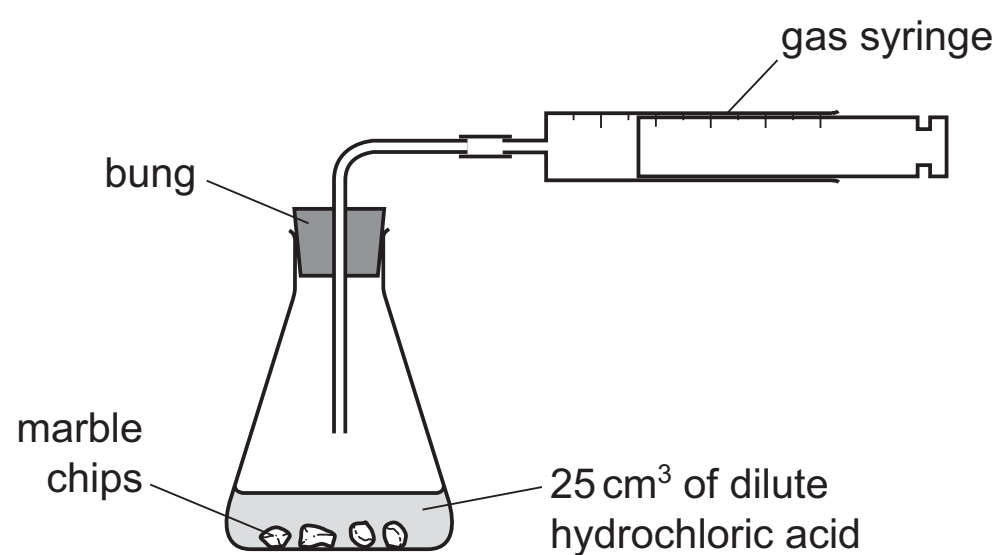
Which words complete gaps 1 and 2?

|          | 1        | 2        |
|----------|----------|----------|
| <b>A</b> | chemical | chemical |
| <b>B</b> | chemical | physical |
| <b>C</b> | physical | chemical |
| <b>D</b> | physical | physical |

**14** Which row correctly matches the experiment and observations to the identity of the underlined substance?

|          | experiment and observations                                                      | identity of the underlined substance |
|----------|----------------------------------------------------------------------------------|--------------------------------------|
| <b>A</b> | <u>Blue crystals</u> are heated. The crystals turn white and steam is given off. | hydrated cobalt(II) chloride         |
| <b>B</b> | <u>Pink crystals</u> are heated. The crystals turn blue and steam is given off.  | anhydrous cobalt(II) chloride        |
| <b>C</b> | Water is added to a <u>blue solid</u> .<br>The blue solid turns pink.            | hydrated copper(II) sulfate          |
| <b>D</b> | Water is added to a <u>white solid</u> .<br>The white solid turns blue.          | anhydrous copper(II) sulfate         |

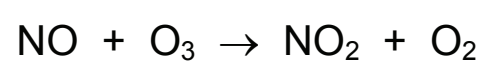
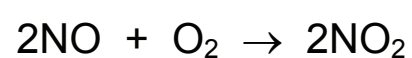
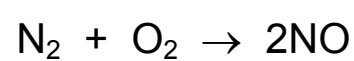
- 15** A student was investigating the reaction between marble chips and dilute hydrochloric acid.



Which changes slow down the rate of reaction?

|          | temperature of acid | concentration of acid | surface area of marble chips |
|----------|---------------------|-----------------------|------------------------------|
| <b>A</b> | decrease            | decrease              | decrease                     |
| <b>B</b> | decrease            | decrease              | increase                     |
| <b>C</b> | increase            | decrease              | decrease                     |
| <b>D</b> | increase            | increase              | increase                     |

- 16** The reactions shown may occur in the air during a thunder-storm.



Which row shows what happens to the reactant molecules in each of these reactions?

|          | $\text{N}_2$ | $\text{NO}$ | $\text{O}_3$ |
|----------|--------------|-------------|--------------|
| <b>A</b> | oxidised     | oxidised    | oxidised     |
| <b>B</b> | oxidised     | oxidised    | reduced      |
| <b>C</b> | reduced      | reduced     | oxidised     |
| <b>D</b> | reduced      | reduced     | reduced      |

**17** Hydrochloric acid is added to magnesium metal and to sodium carbonate in separate tests.

Which row shows the observations?

|          | magnesium metal | sodium carbonate |
|----------|-----------------|------------------|
| <b>A</b> | effervescence   | effervescence    |
| <b>B</b> | effervescence   | no reaction      |
| <b>C</b> | no reaction     | effervescence    |
| <b>D</b> | no reaction     | no reaction      |

**18** Which oxide dissolves in water to form a basic solution?

- A** carbon dioxide
- B** nitrogen dioxide
- C** sodium oxide
- D** sulfur dioxide

**19** Which salt preparation uses a burette and a pipette?

- A** calcium nitrate from calcium carbonate and nitric acid
- B** copper(II) sulfate from copper(II) hydroxide and sulfuric acid
- C** potassium chloride from potassium hydroxide and hydrochloric acid
- D** zinc chloride from zinc and hydrochloric acid

**20** Substance X reacts with warm dilute hydrochloric acid to produce a gas which decolourises acidified aqueous potassium manganate(VII).

Substance X gives a yellow flame in a flame test.

What is X?

- A** potassium chloride
- B** potassium sulfite
- C** sodium chloride
- D** sodium sulfite

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

Which element is a soft solid that reacts violently with cold water?

[illegible]

**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** An element has the following properties.

- It forms coloured compounds.
- It acts as a catalyst.
- It melts at  $1539^{\circ}\text{C}$ .

In which part of the Periodic Table is the element found?

- A** Group I
- B** Group VII
- C** Group VIII
- D** transition elements

**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 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

26 Some reactions of three metals and their oxides are shown.

| metal | metal reacts with dilute hydrochloric acid | metal oxide reacts with carbon |
|-------|--------------------------------------------|--------------------------------|
| S     | no                                         | yes                            |
| T     | yes                                        | no                             |
| U     | yes                                        | yes                            |

What is the order of reactivity of the metals?

|          | least reactive | → | most reactive |
|----------|----------------|---|---------------|
| <b>A</b> | S              | T | U             |
| <b>B</b> | S              | U | T             |
| <b>C</b> | T              | S | U             |
| <b>D</b> | U              | T | S             |

27 Which statement about the extraction of iron in a blast furnace is **not** correct?

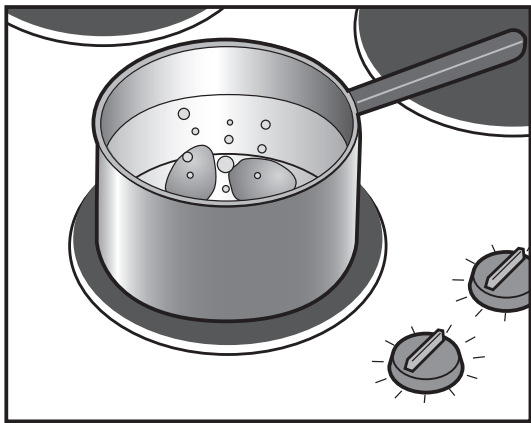
- A** Calcium oxide reacts with acidic impurities.
- B** Iron(III) oxide is reduced to iron by carbon dioxide.
- C** Molten iron is formed at the base of the blast furnace.
- D** The raw materials are hematite, limestone and coke.

- 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.

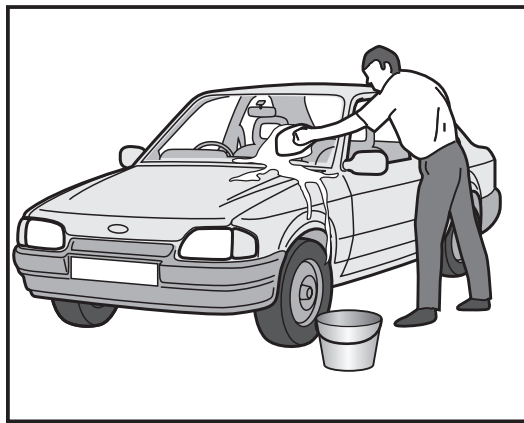
What is **not** made from stainless steel?

- 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



2



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** Which gas is colourless and poisonous?
- A** carbon monoxide
  - B** chlorine
  - C** hydrogen
  - D** nitrogen

31 Two experiments involving water are described.

- 1 Water turns purple when potassium manganate(VII) is added to it.
- 2 Adding water to sodium causes the temperature to increase.

Which row describes the role of water in 1 and 2?

|          | 1                     | 2                     |
|----------|-----------------------|-----------------------|
| <b>A</b> | as a chemical reagent | as a chemical reagent |
| <b>B</b> | as a chemical reagent | as a solvent          |
| <b>C</b> | as a solvent          | as a chemical reagent |
| <b>D</b> | as a solvent          | as a solvent          |

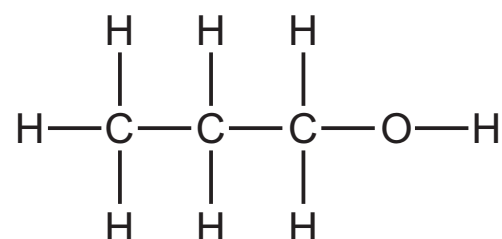
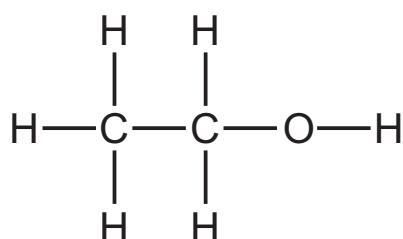
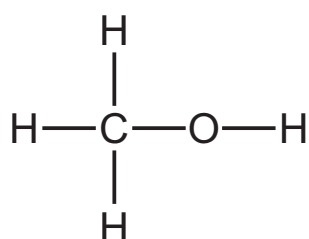
32 In which process is carbon dioxide **not** formed?

- A** burning of natural gas
- B** fermentation
- C** heating lime
- D** respiration

33 Which statement is **not** correct?

- A** Converting limestone into lime is a thermal decomposition reaction.
- B** Flue gas desulfurisation is a neutralisation reaction.
- C** In the extraction of iron, calcium carbonate is converted into calcium oxide.
- D** Slaked lime is added to soil as a fertiliser.

34 The structures of three substances are shown.



Why do these substances all belong to the same homologous series?

- A** They are all compounds.
- B** They are all saturated.
- C** They all contain oxygen.
- D** They all contain the same functional group.

**35** Which fraction of petroleum is **not** matched to its correct use?

|          | fraction | use               |
|----------|----------|-------------------|
| <b>A</b> | bitumen  | making roads      |
| <b>B</b> | gasoline | fuel for cars     |
| <b>C</b> | kerosene | fuel for ships    |
| <b>D</b> | naphtha  | chemical industry |

**36** Cracking is an important process in the petroleum industry.

The products of cracking include .....1..... and an .....2..... of .....3..... relative molecular mass than the .....4..... that was cracked.

Which words complete gaps 1, 2, 3 and 4?

|          | 1        | 2      | 3       | 4      |
|----------|----------|--------|---------|--------|
| <b>A</b> | hydrogen | alkane | greater | alkene |
| <b>B</b> | hydrogen | alkene | smaller | alkane |
| <b>C</b> | steam    | alkane | greater | alkene |
| <b>D</b> | steam    | alkene | smaller | alkane |

**37** Which compound rapidly decolourises aqueous bromine?

- A** ethane
- B** ethanoic acid
- C** ethanol
- D** ethene

**38** There are two methods for producing ethanol.

method 1      catalytic addition of steam to ethene

method 2      fermentation

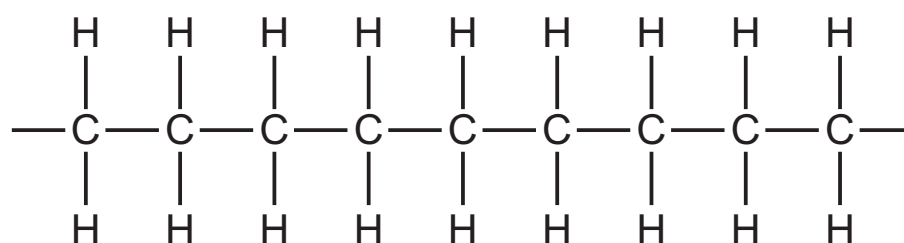
Which statement is **not** correct?

- A** Method 1 produces carbon dioxide.
- B** Method 1 requires high temperature and pressure.
- C** Method 2 produces carbon dioxide.
- D** Method 2 requires a source of sugar.

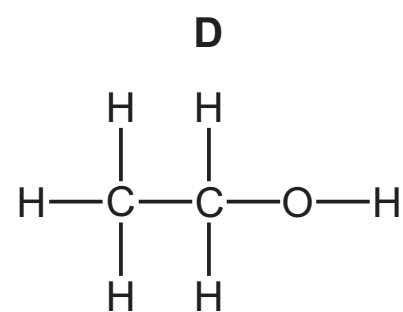
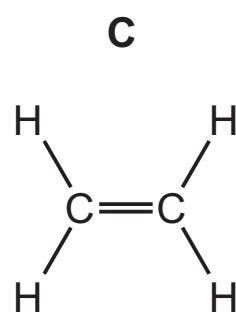
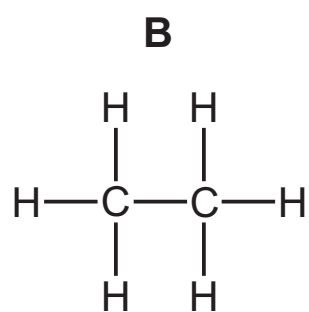
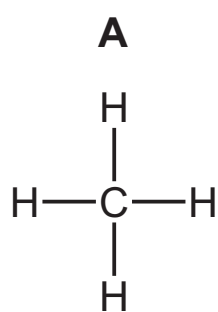
39 Which statement about aqueous ethanoic acid is **not** correct?

- A** It produces carbon dioxide when it reacts with magnesium carbonate.
- B** It produces hydrogen when it reacts with magnesium.
- C** It neutralises magnesium oxide.
- D** It turns red litmus paper blue.

40 The diagram shows part of the molecule of a polymer.



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



**BLANK PAGE**

**BLANK PAGE**

---

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge International Examinations Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at [www.cie.org.uk](http://www.cie.org.uk) after the live examination series.

Cambridge International Examinations is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.

The Periodic Table of Elements

| Group                  |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|------------------------|-------------------------|----------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|-------------------------|--------------------------|-------------------------|--------------------------|--------------------------|----------------------------|---------------------------|---------------------------|------|
| I                      | II                      |                                                                                                                                        |                             |                         |                          |                         | III                      | IV                       | V                          | VI                        | VII                       | VIII |
|                        |                         | <div><div>1Hhydrogen1</div><div><div>Key</div><div>atomic number<br/>atomic symbol<br/>name<br/>relative atomic mass</div></div></div> |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
| 3Li<br>lithium<br>7    | 4Be<br>beryllium<br>9   |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
| 11Na<br>sodium<br>23   | 12Mg<br>magnesium<br>24 |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
| 19K<br>potassium<br>39 | 20Ca<br>calcium<br>40   | 21Sc<br>scandium<br>45                                                                                                                 | 22Ti<br>titanium<br>48      | 23V<br>vanadium<br>51   | 24Cr<br>chromium<br>52   | 25Mn<br>manganese<br>55 | 26Fe<br>iron<br>56       | 27Co<br>cobalt<br>59     | 28Ni<br>nickel<br>59       | 29Cu<br>copper<br>64      | 30Zn<br>zinc<br>65        |      |
| 37Rb<br>rubidium<br>85 | 38Sr<br>strontium<br>88 | 39Y<br>yttrium<br>89                                                                                                                   | 40Zr<br>zirconium<br>91     | 41Nb<br>niobium<br>93   | 42Mo<br>molybdenum<br>96 | 43Tc<br>technetium<br>– | 44Ru<br>ruthenium<br>101 | 45Rh<br>rhodium<br>103   | 46Pd<br>palladium<br>106   | 47Ag<br>silver<br>108     | 48Cd<br>cadmium<br>112    |      |
| 55Cs<br>caesium<br>133 | 56Ba<br>barium<br>137   | 57–71<br>lanthanoids                                                                                                                   | 72Hf<br>hafnium<br>178      | 73Ta<br>tantalum<br>181 | 74W<br>tungsten<br>184   | 75Re<br>rhenium<br>186  | 76Os<br>osmium<br>190    | 77Ir<br>iridium<br>192   | 78Pt<br>platinum<br>195    | 79Au<br>gold<br>197       | 80Hg<br>mercury<br>201    |      |
| 87Fr<br>francium<br>–  | 88Ra<br>radium<br>–     | 89–103<br>actinoids                                                                                                                    | 104Rf<br>rutherfordium<br>– | 105Db<br>dubnium<br>–   | 106Sg<br>seaborgium<br>– | 107Bh<br>bohrium<br>–   | 108Hs<br>hassium<br>–    | 109Mt<br>meitnerium<br>– | 110Ds<br>darmstadtium<br>– | 111Rg<br>roentgenium<br>– | 112Cn<br>copernicium<br>– |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
|                        |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |
| </                     |                         |                                                                                                                                        |                             |                         |                          |                         |                          |                          |                            |                           |                           |      |



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

**CHEMISTRY**

Paper 1 Multiple Choice (Core)

**0620/12**

**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 **14** printed pages and **2** blank pages.



1 Four statements about the arrangement of particles are given.

- 1 Particles are packed in a regular arrangement.
- 2 Particles are randomly arranged.
- 3 Particles move over each other.
- 4 Particles vibrate about fixed points.

Which statements describe the particles in a solid?

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

2 A student needs to measure four different volumes of a solution accurately. The volumes are  $10\text{ cm}^3$ ,  $25\text{ cm}^3$ ,  $50\text{ cm}^3$  and  $60\text{ cm}^3$ .

The apparatus available includes a  $25\text{ cm}^3$  pipette.

Which volumes could be measured using this pipette?

- A**  $10\text{ cm}^3$  and  $25\text{ cm}^3$   
**B**  $25\text{ cm}^3$  and  $50\text{ cm}^3$   
**C**  $25\text{ cm}^3$  only  
**D**  $50\text{ cm}^3$  and  $60\text{ cm}^3$

3 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 |
|----------|---------------|---------------|
| <b>A</b> | increases     | increases     |
| <b>B</b> | increases     | decreases     |
| <b>C</b> | decreases     | increases     |
| <b>D</b> | decreases     | decreases     |

- 4 The table shows the solubility of four substances, W, X, Y and Z, in ethanol and in water.

| substance | solubility in ethanol | solubility in water |
|-----------|-----------------------|---------------------|
| W         | insoluble             | insoluble           |
| X         | insoluble             | soluble             |
| Y         | soluble               | insoluble           |
| Z         | soluble               | soluble             |

Two methods of separation are given.

- method 1: add the substance to ethanol and then filter
- method 2: add the substance to water and then filter

Which substances can be separated from each other by both method 1 and method 2?

- A** W and X      **B** X and Y      **C** X and Z      **D** Y and Z

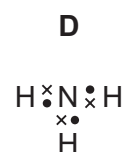
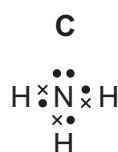
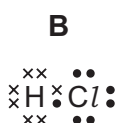
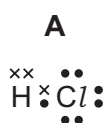
- 5 Q and R are elements in the same period of the Periodic Table.

Q has 7 electrons in its outer shell and R has 2 electrons in its outer shell.

Which statement about Q and R is correct?

- A** Q is a metal and R is a non-metal.  
**B** Q and R have different numbers of electron shells.  
**C** R is found to the right of Q in the Periodic Table.  
**D** The proton number of R is less than the proton number of Q.

- 6 Which electron arrangement for the outer shell electrons in a covalent compound is correct?



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

- A** aluminium  
**B** chlorine  
**C** phosphorus  
**D** potassium

- 8 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 |
|----------|----------|---------|
| <b>A</b> | 3        | 3       |
| <b>B</b> | 3        | 4       |
| <b>C</b> | 4        | 3       |
| <b>D</b> | 4        | 4       |

- 9 When chlorine reacts with hot concentrated aqueous sodium hydroxide one of the products formed is sodium chlorate(V).

The formula of sodium chlorate(V) is  $\text{NaClO}_3$ .

What is the relative formula mass of sodium chlorate(V),  $\text{NaClO}_3$ ?

- A** 52.0                      **B** 74.5                      **C** 106.5                      **D** 223.5

- 10 Concentrated aqueous sodium chloride can be electrolysed.

Which statement is correct?

- A** Hydrogen gas is formed at the anode, and chlorine gas is formed at the cathode.  
**B** Hydrogen gas is formed at the cathode, and chlorine gas is formed at the anode.  
**C** Sodium metal is formed at the anode, and chlorine gas is formed at the cathode.  
**D** Sodium metal is formed at the cathode, and chlorine gas is formed at the anode.

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

Which type of change is this?

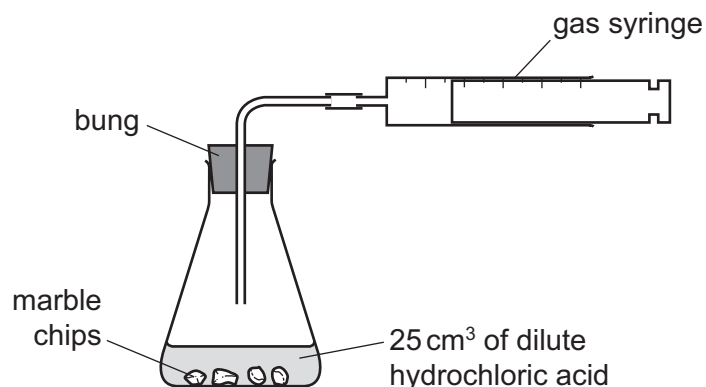
- A** chemical
- B** exothermic
- C** physical
- D** separation

**14** X is a white solid which dissolves in water to give a blue solution.

What is X?

- A** anhydrous cobalt(II) chloride
- B** anhydrous copper(II) sulfate
- C** hydrated cobalt(II) chloride
- D** hydrated copper(II) sulfate

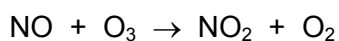
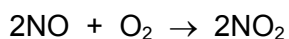
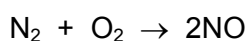
- 15 A student was investigating the reaction between marble chips and dilute hydrochloric acid.



Which changes slow down the rate of reaction?

|          | temperature of acid | concentration of acid | surface area of marble chips |
|----------|---------------------|-----------------------|------------------------------|
| <b>A</b> | decrease            | decrease              | decrease                     |
| <b>B</b> | decrease            | decrease              | increase                     |
| <b>C</b> | increase            | decrease              | decrease                     |
| <b>D</b> | increase            | increase              | increase                     |

- 16 The reactions shown may occur in the air during a thunder-storm.



Which row shows what happens to the reactant molecules in each of these reactions?

|          | $\text{N}_2$ | $\text{NO}$ | $\text{O}_3$ |
|----------|--------------|-------------|--------------|
| <b>A</b> | oxidised     | oxidised    | oxidised     |
| <b>B</b> | oxidised     | oxidised    | reduced      |
| <b>C</b> | reduced      | reduced     | oxidised     |
| <b>D</b> | reduced      | reduced     | reduced      |

17 When compound P is added to sodium carbonate, carbon dioxide is produced.

When compound Q is added to ammonium chloride, ammonia is produced.

What are P and Q?

|          | P       | Q       |
|----------|---------|---------|
| <b>A</b> | a base  | a base  |
| <b>B</b> | a base  | an acid |
| <b>C</b> | an acid | a base  |
| <b>D</b> | an acid | an acid |

18 Which oxide is suitable for treating acidic soil?

- A** calcium oxide
- B** carbon dioxide
- C** phosphorus oxide
- D** silicon(IV) oxide

19 Which salt preparation uses a burette and a pipette?

- A** calcium nitrate from calcium carbonate and nitric acid
- B** copper(II) sulfate from copper(II) hydroxide and sulfuric acid
- C** potassium chloride from potassium hydroxide and hydrochloric acid
- D** zinc chloride from zinc and hydrochloric acid

20 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         |
|----------|------------------|--------------------|
| <b>A</b> | $\text{Ba}^{2+}$ | $\text{CO}_3^{2-}$ |
| <b>B</b> | $\text{Ca}^{2+}$ | $\text{Cl}^-$      |
| <b>C</b> | $\text{Cu}^{2+}$ | $\text{CO}_3^{2-}$ |
| <b>D</b> | $\text{Fe}^{2+}$ | $\text{NO}_3^-$    |

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

Which element is a metal?

A simplified periodic table grid is shown, consisting of a 6x12 grid of squares. The grid is divided into four main sections by a vertical line between the 4th and 5th columns and a horizontal line between the 2nd and 3rd rows. The sections are: a 2x2 block in the top-left, a 2x6 block in the top-right, a 4x6 block in the bottom-left, and a 4x6 block in the bottom-right. The elements are marked as follows: 'A' is in the top-right section, specifically in the 1st row, 10th column. 'B' is in the bottom-right section, specifically in the 2nd row, 8th column. 'C' is in the bottom-left section, specifically in the 3rd row, 10th column. 'D' is in the bottom-right section, specifically in the 4th row, 11th column.

**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** An element has the following properties.

- It forms coloured compounds.
- It acts as a catalyst.
- It melts at  $1539^{\circ}\text{C}$ .

In which part of the Periodic Table is the element found?

- A** Group I  
**B** Group VII  
**C** Group VIII  
**D** transition elements

**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 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

26 Calcium, copper, iron and magnesium are metals. They can be placed in order of reactivity.

Which statement is correct?

- A Copper reacts with dilute hydrochloric acid to form copper(II) chloride.
- B Iron reacts with steam but magnesium does not.
- C Iron(II) oxide cannot be reduced by heating strongly with carbon.
- D Magnesium and calcium both react with hot water.

27 Steel is manufactured from the iron produced in a blast furnace.

Which statement about the manufacture of iron and steel is **not** correct?

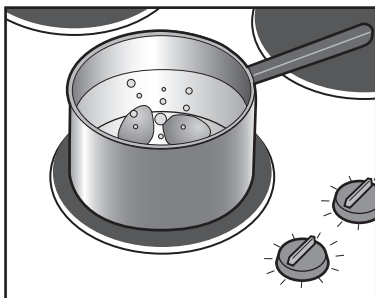
- A In a blast furnace, acidic impurities are removed by adding a basic oxide.
- B In a blast furnace, calcium oxide is added to remove basic impurities.
- C Oxygen is passed into the molten iron from a blast furnace to remove carbon impurities.
- D The molten iron from a blast furnace contains traces of other elements such as phosphorus.

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.

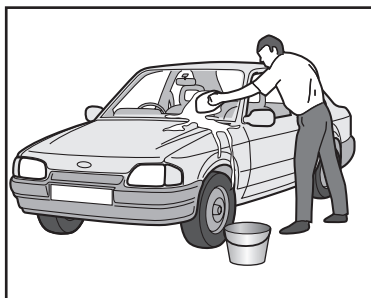
What is **not** made from stainless steel?

- 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



2



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 Which gas in the air is needed for iron to rust?

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

31 A solid fertiliser contains ammonium sulfate.

A sample of the fertiliser is shaken with water.

To show the presence of ammonium ions in the solution, .....1..... is added and the gas produced is tested with damp .....2..... litmus paper.

Which words complete gaps 1 and 2?

|          | 1                        | 2    |
|----------|--------------------------|------|
| <b>A</b> | aqueous sodium hydroxide | blue |
| <b>B</b> | aqueous sodium hydroxide | red  |
| <b>C</b> | dilute hydrochloric acid | blue |
| <b>D</b> | dilute hydrochloric acid | red  |

32 In which process is carbon dioxide **not** formed?

- A burning of natural gas
- B fermentation
- C heating lime
- D respiration

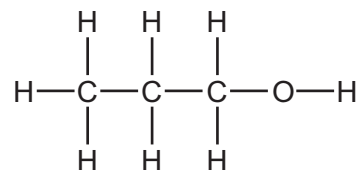
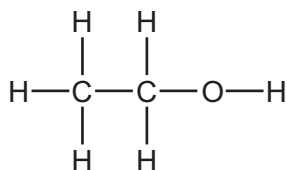
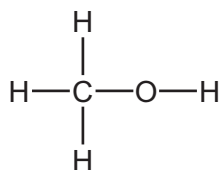
33 Statements about methods of manufacture and uses of calcium oxide are shown.

- 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

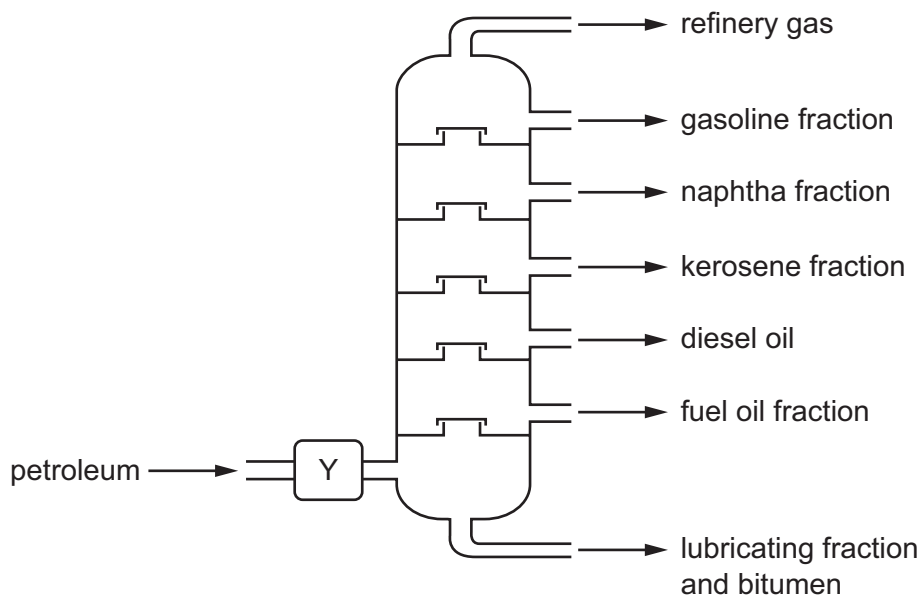
34 The structures of three substances are shown.



Why do these substances all belong to the same homologous series?

- A They are all compounds.
- B They are all saturated.
- C They all contain oxygen.
- D They all contain the same functional group.

35 The industrial fractional distillation of petroleum is shown.



Which process happens at Y?

- A burning
- B condensation
- C cracking
- D evaporation

36 Two reactions are shown.

- 1 butane  $\rightarrow$  ethene
- 2 ethene  $\rightarrow$  ethanol

Which terms describe reactions 1 and 2?

|   | 1            | 2          |
|---|--------------|------------|
| A | cracking     | addition   |
| B | cracking     | combustion |
| C | distillation | addition   |
| D | distillation | combustion |

37 Ethene is a hydrocarbon.

Which row shows the type of bond between the carbon atoms in ethene, and the effect of ethene on aqueous bromine?

|          | type of bond | effect of ethene on aqueous bromine     |
|----------|--------------|-----------------------------------------|
| <b>A</b> | single bond  | colour changes from brown to colourless |
| <b>B</b> | single bond  | colour changes from colourless to brown |
| <b>C</b> | double bond  | colour changes from brown to colourless |
| <b>D</b> | double bond  | colour changes from colourless to brown |

38 Poly(ethene), nylon and *Terylene* are all polymers.

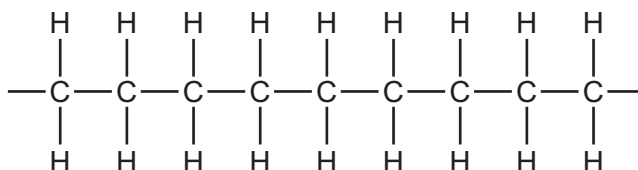
From which small units are all polymers made?

- A** alkenes
- B** monomers
- C** plastics
- D** proteins

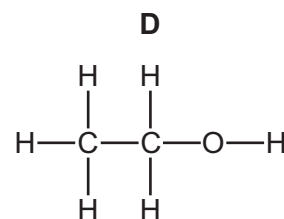
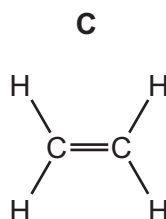
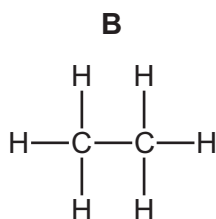
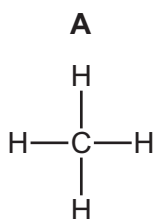
39 Which property is a property of aqueous ethanoic acid?

- A** It rapidly decolourises aqueous bromine.
- B** It has a sweet smell.
- C** It reacts with magnesium ribbon.
- D** It turns red litmus blue.

40 The diagram shows part of the molecule of a polymer.



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



**BLANK PAGE**

**BLANK PAGE**

---

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge International Examinations Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at [www.cie.org.uk](http://www.cie.org.uk) after the live examination series.

Cambridge International Examinations is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.

The Periodic Table of Elements

| Group                                                                                                 |                             |                                                                    |                             |                                 |                              |                              |                              |                            |                              |                                |                               |                               |                             |                             |                               |                              |                           |                        |
|-------------------------------------------------------------------------------------------------------|-----------------------------|--------------------------------------------------------------------|-----------------------------|---------------------------------|------------------------------|------------------------------|------------------------------|----------------------------|------------------------------|--------------------------------|-------------------------------|-------------------------------|-----------------------------|-----------------------------|-------------------------------|------------------------------|---------------------------|------------------------|
| I                                                                                                     | II                          |                                                                    |                             |                                 |                              |                              |                              |                            |                              |                                |                               | III                           | IV                          | V                           | VI                            | VII                          | VIII                      |                        |
| <div><div>Key</div><div>atomic number<br/>atomic symbol<br/>name<br/>relative atomic mass</div></div> |                             | <div><div>1</div><div>H</div><div>hydrogen</div><div>1</div></div> |                             |                                 |                              |                              |                              |                            |                              |                                |                               |                               |                             |                             |                               |                              |                           |                        |
|                                                                                                       |                             |                                                                    |                             |                                 |                              |                              |                              |                            |                              |                                |                               |                               |                             |                             |                               |                              |                           |                        |
|                                                                                                       |                             |                                                                    |                             |                                 |                              |                              |                              |                            |                              |                                |                               |                               |                             |                             |                               |                              |                           |                        |
| 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

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.).



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

**CHEMISTRY**

Paper 1 Multiple Choice (Core)

**0620/13**

**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.

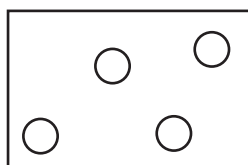
Electronic calculators may be used.

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

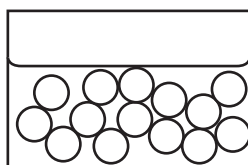
This document consists of **13** printed pages and **3** blank pages.



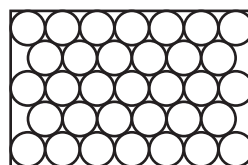
- 1 Diagrams R, S and T represent the three states of matter.



R



S



T

Which change occurs during freezing?

- A**  $R \rightarrow S$       **B**  $S \rightarrow T$       **C**  $T \rightarrow R$       **D**  $T \rightarrow S$

- 2 A student needs to measure  $22\text{ cm}^3$  of water at  $40^\circ\text{C}$ .

Which apparatus is required?

- A** beaker and stopwatch  
**B** beaker and thermometer  
**C** measuring cylinder and stopwatch  
**D** measuring cylinder and thermometer
- 3 A compound, X, has a melting point of  $71^\circ\text{C}$  and a boiling point of  $375^\circ\text{C}$ .
- Which statement about X is correct?
- A** It is a liquid at  $52^\circ\text{C}$  and a gas at  $175^\circ\text{C}$ .  
**B** It is a liquid at  $69^\circ\text{C}$  and a gas at  $380^\circ\text{C}$ .  
**C** It is a liquid at  $75^\circ\text{C}$  and a gas at  $350^\circ\text{C}$ .  
**D** It is a liquid at  $80^\circ\text{C}$  and a gas at  $400^\circ\text{C}$ .
- 4 Which method is used to obtain a concentrated solution of ethanol from a dilute solution of ethanol dissolved in water?
- A** crystallisation  
**B** distillation  
**C** filtration  
**D** paper chromatography

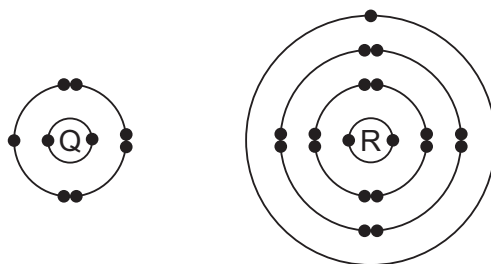
5 Which definition of isotopes is correct?

- A atoms of the same element that have the same number of electrons and nucleons
- B atoms of the same element that have the same number of neutrons and protons
- C atoms of the same element that have the same number of protons but a different number of electrons
- D atoms of the same element that have the same number of protons but a different number of nucleons

6 Which statement about a molecule of ammonia,  $\text{NH}_3$ , is correct?

- A Each hydrogen atom donates a pair of electrons to a nitrogen atom.
- B There are double covalent bonds between the nitrogen atom and the hydrogen atoms.
- C There are single covalent bonds between its hydrogen atoms.
- D There are three shared pairs of electrons in the molecule.

7 The electronic structures of atoms Q and R are shown.



Q and R form an ionic compound.

What is the formula of the compound?

- A  $\text{QR}_7$
- B  $\text{Q}_2\text{R}_4$
- C QR
- D  $\text{Q}_7\text{R}$

8 Which substance is a macromolecule?

- A ammonia
- B carbon dioxide
- C diamond
- D water

9 What is the relative formula mass of aluminium oxide,  $\text{Al}_2\text{O}_3$ ?

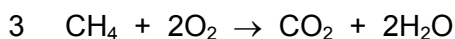
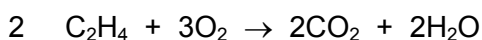
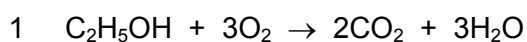
- A 43
- B 70
- C 102
- D 113

- 10 Which products are initially obtained at each electrode during the electrolysis of concentrated aqueous sodium chloride?

|          | cathode  | anode    |
|----------|----------|----------|
| <b>A</b> | hydrogen | chlorine |
| <b>B</b> | hydrogen | oxygen   |
| <b>C</b> | sodium   | chlorine |
| <b>D</b> | sodium   | oxygen   |

- 11 Heat energy is produced when hydrocarbons burn in air.

Which equations represent this statement?



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

- 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 Which changes are physical changes?

1 melting ice to form water

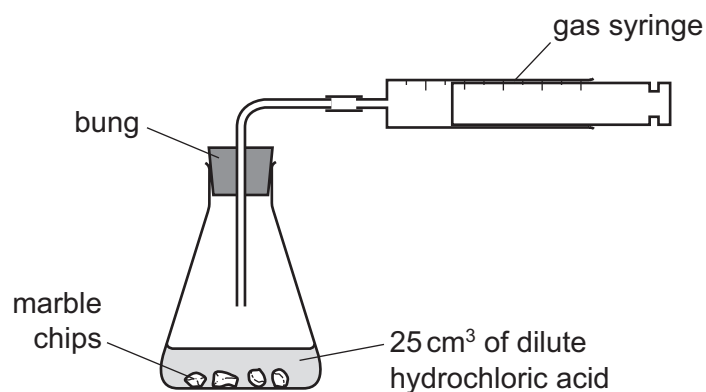
2 burning hydrogen to form water

3 adding sodium to water

4 boiling water to form steam

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

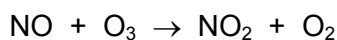
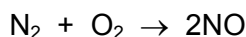
- 14 Which colour change is seen when hydrated cobalt(II) chloride is heated so that it becomes anhydrous cobalt(II) chloride?
- A blue to pink  
B blue to white  
C pink to blue  
D white to blue
- 15 A student was investigating the reaction between marble chips and dilute hydrochloric acid.



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 reactions shown may occur in the air during a thunder-storm.



Which row shows what happens to the reactant molecules in each of these reactions?

|          | $\text{N}_2$ | $\text{NO}$ | $\text{O}_3$ |
|----------|--------------|-------------|--------------|
| <b>A</b> | oxidised     | oxidised    | oxidised     |
| <b>B</b> | oxidised     | oxidised    | reduced      |
| <b>C</b> | reduced      | reduced     | oxidised     |
| <b>D</b> | reduced      | reduced     | reduced      |

17 Three separate experiments are carried out on a solution of substance X.

- 1 A gas is produced when X is heated with ammonium chloride.
- 2 Methyl orange is yellow when added to X.
- 3 There is no reaction between X and sodium carbonate.

Which type of substance is X?

- A** acid
- B** base
- C** indicator
- D** salt

18 Farmers spread slaked lime (calcium hydroxide) on their fields to neutralise soils that are too acidic for crops to grow well.

Which ion in slaked lime neutralises the acid in the soil?

- A**  $\text{Ca}^{2+}$       **B**  $\text{H}^+$       **C**  $\text{O}^{2-}$       **D**  $\text{OH}^-$

19 Which salt preparation uses a burette and a pipette?

- A** calcium nitrate from calcium carbonate and nitric acid
- B** copper(II) sulfate from copper(II) hydroxide and sulfuric acid
- C** potassium chloride from potassium hydroxide and hydrochloric acid
- D** zinc chloride from zinc and hydrochloric acid

- 20** Aqueous sodium hydroxide reacts with an aqueous solution of compound Y to give a green precipitate.

Aqueous ammonia also reacts with an aqueous solution of compound Y to give a green precipitate.

In each case the precipitate is insoluble when an excess of reagent is added.

Which ion is present in Y?

- A** chromium(III)
- B** copper(II)
- C** iron(II)
- D** iron(III)

- 21** Period 3 of the Periodic Table is shown.

|    |    |    |    |   |   |    |    |
|----|----|----|----|---|---|----|----|
| Na | Mg | Al | Si | P | S | Cl | Ar |
|----|----|----|----|---|---|----|----|

What increases from left to right across Period 3?

- A** density
  - B** melting point
  - C** non-metallic character
  - D** the number of electron shells
- 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** An element has the following properties.

- It forms coloured compounds.
- It acts as a catalyst.
- It melts at 1539 °C.

In which part of the Periodic Table is the element found?

- A** Group I
- B** Group VII
- C** Group VIII
- D** transition elements

**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** 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

26 Which row shows how the metal reacts?

|          | metal     | reacts with dilute acid | reacts rapidly with cold water | reacts with steam |
|----------|-----------|-------------------------|--------------------------------|-------------------|
| <b>A</b> | calcium   | x                       | ✓                              | ✓                 |
| <b>B</b> | copper    | ✓                       | x                              | x                 |
| <b>C</b> | magnesium | ✓                       | x                              | ✓                 |
| <b>D</b> | zinc      | ✓                       | x                              | x                 |

27 Which statement about the extraction of iron from hematite is correct?

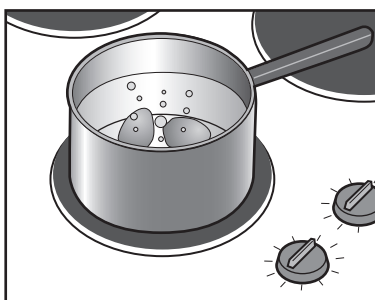
- A** Air is blown into the blast furnace to oxidise the molten iron.
- B** Carbon dioxide is reduced by coke to carbon monoxide.
- C** Hematite is oxidised by carbon to molten iron.
- D** The slag produced is denser than molten iron.

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.

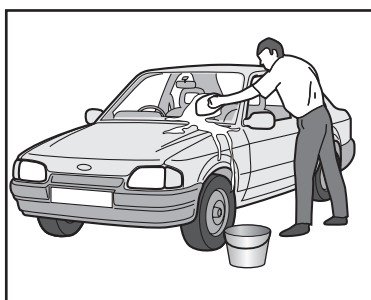
What is **not** made from stainless steel?

- A** cutlery
- B** pipes in a chemical factory
- C** railway lines
- D** saucepans

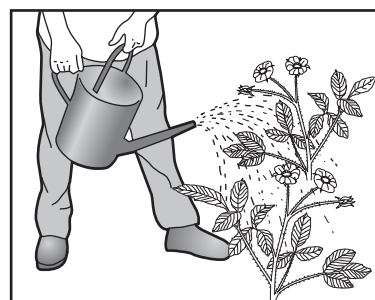
29 The diagram shows some uses of water in the home.



1



2



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 Which pollutant gas **cannot** be produced by the combustion of fossil fuels (coal, petroleum and natural gas)?

- A carbon monoxide
- B methane
- C nitrogen dioxide
- D sulfur dioxide

31 A farmer wrongly adds two substances to the soil at the same time.

They react together to form a gas which turns damp red litmus blue.

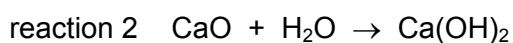
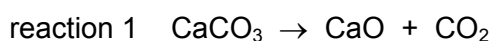
What are the two substances?

- A a basic oxide and a potassium salt
- B a basic oxide and an ammonium salt
- C an acidic oxide and a potassium salt
- D an acidic oxide and an ammonium salt

32 In which process is carbon dioxide **not** formed?

- A burning of natural gas
- B fermentation
- C heating lime
- D respiration

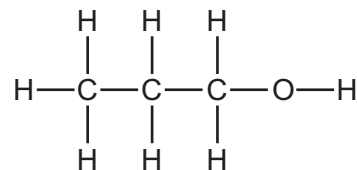
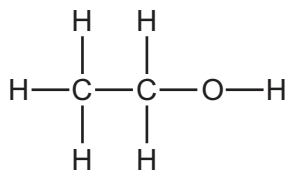
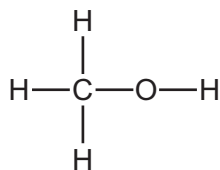
33 Two equations are shown.



Which terms describe reactions 1 and 2?

|   | reaction 1            | reaction 2 |
|---|-----------------------|------------|
| A | reduction             | hydration  |
| B | reduction             | hydrolysis |
| C | thermal decomposition | hydration  |
| D | thermal decomposition | hydrolysis |

34 The structures of three substances are shown.



Why do these substances all belong to the same homologous series?

- A They are all compounds.
- B They are all saturated.
- C They all contain oxygen.
- D They all contain the same functional group.

35 Fuel oil, gasoline, kerosene and naphtha are four fractions obtained from the fractional distillation of petroleum.

What is the order of the boiling points of these fractions?

|   | highest boiling point → lowest boiling point |
|---|----------------------------------------------|
| A | fuel oil → kerosene → gasoline → naphtha     |
| B | fuel oil → kerosene → naphtha → gasoline     |
| C | gasoline → naphtha → kerosene → fuel oil     |
| D | naphtha → gasoline → kerosene → fuel oil     |

36 Which process produces alkenes from alkanes?

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

37 Poly(ethene) is made from ethene.

Ethene is .....1..... hydrocarbon because it contains a carbon to carbon .....2..... bond.

The general name given to small molecules that undergo polymerisation is .....3..... .

Which words complete gaps 1, 2 and 3?

|          | 1              | 2      | 3        |
|----------|----------------|--------|----------|
| <b>A</b> | an unsaturated | double | monomers |
| <b>B</b> | an unsaturated | single | alkenes  |
| <b>C</b> | a saturated    | double | alkenes  |
| <b>D</b> | a saturated    | single | monomers |

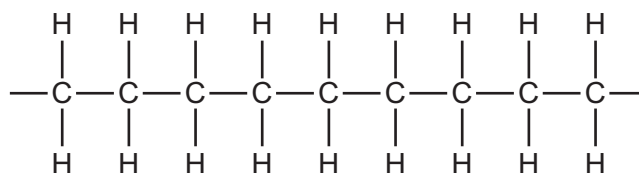
38 Which reaction is used to manufacture ethanol?

- A** reacting ethane with oxygen in the presence of a catalyst
- B** reacting ethane with steam in the presence of a catalyst
- C** reacting ethene with steam in the presence of a catalyst
- D** reacting glucose with steam in the presence of a catalyst

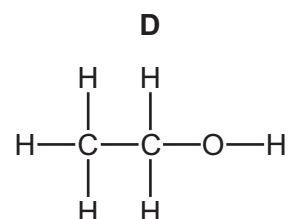
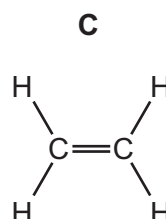
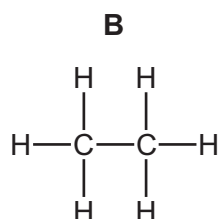
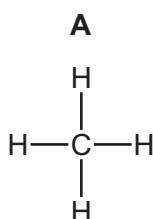
39 Which statement about aqueous ethanoic acid is **not** correct?

- A** It effervesces with sodium carbonate.
- B** It neutralises aqueous sodium hydroxide.
- C** It turns blue litmus from blue to red.
- D** It turns methyl orange from orange to yellow.

40 The diagram shows part of the molecule of a polymer.



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



**BLANK PAGE**

**BLANK PAGE**

**BLANK PAGE**

---

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge International Examinations Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at [www.cie.org.uk](http://www.cie.org.uk) after the live examination series.

Cambridge International Examinations is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.

## The Periodic Table of Elements

| Group                                |                                       |                                                                                            |                                           |                                       |                                        |                                       |                                        |                                        |                                          |                                         |                                         |                                       |                                       |                                       |                                         |                                     |                                     |                                       |
|--------------------------------------|---------------------------------------|--------------------------------------------------------------------------------------------|-------------------------------------------|---------------------------------------|----------------------------------------|---------------------------------------|----------------------------------------|----------------------------------------|------------------------------------------|-----------------------------------------|-----------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|-----------------------------------------|-------------------------------------|-------------------------------------|---------------------------------------|
| I                                    | II                                    | <div>1<div>Hhydrogen1</div></div>                                                          |                                           |                                       |                                        |                                       |                                        |                                        |                                          |                                         |                                         | III                                   | IV                                    | V                                     | VI                                      | VII                                 | VIII                                |                                       |
| 3 <div>Li<br/>lithium<br/>7</div>    | 4 <div>Be<br/>beryllium<br/>9</div>   | <div>Key<div>atomic number<br/>atomic symbol<br/>name<br/>relative atomic mass</div></div> |                                           |                                       |                                        |                                       |                                        |                                        |                                          |                                         |                                         |                                       |                                       |                                       |                                         |                                     |                                     | 2 <div>He<br/>helium<br/>4</div>      |
|                                      | 11 <div>Na<br/>sodium<br/>23</div>    |                                                                                            |                                           |                                       |                                        |                                       |                                        |                                        |                                          |                                         |                                         |                                       |                                       |                                       |                                         |                                     |                                     | 12 <div>Mg<br/>magnesium<br/>24</div> |
| 19 <div>K<br/>potassium<br/>39</div> | 20 <div>Ca<br/>calcium<br/>40</div>   | 21 <div>Sc<br/>scandium<br/>45</div>                                                       | 22 <div>Ti<br/>titanium<br/>48</div>      | 23 <div>V<br/>vanadium<br/>51</div>   | 24 <div>Cr<br/>chromium<br/>52</div>   | 25 <div>Mn<br/>manganese<br/>55</div> | 26 <div>Fe<br/>iron<br/>56</div>       | 27 <div>Co<br/>cobalt<br/>59</div>     | 28 <div>Ni<br/>nickel<br/>59</div>       | 29 <div>Cu<br/>copper<br/>64</div>      | 30 <div>Zn<br/>zinc<br/>65</div>        | 31 <div>Ga<br/>gallium<br/>70</div>   | 32 <div>Ge<br/>germanium<br/>73</div> | 33 <div>As<br/>arsenic<br/>75</div>   | 34 <div>Se<br/>selenium<br/>79</div>    | 35 <div>Br<br/>bromine<br/>80</div> | 36 <div>Kr<br/>krypton<br/>84</div> |                                       |
| 37 <div>Rb<br/>rubidium<br/>85</div> | 38 <div>Sr<br/>strontium<br/>88</div> | 39 <div>Y<br/>yttrium<br/>89</div>                                                         | 40 <div>Zr<br/>zirconium<br/>91</div>     | 41 <div>Nb<br/>niobium<br/>93</div>   | 42 <div>Mo<br/>molybdenum<br/>96</div> | 43 <div>Tc<br/>technetium<br/>—</div> | 44 <div>Ru<br/>ruthenium<br/>101</div> | 45 <div>Rh<br/>rhodium<br/>103</div>   | 46 <div>Pd<br/>palladium<br/>106</div>   | 47 <div>Ag<br/>silver<br/>108</div>     | 48 <div>Cd<br/>cadmium<br/>112</div>    | 49 <div>In<br/>indium<br/>115</div>   | 50 <div>Sn<br/>tin<br/>119</div>      | 51 <div>Sb<br/>antimony<br/>122</div> | 52 <div>Te<br/>tellurium<br/>128</div>  | 53 <div>I<br/>iodine<br/>127</div>  | 54 <div>Xe<br/>xenon<br/>131</div>  |                                       |
| 55 <div>Cs<br/>caesium<br/>133</div> | 56 <div>Ba<br/>barium<br/>137</div>   | 57–71 <div>lanthanoids</div>                                                               | 72 <div>Hf<br/>hafnium<br/>178</div>      | 73 <div>Ta<br/>tantalum<br/>181</div> | 74 <div>W<br/>tungsten<br/>184</div>   | 75 <div>Re<br/>rhenium<br/>186</div>  | 76 <div>Os<br/>osmium<br/>190</div>    | 77 <div>Ir<br/>iridium<br/>192</div>   | 78 <div>Pt<br/>platinum<br/>195</div>    | 79 <div>Au<br/>gold<br/>197</div>       | 80 <div>Hg<br/>mercury<br/>201</div>    | 81 <div>Tl<br/>thallium<br/>204</div> | 82 <div>Pb<br/>lead<br/>207</div>     | 83 <div>Bi<br/>bismuth<br/>209</div>  | 84 <div>Po<br/>polonium<br/>—</div>     | 85 <div>At<br/>astatine<br/>—</div> | 86 <div>Rn<br/>radon<br/>—</div>    |                                       |
| 87 <div>Fr<br/>francium<br/>—</div>  | 88 <div>Ra<br/>radium<br/>—</div>     | 89–103 <div>actinoids</div>                                                                | 104 <div>Rf<br/>rutherfordium<br/>—</div> | 105 <div>Db<br/>dubnium<br/>—</div>   | 106 <div>Sg<br/>seaborgium<br/>—</div> | 107 <div>Bh<br/>bohrium<br/>—</div>   | 108 <div>Hs<br/>hassium<br/>—</div>    | 109 <div>Mt<br/>meitnerium<br/>—</div> | 110 <div>Ds<br/>darmstadtium<br/>—</div> | 111 <div>Rg<br/>roentgenium<br/>—</div> | 112 <div>Cn<br/>copernicium<br/>—</div> |                                       | 114 <div>Fl<br/>flerovium<br/>—</div> |                                       | 116 <div>Lv<br/>livermorium<br/>—</div> |                                     |                                     |                                       |

lanthanoids

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

actinoids

The volume of one mole of any gas is 24 dm<sup>3</sup> at room temperature and pressure (r.t.p.).