

# Cambridge IGCSE™

## CHEMISTRY

Paper 2 Multiple Choice (Extended)

0620/23

October/November 2021

45 minutes

You must answer on the multiple choice answer sheet.

You will need: Multiple choice answer sheet  
Soft clean eraser  
Soft pencil (type B or HB is recommended)

### INSTRUCTIONS

- 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 multiple choice answer sheet.
- Follow the instructions on the multiple choice answer sheet.
- Write in soft pencil.
- Write your name, centre number and candidate number on the multiple choice answer sheet in the spaces provided unless this has been done for you.
- Do **not** use correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.

### INFORMATION

- The total mark for this paper is 40.
- Each correct answer will score one mark.
- Any rough working should be done on this question paper.
- The Periodic Table is printed in the question paper.

This document has **16** pages.



- 1 Brownian motion and the diffusion of gases provide evidence for the particulate nature of matter.

Which row identifies an example of Brownian motion and how molecular mass determines the rate of diffusion of gas molecules?

|          | Brownian motion                                       | diffusion                                  |
|----------|-------------------------------------------------------|--------------------------------------------|
| <b>A</b> | pollen grains in water are seen to move randomly      | heavier gas molecules diffuse more quickly |
| <b>B</b> | pollen grains in water are seen to move randomly      | lighter gas molecules diffuse more quickly |
| <b>C</b> | salt dissolves faster in hot water than in cold water | heavier gas molecules diffuse more quickly |
| <b>D</b> | salt dissolves faster in hot water than in cold water | lighter gas molecules diffuse more quickly |

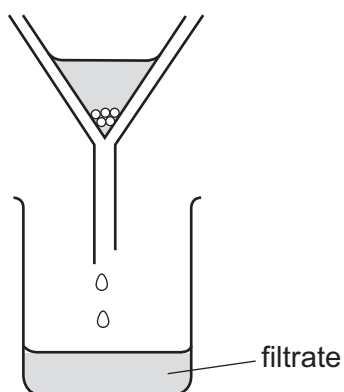
- 2 A student put exactly  $25.00\text{ cm}^3$  of dilute hydrochloric acid into a conical flask.

The student added 2.5 g of solid sodium carbonate and measured the change in temperature of the mixture.

Which apparatus does the student need to use?

- A** balance, measuring cylinder, thermometer
- B** balance, pipette, stopwatch
- C** balance, pipette, thermometer
- D** burette, pipette, thermometer

- 3 A student separates sugar from pieces of broken glass by dissolving the sugar in water and filtering off the broken glass.



What is the filtrate?

- A broken glass only
  - B broken glass and sugar solution
  - C pure water
  - D sugar solution
- 4 The nucleus of a particular atom consists of nineteen particles.
- Nine of them are positively charged and ten of them are uncharged.
- Which statement about this nucleus is correct?
- A The nucleus has a nucleon number of nine.
  - B The nucleus has a nucleon number of ten.
  - C The nucleus has a proton number of nine.
  - D The nucleus has a proton number of ten.
- 5 Which description of brass is correct?
- A alloy
  - B compound
  - C element
  - D non-metal

- 6 A Group I element combines with a Group VII element and forms an ionic bond.

Which row shows how the electronic structures change?

|          | Group I element |               | Group VII element |               |
|----------|-----------------|---------------|-------------------|---------------|
|          | before bonding  | after bonding | before bonding    | after bonding |
| <b>A</b> | 2,8,1           | 2,8,2         | 2,7               | 2,6           |
| <b>B</b> | 2,8             | 2,7           | 2,8               | 2,8,1         |
| <b>C</b> | 2,8,1           | 2,8           | 2,7               | 2,8           |
| <b>D</b> | 2,8             | 2,8,1         | 2,8               | 2,7           |

- 7 Which statement describes the attractive forces between molecules?

- A** They are strong covalent bonds which hold molecules together.  
**B** They are strong ionic bonds which hold molecules together.  
**C** They are weak forces formed between covalently-bonded molecules.  
**D** They are weak forces which hold ions together in a lattice.

- 8 Which diagram shows the outer electron arrangement in a molecule of carbon dioxide?



- 9 Aluminium oxide is an ionic compound containing  $Al^{3+}$  ions and  $O^{2-}$  ions.

Aluminium hydroxide is an ionic compound containing  $Al^{3+}$  ions and  $OH^{-}$  ions.

In which row are the formulae for aluminium oxide and aluminium hydroxide correct?

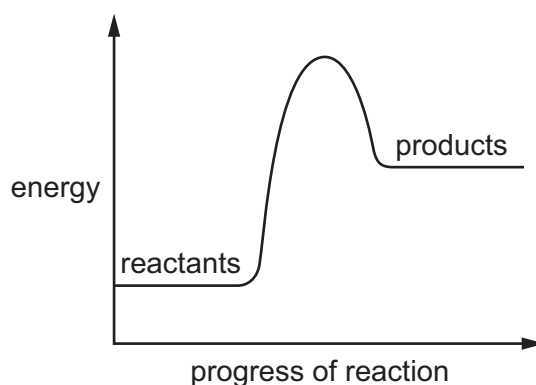
|          | aluminium oxide | aluminium hydroxide |
|----------|-----------------|---------------------|
| <b>A</b> | $Al_2O_3$       | $Al(OH)_3$          |
| <b>B</b> | $Al_3O_2$       | $AlOH_3$            |
| <b>C</b> | $Al_2O_3$       | $AlOH_3$            |
| <b>D</b> | $Al_3O_2$       | $Al(OH)_3$          |

- 10 Effervescence is observed at the negative electrode (cathode) during the electrolysis of concentrated aqueous sodium chloride.

Which element is produced at the negative electrode (cathode)?

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

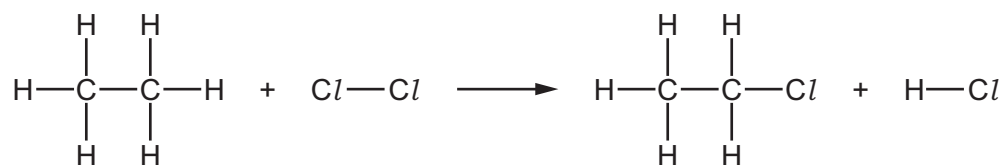
- 11 The energy level diagram for a chemical reaction is shown.



Which statement about this reaction is correct?

- A The reaction is endothermic and energy is given out to the surroundings.
- B The reaction is endothermic and energy is taken in from the surroundings.
- C The reaction is exothermic and energy is given out to the surroundings.
- D The reaction is exothermic and energy is taken in from the surroundings.

12 Chlorine reacts with ethane to produce chloroethane and hydrogen chloride.



The reaction is exothermic.

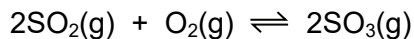
The bond energies are shown in the table.

| bond  | bond energy<br>in kJ/mol |
|-------|--------------------------|
| C-Cl  | +340                     |
| C-C   | +350                     |
| C-H   | +410                     |
| Cl-Cl | +240                     |
| H-Cl  | +430                     |

What is the energy change for the reaction?

- A** -1420 kJ/mol
- B** -120 kJ/mol
- C** +120 kJ/mol
- D** +1420 kJ/mol
- 13 What is the concentration of the solution when 31.8 g of sodium carbonate,  $\text{Na}_2\text{CO}_3$ , is dissolved in water to make a solution of  $250 \text{ cm}^3$ ?
- A**  $0.075 \text{ mol/dm}^3$
- B**  $0.30 \text{ mol/dm}^3$
- C**  $1.2 \text{ mol/dm}^3$
- D**  $1.5 \text{ mol/dm}^3$
- 14 A fuel cell is used to generate electricity.
- Which chemicals are used in a fuel cell?
- A** hydrogen and methane
- B** hydrogen and oxygen
- C** nitrogen and methane
- D** nitrogen and oxygen

- 15** Sulfuric acid is manufactured using the Contact process. One of the reactions is shown.



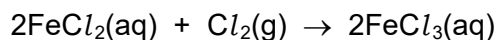
The forward reaction is exothermic.

- statement 1    The equation has more molecules on the left-hand side than on the right-hand side.
- statement 2    Using a higher pressure shifts the equilibrium to the left.
- statement 3    Higher temperatures increase the rate of reaction.
- statement 4    Increasing the temperature shifts the equilibrium to the right.

Which alternative is correct?

- A**   Statement 1 is correct and explains statement 2.
- B**   Statement 1 and statement 3 are correct.
- C**   Statement 2 and statement 4 are correct.
- D**   Statement 3 is correct and explains statement 4.
- 16** Iron(II) chloride solution reacts with chlorine gas.

The equation is shown.



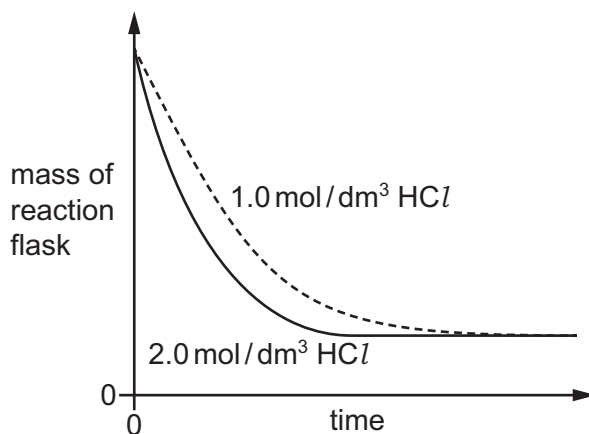
Which statements about this reaction are correct?

- 1     $\text{Fe}^{2+}$  ions are reduced to  $\text{Fe}^{3+}$  ions.
- 2    Chlorine acts as a reducing agent.
- 3     $\text{Fe}^{2+}$  ions each lose an electron.
- 4     $\text{Cl}_2$  molecules are reduced to  $\text{Cl}^-$  ions.
- A**   1 and 2                    **B**   2 and 3                    **C**   2 and 4                    **D**   3 and 4

- 17** Excess dilute hydrochloric acid is added to equal masses of powdered calcium carbonate in two separate experiments.

Two different concentrations of hydrochloric acid are used. The temperature in both experiments is the same.

The results show the change in mass of the reaction flask measured over time.



Why is the rate of reaction for the  $1.0 \text{ mol/dm}^3$  hydrochloric acid slower?

|          | collision energy                   | collision rate |
|----------|------------------------------------|----------------|
| <b>A</b> | lower                              | higher         |
| <b>B</b> | lower                              | lower          |
| <b>C</b> | same as for $2.0 \text{ mol/dm}^3$ | higher         |
| <b>D</b> | same as for $2.0 \text{ mol/dm}^3$ | lower          |

- 18** Basic oxides are neutralised by acidic oxides.

Which element forms an oxide that neutralises calcium oxide?

- A** hydrogen
- B** magnesium
- C** sodium
- D** sulfur

**19** Four solid oxides are added to dilute hydrochloric acid and aqueous sodium hydroxide.

Which row describes an amphoteric oxide?

|          | hydrochloric acid | sodium hydroxide |
|----------|-------------------|------------------|
| <b>A</b> | ✓                 | ✓                |
| <b>B</b> | x                 | ✓                |
| <b>C</b> | ✓                 | x                |
| <b>D</b> | x                 | x                |

key

✓ = reacts

x = does not react

**20** Which row describes an acid and an oxidising agent?

|          | acid            | oxidising agent   |
|----------|-----------------|-------------------|
| <b>A</b> | proton acceptor | electron acceptor |
| <b>B</b> | proton acceptor | electron donor    |
| <b>C</b> | proton donor    | electron acceptor |
| <b>D</b> | proton donor    | electron donor    |

**21** A period of the Periodic Table is shown.

| group   | I | II | III | IV | V | VI | VII | VIII |
|---------|---|----|-----|----|---|----|-----|------|
| element | R | S  | T   | V  | W | X  | Y   | Z    |

The letters are not their chemical symbols.

Which statement is correct?

- A** Element R does not conduct electricity.
- B** Elements R and Y react together to form an ionic compound.
- C** Element Z exists as a diatomic molecule.
- D** Element Z reacts with element T.



**26** Chromium is a more reactive metal than iron but less reactive than zinc.

Which statements are correct?

- 1 Chromium does not react with dilute hydrochloric acid.
- 2 Chromium oxide is reduced when it is heated with carbon.
- 3 Chromium reacts with zinc oxide to form zinc.
- 4 Chromium reacts with steam to form hydrogen gas.

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

**27** Aluminium objects do not need protection from corrosion.

Iron objects must be protected from corrosion.

Which statement explains why aluminium resists corrosion?

- A** Aluminium does not form ions easily.
- B** Aluminium does not react with water or air.
- C** Aluminium has a protective oxide layer.
- D** Aluminium is below iron in the reactivity series.

**28** Which statement describes how oxides of nitrogen are formed in a car engine?

- A** Nitrogen from the air reacts with oxygen from petrol.
- B** Nitrogen from the air reacts with oxygen from the air.
- C** Nitrogen from petrol reacts with oxygen from petrol.
- D** Nitrogen from petrol reacts with oxygen from the air.

**29** Ships are made of steel, an alloy of iron.

Blocks of magnesium are attached to the underside of ships to prevent rusting.

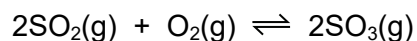
Which statement explains how the magnesium prevents rusting?

- A** Magnesium oxidises instead of iron.
- B** Magnesium stops air and water getting to the iron.
- C** The magnesium forms an alloy with iron which does not corrode.
- D** The magnesium reacts with rust as soon as it is formed.

30 Which process is used to produce hydrogen for the Haber process?

- A electrolysis of water
- B reacting aluminium with sodium hydroxide
- C reacting iron with sulfuric acid
- D reacting methane with steam

31 One of the steps in manufacturing sulfuric acid in the Contact process is shown.



Which catalyst is used to increase the rate of this reaction?

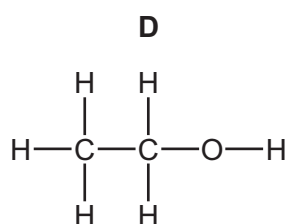
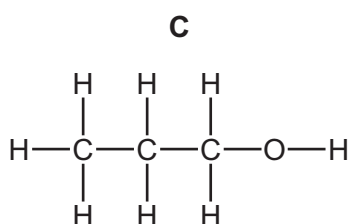
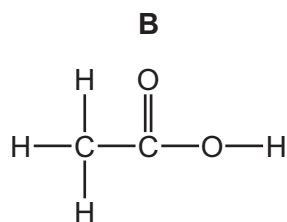
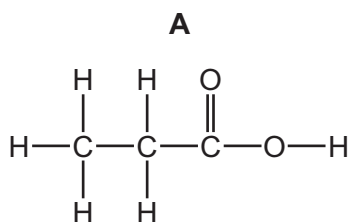
- A aluminium oxide
- B iron
- C phosphoric acid
- D vanadium(V) oxide

32 Lime (calcium oxide) is used to treat waste water from a factory.

Which substance is removed by the lime?

- A ammonia
- B sodium chloride
- C sodium hydroxide
- D sulfuric acid

33 What is the structure of propanol?



- 34 Fuel X produces carbon dioxide and water when it is burned in air. So does fuel Y.

What could X and Y be?

|          | X               | Y                              |
|----------|-----------------|--------------------------------|
| <b>A</b> | C               | H <sub>2</sub>                 |
| <b>B</b> | C               | C <sub>8</sub> H <sub>18</sub> |
| <b>C</b> | CH <sub>4</sub> | H <sub>2</sub>                 |
| <b>D</b> | CH <sub>4</sub> | C <sub>8</sub> H <sub>18</sub> |

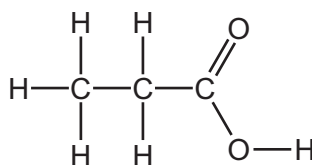
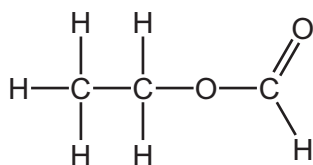
- 35 What is the main constituent of natural gas?

- A** hydrogen
- B** carbon monoxide
- C** methane
- D** nitrogen

- 36 Which statement describes the members of a homologous series?

- A** compounds with the same physical properties
- B** compounds containing the same functional group
- C** compounds containing the same number and type of bonds
- D** compounds obtained from the same raw material

- 37 The structures of two compounds are shown.

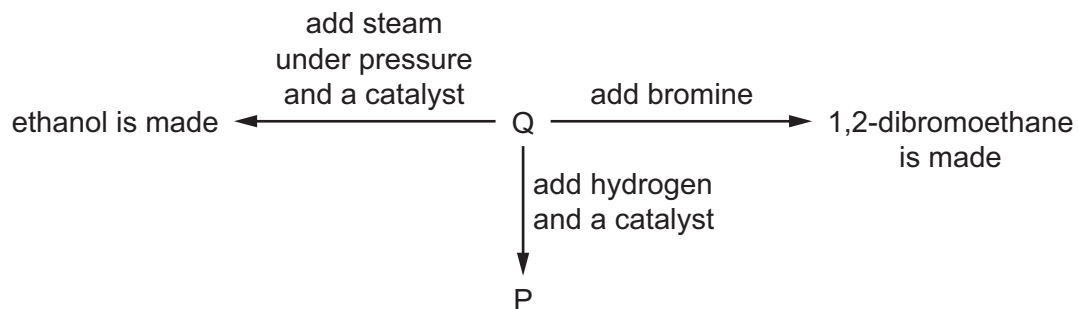


Which statements about these compounds are correct?

- 1 They have the same molecular formula.
- 2 They have similar chemical properties.
- 3 They are structural isomers.

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

38 Some reactions of substance Q are shown.



What is P?

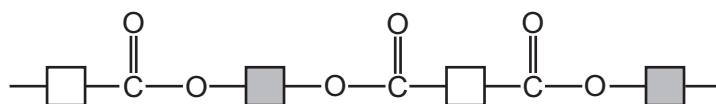
- A ethane
- B ethanoic acid
- C ethene
- D poly(ethene)

39 Proteins and starch are natural polymers.

Which row identifies the method of polymerisation of proteins and starch?

|   | proteins     | starch       |
|---|--------------|--------------|
| A | addition     | addition     |
| B | condensation | condensation |
| C | addition     | condensation |
| D | condensation | addition     |

40 The diagram shows the partial structure of *Terylene*.



From which pair of compounds is it made?

- A**  $\text{HO}-\text{C}(=\text{O})-\text{[white square]}-\text{C}(=\text{O})-\text{OH}$  +  $\text{HO}-\text{[grey square]}-\text{OH}$
- B**  $\text{HO}-\text{[white square]}-\text{C}(=\text{O})-\text{OH}$  +  $\text{HO}-\text{[grey square]}-\text{C}(=\text{O})-\text{OH}$
- C**  $\text{HO}-\text{[white square]}-\text{OH}$  +  $\text{HO}-\text{C}(=\text{O})-\text{[grey square]}-\text{C}(=\text{O})-\text{OH}$
- D**  $\text{HO}-\text{C}(=\text{O})-\text{[white square]}-\text{C}(=\text{O})-\text{OH}$  +  $\text{HO}-\text{C}(=\text{O})-\text{[grey square]}-\text{C}(=\text{O})-\text{OH}$

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The Periodic Table of Elements

| Group                      |                             |                                                                                             |                                 |                             |                              |                             |                              |                              |                                |                               |                               |                             |                               |                             |                              |                            |                                |
|----------------------------|-----------------------------|---------------------------------------------------------------------------------------------|---------------------------------|-----------------------------|------------------------------|-----------------------------|------------------------------|------------------------------|--------------------------------|-------------------------------|-------------------------------|-----------------------------|-------------------------------|-----------------------------|------------------------------|----------------------------|--------------------------------|
| I                          | II                          | 1<br>H<br>hydrogen<br>1                                                                     |                                 |                             |                              |                             |                              |                              |                                |                               |                               | III                         | IV                            | V                           | VI                           | VII                        | VIII                           |
| 3<br>Li<br>lithium<br>7    | 4<br>Be<br>beryllium<br>9   | <div>Key</div> <div>atomic number<br/>atomic symbol<br/>name<br/>relative atomic mass</div> |                                 |                             |                              |                             |                              |                              |                                |                               |                               | 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    |                                                                                             |                                 |                             |                              |                             |                              |                              |                                |                               |                               |                             |                               |                             |                              |                            |                                |
| 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>— | 118<br>Og<br>oganesson<br>— | 119<br>Ts<br>tennessine<br>— | 120<br>Nh<br>nihonium<br>— | 121<br>Ds<br>darmstadtium<br>— |

lanthanoids

actinoids

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