



Cambridge IGCSE™

CHEMISTRY

0620/22

Paper 2 Multiple Choice (Extended)

May/June 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.

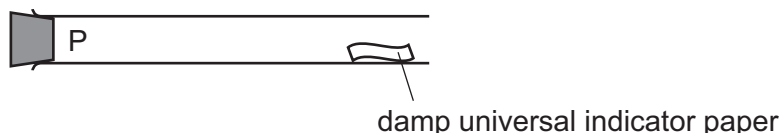
INFORMATION

- 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. Any blank pages are indicated.



- 1 A gas is released at point P in the apparatus shown.



Which gas turns the damp universal indicator paper red most quickly?

- A ammonia, NH_3
 - B chlorine, Cl_2
 - C hydrogen chloride, HCl
 - D sulfur dioxide, SO_2
- 2 A mixture of colourless compounds is separated using chromatography.
- Which type of reagent is used to detect these compounds after separation?
- A a dehydrating agent
 - B a locating agent
 - C an oxidising agent
 - D a reducing agent
- 3 Which statement about paper chromatography is correct?
- A A solvent is needed to dissolve the paper.
 - B Paper chromatography separates mixtures of solvents.
 - C The solvent should cover the baseline.
 - D The baseline should be drawn in pencil.
- 4 Element X has 7 protons.
- Element Y has 8 more protons than X.
- Which statement about element Y is correct?
- A Y has more electron shells than X.
 - B Y has more electrons in its outer shell than X.
 - C Y is in a different group of the Periodic Table from X.
 - D Y is in the same period of the Periodic Table as X.

- 5 A covalent molecule Q contains only six shared electrons.

What is Q?

- A ammonia, NH_3
- B chlorine, Cl_2
- C methane, CH_4
- D water, H_2O

- 6 Information about four substances E, F, G and H is shown.

| | melting point / °C | electrical conductivity |
|---|--------------------|-----------------------------|
| E | 1710 | does not conduct when solid |
| F | 3500 | conducts when solid |
| G | 120 | does not conduct |
| H | 801 | conducts when molten |

E, F, G and H are graphite, poly(ethene), sodium chloride and silicon(IV) oxide but not in that order.

What are E, F, G and H?

| | E | F | G | H |
|----------|-------------------|-----------------|-------------------|-------------------|
| A | graphite | poly(ethene) | silicon(IV) oxide | sodium chloride |
| B | sodium chloride | graphite | poly(ethene) | silicon(IV) oxide |
| C | poly(ethene) | sodium chloride | graphite | silicon(IV) oxide |
| D | silicon(IV) oxide | graphite | poly(ethene) | sodium chloride |

- 7 Chemical compounds formed from a Group I element and a Group VII element contain ionic bonds.

How are the ionic bonds formed?

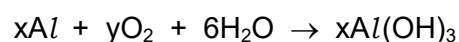
- A Electrons are transferred from Group VII atoms to Group I atoms.
- B Electrons are shared between Group I atoms and Group VII atoms.
- C Electrons are lost by Group I atoms and Group VII atoms.
- D Electrons are transferred from Group I atoms to Group VII atoms.

- 8 Some information about particles P, Q, R and S is shown.

| | nucleon number | number of neutrons | number of electrons |
|---|----------------|--------------------|---------------------|
| P | 12 | 6 | 6 |
| Q | 24 | 12 | 10 |
| R | 16 | 8 | 10 |
| S | 14 | 8 | 6 |

Which two particles are isotopes of the same element?

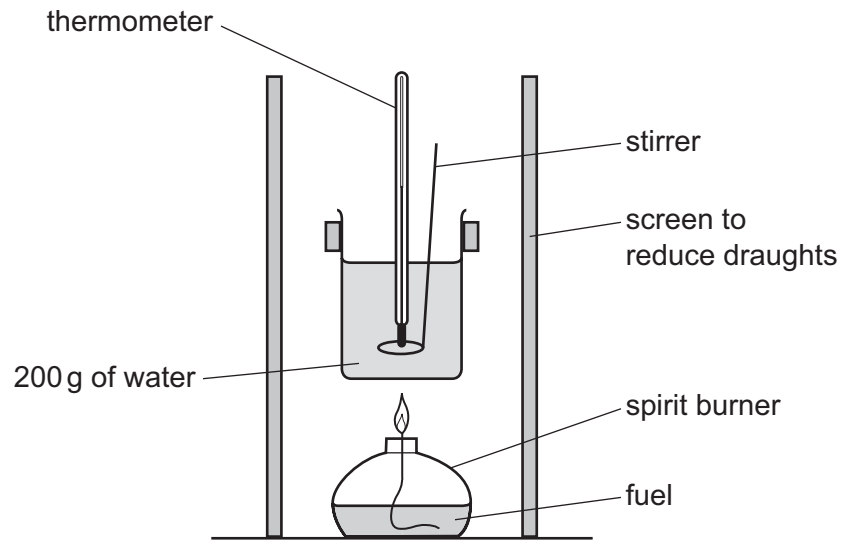
- A** P and Q **B** P and S **C** Q and R **D** R and S
- 9 Chlorine gas will react with iron metal.
- Exactly 21.3 g of chlorine reacts with 11.2 g of iron.
- How many iron atoms react with 30 molecules of chlorine?
- A** 10 **B** 15 **C** 20 **D** 30
- 10 In separate experiments, electricity was passed through concentrated aqueous sodium chloride and molten lead(II) bromide.
- What would happen in **both** experiments?
- A** A halogen would be formed at the anode.
B A metal would be formed at the cathode.
C Hydrogen would be formed at the anode.
D Hydrogen would be formed at the cathode.
- 11 A reaction involving aluminium is shown.



Which values of x and y balance the equation?

| | x | y |
|----------|---|---|
| A | 2 | 3 |
| B | 3 | 2 |
| C | 3 | 4 |
| D | 4 | 3 |

- 12 Four different fuels are used to heat a beaker of water, for the same amount of time, using the apparatus shown.



The initial temperature of the water and the temperature after heating by the fuel are recorded.

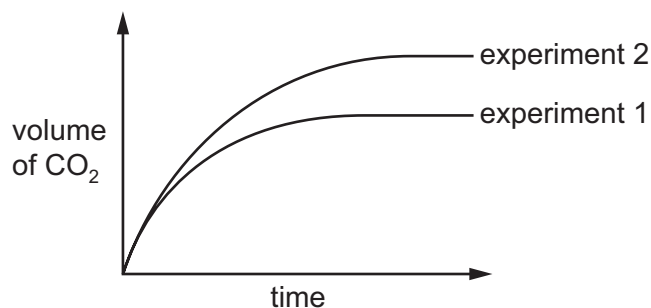
Which fuel releases the most heat energy?

| | initial temperature /°C | temperature after heating /°C |
|----------|----------------------------|----------------------------------|
| A | 17 | 46 |
| B | 24 | 52 |
| C | 26 | 61 |
| D | 30 | 62 |

- 13 An excess of calcium carbonate reacts with dilute hydrochloric acid. The volume of carbon dioxide produced is measured at regular time intervals. The results are shown as experiment 1.

The experiment is repeated with only **one** change to the reaction conditions.

The results are shown as experiment 2.



Which change is made in experiment 2?

- A The concentration of the acid is increased.
 - B The volume of acid is increased.
 - C The mass of calcium carbonate is increased.
 - D The calcium carbonate is powdered.
- 14 When sulfur is heated it undergoes a1..... change as it melts.

Further heating causes the sulfur to undergo a2..... change and form sulfur dioxide.

Which words complete gaps 1 and 2?

| | 1 | 2 |
|----------|----------|----------|
| A | chemical | chemical |
| B | chemical | physical |
| C | physical | chemical |
| D | physical | physical |

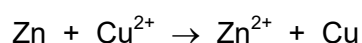
15 Four statements about the effect of increasing temperature on a reaction are shown.

- 1 The activation energy becomes lower.
- 2 The particles move faster.
- 3 There are more collisions between reacting particles per second.
- 4 There are more collisions which have energy greater than the activation energy.

Which statements are correct?

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

16 An example of a redox reaction is shown.



Which statement about the reaction is correct?

- A** Zn is the oxidising agent and it oxidises Cu^{2+} .
B Zn is the oxidising agent and it reduces Cu^{2+} .
C Zn is the reducing agent and it oxidises Cu^{2+} .
D Zn is the reducing agent and it reduces Cu^{2+} .

17 When bismuth(III) chloride, BiCl_3 , reacts with water, a white precipitate of bismuth(III) oxychloride, BiOCl , is formed. The equation for the reaction is shown.



The reaction is in equilibrium.

Which changes cause the white precipitate to dissolve?

- 1 adding acid
- 2 adding water
- 3 adding sodium chloride solution

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

18 Element X forms an oxide, XO, that neutralises sulfuric acid.

Which row describes X and XO?

| | element X | nature of oxide, XO |
|----------|-----------|---------------------|
| A | metal | acidic |
| B | metal | basic |
| C | non-metal | acidic |
| D | non-metal | basic |

19 Information about the solubility of salts is shown.

| salt | solubility |
|-----------|--|
| chlorides | soluble (except for lead(II) chloride and silver chloride) |
| nitrates | soluble |
| sulfates | soluble (except for barium sulfate and lead(II) sulfate) |

Aqueous solutions of which two compounds would produce a precipitate when added together?

- A** $\text{Ba}(\text{NO}_3)_2$ and CaCl_2
- B** CuSO_4 and $\text{Zn}(\text{NO}_3)_2$
- C** KCl and Na_2SO_4
- D** $\text{Pb}(\text{NO}_3)_2$ and MgSO_4

20 The equation shows the reaction between hydrogen and oxygen.



The bond energies are shown.

| | bond energy in kJ/mol |
|-----|--------------------------|
| H-H | 436 |
| O=O | 495 |
| O-H | 463 |

Which row shows the energy change and the type of reaction?

| | energy change in kJ/mol | type of reaction |
|----------|----------------------------|------------------|
| A | 441 | exothermic |
| B | 441 | endothermic |
| C | 485 | exothermic |
| D | 485 | endothermic |

21 Burning fossil fuels releases sulfur dioxide which leads to acid rain.

Which ion in the rain water causes it to be acidic?

- A** H^+ **B** OH^- **C** O^{2-} **D** SO_4^{2-}

22 Which statement about the trends shown by the elements of Period 3 in the Periodic Table is **not** correct?

- A** The elements become less metallic across the period.
B The group number increases across the period.
C The number of electron shells increases across the period.
D The number of outer electrons increases across the period.

23 The diagram shows the positions of elements E, F, G and H in the Periodic Table.

| | | | | | | | | | | | | | | | | | | |
|---|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
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| | | | | | | | | | | | | | | | | | | |
| E | | | | | | | | | | | | | | | | | | |
| F | | | | | | | | | | | | | | | | | | |

Which statements about elements E, F, G and H are correct?

- 1 E has a higher density than F.
- 2 E has a higher melting point than F.
- 3 G has a darker colour than H.
- 4 G has a lower melting point than H.

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

24 When aqueous iodine is added to a solution of vanadium ions, V^{2+} , the V^{2+} ions each lose one electron.

Which property of transition elements is shown by this reaction?

- A** Transition elements have variable oxidation states.
- B** Transition elements form a stable 1+ ion.
- C** Transition elements are oxidising agents.
- D** Transition elements can act as catalysts.

25 A piece of aluminium is dropped into dilute hydrochloric acid.

No immediate reaction is observed.

Which statement explains this observation?

- A** Aluminium does not neutralise acids.
- B** Aluminium is a non-metal so does not react with acids.
- C** Aluminium is below hydrogen in the reactivity series.
- D** Aluminium is covered in an unreactive oxide layer.

- 26 Some metal nitrates and carbonates decompose when heated strongly.

Metal Q has a nitrate that decomposes to give a salt and a colourless gas only.

The carbonate of metal Q does not decompose when heated with a Bunsen burner.

What is metal Q?

- A calcium
- B copper
- C sodium
- D zinc

- 27 Aluminium is extracted from its ore by electrolysis.

Which equation represents the reaction that occurs at the anode during the electrolysis?

- A $Al^{3+} + 3e^{-} \rightarrow Al$
- B $Al^{3+} \rightarrow Al + 3e^{-}$
- C $2O^{2-} \rightarrow O_2 + 4e^{-}$
- D $2O^{2-} + 2e^{-} \rightarrow O_2$

- 28 Mild steel consists mostly of iron. Mild steel can be prevented from rusting by a process called galvanising.

Copper is not a very strong metal, however if it is mixed with a suitable metal a strong alloy called brass is produced.

Which statement is correct?

- A Copper corrodes very quickly when wet and brass does not.
- B Copper is mixed with zinc to produce brass.
- C Galvanising mild steel changes it from a pure metal into an alloy.
- D When a steel object is galvanised this means it is coated with a thin layer of tin.

- 29 Water is used for the irrigation of crops and for drinking water.

For which uses must water be chlorinated?

| | irrigation | drinking |
|----------|------------|----------|
| A | ✓ | ✓ |
| B | ✓ | x |
| C | x | ✓ |
| D | x | x |

30 Which natural resource **cannot** provide a raw material for the manufacture of ammonia?

- A air
- B limestone
- C petroleum
- D water

31 Ammonia is made in the Haber process.

Which conditions are used in the Haber process?

| | temperature /°C | pressure /atmospheres | catalyst used |
|----------|--------------------|--------------------------|-------------------|
| A | 450 | 200 | iron |
| B | 450 | 5 | vanadium(V) oxide |
| C | 200 | 450 | iron |
| D | 200 | 5 | vanadium(V) oxide |

32 Which process in the carbon cycle is responsible for removing carbon dioxide from the atmosphere?

- A combustion
- B decomposition
- C photosynthesis
- D respiration

33 The equations represent two reactions, P and Q, of lime (calcium oxide).

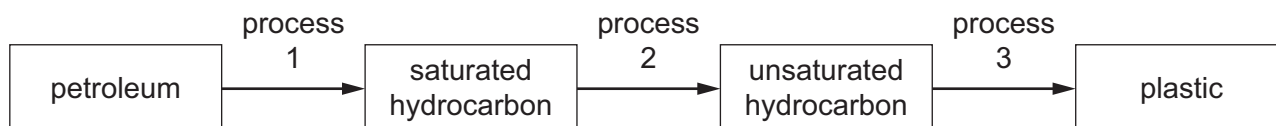


In which processes do the reactions occur?

| | P | Q |
|----------|--------------------------|--------------------------|
| A | extraction of iron | extraction of iron |
| B | extraction of iron | flue gas desulfurisation |
| C | flue gas desulfurisation | extraction of iron |
| D | flue gas desulfurisation | flue gas desulfurisation |

- 34 Which statement about ethanol is **not** correct?
- A Ethanol can be made by fermentation.
 - B Ethanol is oxidised to make ethanoic acid.
 - C Ethanol reacts with oxygen exothermically, making it a good fuel.
 - D Ethanol reacts with propanoic acid to make propyl ethanoate.
- 35 Which pair of formulae represents two alkanes?
- A CH_4 and C_8H_{18}
 - B C_2H_6 and C_5H_8
 - C C_3H_6 and C_5H_{12}
 - D C_{10}H_8 and C_4H_8
- 36 Which statement about alkanes is correct?
- A They burn in oxygen.
 - B They contain carbon, hydrogen and oxygen atoms.
 - C They contain double bonds.
 - D They contain ionic bonds.
- 37 Which statements about ethanoic acid are correct?
- 1 It is a strong acid.
 - 2 It reacts with ethanol to form an ester.
 - 3 It has the formula CH_3COOH .
- A 1 and 2 only B 1 and 3 only C 2 and 3 only D 1, 2 and 3

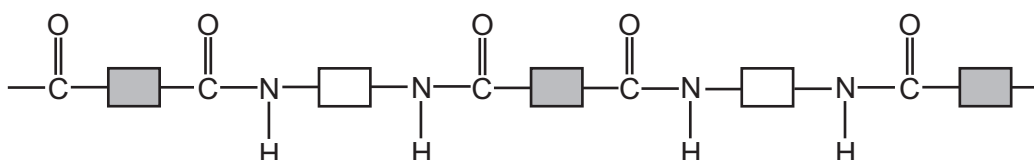
38 The flow chart shows how petroleum may be turned into a plastic.



What are processes 1, 2 and 3?

| | process 1 | process 2 | process 3 |
|----------|-------------------------|-------------------------|-------------------------|
| A | cracking | fractional distillation | polymerisation |
| B | cracking | polymerisation | fractional distillation |
| C | fractional distillation | cracking | polymerisation |
| D | fractional distillation | polymerisation | cracking |

39 The structure of a synthetic polymer is shown.



The structure shows that it is a1..... . It is formed by2..... polymerisation.

Which words complete gaps 1 and 2?

| | 1 | 2 |
|----------|-----------|--------------|
| A | polyamide | addition |
| B | polyamide | condensation |
| C | polyester | addition |
| D | polyester | condensation |

40 Which substance is a natural polymer?

- A** ethene
- B** *Terylene*
- C** nylon
- D** protein

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The Periodic Table of Elements

| | | Group | | | | | | | | | | | | | | | | |
|----------------------------|-----------------------------|-----------------------------|---------------------------------|-----------------------------|------------------------------|------------------------------|------------------------------|--|--------------------------------|-------------------------------|-------------------------------|-----------------------------|-------------------------------|------------------------------|------------------------------|---------------------------|---------------------------|--|
| I | II | III | IV | V | VI | VII | VIII | | | | | VIII | | | | | | |
| 3 Li lithium 7 | 4 Be beryllium 9 | 5 B boron 11 | 6 C carbon 12 | 7 N nitrogen 14 | 8 O oxygen 16 | 9 F fluorine 19 | 10 Ne neon 20 | <p>Key</p> <p>atomic number atomic symbol name relative atomic mass</p> | | | | 2 He helium 4 | | | | | | |
| 11 Na sodium 23 | 12 Mg magnesium 24 | 13 Al aluminium 27 | 14 Si silicon 28 | 15 P phosphorus 31 | 16 S sulfur 32 | 17 Cl chlorine 35.5 | 18 Ar argon 40 | | | | | | | | | | | |
| 19 K potassium 39 | 20 Ca calcium 40 | 21 Sc scandium 45 | 22 Ti titanium 48 | 23 V vanadium 51 | 24 Cr chromium 52 | 25 Mn manganese 55 | 26 Fe iron 56 | 27 Co cobalt 59 | 28 Ni nickel 59 | 29 Cu copper 64 | 30 Zn zinc 65 | 31 Ga gallium 70 | 32 Ge germanium 73 | 33 As arsenic 75 | 34 Se selenium 79 | 35 Br bromine 80 | 36 Kr krypton 84 | |
| 37 Rb rubidium 85 | 38 Sr strontium 88 | 39 Y yttrium 89 | 40 Zr zirconium 91 | 41 Nb niobium 93 | 42 Mo molybdenum 96 | 43 Tc technetium - | 44 Ru ruthenium 101 | 45 Rh rhodium 103 | 46 Pd palladium 106 | 47 Ag silver 108 | 48 Cd cadmium 112 | 49 In indium 115 | 50 Sn tin 119 | 51 Sb antimony 122 | 52 Te tellurium 128 | 53 I iodine 127 | 54 Xe xenon 131 | |
| 55 Cs caesium 133 | 56 Ba barium 137 | 57-71 lanthanoids | 72 Hf hafnium 178 | 73 Ta tantalum 181 | 74 W tungsten 184 | 75 Re rhenium 186 | 76 Os osmium 190 | 77 Ir iridium 192 | 78 Pt platinum 195 | 79 Au gold 197 | 80 Hg mercury 201 | 81 Tl thallium 204 | 82 Pb lead 207 | 83 Bi bismuth 209 | 84 Po polonium - | 85 At astatine - | 86 Rn radon - | |
| 87 Fr francium - | 88 Ra radium - | 89-103 actinoids | 104 Rf rutherfordium - | 105 Db dubnium - | 106 Sg seaborgium - | 107 Bh bohrium - | 108 Hs hassium - | 109 Mt meitnerium - | 110 Ds darmstadtium - | 111 Rg roentgenium - | 112 Cn copernicium - | 114 Fl flerovium - | 116 Lv livermorium - | 117 Ts tennessine - | 118 Og oganesson - | | | |

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

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).