Please check the examination details below before entering your candidate information

| Candidate surname | Other names |
|---|---|
| StemUp Model Solution | |

**Pearson Edexcel Level 3 GCE**

| Centre Number | Candidate Number |
|---|---|
| | |

# Monday 18 May 2020

| Morning (Time: 1 hour 30 minutes) | Paper Reference **8CH0/01** |
|---|---|

# Chemistry

## Advanced Subsidiary

## Paper 1: Core Inorganic and Physical Chemistry

**Candidates must have: Scientific calculator**
**Data Booklet**
**Ruler**

Total Marks

## Instructions

- Use **black** ink or **black** ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*

## Information

- The total mark for this paper is 80.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*
- For the question marked with an **asterisk** (*), marks will be awarded for your ability to structure your answer logically, showing the points that you make are related or follow on from each other where appropriate.
- A Periodic Table is printed on the back cover of this paper.

## Advice

- Read each question carefully before you start to answer it.
- Show all your working in calculations and include units where appropriate.
- Check your answers if you have time at the end.

*Turn over* ▶

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P 6 2 3 0 6 A 0 1 2 4

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**Answer ALL questions.**

**Some questions must be answered with a cross in a box ☒.**
**If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.**

**1** This question is about the electronic structure of some Group 5 elements.

(a) Which is the electronic configuration of the arsenide ion, $As^{3-}$?

**(1)**

☒ **A** $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2$

☒ **B** $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^3$

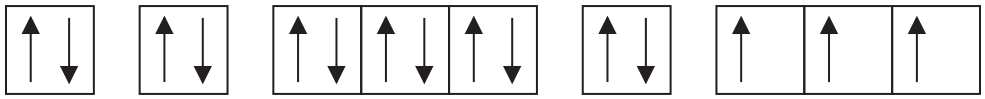
☒ **C** $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6$

☒ **D** $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^3 4d^3$

(b) The electronic configuration of a phosphorus atom can be written

$$1s^2 2s^2 2p^6 3s^2 3p^3$$

An alternative way to express the electronic configuration is




(i) State what is meant by the two arrows in the first box.

**(1)**

*The two electrons in the same orbital have opposite spins.*

(ii) State why the arrows are all pointing in the same direction in the 3p boxes.

**(1)**

*The three electrons have parallel spins (the same direction of spin), because each electron goes into a separate p orbital first, before pairing (Hund's rule).*

**(Total for Question 1 = 3 marks)**

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**2** This question is about ionisation energies.

(a) (i) Which equation represents the **second** ionisation of bromine?

**(1)**

☐ **A** $Br(g) + e^- \rightarrow Br^-(g)$

☐ **B** $Br^-(g) + e^- \rightarrow Br^{2-}(g)$

☐ **C** $Br(g) - 2e^- \rightarrow Br^{2+}(g)$

☒ **D** $Br^+(g) - e^- \rightarrow Br^{2+}(g)$

(ii) Which set of successive ionisation energies is most likely to be associated with the element boron?

**(1)**

☐ **A** 738, 1 451, 7 733, 10 541, 13 629

☒ **B** 801, 2 427, 3 660, 25 026, 32 828

☐ **C** 1 086, 2 353, 4 621, 6 223, 37 832

☐ **D** 1 402, 2 856, 4 578, 7 475, 9 445

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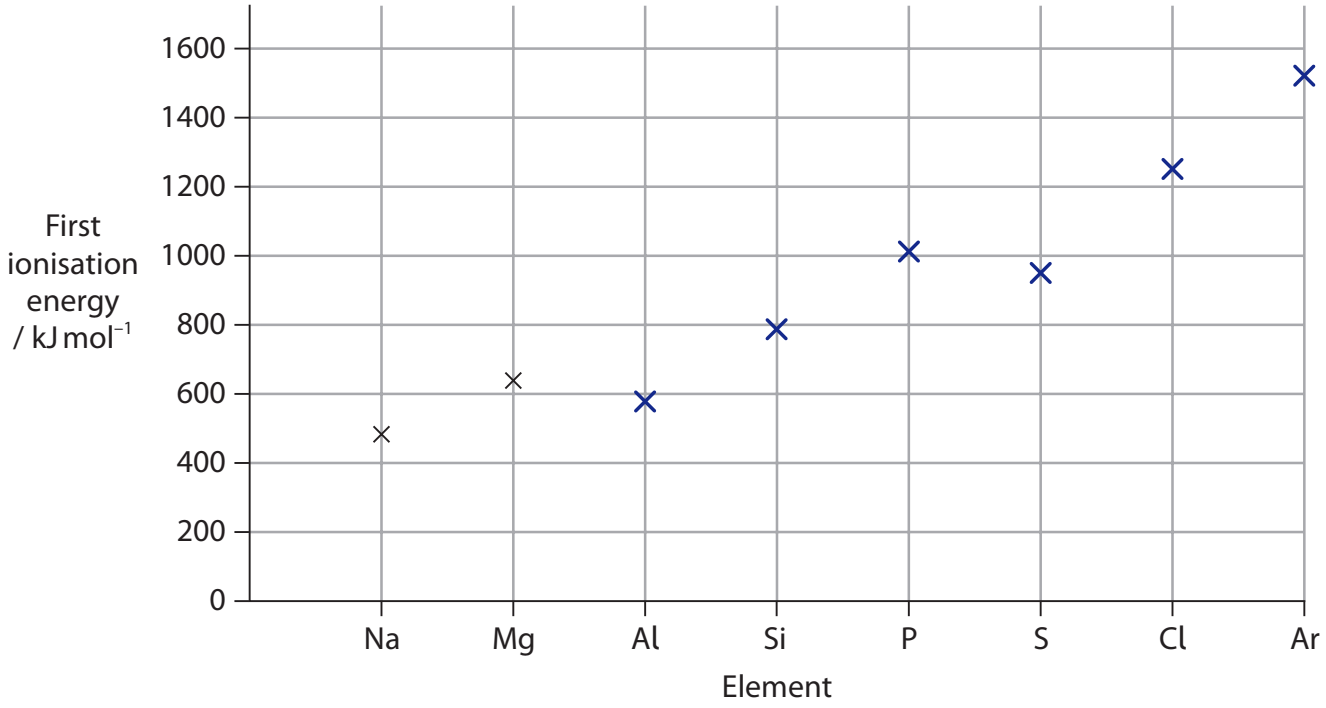
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(b) (i) Complete the graph to show how the first ionisation energies of the Period 3 elements change across the period. Precise figures are not required.

**(3)**

First ionisation energies of the Period 3 elements

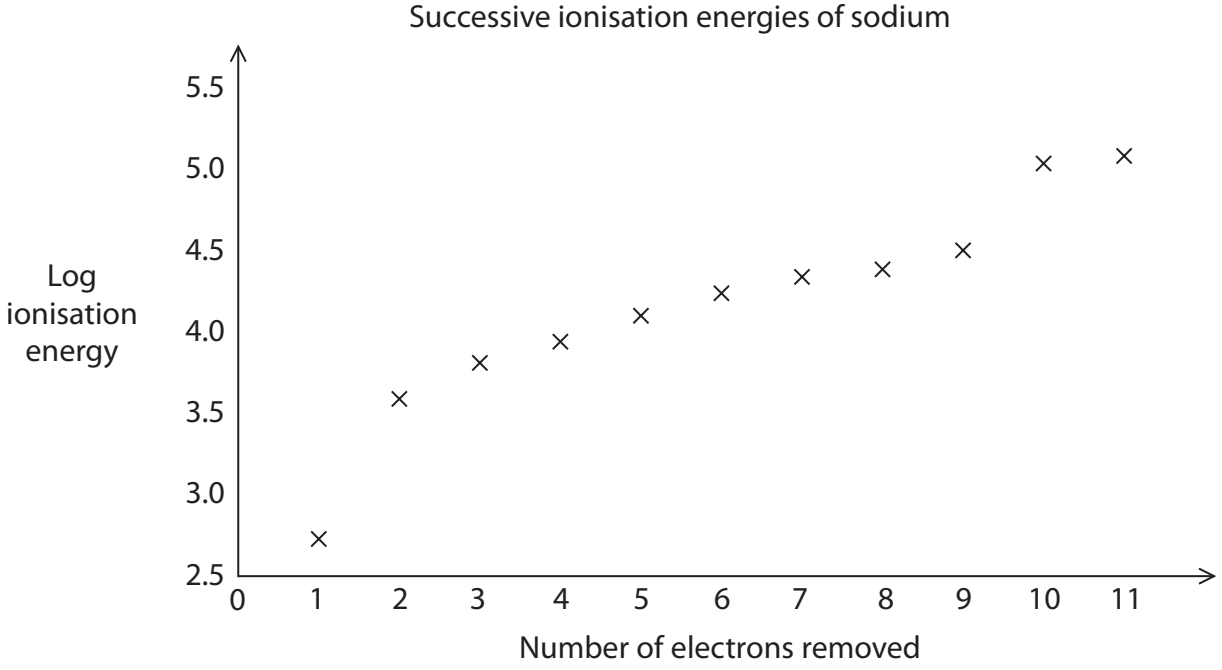



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(ii) The successive ionisation energies of sodium are shown on the graph.




State what deductions can be made from this graph.

**(2)**

*There is a big jump in ionisation energy between the 1st and 2nd electrons removed, and another big jump between the 9th and 10th electrons removed. So sodium has three shells of electrons (2, 8, 1): one electron in the outer (third) shell, eight electrons (electrons 2 to 9) in the second shell, and two electrons (electrons 10 and 11) in the innermost (first) shell, so Na is in Group 1.*

**(Total for Question 2 = 7 marks)**

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**3** Nitrogen forms several hydrides. In addition to ammonia, $NH_3$, it forms hydrazine, $N_2H_4$, in which the two nitrogen atoms are covalently bonded together.

(a) (i) Explain what is meant by a covalent bond.

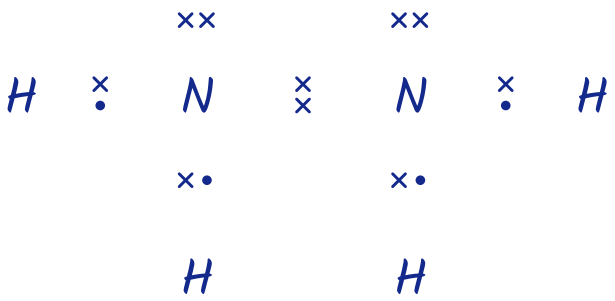
**(2)**

A covalent bond is the strong electrostatic attraction between the two nuclei and a shared pair of electrons between them.

(ii) Draw a dot-and-cross diagram for hydrazine, showing the outer electrons only.

Use crosses (×) to represent the electrons from nitrogen and dots (•) to represent the electrons from hydrogen.

**(1)**




(iii) Estimate the H—N—H bond angle in hydrazine.

**(1)**

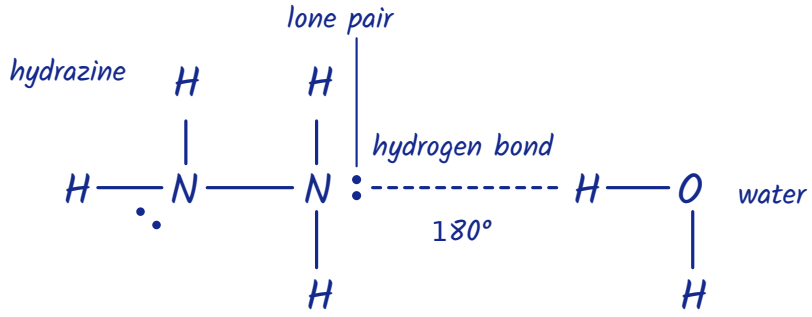
Bond angle = 107°

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(b) Hydrazine is very soluble in water.

Explain, using a labelled diagram and naming the relevant intermolecular interactions, why hydrazine is **very** soluble in water.

**(3)**




Hydrazine forms hydrogen bonds with water molecules: a lone pair on a nitrogen atom of hydrazine bonds to a δ+ hydrogen atom of water (and a lone pair on oxygen bonds to a δ+ hydrogen of an N-H group).

These hydrogen bonds are similar in strength to those in water and hydrazine, so hydrazine mixes with water and is very soluble.

(c) Hydrazine has been used as a rocket fuel.

It is a powerful reducing agent and will react very exothermically with oxidising agents such as hydrogen peroxide.

The equation for the reaction of hydrazine with hydrogen peroxide is

$$N_2H_4(l) + 2H_2O_2(l) \rightarrow N_2(g) + 4H_2O(g)$$

Give **two** reasons why hydrazine is a good rocket fuel when reacted with hydrogen peroxide.

**(2)**

A large quantity of gas ($N_2$ and water vapour) is produced from liquid reactants, and the hot gases expand rapidly to give thrust.

Forming the strong N≡N triple bond releases a large quantity of energy, and the reaction is very fast. The products $N_2$ and $H_2O$ are also non-toxic and non-polluting.

**(Total for Question 3 = 9 marks)**

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**4** This question is about isotopes.

(a) The table shows data for some isotopes of potassium.

| Isotope | Relative isotopic mass | Abundance % |
|---|---|---|
| $^{39}K$ | 38.9637 | 93.218 |
| $^{40}K$ | 39.9340 | 0.012 |
| $^{41}K$ | 40.9618 | 6.770 |

(i) State what is meant by the terms 'relative isotopic mass' and 'relative atomic mass'.

**(3)**

*Relative isotopic mass is the mass of an atom of a particular isotope relative to 1/12th of the mass of an atom of carbon-12.*

*Relative atomic mass is the weighted mean (average) mass of an atom of an element relative to 1/12th of the mass of an atom of carbon-12.*

(ii) State what is meant by the term 'isotopes'. Illustrate your answer by referring to the isotopes of potassium.

**(2)**

*Isotopes are atoms of the same element with the same number of protons but different numbers of neutrons.*

*All three K isotopes have 19 protons; $^{39}K$ has 20 neutrons, $^{40}K$ has 21 and $^{41}K$ has 22 neutrons.*

(iii) Use the data in the table to calculate the relative atomic mass of potassium. Give your answer to 4 significant figures.

**(2)**

$A_r = (38.9637 \times 93.218 + 39.9340 \times 0.012 + 40.9618 \times 6.770) \div 100$

$A_r = 3909.908781 \div 100 = 39.09908781$

*relative atomic mass of potassium = 39.10 (4 s.f.)*

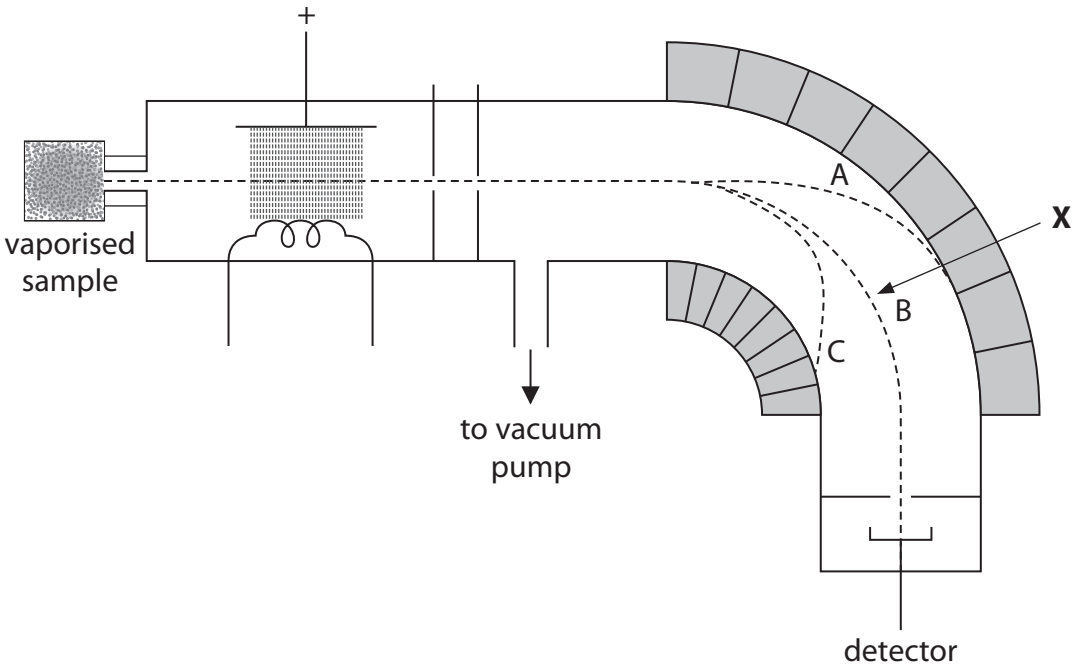
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(b) The relative isotopic abundances of an element can be measured using a mass spectrometer.

A simplified and incompletely labelled diagram of a mass spectrometer is shown.




(i) Name the feature of the mass spectrometer responsible for the behaviour of the ions in the region indicated by the arrow **X**.

**(1)**

*An (electro)magnet producing a magnetic field.*

(ii) Explain the three ion pathways, A, B and C, shown in the region indicated by the arrow **X**.

**(3)**

*Pathway B: ions are deflected by the magnetic field and reach the detector.*

*Pathway A: ions with a greater mass (higher m/z) are deflected less.*

*Pathway C: ions with a smaller mass (lower m/z), or with a greater charge, are deflected more.*

(iii) Give a reason why the mass spectrometer must be operated under vacuum.

**(1)**

*To prevent the ions colliding with air molecules, which would deflect them.*

**(Total for Question 4 = 12 marks)**

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**5** This question is about the reactions of the halogens and halide ions.

(a) (i) When chlorine gas is bubbled through an aqueous solution of potassium iodide, the reaction involves

**(1)**

☒ **A** oxidation only

☒ **B** reduction only

☒ **C** redox

☒ **D** disproportionation

(ii) Cyclohexane was added to the resulting solution from (a)(i). The mixture was shaken and then allowed to stand for a few minutes. Two layers were formed.

[Density: aqueous layer solution = 1.10 g $cm^{-3}$, cyclohexane layer = 0.78 g $cm^{-3}$]

The colour of the **lower** layer was

**(1)**

☒ **A** pale yellow

☒ **B** purple

☒ **C** red

☒ **D** pale green

(b) Concentrated sulfuric acid was added to a small quantity of solid potassium iodide in a test tube.

(i) In this exothermic reaction, which of the following mixtures of gases would be produced?

**(1)**

☒ **A** hydrogen iodide and sulfur dioxide only

☒ **B** hydrogen iodide and hydrogen sulfide only

☒ **C** hydrogen iodide, sulfur dioxide and hydrogen sulfide

☒ **D** hydrogen iodide, hydrogen sulfide and iodine

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(ii) Hydrogen iodide is a gas which reacts in a similar way to hydrogen chloride.

State the observation when the hydrogen iodide gas is passed over the mouth of an open bottle of concentrated ammonia solution.
Write an equation, including state symbols, for the reaction.

**(3)**

Observation White smoke is formed.

Equation $HI(g) + NH_3(g) \rightarrow NH_4I(s)$

(c) Potassium iodate(V) can be prepared by adding solid iodine to a **hot** aqueous solution of potassium hydroxide.

The equation for the reaction is

$$3I_2 + 6KOH \rightarrow KIO_3 + 5KI + 3H_2O$$

Potassium iodate(V) can be separated from the other reaction product using their differing solubilities in water.

| | Solubility in water at 25 °C / mol $dm^{-3}$ |
|---|---|
| KI | 8.92 |
| $KIO_3$ | 0.43 |

(i) Outline a procedure that you could use to obtain a sample of dry, solid potassium iodate(V) from the reaction mixture.

**(3)**

Cool the hot reaction mixture (e.g. in ice) and leave it, so that the less soluble potassium iodate(V) crystallises out while the very soluble KI stays in solution.

Filter off the crystals of potassium iodate(V) (using suction filtration).

Dry the solid by pressing it between filter papers, or leave it to dry in a warm oven.

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(ii) Describe how you would show that iodide ions are present in an aqueous solution of potassium iodide.

**(2)**

*Add dilute nitric acid and then silver nitrate solution, $AgNO_3(aq)$, to the solution.*

*A yellow precipitate (of silver iodide, AgI) forms, showing that iodide ions are present.*

(d) Fluorine is an element in Group 7.

Group 7 includes the elements chlorine, bromine and iodine.

Some information about the melting and boiling temperatures of Group 7 elements is shown in the table.

| Element | Melting temperature / K | Boiling temperature / K |
|---|---|---|
| chlorine | 172 | 238 |
| bromine | 266 | 332 |
| iodine | 387 | 457 |

Which is the expected boiling temperature of fluorine, in kelvin, K?

**(1)**

☒ **A** 4

☒ **B** 85

☒ **C** 575

☒ **D** 610

**(Total for Question 5 = 12 marks)**

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**6** Malachite is a green mineral with the formula $Cu_2CO_3(OH)_2$. It has a molar mass of 221 g $mol^{-1}$.

(a) What is the percentage by mass of copper in pure malachite?

**(1)**

☒ **A** 40.3%

☒ **B** 51.4%

☒ **C** 57.5%

☒ **D** 67.9%

(b) Describe what you would expect to **see** when an excess of dilute hydrochloric acid is added to a sample of pure solid malachite.

**(3)**

*The green solid (malachite) disappears (dissolves).*

*Effervescence (fizzing) is seen as carbon dioxide is given off.*

*A blue-green solution of copper(II) chloride is formed.*

(c) (i) Describe how you would carry out a flame test on a sample of powdered malachite.

**(3)**

*Clean a nichrome (or platinum) wire loop by dipping it in concentrated hydrochloric acid and holding it in a roaring Bunsen flame until it gives no colour.*

*Dip the wire into the concentrated hydrochloric acid again, then dip the wet wire into the powdered malachite so some solid sticks to it.*

*Place the wire with the sample in the edge of a non-luminous (roaring blue) Bunsen flame and observe the flame colour.*

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(ii) When the atoms of some elements are heated, they produce a characteristic flame colour. For example, the copper in malachite gives a blue-green colour. Explain how atoms of different elements can produce different characteristic flame colours when heated.

**(4)**

When the atoms are heated, electrons absorb energy and are excited (promoted) to higher energy levels.

The electrons then fall back (return) to lower energy levels or the ground state.

As they do this, energy is emitted from the atom as visible light, which is seen as the flame colour.

Different elements have different energy gaps between their energy levels, so different amounts of energy are emitted, so light of different frequencies, and so different colours, is produced.

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(d) (i) When malachite is heated to approximately 300 °C, water, carbon dioxide and copper(II) oxide are formed.

The equation for this decomposition is

$$Cu_2CO_3(OH)_2 \rightarrow 2CuO + CO_2 + H_2O$$

Calculate the maximum volume of carbon dioxide that could be produced when 0.810 g of malachite is thermally decomposed.
Assume that the gas is collected at a temperature of 25 °C and 101 kPa pressure.

Give your answer to an appropriate number of significant figures and state the units.
[The ideal gas equation is $pV = nRT$. Gas constant ($R$) = 8.31 J mol$^{-1}$ K$^{-1}$]

**(5)**

moles of malachite = 0.810 ÷ 221 = $3.665 \times 10^{-3}$ mol

moles of $CO_2$ = moles of malachite = $3.665 \times 10^{-3}$ mol

T = 25 + 273 = 298 K  p = 101 kPa = 101 000 Pa

pV = nRT, so V = nRT ÷ p

V = $(3.665 \times 10^{-3} \times 8.31 \times 298) \div 101\ 000$

V = $8.986 \times 10^{-5}$ m$^3$

maximum volume of $CO_2$ = $8.99 \times 10^{-5}$ m$^3$ (= 89.9 cm$^3$)

(ii) The gas was collected in a gas syringe with a stated accuracy of ±0.5 cm$^3$.

Calculate the percentage uncertainty in the volume of gas collected.

**(1)**

% uncertainty = (0.5 ÷ 89.9) × 100 = 0.556 %

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(iii) Malachite ore is a mixture of malachite and rock. A 0.810 g sample of malachite ore was thermally decomposed, producing 0.571 g of copper(II) oxide.

Calculate the percentage purity of this malachite ore sample.
Give your answer to an appropriate number of significant figures.

**(3)**

moles of malachite = 0.810 ÷ 221 = $3.665 \times 10^{-3}$ mol

1 mol malachite gives 2 mol CuO

moles of CuO expected = $2 \times 3.665 \times 10^{-3} = 7.330 \times 10^{-3}$ mol

$M_r$ of CuO = 63.5 + 16.0 = 79.5

mass of CuO expected = $7.330 \times 10^{-3} \times 79.5 = 0.5828$ g

% purity = (actual mass ÷ expected mass) × 100

% purity = (0.571 ÷ 0.5828) × 100 = 97.98 %

percentage purity = 98.0 % (3 s.f.)

**(Total for Question 6 = 20 marks)**

**7** (a) Give the meaning of the term 'periodicity'.
Illustrate your answer by referring to the atomic radii of the Period 2 and Period 3 elements.
Specific values of atomic radii are not required.

**(3)**

Periodicity is a regular, repeating pattern (trend) in the physical and chemical properties of the elements with increasing atomic number, across each period.

For example, atomic radius decreases from left to right across Period 2 (Li to Ne), and the same pattern of decreasing atomic radius is repeated across Period 3 (Na to Ar).

*(b) The melting temperatures of the Period 2 elements are shown.

| Symbol of the element | Li | Be | B | $C_{(diamond)}$ | N | O | F | Ne |
|---|---|---|---|---|---|---|---|---|
| Melting temperature / K | 454 | 1551 | 2573 | 3970 | 63 | 55 | 53 | 25 |

Explain the trend in melting temperatures across the elements of Period 2 in terms of their structure and bonding.

**(6)**

At the start of the period, lithium and beryllium have giant metallic structures with metallic bonding: a lattice of positive ions in a sea of delocalised electrons, held together by strong electrostatic attraction.

The melting temperature increases from Li (454 K) to Be (1551 K) because the metallic bonding gets stronger: $Be^{2+}$ has a greater charge and a smaller ionic radius than $Li^{+}$, and each Be atom donates two delocalised electrons rather than one, so the attraction between the cations and the delocalised electrons is stronger.

In the middle of the period, boron and carbon (diamond) have giant covalent (giant molecular) structures, in which each atom is bonded to other atoms by strong covalent bonds (in diamond each C atom is bonded to 4 others).

To melt them, a lot of energy is needed to break many strong covalent bonds, so B (2573 K) and C (3970 K) have the highest melting temperatures.

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At the end of the period, nitrogen, oxygen and fluorine exist as simple molecules ($N_2$, $O_2$, $F_2$) and neon exists as single atoms.

Only weak London forces between the molecules (or atoms) have to be overcome on melting, not the strong covalent bonds within the molecules, so very little energy is needed and the melting temperatures are very low (63 K to 25 K).

So across Period 2 the melting temperature rises to a maximum at carbon, then falls sharply as the structure changes from giant covalent to simple molecular.

**(Total for Question 7 = 9 marks)**

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**8** This question is about the thermal stability of Group 1 and Group 2 nitrates and carbonates.

(a) Complete the equations for the thermal decomposition of sodium nitrate, $NaNO_3$, and for the thermal decomposition of calcium nitrate, $Ca(NO_3)_2$.
State symbols are not required.

**(2)**

$NaNO_3 \rightarrow$ *$NaNO_2 + ½O_2$*

$Ca(NO_3)_2 \rightarrow$ *$CaO + 2NO_2 + ½O_2$*

(b) The thermal stability of Group 1 nitrates increases down the group.
The decomposition temperatures of some Group 1 nitrates are shown.

| Name | Formula | Decomposition temperature / K |
|---|---|---|
| sodium nitrate | $NaNO_3$ | 653 |
| potassium nitrate | $KNO_3$ | 673 |
| caesium nitrate | $CsNO_3$ | 687 |

Explain why the thermal stability of caesium nitrate is greater than that of sodium nitrate.

**(3)**

*The thermal stability of the nitrates depends on the polarising power (charge density) of the cation.*

*$Na^+$ is a smaller cation than $Cs^+$ (with the same charge), so $Na^+$ has a greater charge density.*

*So $Na^+$ polarises (distorts) the electron cloud of the nitrate ion more than $Cs^+$ does, weakening the N-O bonds in the nitrate ion to a greater extent. Caesium nitrate is distorted less, so it needs a higher temperature to decompose.*

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(c) Calcium carbonate is thermally decomposed during the manufacture of cement.

(i) Write an equation, including state symbols, for the thermal decomposition of calcium carbonate.

**(1)**

$CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$

(ii) Name all the types of bond present in calcium carbonate.

**(1)**

Ionic and covalent bonds.

(iii) Give a reason, in terms of the bonding, why a high decomposition temperature is required.

**(1)**

The covalent bonds (C-O bonds) within the carbonate ion, $CO_3^{2-}$, are strong, so a lot of energy is needed to break them.

**(Total for Question 8 = 8 marks)**

**TOTAL FOR PAPER = 80 MARKS**

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# The Periodic Table of Elements

| 1 | 2 | | | | | | | | | | | 3 | 4 | 5 | 6 | 7 | 0 (8) (18) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 1.0 H hydrogen 1 | | | | | | | | | | 4.0 He helium 2 |
| (1) | (2) | | | | | | | | | | | (13) | (14) | (15) | (16) | (17) | |
| 6.9 Li lithium 3 | 9.0 Be beryllium 4 | | | | | | | | | | | 10.8 B boron 5 | 12.0 C carbon 6 | 14.0 N nitrogen 7 | 16.0 O oxygen 8 | 19.0 F fluorine 9 | 20.2 Ne neon 10 |
| 23.0 Na sodium 11 | 24.3 Mg magnesium 12 | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | 27.0 Al aluminium 13 | 28.1 Si silicon 14 | 31.0 P phosphorus 15 | 32.1 S sulfur 16 | 35.5 Cl chlorine 17 | 39.9 Ar argon 18 |
| 39.1 K potassium 19 | 40.1 Ca calcium 20 | 45.0 Sc scandium 21 | 47.9 Ti titanium 22 | 50.9 V vanadium 23 | 52.0 Cr chromium 24 | 54.9 Mn manganese 25 | 55.8 Fe iron 26 | 58.9 Co cobalt 27 | 58.7 Ni nickel 28 | 63.5 Cu copper 29 | 65.4 Zn zinc 30 | 69.7 Ga gallium 31 | 72.6 Ge germanium 32 | 74.9 As arsenic 33 | 79.0 Se selenium 34 | 79.9 Br bromine 35 | 83.8 Kr krypton 36 |
| 85.5 Rb rubidium 37 | 87.6 Sr strontium 38 | 88.9 Y yttrium 39 | 91.2 Zr zirconium 40 | 92.9 Nb niobium 41 | 95.9 Mo molybdenum 42 | [98] Tc technetium 43 | 101.1 Ru ruthenium 44 | 102.9 Rh rhodium 45 | 106.4 Pd palladium 46 | 107.9 Ag silver 47 | 112.4 Cd cadmium 48 | 114.8 In indium 49 | 118.7 Sn tin 50 | 121.8 Sb antimony 51 | 127.6 Te tellurium 52 | 126.9 I iodine 53 | 131.3 Xe xenon 54 |
| 132.9 Cs caesium 55 | 137.3 Ba barium 56 | 138.9 La* lanthanum 57 | 178.5 Hf hafnium 72 | 180.9 Ta tantalum 73 | 183.8 W tungsten 74 | 186.2 Re rhenium 75 | 190.2 Os osmium 76 | 192.2 Ir iridium 77 | 195.1 Pt platinum 78 | 197.0 Au gold 79 | 200.6 Hg mercury 80 | 204.4 Tl thallium 81 | 207.2 Pb lead 82 | 209.0 Bi bismuth 83 | [209] Po polonium 84 | [210] At astatine 85 | [222] Rn radon 86 |
| [223] Fr francium 87 | [226] Ra radium 88 | [227] Ac* actinium 89 | [261] Rf rutherfordium 104 | [262] Db dubnium 105 | [266] Sg seaborgium 106 | [264] Bh bohrium 107 | [277] Hs hassium 108 | [268] Mt meitnerium 109 | [271] Ds darmstadtium 110 | [272] Rg roentgenium 111 | | | | | | | |

**Key**

relative atomic mass
**atomic symbol**
name
atomic (proton) number

Elements with atomic numbers 112-116 have been reported but not fully authenticated

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| * Lanthanide series | 140 Ce cerium 58 | 141 Pr praseodymium 59 | 144 Nd neodymium 60 | [147] Pm promethium 61 | 150 Sm samarium 62 | 152 Eu europium 63 | 157 Gd gadolinium 64 | 159 Tb terbium 65 | 163 Dy dysprosium 66 | 165 Ho holmium 67 | 167 Er erbium 68 | 169 Tm thulium 69 | 173 Yb ytterbium 70 | 175 Lu lutetium 71 |
| * Actinide series | 232 Th thorium 90 | [231] Pa protactinium 91 | 238 U uranium 92 | [237] Np neptunium 93 | [242] Pu plutonium 94 | [243] Am americium 95 | [247] Cm curium 96 | [245] Bk berkelium 97 | [251] Cf californium 98 | [254] Es einsteinium 99 | [253] Fm fermium 100 | [256] Md mendelevium 101 | [254] No nobelium 102 | [257] Lr lawrencium 103 |

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