

Paper Reference(s) 8CH0/01

Pearson Edexcel GCE

Chemistry

Advanced Subsidiary

Paper 1: Core Inorganic and Physical Chemistry

Monday 20 May 2019 – Morning

Time: 1 hour 30 minutes plus your additional time allowance

INSTRUCTIONS TO CANDIDATES

Write your centre number, candidate number, surname, other names and your signature in the boxes below. Check that you have the correct question paper.

Centre No.					
Candidate No.					
Surname					
Other names					
Signature					
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- Use **BLACK** ink or **BLACK** ball-point pen.
- Answer **ALL** questions.
- Answer the questions in the spaces provided – there may be more space than you need.

MATERIALS REQUIRED FOR EXAMINATION

Data booklet, scientific calculator

ITEMS INCLUDED WITH QUESTION PAPERS

Periodic Table

INFORMATION FOR CANDIDATES

- 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 provided.

ADVICE TO CANDIDATES

- 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)

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 How many IONS are present in 306 g of aluminium oxide, Al_2O_3 ?

[Avogadro constant = $6.02 \times 10^{23} \text{ mol}^{-1}$
Molar mass of Al_2O_3 = 102 g mol^{-1}]

☐ A 6.02×10^{23}

☐ B 1.81×10^{24}

☐ C 3.01×10^{24}

☐ D 9.03×10^{24}

(TOTAL FOR QUESTION 1 = 1 MARK)

(Questions continue on next page)

(Turn over)

2 What is the electronic configuration of the sulfide ion, S^{2-} ?

☐ A $1s^2 2s^2 2p^6 3s^2 3p^2$

☐ B $1s^2 2s^2 2p^6 3p^4$

☐ C $1s^2 2s^2 2p^6 3s^2 3p^4$

☐ D $1s^2 2s^2 2p^6 3s^2 3p^6$

(TOTAL FOR QUESTION 2 = 1 MARK)

(Questions continue on next page)

3 This question is about isotopes.

(a) State, in terms of subatomic particles, what is meant by the term ISOTOPES. (2 marks)

(Question continues on next page)

- (b) The element gallium has a relative atomic mass of 69.735 and only contains two isotopes. A sample of gallium contained the isotope ^{69}Ga , with a relative abundance of 63.25 %.

Calculate the mass number of the other isotope. You MUST show all your working. (2 marks)

(TOTAL FOR QUESTION 3 = 4 MARKS)

(Questions continue on next page)

(Turn over)

4 This question is about trends within Group 2 of the Periodic Table.

(a) Which of the following describes the trends in thermal stability of the Group 2 carbonates and nitrates going down the group? (1 mark)

Thermal stability		
	Carbonates	Nitrates
<input type="checkbox"/> A	increases	increases
<input type="checkbox"/> B	increases	decreases
<input type="checkbox"/> C	decreases	increases
<input type="checkbox"/> D	decreases	decreases

(Question continues on next page)

- (b) Describe, with the aid of a labelled diagram, how you would compare the thermal stability of two different Group 2 nitrates using simple laboratory equipment.**

Your answer MUST include ONE safety precaution (excluding the use of gloves, laboratory coat and eye protection). (4 marks)

(Continue your answer on next page)

(Turn over)

(Question continues on next page)

(Turn over)

- (c) Which of the following describes the trends in the solubility in water of the Group 2 hydroxides and sulfates going down the group? (1 mark)

Solubility in water		
	Hydroxides	Sulfates
<input type="checkbox"/> A	increases	increases
<input type="checkbox"/> B	increases	decreases
<input type="checkbox"/> C	decreases	increases
<input type="checkbox"/> D	decreases	decreases

(TOTAL FOR QUESTION 4 = 6 MARKS)

(Questions continue on next page)

(Turn over)

5 This question is about iron(II) salts.

(a) What is the percentage by mass of iron in anhydrous iron(II) sulfate, FeSO_4 , to 3 significant figures? (1 mark)

☐ **A 21.3%**

☐ **B 35.1%**

☐ **C 36.7%**

☐ **D 53.8%**

(Question continues on next page)

- (b) Describe a chemical test, and the expected result, to show that sulfate ions are present in a solution of iron(II) sulfate in water. (2 marks)**

(Question continues on next page)

- (c) Mohr's salt is another compound containing iron(II) ions.

It has the formula $(\text{NH}_4)_2\text{Fe}(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$.

What is the molar mass, in g mol^{-1} , of Mohr's salt?

(1 mark)

☐ A 392.0

☐ B 312.0

☐ C 302.0

☐ D 284.0

(TOTAL FOR QUESTION 5 = 4 MARKS)

(Questions continue on next page)

(Turn over)

6 A solid, white, water-soluble compound was thought to be magnesium bromide.

A student carried out tests to confirm the identity of both ions present.

(a) A flame test was carried out to test for the cation.

**(i) Describe how a flame test is carried out.
(3 marks)**

(Question continues on next page)

(Turn over)

(ii) Explain the origin of flame test colours. (4 marks)

[illegible]

(Continue your answer on next page)

(Turn over)

(Question continues on next page)

(iii) Give a reason why the magnesium ion does not produce a flame colour. (1 mark)

(iv) Give a reason why the lack of a flame colour is not a positive test for the magnesium ion. (1 mark)

(Question continues on next page)

(Turn over)

- (b) (i) Give the **FORMULA** of a reagent that would produce a cream-coloured precipitate when added to an aqueous solution of magnesium bromide. (1 mark)
-

- (ii) The identity of the anion may be confirmed by testing the solubility of the cream-coloured precipitate in ammonia solution. Which pair of responses helps to confirm the identity of the anion? (1 mark)

	Solubility in dilute ammonia solution	Solubility in concentrated ammonia solution
<input type="checkbox"/> A	insoluble	insoluble
<input type="checkbox"/> B	insoluble	soluble
<input type="checkbox"/> C	soluble	insoluble
<input type="checkbox"/> D	soluble	soluble

(TOTAL FOR QUESTION 6 = 11 MARKS)

(Questions continue on next page)

(Turn over)

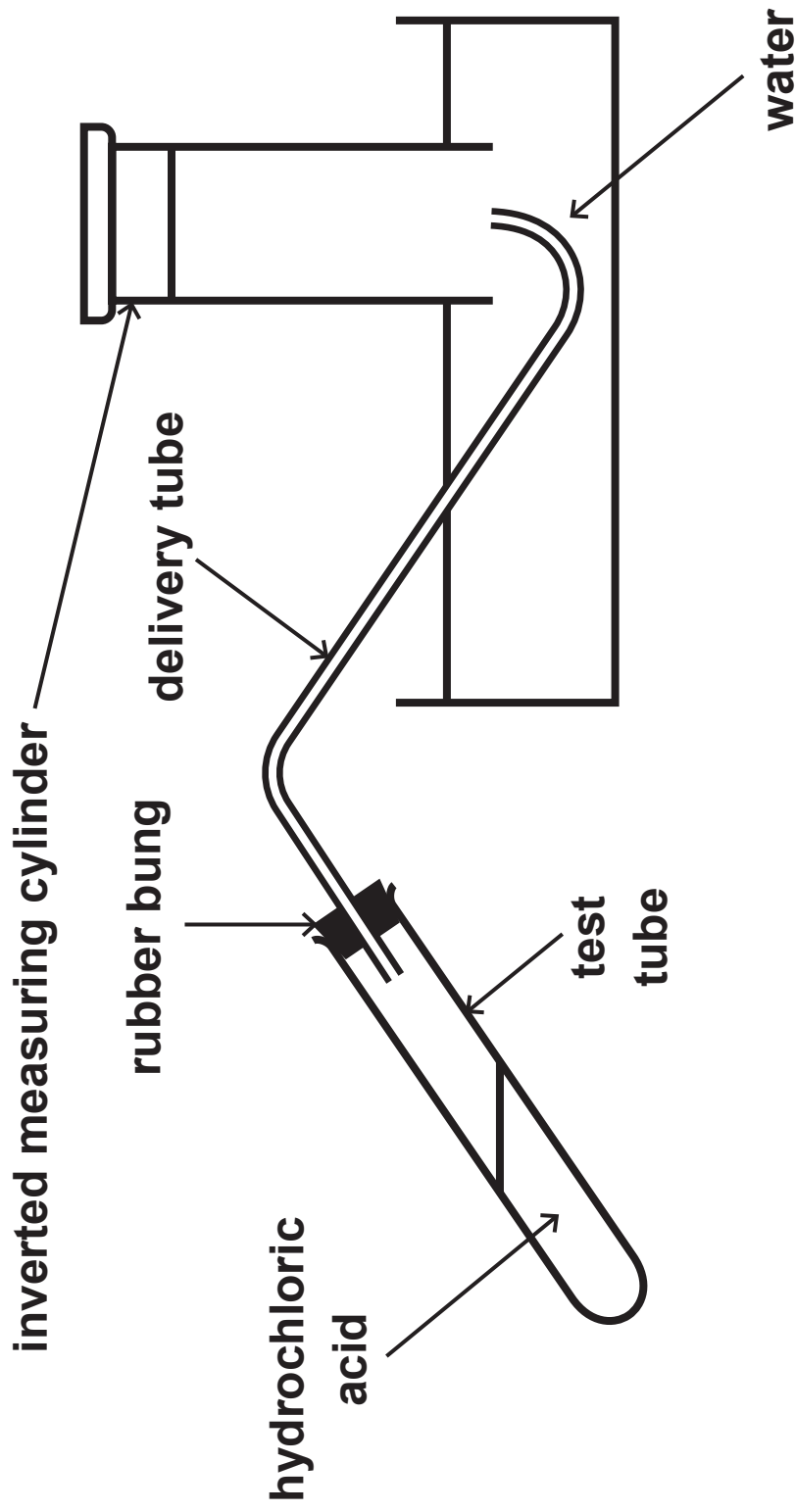
7 This question is about the reaction of magnesium with dilute hydrochloric acid.

(a) Write an equation for the reaction of magnesium with hydrochloric acid.

Include state symbols. (2 marks)

(Question continues on next page)

- (b) The apparatus shown in the diagram can be used to collect the gas produced during the reaction of magnesium with dilute hydrochloric acid.



(Question continues on next page)

(Turn over)

The following procedure was used.

- Step 1** The apparatus was set up as shown in the diagram. The test tube contained 10.0 cm^3 of 0.20 mol dm^{-3} hydrochloric acid.
- Step 2** A piece of magnesium ribbon was weighed. It had a mass of 0.12 g .
- Step 3** The delivery tube and bung were removed from the test tube, the magnesium ribbon was added and the delivery tube and bung quickly replaced.
- Step 4** When the reaction was complete, the final volume of gas was recorded.
- (i) A measuring cylinder was used to measure the 10.0 cm^3 of dilute hydrochloric acid in Step 1. The uncertainty for a volume measurement is $\pm 0.5\text{ cm}^3$.
Calculate the percentage uncertainty in the volume of hydrochloric acid. (1 mark)

- (ii) Determine which reactant is in excess by calculating the number of moles of magnesium and of hydrochloric acid used in the experiment. (3 marks)

(Question continues on next page)

(Turn over)

- (iii) Calculate the maximum number of moles of gas that could be produced, using your answers to (a) and (b)(ii). (1 mark)

(Question continues on next page)

(Turn over)

- (iv) Under the conditions of the experiment, the temperature was 23°C and the pressure $98\,000\text{ Pa}$.

Calculate the maximum volume of gas, in cm^3 , that could be produced using your answer in (b)(iii). Give your answer to an appropriate number of significant figures.

[The ideal gas equation is $pV = nRT$.

Gas constant (R) = $8.31\text{ J mol}^{-1}\text{ K}^{-1}$] (4 marks)

- (c) (i) Deduce TWO possible reasons why the volume of gas collected in the experiment was smaller than that calculated in (b)(iv).
(2 marks)

(Question continues on next page)

(Turn over)

(ii) Describe TWO changes to the procedure that would enable the volume of gas collected to be closer to that calculated in (b)(iv). (2 marks)

[illegible]

(TOTAL FOR QUESTION 7 = 15 MARKS)

8 The table shows some information about a selection of elements and compounds.

	Graphene	Graphite	Diamond	Magnesium oxide	Potassium bromide	Iron
Melting temperature / K	> 4000	3950	3820	3125	1007	1808
Density / g cm ⁻³	not measured	2.2 to 2.8	3.51	3.58	2.75	7.86
Compressive strength / GPa	not measured	2.3 and 15.3	443	152	15	170

(Question continues on next page)

- (a) Explain the difference in the melting temperatures of magnesium oxide and potassium bromide.
(3 marks)

(Question continues on next page)

(Turn over)

- (b) Explain why the electrical conductivity of solid potassium bromide is poor but an aqueous solution of potassium bromide is a good electrical conductor. (2 marks)**

(Question continues on next page)

(Turn over)

***(c) Graphene, graphite and diamond are all forms of solid carbon.**

Explain, in terms of structure and bonding, why graphene and graphite are good electrical conductors but diamond is a poor electrical conductor.

**You may include labelled diagrams in your answer.
(6 marks)**

(Turn over)

- (d) Deduce TWO possible reasons why the density of iron (7.86 g cm^{-3}) is much greater than the density of graphite (2.2 to 2.8 g cm^{-3}). (2 marks)

(Question continues on next page)

- (e) The compressive strength is a measure of the energy required to break some of the bonds within a substance.

Deduce possible reasons why there are two widely different values for the compressive strength of graphite.

Both the values (2·3 and 15·3 GPa) are valid experimental results. (2 marks)

(TOTAL FOR QUESTION 8 = 15 MARKS)

(Questions continue on next page)

(Turn over)

9 This question is about chlorine and its compounds.

(a) Potassium chlorate(V) can be produced by passing chlorine gas into hot, concentrated potassium hydroxide solution.

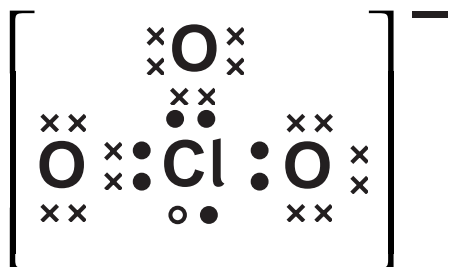


(i) This reaction is an example of
(1 mark)

- ☐ A oxidation only
- ☐ B reduction only
- ☐ C disproportionation
- ☐ D decomposition

(Question continues on next page)

(ii) A dot-and-cross diagram for the chlorate(V) ion (ClO_3^-) is shown.



Key

- = chlorine electrons
- = an added electron
- × = oxygen electrons

Predict the shape and bond angle (O—Cl—O) of the chlorate(V) ion.

Justify your answer. (4 marks)

- (b) (i) The following reaction occurs when potassium chlorate(V) is heated at a suitable temperature. Complete the equation by balancing it. State symbols are not required.



- (ii) The table shows some properties of potassium chloride and potassium chlorate(VII).

	Potassium chloride KCl	Potassium chlorate(VII) KClO_4
Solubility in water (mol/100 g)	4.81×10^{-1}	1.29×10^{-2}
Solubility in ethanol (mol/100 g)	2.9×10^{-4}	8.7×10^{-6}

Devise a brief method to show how the compounds produced in the decomposition of potassium chlorate(V) could most effectively be separated. Use information from the table.
(3 marks)

(Turn over)

- (c) Chlorine gas, Cl_2 , can be dissolved in swimming pool water to disinfect it.

An Olympic-sized swimming pool contains about 2500 m^3 of water.

The chlorine content is 2 ppm (parts per million) by mass.

Calculate the number of moles of chlorine, Cl_2 , in the swimming pool.

[One ppm is equivalent to 1 g of chlorine dissolved in $1 \times 10^6 \text{ g}$ of water.

Density of water = 1 g cm^{-3}] (3 marks)

- (d) When chlorine gas is dissolved in water, it reacts according to the equation



The chloric(I) acid (HClO) produced is much more effective as a disinfectant than dissolved chlorine. Chloric(I) acid is a weak acid and has little effect on the pH of the water.

Swimming pools usually have a chlorine content of 1 – 3 ppm.

USE THE EQUATION to explain one DISADVANTAGE of a chlorine content that is much lower than 1 ppm and one DISADVANTAGE of a chlorine content that is much higher than 3 ppm. (4 marks)

(Question continues on next page)

(Turn over)

- (e) In many swimming pools, sodium chlorate(I) has replaced chlorine gas as a disinfectant.

Sodium chlorate(I) is an ionic compound. It is very soluble in water.

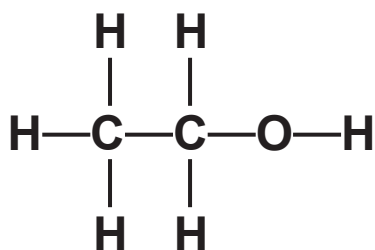


- (i) Describe, using diagrams to illustrate your answer, the interactions between each of the ions and the solvent when sodium chlorate(I) dissolves in water. (2 marks)

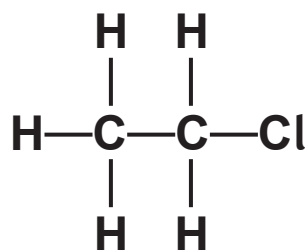
(Continue your answer on next page)

(Turn over)

(ii) The displayed formulae of ethanol and chloroethane are shown.



ethanol



chloroethane

Ethanol is very soluble in water whereas chloroethane is almost insoluble in water.

(Question continues on next page)

Explain this observation by comparing the types of intermolecular forces formed by each of these molecules with water. (2 marks)

(Question continues on next page)

(Turn over)

- (f) Calcium chlorate(I), $\text{Ca}(\text{ClO})_2$, can be used to disinfect drinking water.

The concentration of chlorate(I) ions required to disinfect water is about $5.6 \times 10^{-6} \text{ mol dm}^{-3}$.

Calculate the mass of calcium chlorate(I), in g, that should be added to 1000 dm^3 of water to produce a chlorate(I) ion concentration of $5.6 \times 10^{-6} \text{ mol dm}^{-3}$.
(3 marks)

(Continue calculation on next page)

(Turn over)

(TOTAL FOR QUESTION 9 = 23 MARKS)

TOTAL FOR PAPER = 80 MARKS

END