

Please check the examination details below before entering your candidate information

|                      |                      |                      |                      |                      |                      |                      |                      |                      |  |
|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|--|
| Candidate surname    |                      |                      |                      |                      | Other names          |                      |                      |                      |  |
| Centre Number        |                      |                      |                      |                      | Candidate Number     |                      |                      |                      |  |
| <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> |  |

**Pearson Edexcel International GCSE (9–1)**

**Tuesday 14 November 2023**

Morning (Time: 2 hours)

Paper reference **4CH1/1C 4SD0/1C**

**Chemistry**

**UNIT: 4CH1**

**Science (Double Award) 4SD0**

**PAPER: 1C**

**You must have:**  
Calculator, ruler

Total Marks

### Instructions

- Use **black** ink or 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.*
- Show all the steps in any calculations and state the units.

### Information

- The total mark for this paper is 110.
- The marks for **each** question are shown in brackets  
– *use this as a guide as to how much time to spend on each question.*

### Advice

- Read each question carefully before you start to answer it.
- Write your answers neatly and in good English.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ►

P73423A

©2023 Pearson Education Ltd.  
Z:1/1/1/1/1/



  
**Pearson**

# The Periodic Table of the Elements

|       |                      |                                                                         |                       |       |       |       |       |       |       |       |       |       |                                                                                     |     |     |     |       |       |       |
|-------|----------------------|-------------------------------------------------------------------------|-----------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------------------------------------------------------------------------------------|-----|-----|-----|-------|-------|-------|
| 1     | 2                    | Key                                                                     |                       |       |       |       |       |       |       |       |       | 3     | 4                                                                                   | 5   | 6   | 7   | 0     |       |       |
|       |                      | relative atomic mass<br>atomic symbol<br>name<br>atomic (proton) number |                       |       |       |       |       |       |       |       |       |       |                                                                                     |     |     |     |       |       |       |
| 7     | Li<br>lithium<br>3   | 9                                                                       | Be<br>beryllium<br>4  |       |       |       |       |       |       |       |       |       |                                                                                     | 11  | 12  | 14  | 16    | 19    | 20    |
| 23    | Na<br>sodium<br>11   | 24                                                                      | Mg<br>magnesium<br>12 |       |       |       |       |       |       |       |       |       |                                                                                     | 27  | 28  | 31  | 32    | 35.5  | 40    |
| 39    | K<br>potassium<br>19 | 40                                                                      | Ca<br>calcium<br>20   | 45    | 48    | 51    | 52    | 55    | 56    | 59    | 59    | 63.5  | 65                                                                                  | 70  | 73  | 75  | 79    | 80    | 84    |
| 85    | Rb<br>rubidium<br>37 | 88                                                                      | Sr<br>strontium<br>38 | 89    | 91    | 93    | 96    | [98]  | 101   | 103   | 106   | 108   | 112                                                                                 | 115 | 119 | 122 | 128   | 127   | 131   |
| 133   | Cs<br>caesium<br>55  | 137                                                                     | Ba<br>barium<br>56    | 139   | 178   | 181   | 184   | 186   | 190   | 192   | 195   | 197   | 201                                                                                 | 204 | 207 | 209 | [209] | [210] | [222] |
| [223] | Fr<br>francium<br>87 | [226]                                                                   | Ra<br>radium<br>88    | [227] | [261] | [262] | [266] | [264] | [277] | [268] | [271] | [272] | Elements with atomic numbers 112-116 have been reported but not fully authenticated |     |     |     |       |       |       |
|       |                      |                                                                         |                       | Ac*   | Rf    | Db    | Sg    | Bh    | Hs    | Mt    | Ds    | Rg    |                                                                                     |     |     |     |       |       |       |

***The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number.***

**DO NOT WRITE IN THIS AREA**

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

**BLANK PAGE**

**Answer ALL questions.**

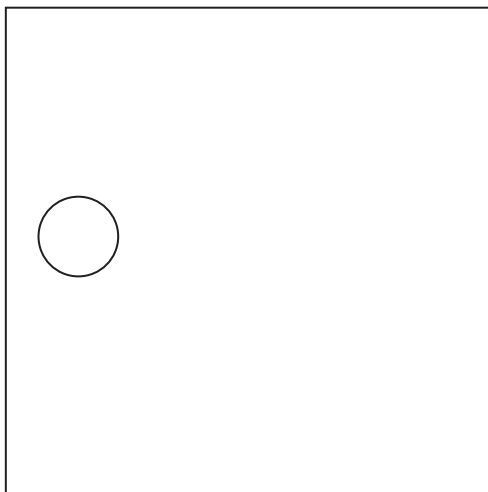
**Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.**

- 1** A substance can exist in three states of matter, solid, liquid or gas.

When a liquid evaporates at room temperature it changes into a gas.

- (a) Complete the diagram to show the arrangement of another four particles in a gas.

(1)



- (b) Explain why heating a liquid causes it to evaporate more quickly.

(2)

.....

.....

.....

.....

- (c) When the temperature decreases, water in the gas state changes to a liquid.

- (i) Give the name of this change of state.

(1)

.....

- (ii) Write an equation, including state symbols, to show the change of state of water from a gas to a liquid.

(1)

.....

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

(d) Describe the arrangement and movement of particles in a solid.

(2)

(Total for Question 1 = 7 marks)



- 2 (a) Table 1 shows some relative masses and charges of subatomic particles.

Complete table 1 by giving the missing information.

(2)

|                 | Electron | Proton | Neutron |
|-----------------|----------|--------|---------|
| Relative mass   | 0.0005   |        |         |
| Relative charge |          |        | 0       |

Table 1

- (b) Table 2 gives the number of protons, neutrons and electrons in atoms and ions of some elements.

The letters are **not** the symbols of the elements.

| Atom or ion | Protons | Neutrons | Electrons |
|-------------|---------|----------|-----------|
| P           | 3       | 4        | 2         |
| Q           | 5       | 5        | 5         |
| R           | 5       | 6        | 5         |
| S           | 7       | 7        | 7         |
| T           | 8       | 8        | 8         |
| U           | 8       | 8        | 10        |

Table 2

- (i) What is the atomic number of P in table 2?

(1)

- ☐ **A** 2
- ☐ **B** 3
- ☐ **C** 4
- ☐ **D** 7



(ii) What is the mass number of U in table 2?

(1)

- ☐ **A** 8
- ☐ **B** 16
- ☐ **C** 18
- ☐ **D** 26

(iii) Give the letter in table 2 that represents an element in Group 5 of the Periodic Table.

(1)

(c) Q and R represent isotopes of the same element.

(i) Explain, in terms of subatomic particles, why Q and R are isotopes.

(2)

(ii) A sample containing the isotopes Q and R has this percentage composition by mass.

Q = 20.6 %

R = 79.4 %

Calculate the relative atomic mass ( $A_r$ ) of this sample of the element.

Give your answer to one decimal place.

(3)

$A_r =$  .....

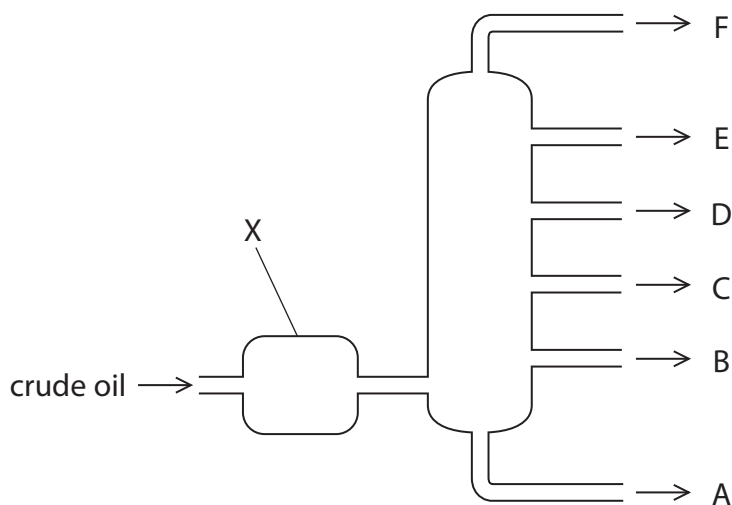
(Total for Question 2 = 10 marks)



P 7 3 4 2 3 A 0 7 2 8

**3** Crude oil is an important source of organic compounds.

- (a) The diagram shows how crude oil can be separated into useful mixtures of hydrocarbons.



- (i) Give the name of this method of separation.

(1)

- (ii) State what happens to the crude oil when it is in X.

(1)

- (iii) Give the letter of the mixture that is most likely to contain a hydrocarbon with six carbon atoms.

(1)

- (iv) Give the name of mixture D.

(1)

- (v) Give a use for mixture B.

(1)



DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

- (b) Explain, in terms of intermolecular forces, why a hydrocarbon in mixture B has a higher boiling point than a hydrocarbon in mixture D.

(3)

- (c) Catalytic cracking can be used to break down long-chain hydrocarbons to produce shorter-chain alkanes and alkenes.

- (i) Give the name of a catalyst used in catalytic cracking.

(1)

- (ii) Complete the equation to show two different alkenes that could be produced in this cracking reaction.

(2)



- (iii) Give one important use for short-chain alkenes.

(1)

(Total for Question 3 = 12 marks)



4 This question is about gases.

(a) The table gives information about five gases.

| Name of gas    | argon | carbon dioxide  | hydrogen       | oxygen         | nitrogen       |
|----------------|-------|-----------------|----------------|----------------|----------------|
| Formula of gas | Ar    | CO <sub>2</sub> | H <sub>2</sub> | O <sub>2</sub> | N <sub>2</sub> |
| $M_r$ of gas   | 40    |                 | 2              | 32             | 28             |

Use information from the table to answer these questions.  
Each gas may be used once, more than once or not at all.

(i) Give the name of the gas that is about 79% of the atmosphere by volume.

(1)

(ii) Give the name of the gas that is a compound.

(1)

(iii) Give the name of the least reactive gas.

(1)

(iv) Give the name of the gas that is not normally found in the atmosphere.

(1)

(v) Give the name of the gas that affects global warming.

(1)

(vi) Calculate the  $M_r$  for carbon dioxide.

(1)

$M_r =$  .....

(vii) Give a reason why it is not possible to give information for air in the table.

(1)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

(b) When copper(II) carbonate is heated, the products are copper(II) oxide and carbon dioxide.

(i) Give the name for this type of reaction.

(1)

(ii) Give the colour change that occurs during this reaction.

(2)

..... to .....

(iii) Give a chemical equation for this reaction.

(1)

(Total for Question 4 = 11 marks)



5 This question is about alkanes and alkenes.

(a) The alkane  $C_4H_{10}$  exists as two isomers.

(i) State what is meant by the term **isomers**.

(2)

.....

.....

.....

.....

(ii) Draw the displayed formulae for the two isomers of  $C_4H_{10}$

(2)

| Isomer 1 | Isomer 2 |
|----------|----------|
|          |          |

(b) Ethane ( $C_2H_6$ ) can react with bromine.

(i) State the condition needed for ethane to react with bromine.

(1)

.....

(ii) Complete the equation for this reaction.

(1)



(iii) Give the name for this type of reaction.

(1)

.....



DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

(c) Explain why ethane is described as a saturated compound.

(2)

(d) State what you would observe when ethane and ethene are added separately to two samples of bromine water.

(2)

ethane

ethene

(e) Explain why straight-chain alkenes always have the same empirical formula, but straight-chain alkanes have different empirical formulae.

Refer to the molecular formulae of the alkanes  $C_2H_6$  and  $C_4H_{10}$  in your answer.

(3)



DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

(f) An organic compound has this percentage composition by mass.

C = 19.2%    H = 4.0%    O = 12.8%    Br = 64.0%

Calculate the empirical formula of this compound.

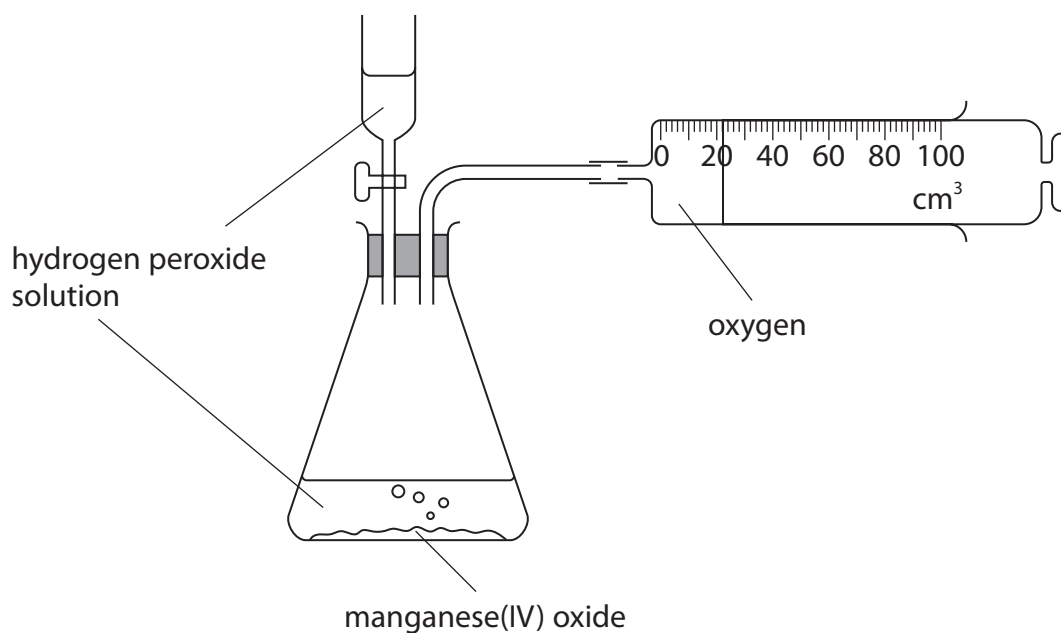
(3)

empirical formula = .....

**(Total for Question 5 = 17 marks)**



- 6 A student uses this apparatus to investigate the decomposition of hydrogen peroxide solution.



This is the equation for the reaction.



- (a) Give the test for oxygen.

(1)

- (b) Complete the dot-and-cross diagram for a molecule of hydrogen peroxide.

Show outer electrons only.

(2)

H O O H

- (c) The student measures the volume of oxygen collected at regular intervals until the reaction stops.

The table shows the student's results.

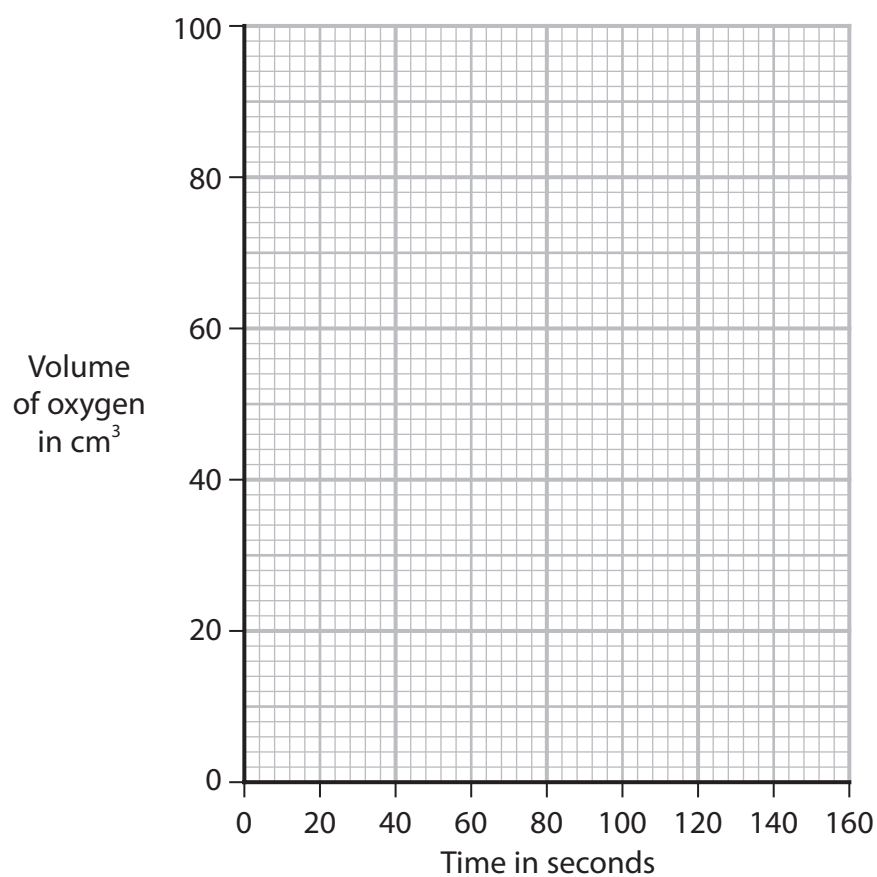
| Time in seconds                   | 0 | 20 | 40 | 60 | 80 | 100 | 120 | 140 | 160 |
|-----------------------------------|---|----|----|----|----|-----|-----|-----|-----|
| Volume of oxygen in $\text{cm}^3$ | 0 | 24 | 44 | 62 | 78 | 88  | 94  | 94  | 94  |

- (i) Plot the student's results on the grid.

(1)

- (ii) Draw a curve of best fit.

(1)



DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

- (d) (i) Explain in terms of particle collision theory how decreasing the concentration affects the rate of a reaction.

(3)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

- (ii) The student repeats the experiment using the same volume of hydrogen peroxide solution but with half the original concentration.

All other conditions are kept the same.

On the grid, draw the curve you would expect the student to obtain.

(2)

- (e) In this reaction, the manganese(IV) oxide acts as a catalyst.

Explain how a catalyst works.

(2)

.....

.....

.....

.....

**(Total for Question 6 = 12 marks)**

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....



7 (a) A technician needs to identify the solution in an unlabelled bottle.

The technician knows that the solution contains one of these compounds.

- iron(II) bromide
- iron(II) chloride
- iron(III) bromide
- iron(III) chloride

Describe how the technician can use chemical tests to identify the compound.

(6)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



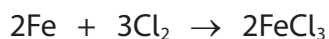
DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

- (b) When chlorine gas is passed over heated iron powder, iron(III) chloride forms.

This is the equation for the reaction.



0.060 mol of chlorine gas is passed over 2.8 g of iron powder.

Show by calculation that the iron powder is in excess.

(3)

- (c) When iron(III) chloride dissolves in water, an acidic solution forms.

- (i) Give the colour of litmus in this solution.

(1)

- (ii) Give the formula of the ion that causes the solution to be acidic.

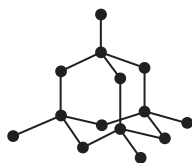
(1)

(Total for Question 7 = 11 marks)

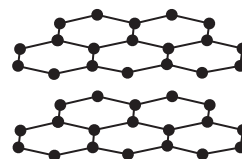


- 8 Diamond and graphite are made of carbon atoms, joined together by covalent bonds.

The diagram shows their structures.



diamond



graphite

- (a) State, in terms of electrostatic attractions, what is meant by a covalent bond.

(2)

.....

.....

.....

.....

- (b) Explain why diamond has a high melting point.

(3)

.....

.....

.....

.....

.....

.....

- (c) Explain why graphite is a good conductor of electricity.

(2)

.....

.....

.....

.....

DO NOT WRITE IN THIS AREA

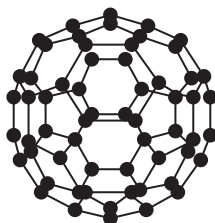
DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



(d)  $C_{60}$  fullerene is a molecule made of 60 carbon atoms.

The diagram shows the structure of  $C_{60}$  fullerene.



One mole of atoms contains  $6.0 \times 10^{23}$  atoms.

Determine the number of atoms in one mole of  $C_{60}$  fullerene.

Give your answer in standard form.

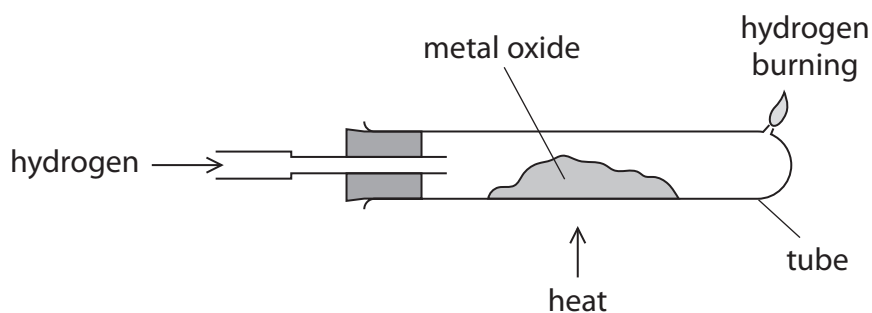
(2)

number of atoms = .....

**(Total for Question 8 = 9 marks)**



- 9 A scientist uses this apparatus in an experiment to reduce a metal oxide to a metal.



Before heating the mass of the empty tube and the mass of the tube and the metal oxide are recorded.

After heating, the tube is allowed to cool and the mass of the tube and its contents is recorded again.

- (a) (i) State why the reaction of the metal oxide to form a metal is described as a reduction reaction.

(1)

- (ii) State why it is important to relight the hydrogen at the end of the tube if the flame goes out.

(1)

- (iii) Explain why it is important to continue passing hydrogen into the tube and burning the hydrogen at the end of the tube until the contents have cooled.

(2)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



- (iv) Describe what should be done next to ensure that all the metal oxide has been converted into the metal.

(2)

.....

.....

.....

.....

- (b) In this experiment a mass of 4.14 g of metal is formed from 4.46 g of the metal oxide.

- (i) Calculate the amount, in moles, of oxygen atoms in the sample of the metal oxide.

(2)

amount of oxygen atoms = ..... mol

- (ii) The formula of the metal oxide is  $\text{MO}$ , where  $\text{M}$  represents the symbol of the metal.

Deduce the amount, in moles, of  $\text{M}$  in the sample of the metal oxide.

(1)

amount of  $\text{M}$  = ..... mol

- (iii) Calculate the relative atomic mass of  $\text{M}$ .

(2)

relative atomic mass of  $\text{M}$  = .....

- (iv) Use the Periodic Table to identify metal  $\text{M}$ .

(1)

.....

**(Total for Question 9 = 12 marks)**

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



**10** This method is used in an experiment to produce hydrated zinc nitrate crystals.

- pour 50 cm<sup>3</sup> of dilute nitric acid into a beaker
- add a spatula of zinc powder to the acid
- add more zinc until it is in excess
- filter the mixture
- obtain crystals of zinc nitrate from the filtrate

(a) State why the mixture is filtered.

(1)

(b) Describe how a pure, dry sample of hydrated zinc nitrate crystals could be obtained from the filtrate.

(4)

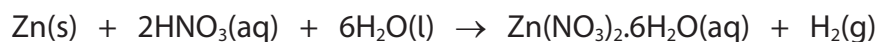
DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



(c) This equation represents the formation of hydrated zinc nitrate in the experiment.



(i) In another experiment, 9.75 g of zinc is completely reacted with nitric acid.

Show that the maximum possible mass of hydrated zinc nitrate crystals that could be formed is approximately 45 g.

[for  $\text{Zn(NO}_3)_2 \cdot 6\text{H}_2\text{O}$ ,  $M_r = 297$ ]

(2)

(ii) The actual yield of hydrated zinc nitrate crystals is 36.4 g.

Calculate the percentage yield of hydrated zinc nitrate crystals.

(2)

percentage yield = ..... %

**(Total for Question 10 = 9 marks)**

**TOTAL FOR PAPER = 110 MARKS**



DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

**BLANK PAGE**

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

**BLANK PAGE**

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

**BLANK PAGE**