

|                                    |                      |
|------------------------------------|----------------------|
| Write your name here               |                      |
| Surname                            | Other names          |
| Centre Number                      | Candidate Number     |
| <input type="text"/>               | <input type="text"/> |
| <b>Edexcel IGCSE</b>               |                      |
| <b>Chemistry</b>                   |                      |
| <b>Unit: 4CH0</b>                  |                      |
| <b>Science (Double Award) 4SC0</b> |                      |
| <b>Paper: 1C</b>                   |                      |
| Wednesday 25 May 2011 – Morning    | Paper Reference      |
| <b>Time: 2 hours</b>               | <b>4CH0/1C</b>       |
| <b>You must have:</b>              | Total Marks          |
| Ruler                              | <input type="text"/> |
| Candidates may use a calculator.   |                      |

### 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 120.
- 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.
- Keep an eye on the time.
- Write your answers neatly and in good English.
- Try to answer every question.
- Check your answers if you have time at the end.

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Turn over ►

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THE PERIODIC TABLE

Period 1 2 3 4 5 6 7 0 Group

|   |   |                             |                              |                             |                             |                              |                              |  |                             |                              |                             |                            |                              |                             |                              |                             |                           |                          |
|---|---|-----------------------------|------------------------------|-----------------------------|-----------------------------|------------------------------|------------------------------|--|-----------------------------|------------------------------|-----------------------------|----------------------------|------------------------------|-----------------------------|------------------------------|-----------------------------|---------------------------|--------------------------|
| 1 | 1   | 2                           | 3                            | 4                           | 5                           | 6                            | 7                            | 0  |                             |                              |                             |                            |                              |                             |                              |                             |                           |                          |
| 1 | <div style="border: 1px solid black; padding: 2px; display: inline-block;">                 1<br/>H<br/>Hydrogen<br/>1             </div> |                             |                              |                             |                             |                              |                              | <div style="border: 1px solid black; padding: 2px; display: inline-block;">                 4<br/>He<br/>Helium<br/>2             </div> |                             |                              |                             |                            |                              |                             |                              |                             |                           |                          |
| 2 | 7<br>Li<br>Lithium<br>3   | 9<br>Be<br>Beryllium<br>4   |                              |                             |                             |                              |                              |  | 11<br>B<br>Boron<br>5       | 12<br>C<br>Carbon<br>6       | 14<br>N<br>Nitrogen<br>7    | 16<br>O<br>Oxygen<br>8     | 19<br>F<br>Fluorine<br>9     | 20<br>Ne<br>Neon<br>10      |                              |                             |                           |                          |
| 3 | 23<br>Na<br>Sodium<br>11  | 24<br>Mg<br>Magnesium<br>12 |                              |                             |                             |                              |                              |  | 27<br>Al<br>Aluminium<br>13 | 28<br>Si<br>Silicon<br>14    | 31<br>P<br>Phosphorus<br>15 | 32<br>S<br>Sulfur<br>16    | 35.5<br>Cl<br>Chlorine<br>17 | 40<br>Ar<br>Argon<br>18     |                              |                             |                           |                          |
| 4 | 39<br>K<br>Potassium<br>19  | 40<br>Ca<br>Calcium<br>20   | 45<br>Sc<br>Scandium<br>21   | 48<br>Ti<br>Titanium<br>22  | 51<br>V<br>Vanadium<br>23   | 52<br>Cr<br>Chromium<br>24   | 55<br>Mn<br>Manganese<br>25  | 56<br>Fe<br>Iron<br>26   | 59<br>Co<br>Cobalt<br>27    | 59<br>Ni<br>Nickel<br>28     | 63.5<br>Cu<br>Copper<br>29  | 70<br>Zn<br>Zinc<br>30     | 73<br>Ga<br>Gallium<br>31    | 75<br>As<br>Arsenic<br>33   | 79<br>Se<br>Selenium<br>34   | 80<br>Br<br>Bromine<br>35   | 84<br>Kr<br>Krypton<br>36 |                          |
| 5 | 86<br>Rb<br>Rubidium<br>37  | 88<br>Sr<br>Strontium<br>38 | 89<br>Y<br>Yttrium<br>39     | 91<br>Zr<br>Zirconium<br>40 | 93<br>Nb<br>Niobium<br>41   | 96<br>Mo<br>Molybdenum<br>42 | 99<br>Tc<br>Technetium<br>43 | 101<br>Ru<br>Ruthenium<br>44   | 103<br>Rh<br>Rhodium<br>45  | 106<br>Pd<br>Palladium<br>46 | 108<br>Ag<br>Silver<br>47   | 112<br>Cd<br>Cadmium<br>48 | 115<br>In<br>Indium<br>49    | 122<br>Sb<br>Antimony<br>51 | 128<br>Te<br>Tellurium<br>52 | 127<br>I<br>Iodine<br>53    | 131<br>Xe<br>Xenon<br>54  | 222<br>Rn<br>Radon<br>86 |
| 6 | 133<br>Cs<br>Caesium<br>55  | 137<br>Ba<br>Barium<br>56   | 139<br>La<br>Lanthanum<br>57 | 179<br>Hf<br>Hafnium<br>72  | 181<br>Ta<br>Tantalum<br>73 | 184<br>W<br>Tungsten<br>74   | 186<br>Re<br>Rhenium<br>75   | 190<br>Os<br>Osmium<br>76  | 192<br>Ir<br>Iridium<br>77  | 195<br>Pt<br>Platinum<br>78  | 197<br>Au<br>Gold<br>79     | 201<br>Hg<br>Mercury<br>80 | 204<br>Tl<br>Thallium<br>81  | 209<br>Bi<br>Bismuth<br>83  | 210<br>Po<br>Polonium<br>84  | 210<br>At<br>Astatine<br>85 | 222<br>Rn<br>Radon<br>86  |                          |
| 7 | 223<br>Fr<br>Francium<br>87   | 226<br>Ra<br>Radium<br>88   | 227<br>Ac<br>Actinium<br>89  |                             |                             |                              |                              |  |                             |                              |                             |                            |                              |                             |                              |                             |                           |                          |

Key

|                      |
|----------------------|
| Relative atomic mass |
| Symbol               |
| Name                 |
| Atomic number        |



**Answer ALL questions.**

**1** Atoms contain three different types of particle.

These are electrons, neutrons and protons.

(a) Which **one** of the three particles has a negative charge?

(1)

(b) Which **one** of the three particles has the smallest mass?

(1)

(c) Use words from the box to complete the sentences below.

Each word may be used once, more than once, or not at all.

|           |          |           |          |         |
|-----------|----------|-----------|----------|---------|
| electrons | elements | molecules | neutrons | protons |
|-----------|----------|-----------|----------|---------|

(i) Atoms are neutral because they contain equal numbers of

..... and .....

(1)

(ii) Isotopes are atoms with the same number of .....

but different numbers of ..... in the nucleus.

(2)

(d) An atom of magnesium can be represented by the symbol  $^{24}_{12}\text{Mg}$ .

Use numbers to complete these statements about this atom.

(i) The atomic number of this atom is .....

(1)

(ii) The mass number of this atom is .....

(1)

(iii) The electronic configuration of this atom is .....

(1)

**(Total for Question 1 = 8 marks)**

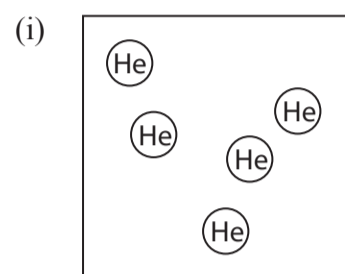


P 3 8 7 3 1 A 0 3 3 2

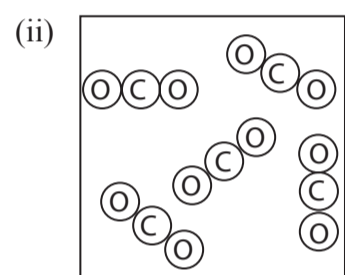
2 (a) Substances can be classified as elements, compounds or mixtures.

Each of the diagrams below represents either an element, a compound or a mixture.

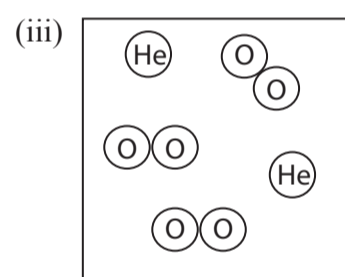
State which one of these is represented by each diagram.



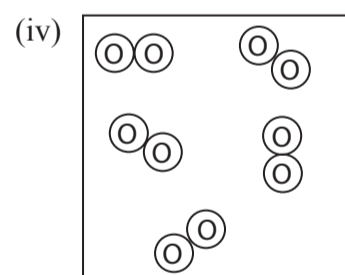
..... (1)



..... (1)



..... (1)



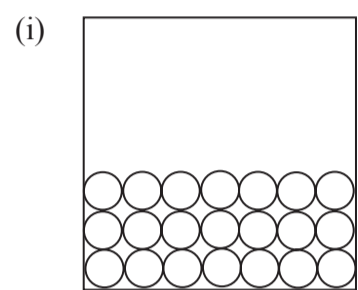
..... (1)



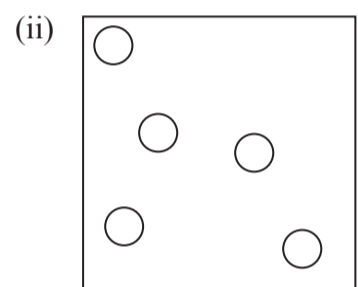
(b) Substances can also be classified as solids, liquids or gases.

Each of the diagrams below represents either a solid, a liquid or a gas.

State which one of these is represented by each diagram.



..... (1)

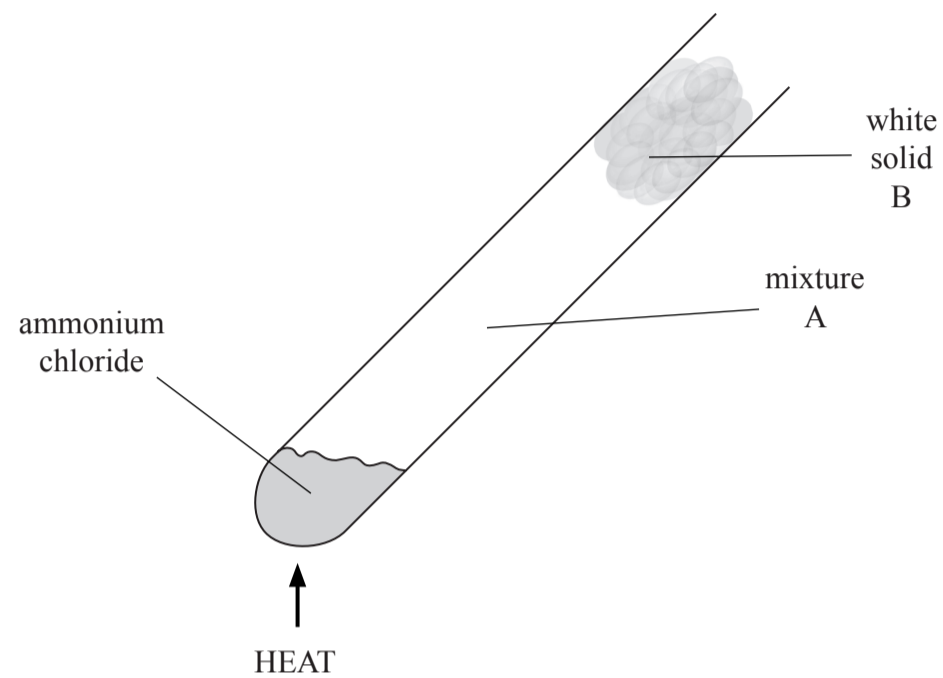


..... (1)

(Total for Question 2 = 6 marks)



3 The diagram shows ammonium chloride being heated in a test tube.



(a) The formula of ammonium chloride is  $\text{NH}_4\text{Cl}$ .

How many different elements are there in ammonium chloride?

(1)

(b) Identify the two gases in mixture A.

(2)

and

(c) Identify the white solid B.

(1)

(d) Place crosses (☒) in **two** boxes to identify the processes that occur in the test tube.

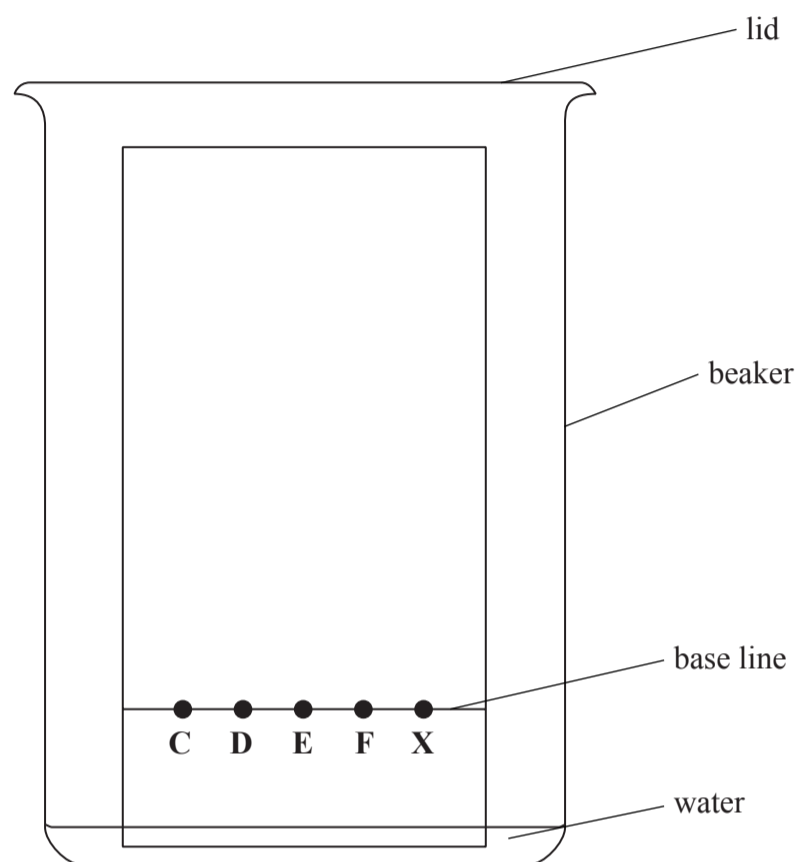
(2)

- boiling
- decomposition
- melting
- neutralisation

(Total for Question 3 = 6 marks)



- 4 Four separate food dyes (C, D, E and F) and a mixture of food dyes (X) were investigated using paper chromatography. The diagram shows the apparatus used.



- (a) Why should the water level be below the food dyes?

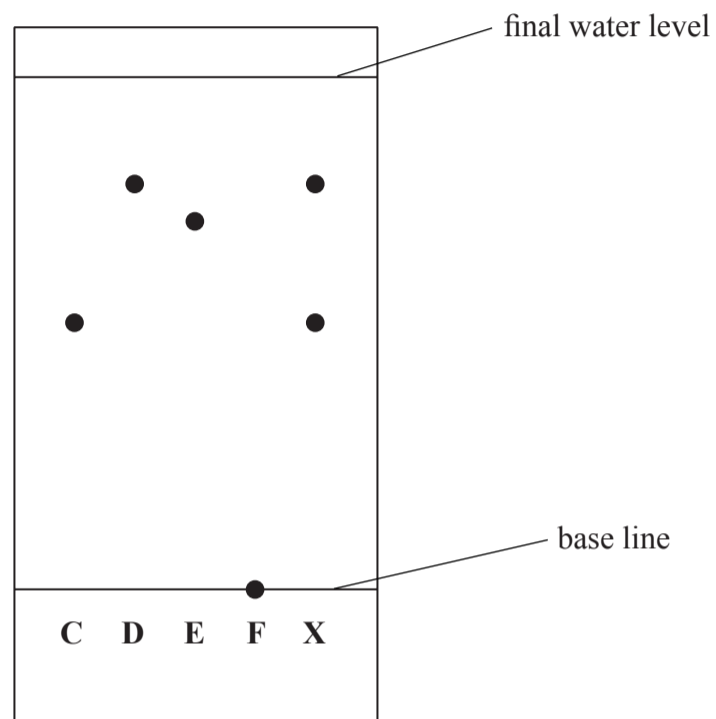
(1)



P 3 8 7 3 1 A 0 7 3 2

- (b) During the experiment the water rises up the paper. The experiment is stopped just before the water reaches the top of the paper.

The diagram shows the paper after it has been removed from the beaker and dried.



- (i) Which of the food dyes C, D, E and F does X contain?

(1)

- (ii) Suggest why food dye F did not move up the paper during the experiment.

(1)





(c) Each food dye has an  $R_f$  value that can be calculated using this expression:

$$R_f = \frac{\text{distance moved by food dye from base line}}{\text{distance moved by solvent from base line}}$$

Record the distances for food dye **D** in the table below and calculate its  $R_f$  value.

(3)

|  |  |
|--|--|
| Distance moved by food dye <b>D</b> from base line in mm |  |
| Distance moved by solvent from base line in mm           |  |
| $R_f$ value  |  |

(Total for Question 4 = 6 marks)



P 3 8 7 3 1 A 0 9 3 2

5 Bromine is an element in Group 7 of the Periodic Table.

(a) (i) State the number of outer electrons in an atom of bromine.

(1)

(ii) Identify an element in Group 7 that is a solid at room temperature.

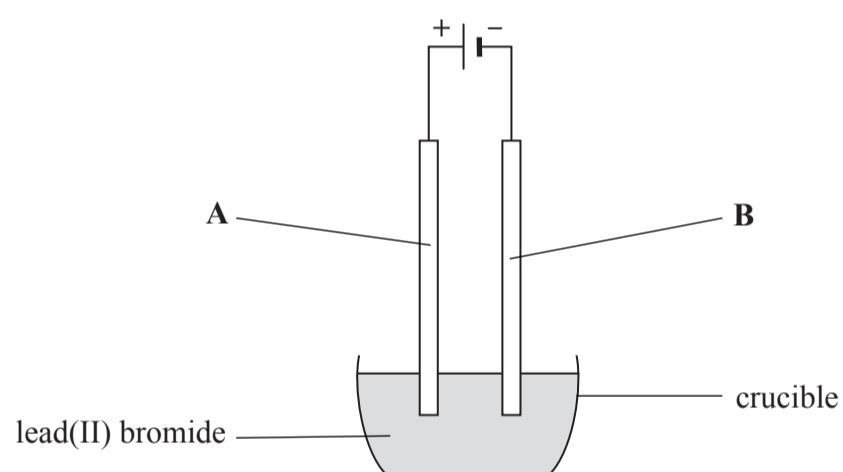
(1)

(iii) Identify an element in Group 7 that is more reactive than bromine.

(1)

(b) Bromine is formed by the electrolysis of molten lead(II) bromide.

The diagram shows the apparatus used.



(i) Solid lead(II) bromide contains ions.

Why does solid lead(II) bromide not conduct electricity?

(1)



(ii) The formula of lead(II) bromide is  $\text{PbBr}_2$ .

During electrolysis, brown fumes of bromine appear at electrode **A**.

The ionic half-equation for the reaction at electrode **A** is



Why is this reaction described as oxidation?

(1)

(iii) Write an ionic half-equation for the reaction at electrode **B** and describe the appearance of the product.

(2)

Ionic half-equation

Appearance of product

(c) Sodium bromate is a compound of sodium, bromine and oxygen.

A sample of sodium bromate contains 2.3 g of sodium, 8.0 g of bromine and 4.8 g of oxygen.

Calculate the empirical formula of sodium bromate.

(3)

Empirical formula is .....

**(Total for Question 5 = 10 marks)**



6 Some iron(II) sulfate ( $\text{FeSO}_4$ ) is dissolved in water to make a solution.

(a) A reaction takes place when sodium hydroxide solution is added to a solution of iron(II) sulfate.

(i) Complete the word equation to show this reaction.

(2)



(ii) State what you would observe in this reaction.

(1)

(b) Barium chloride is used to test for sulfate ions.

(i) Barium chloride solution is added to another solution of iron(II) sulfate. A white precipitate forms.

Identify the white precipitate.

(1)

(ii) In this test, another substance should be added to react with any carbonate ions that might be present.

Identify this other substance and state one observation that would be made if carbonate ions were present.

(2)

Other substance

Observation



(c) A compound with the formula  $(\text{NH}_4)_2\text{Fe}(\text{SO}_4)_2$  gives the same results in the tests in parts (a) and (b) as iron(II) sulfate ( $\text{FeSO}_4$ ).

Describe how you could show that a solution of  $(\text{NH}_4)_2\text{Fe}(\text{SO}_4)_2$  contains ammonium ions.

(3)

.....

.....

.....

.....

.....

.....

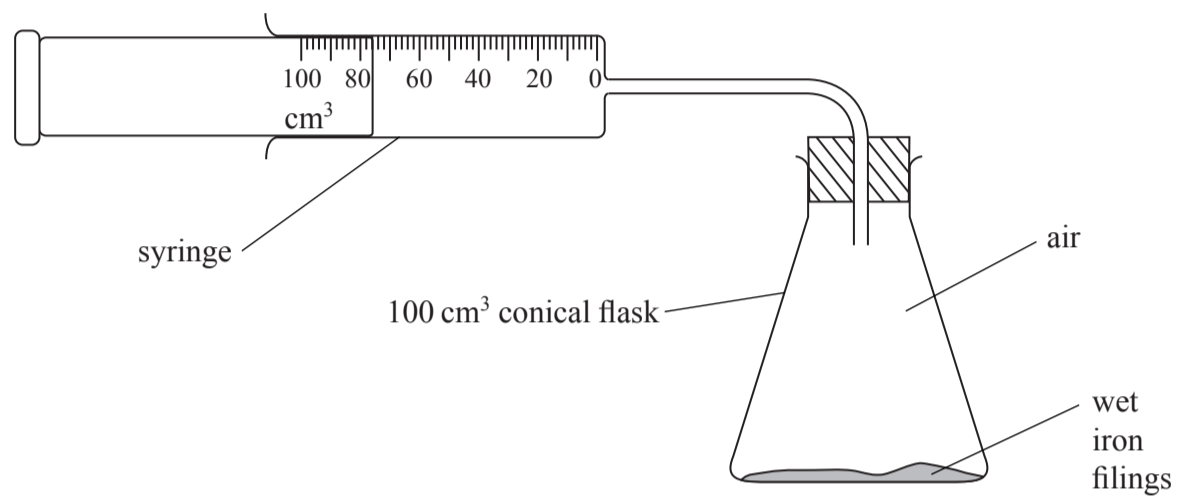
.....

**(Total for Question 6 = 9 marks)**



- 7 Rusting occurs when iron is exposed to air and water. During rusting, iron reacts with oxygen from the air to form an oxide.

Some students set up this apparatus to measure the volume of oxygen in a sample of air.

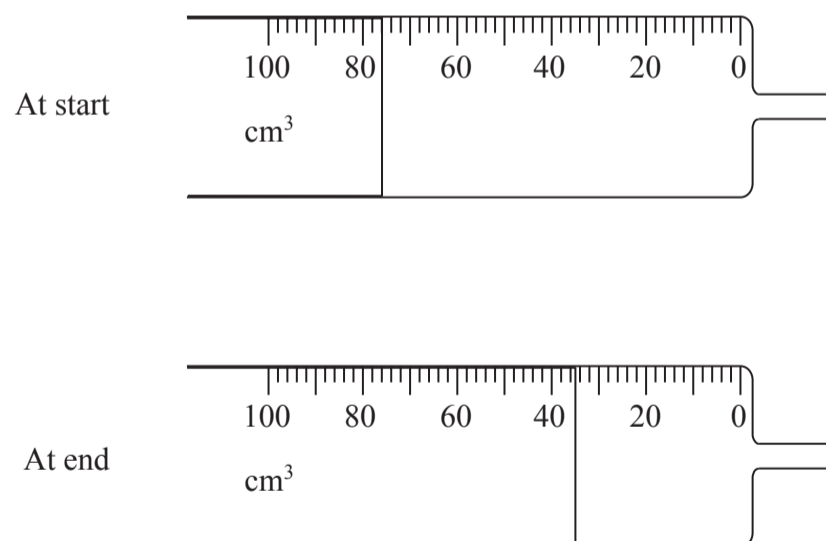


Each student used an excess of wet iron filings.

At the start of the experiment the reading on the syringe was recorded and the apparatus was then left for a week until the reaction was completed.

At the end of the experiment the reading on the syringe was recorded again.

- (a) The syringes used in one student's experiment are shown below.



Record the syringe readings at the start and at the end of the experiment in the table below, and calculate the volume of oxygen used up.

|   |  |
|---|--|
| Syringe reading at start in $\text{cm}^3$ |  |
| Syringe reading at end in $\text{cm}^3$   |  |
| Volume of oxygen used up in $\text{cm}^3$ |  |

(3)



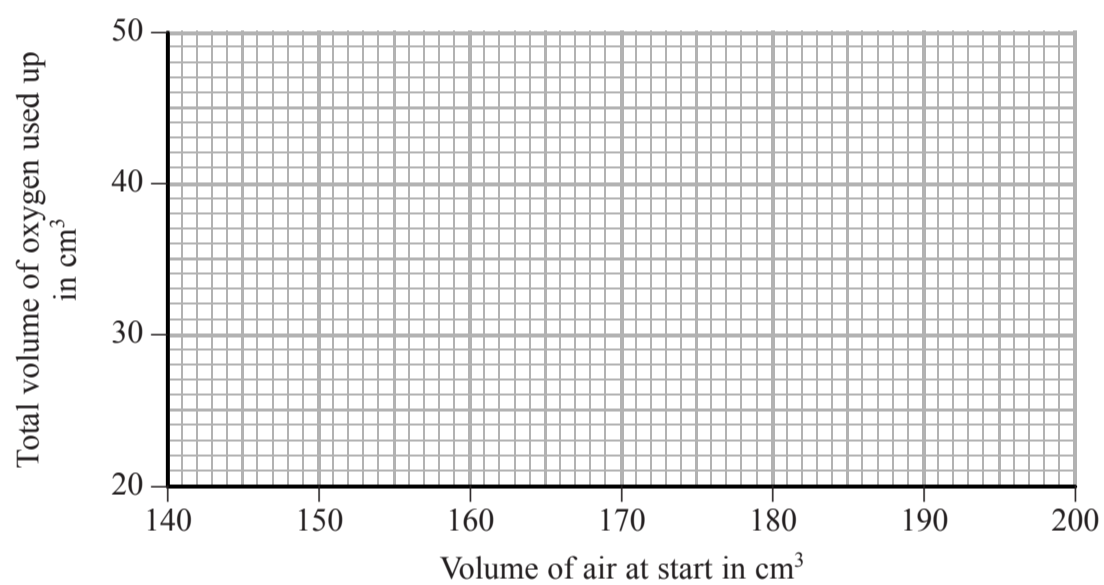
P 3 8 7 3 1 A 0 1 5 3 2

(b) The results of the other students are shown in the table.

| Total volume of air at start in $\text{cm}^3$ | Total volume of gas at end in $\text{cm}^3$ | Volume of oxygen used up in $\text{cm}^3$ |
|---|---|---|
| 200   | 160   | 40  |
| 180   | 144   | 36  |
| 165   | 140   | 25  |
| 150   | 120   | 30  |
| 185   | 148   | 37  |

(i) Use the results in the table to plot a graph of volume of oxygen used up against volume of air at start. Draw a straight line of best fit.

(3)



(ii) One of the results is anomalous. Identify this result by circling it on the graph.

(1)





- (c) Another group of students did experiments that gave several anomalous results. The teacher discussed possible errors that could have caused these anomalous results.

Complete the table by choosing words from the following list to show what effect each error would have on the volume of oxygen used up.

**decreased**

**increased**

**no change**

| Possible error causing anomalous result     | Effect on volume of oxygen used up |
|---|------------------------------------|
| iron filings not in excess                  |                                    |
| experiment left for 1 day instead of 1 week |                                    |
| apparatus left in warmer place for 1 week   |                                    |

(3)

- (d) Use the following results to calculate the percentage of oxygen in air.

Give your answer to one decimal place.

|   |     |
|---|-----|
| Total volume of air at start in cm <sup>3</sup> | 140 |
| Volume of gas at end in cm <sup>3</sup>         | 111 |

(2)

.....%

**(Total for Question 7 = 12 marks)**



- 8 A teacher explained the different types of formula used in organic chemistry, using ethene as an example.

| Description | Formula  |
|-------------|--|
| general     | $C_nH_{2n}$  |
| empirical   | $CH_2$   |
| molecular   | $C_2H_4$   |
| structural  | $CH_2=CH_2$  |
| displayed   | $  \begin{array}{c}  H & & H \\  & \diagdown & / \\  & C=C & \\  & / & \diagdown \\  H & & H  \end{array}  $ |

- (a) Use this example to help you write the formulae described below.

(i) The empirical formula of methane

(1)

(ii) The molecular formula of ethane

(1)

(iii) The structural formula of propane

(1)

(iv) The displayed formula of butane

(1)



(b) All the compounds in part (a) belong to the same homologous series and have the same general formula.

(i) State the name of this homologous series. (1)

(ii) State the general formula of this homologous series. (1)

(iii) State **two** characteristics of the compounds in a homologous series, other than having the same general formula. (2)

1

2





(e) When methane reacts with bromine, one of the products is hydrogen bromide.

(i) State a condition needed for this reaction.

(1)

(ii) Name the organic product of the reaction.

(1)

(iii) Write a chemical equation for the reaction.

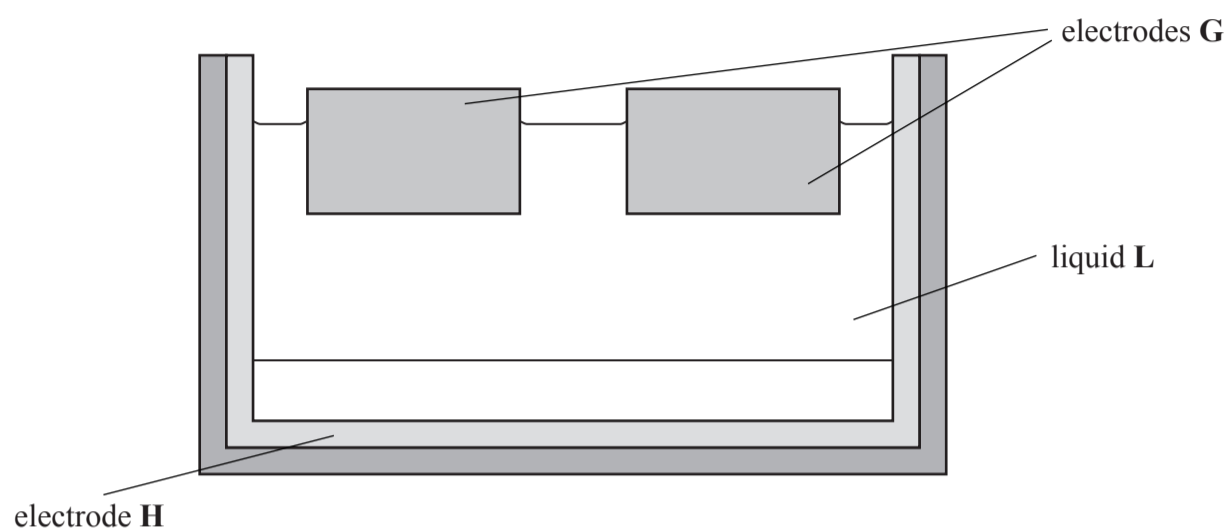
(2)

**(Total for Question 8 = 18 marks)**



P 3 8 7 3 1 A 0 2 1 3 2

9 The diagram shows how aluminium is extracted in industry.



(a) (i) Name the process used to extract aluminium.

(1)

(ii) Identify the element used to make the electrodes labelled **G**.

(1)

(iii) State whether electrode **H** is positive or negative.

(1)

(iv) Liquid **L** contains aluminium oxide and one other substance.

Name this other substance and give **one** reason for its use in the extraction of aluminium.

(2)

Other substance

Reason for use



(b) The product formed at electrode G reacts with the electrode to form carbon monoxide and carbon dioxide.

(i) Identify this product. (1)

(ii) State why carbon monoxide is poisonous. (1)

(iii) Describe a simple chemical test, and its result, for carbon dioxide. (2)

Test

Result



(c) The uses of aluminium depend on its structure and physical properties.

(i) The strength of solid aluminium depends on the electrostatic force of attraction between two types of particle in its structure.

Name these two types of particle.

(2)

..... and .....

(ii) Aluminium is described as ductile because it can easily be pulled into a wire. Explain, in terms of its structure, why it is ductile.

(2)

(iii) Explain, in terms of its structure, why aluminium is a good conductor of electricity.

(2)

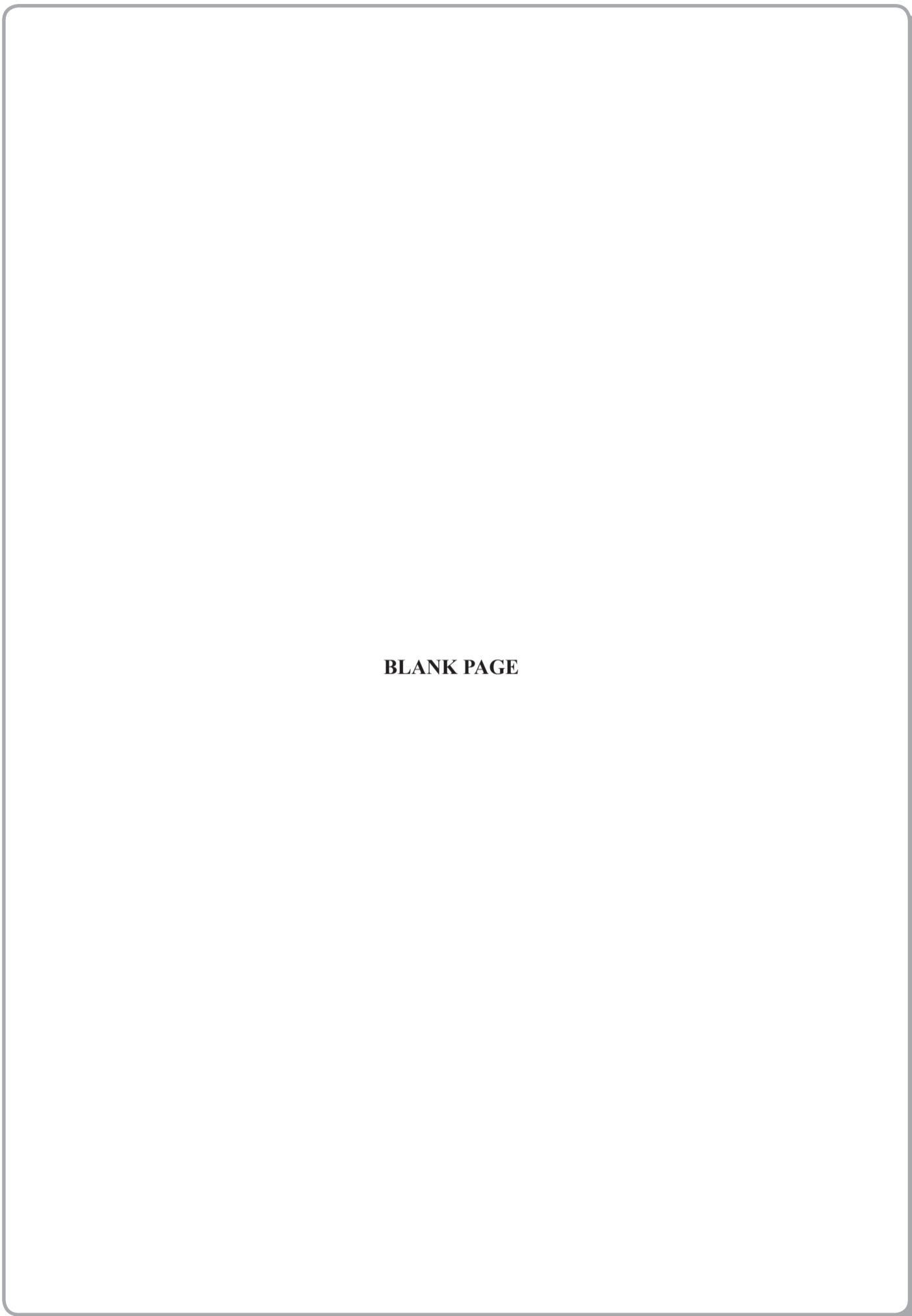
(iv) State a property that makes aluminium suitable for manufacturing aircraft bodies.

(1)

**(Total for Question 9 = 16 marks)**







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P 3 8 7 3 1 A 0 2 5 3 2



10 Several methods are used to prepare salts. The method chosen depends on whether the salt is soluble or insoluble in water.

(a) An insoluble salt is prepared by mixing solutions of silver nitrate and sodium chloride.

(i) State the **name** of the insoluble salt formed.

(1)

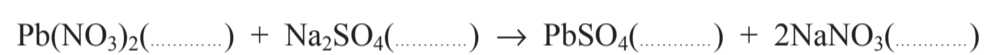
(ii) Write a chemical equation for the reaction occurring.

(2)

(b) The chemical equation for the preparation of the insoluble salt lead(II) sulfate is shown below.

Complete the equation by adding state symbols.

(1)



(c) A soluble salt is prepared from solutions of an acid and an alkali.

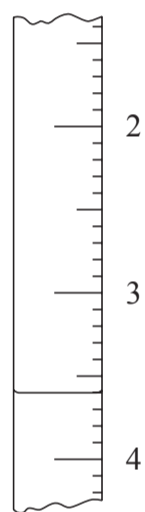
(i) Identify the acid and the alkali used to prepare sodium nitrate. (2)

Acid

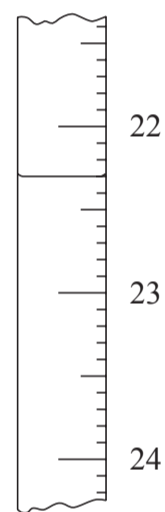
Alkali

(ii) The diagrams show the readings on a burette before and after a student added an alkali to an acid during a titration.

Before



After



Use these diagrams to complete the table below, entering all values to the nearest 0.05 cm<sup>3</sup>.

|   |  |
|---|--|
| Burette reading after adding alkali in cm <sup>3</sup>  |  |
| Burette reading before adding alkali in cm <sup>3</sup> |  |
| Volume of alkali added in cm <sup>3</sup>               |  |

(3)



(d) A second student also did the titration and recorded these results:

|   |       |       |       |       |
|---|-------|-------|-------|-------|
| Burette reading after adding alkali in $\text{cm}^3$  | 24.05 | 23.30 | 23.55 | 23.80 |
| Burette reading before adding alkali in $\text{cm}^3$ | 0.50  | 0.80  | 0.60  | 1.20  |
| Volume of alkali added in $\text{cm}^3$               | 23.55 | 22.50 | 22.95 | 22.60 |
| Titration results to be used (✓)                      |       |       |       |       |

The volumes of alkali added during these titrations are not all the same. The average (mean) volume of alkali should be calculated using only concordant results.

Concordant results are those volumes that differ from each other by  $0.20 \text{ cm}^3$  or less.

- (i) Identify the concordant results by placing ticks (✓) in the table as shown. (1)
- (ii) Use your ticked results to calculate the average (mean) volume of alkali added. (2)

Average (mean) volume = .....  $\text{cm}^3$



- (e) A student mixed together the acid and alkali to form sodium nitrate solution. She used the volumes needed for complete reaction found in the titration. She heated this solution in an evaporating basin to remove some of the water.

After cooling the concentrated solution, crystals of sodium nitrate formed.

What steps should she now take to obtain dry crystals of sodium nitrate?

(2)

- (f) Sodium nitrate decomposes when heated, as shown by the equation



A 1.70 g sample of sodium nitrate ( $M_r = 85$ ) was completely decomposed to sodium nitrite ( $\text{NaNO}_2$ ) and oxygen.

Calculate the mass of sodium nitrite formed.

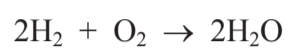
(3)

Mass of sodium nitrite = ..... g

**(Total for Question 10 = 17 marks)**



11 Hydrogen is used as a fuel. The equation for its combustion is



- (a) Explain, in terms of the energy changes involved in breaking and making bonds, why this reaction gives out heat.

(3)

- (b) Hydrogen is often described as a clean fuel because the only product of its combustion is water.

- (i) Anhydrous copper(II) sulfate can be used to show the presence of water.

State the colour change of anhydrous copper(II) sulfate when water is added to it, and write a chemical equation for the reaction.

(4)

Colour change

to

Equation

- (ii) A physical test can be used to show that a sample of the water formed is pure. State the test and the result for pure water.

(2)

Test

Result



- (c) The water formed by burning hydrogen as a fuel is often slightly acidic because it is contaminated with nitric acid.

The presence of acid in this water can be detected using methyl orange or by measuring the pH of the water.

- (i) State the colour of methyl orange in water contaminated with a small amount of nitric acid.

(1)

- (ii) Suggest why universal indicator is more suitable than methyl orange for comparing the acidities of samples of water.

(1)

- (iii) Suggest a possible pH value for water contaminated with a small amount of nitric acid.

(1)

(Total for Question 11 = 12 marks)

(TOTAL FOR PAPER = 120 MARKS)



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