Write your name here

Surname	Other names

Edexcel IGCSE

Centre Number	Candidate Number

Chemistry

Unit: 4CH0
Science (Double Award) 4SC0
Paper: 1C

Wednesday 25 May 2011 – Morning
Time: 2 hours

Paper Reference
4CH0/1C
4SC0/1C

You must have:
Ruler
Candidates may use a calculator.

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 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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1/1/1/1/

P 3 8 7 3 1 A 0 1 3 2

Turn over ▶

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THE PERIODIC TABLE

Period	1	2											3	4	5	6	7	0
	Group																	
1	1 H Hydrogen 1																	4 He Helium 2
2	7 Li Lithium 3	9 Be Beryllium 4											11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10
3	23 Na Sodium 11	24 Mg Magnesium 12											27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulfur 16	35.5 Cl Chlorine 17	40 Ar Argon 18
4	39 K Potassium 19	40 Ca Calcium 20	45 Sc Scandium 21	48 Ti Titanium 22	51 V Vanadium 23	52 Cr Chromium 24	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	59 Ni Nickel 28	63.5 Cu Copper 29	65 Zn Zinc 30	70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36
5	86 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	99 Tc Technetium 43	101 Ru Ruthenium 44	103 Rh Rhodium 45	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54
6	133 Cs Caesium 55	137 Ba Barium 56	139 La Lanthanum 57	179 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	186 Re Rhenium 75	190 Os Osmium 76	192 Ir Iridium 77	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	210 Po Polonium 84	210 At Astatine 85	222 Rn Radon 86
7	223 Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 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 $^{24}_{12}Mg$.

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)

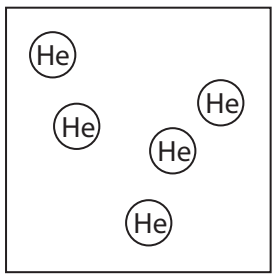
(Total for Question 1 = 8 marks)

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.

(i)



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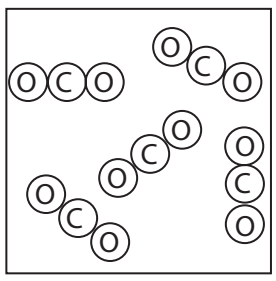
(1)

(ii)



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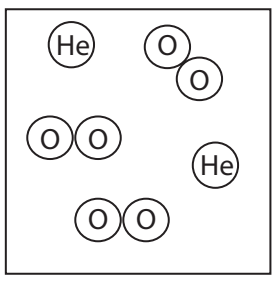
(1)

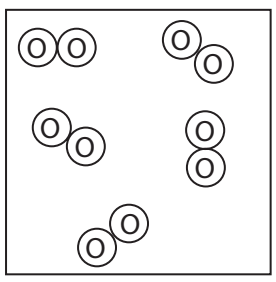
(iii)



.....

(1)

(iv)



.....

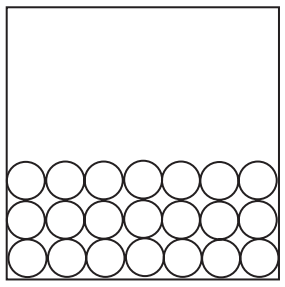
(1)

(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.

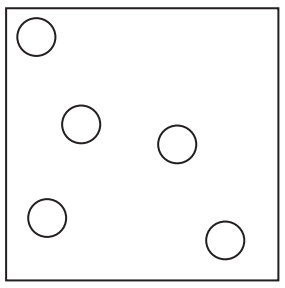
(i)



.....

(1)

(ii)

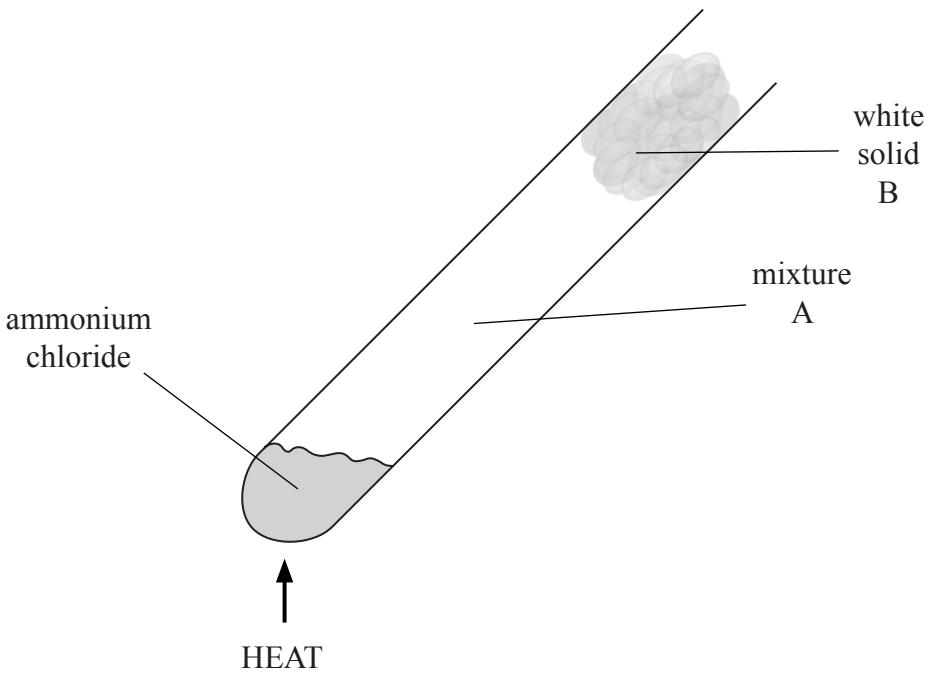


.....

(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 NH_4Cl.

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 ☒

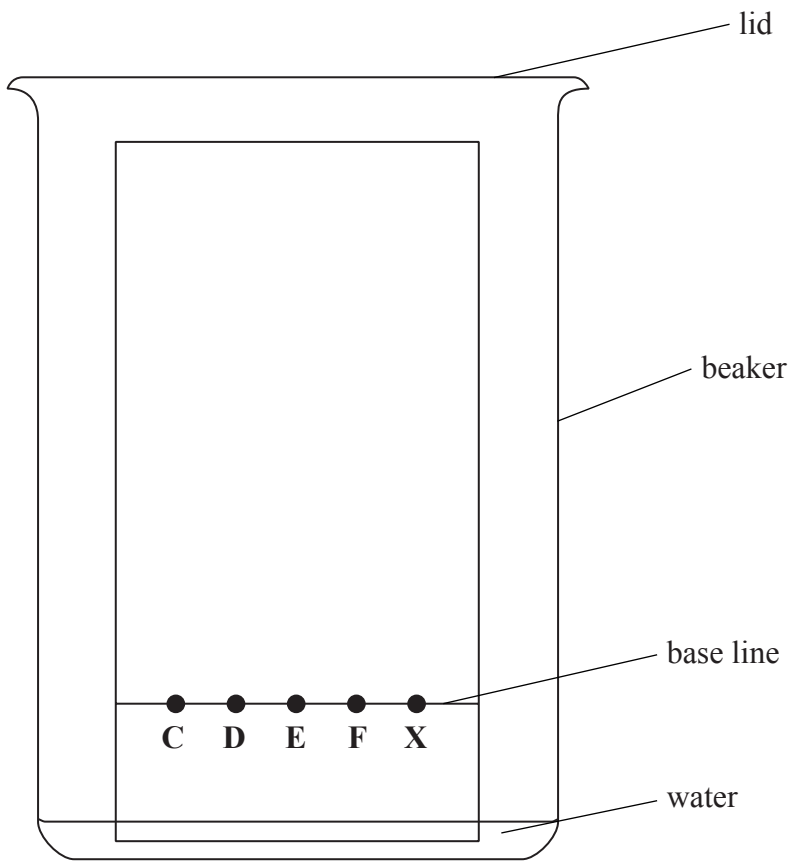
decomposition ☒

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.

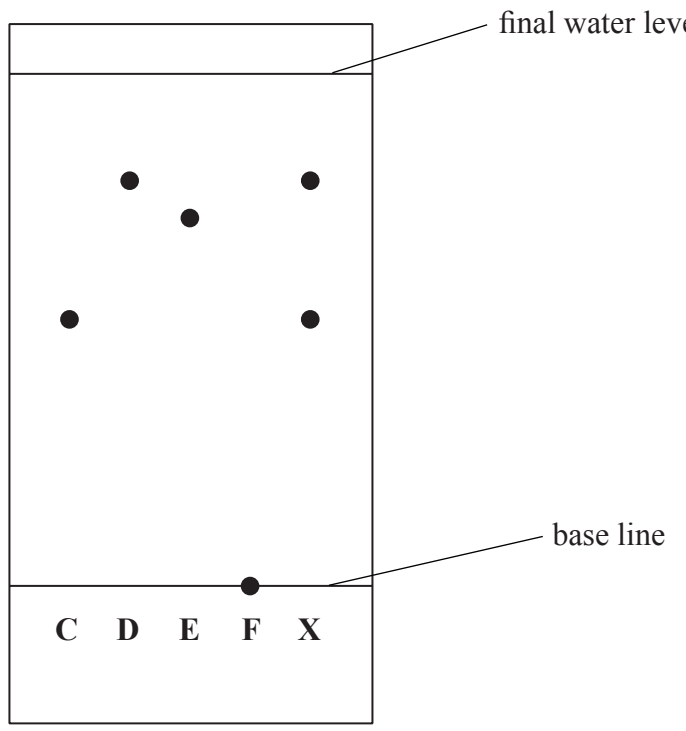


(a) Why should the water level be below the food dyes?

(1)

(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 **D** from base line in mm	
Distance moved by solvent from base line in mm	
R_f value	

(Total for Question 4 = 6 marks)

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.

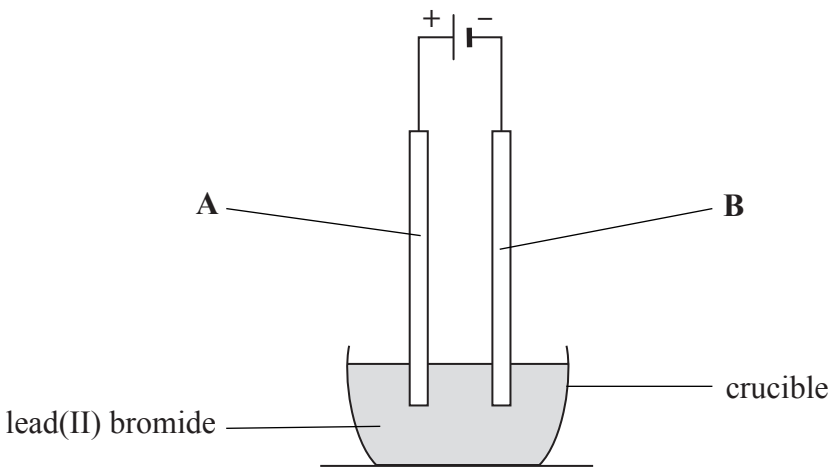
(1)

(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 $PbBr_2$.

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

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

$$2Br^- \rightarrow Br_2 + 2e^-$$

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 ($FeSO_4$) 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)

sodium hydroxide + iron(II) sulfate ⟶ +

(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 $(NH_4)_2Fe(SO_4)_2$ gives the same results in the tests in parts (a) and (b) as iron(II) sulfate ($FeSO_4$).

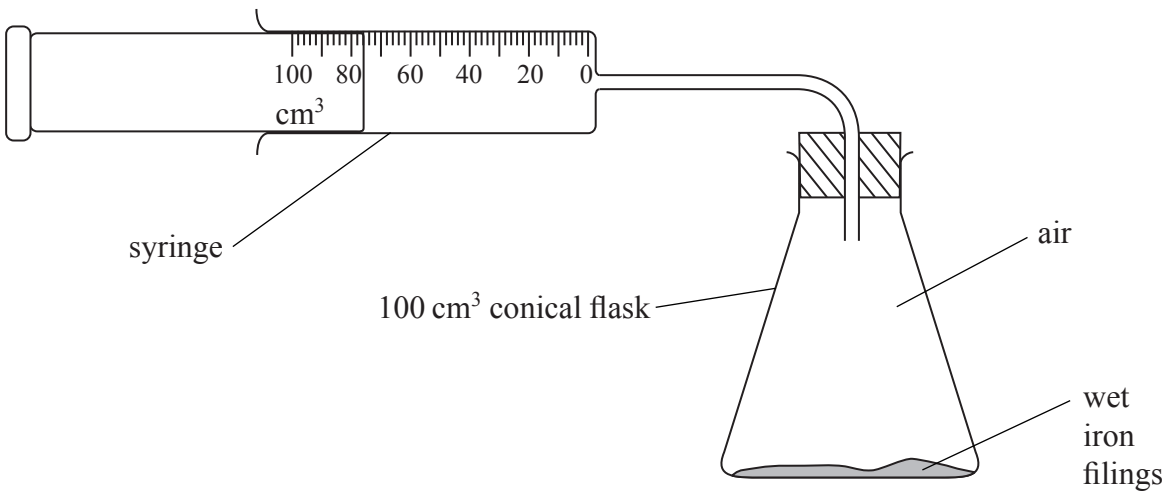
Describe how you could show that a solution of $(NH_4)_2Fe(SO_4)_2$ contains ammonium ions.

(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.

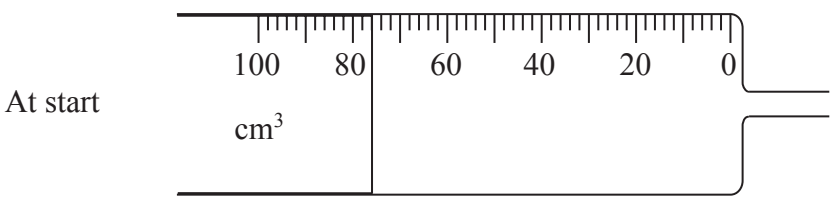


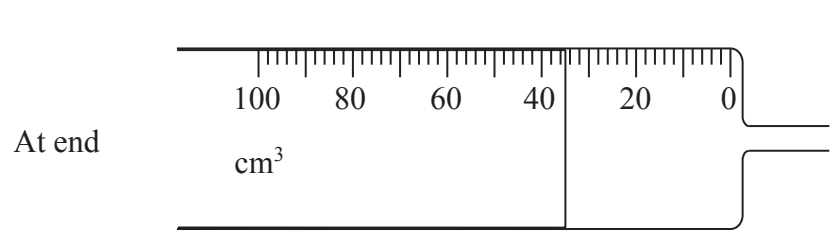
Each student used an excess of wet iron filings.

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 cm^3	
Syringe reading at end in cm^3	
Volume of oxygen used up in cm^3	

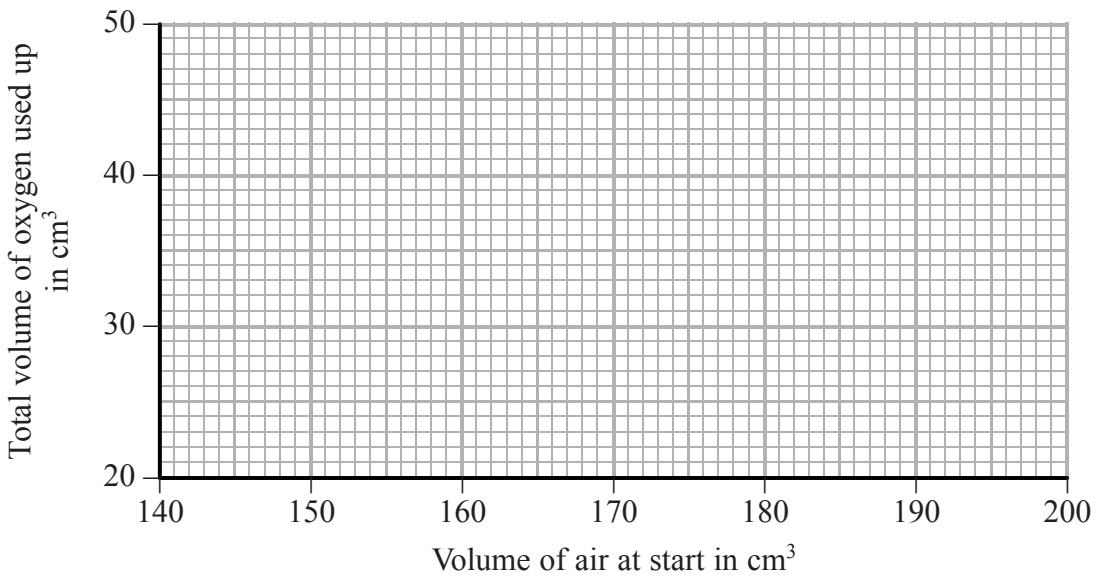
(3)

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

Total volume of air at start in cm^3	Total volume of gas at end in cm^3	Volume of oxygen used up in 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.

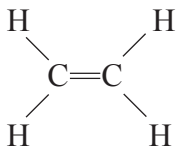
Total volume of air at start in cm^3	140
Volume of gas at end in cm^3	111

(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	

(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

(c) All the compounds in part (a) are hydrocarbons. They can undergo complete combustion when burned in oxygen to form carbon dioxide and water.

(i) Write a chemical equation for the **complete** combustion of propane (C_3H_8).

(2)

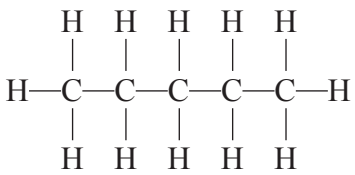
(ii) Identify one solid product and one gaseous product that could form during the **incomplete** combustion of propane.

(2)

Solid product

Gaseous product

(d) The displayed formula of pentane is



Draw a displayed formula for each of the two isomers of pentane.

(2)

Isomer 1

Isomer 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.

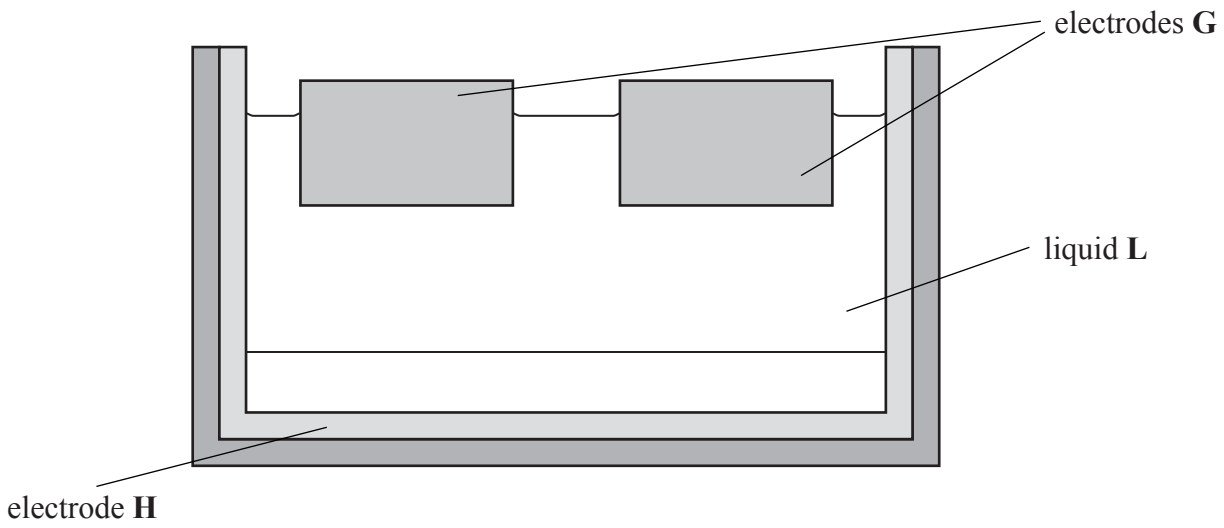
(1)

(iii) Write a chemical equation for the reaction.

(2)

(Total for Question 8 = 18 marks)

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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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)

$$Pb(NO_3)_2(\ldots\ldots) + Na_2SO_4(\ldots\ldots) \rightarrow PbSO_4(\ldots\ldots) + 2NaNO_3(\ldots\ldots)$$

(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)

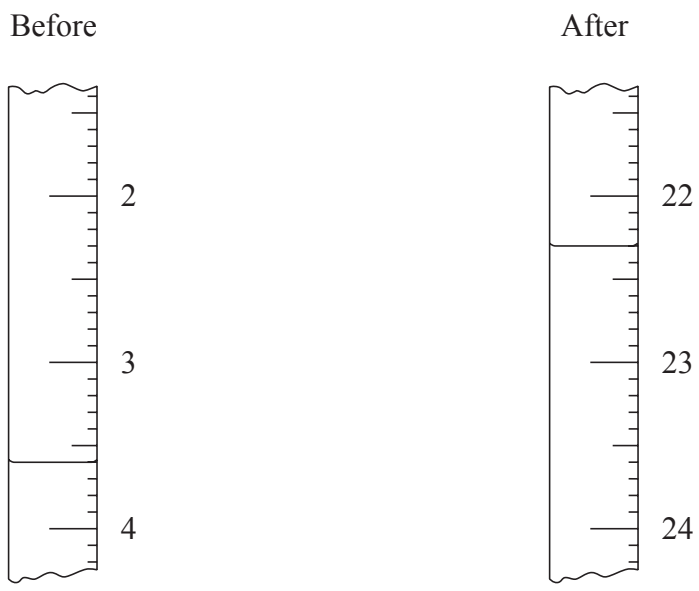
Acid

.....

Alkali

.....

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



Use these diagrams to complete the table below, entering all values to the nearest 0.05 cm^3.

Burette reading after adding alkali in cm^3	
Burette reading before adding alkali in cm^3	
Volume of alkali added in cm^3	

(3)

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

Burette reading after adding alkali in cm^3	24.05	23.30	23.55	23.80
Burette reading before adding alkali in cm^3	0.50	0.80	0.60	1.20
Volume of alkali added in 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 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 = ... 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

$$2NaNO_3 \rightarrow 2NaNO_2 + O_2$$

A 1.70 g sample of sodium nitrate ($M_r = 85$) was completely decomposed to sodium nitrite ($NaNO_2$) 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

$$2H_2 + O_2 \rightarrow 2H_2O$$

(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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