Pearson Edexcel

INTERNATIONAL GCSE

Chemistry (9-1)

SAMPLE ASSESSMENT MATERIALS

Pearson Edexcel International GCSE in Chemistry (4CH1)

For first teaching September 2017
First examination June 2019
Issue 2

Edexcel, BTEC and LCCI qualifications

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ISBN 978 1 446 94321 2

Summary of Pearson Edexcel International GCSE in Chemistry (4CH1) sample assessment materials Issue 2 changes

<table>
<tr><th>Summary of changes made between previous issue and this current issue</th><th>Page number</th></tr>
<tr><td>In Paper 2, the mark scheme for Question 6(e) has been supplemented and replaces the mark scheme for Question 6(a), originally included on this page in error.
<table>
<tr><th>Question number</th><th>Answer</th><th>Additional guidance</th><th>Mark</th></tr>
<tr><td>6(e)</td><td>• calculate the amount of magnesium carbonate (1)
• calculate the volume of carbon dioxide in dm^3 (1)
• calculate the volume of carbon dioxide in cm^3 (1)

Example calculation:
$n(MgCO_3) = 4.2 \div 84 = 0.050$ mol (1)
$vol(CO_2) = 0.050 \times 24 = 1.2\ dm^3$ (1)
$vol(CO_2) = (1.2 \times 1000)$
$= 1200\ (cm^3)$ (1)</td><td>give full credit for alternative methods</td><td>3</td></tr>
</table>
</td><td>77</td></tr>
</table>

If you need further information on these changes or what they mean, contact us via our website at: qualifications.pearson.com/en/support/contact-us.html.

Contents

Introduction

The Pearson Edexcel International GCSE (9-1) in Chemistry is part of a suite of International GCSE qualifications offered by Pearson.

These sample assessment materials have been developed to support this qualification and will be used as the benchmark to develop the assessment candidates will take.

General marking guidance

- All candidates must receive the same treatment. Examiners must mark the last candidate in exactly the same way as they mark the first.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than be penalised for omissions.
- Examiners should mark according to the mark scheme – not according to their perception of where the grade boundaries may lie.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification/indicative content will not be exhaustive. However, different examples of responses will be provided at standardisation.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, a senior examiner must be consulted before a mark is given.
- Crossed-out work should be marked **unless** the candidate has replaced it with an alternative response.

Subject specific marking guidance

Symbols and terms used in the mark scheme:

- Round brackets ( ): words inside round brackets are to aid understanding of the marking point but are not required to award the point
- Curly brackets { }: indicate the beginning and end of a list of alternatives (separated by obliques) where necessary, to avoid confusion
- Oblique /: words or phrases separated by an oblique are alternatives to each other and either answer should receive full credit
- ecf: indicates error carried forward which means that a wrong answer given in an early part of a question is used correctly in a later part of a question.

You will not see 'owtte' (or words to that effect). Alternative correct wording should be credited in every answer unless the mark scheme has specified otherwise.

The Additional Guidance column is used for extra guidance to clarify any points in the mark scheme. It may be used to indicate:

- what will not be accepted for that marking point, in which case the phrase 'do not accept' will appear alongside the relevant marking point
- it might have examples of possible acceptable answers which will be adjacent to that marking point.

Write your name here

Surname	Other names

Pearson Edexcel International GCSE (9 - 1)

Centre Number	Candidate Number

Chemistry

Paper 1

Sample Assessment Materials for first teaching September 2017	Paper Reference
Time: 2 hours	**4CH1/1C** **4SD0/1C**

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.*
- Calculators may be used.
- 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 ☒.

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.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

S52915A

1/1/1/1/

S 5 2 9 1 5 A 0 1 3 2

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The Periodic Table of the Elements

1	2											3	4	5	6	7	0
							1 **H** hydrogen 1										4 **He** helium 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
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
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
85 **Rb** rubidium 37	88 **Sr** strontium 38	89 **Y** yttrium 39	91 **Zr** zirconium 40	93 **Nb** niobium 41	96 **Mo** molybdenum 42	[98] **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
133 **Cs** caesium 55	137 **Ba** barium 56	139 **La*** lanthanum 57	178 **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	[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	Elements with atomic numbers 112–116 have been reported but not fully authenticated						

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

**** The lanthanoids (atomic numbers 58–71) and the actinoids (atomic numbers 90–103) have been omitted.***

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

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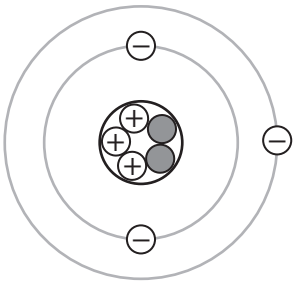
Answer ALL questions. Write your answers in the spaces provided.

1 The diagram shows the structure of an atom.



(a) Name the central part of an atom.

(1)

(b) Name the positively charged particles in an atom.

(1)

(c) State how the diagram shows that this atom is neutral.

(1)

(d) Give the mass number of this atom.

(1)

(e) Give the name of the element containing this atom.
Use the Periodic Table to help you.

(1)

(Total for Question 1 = 5 marks)

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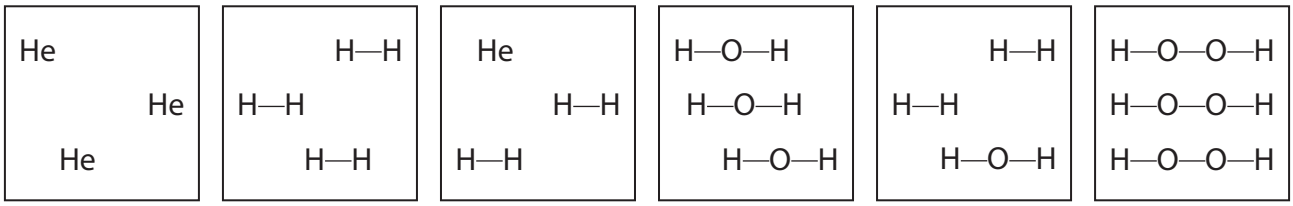
2 Substances can be classified as elements, compounds or mixtures.

(a) Each of the boxes in the diagram represents either an element, a compound or a mixture.



box 1 box 2 box 3 box 4 box 5 box 6

(i) Explain which **two** boxes represent an element.

(2)

(ii) Explain which **two** boxes represent a mixture.

(2)

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(b) The list gives the names of some methods used in the separation of mixtures:

- chromatography
- crystallisation
- distillation
- filtration

Use names from the list to choose a suitable method for each separation.

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

(i) Separating water from sodium chloride solution.

(1)

.....

(ii) Separating the blue dye from a mixture of blue and red dyes.

(1)

.....

(iii) Separating potassium nitrate from potassium nitrate solution.

(1)

.....

(Total for Question 2 = 7 marks)

3 Ammonium chloride decomposes in a reversible reaction. The equation for this reaction is

$$NH_4Cl(s) \rightleftharpoons NH_3(g) + HCl(g)$$

(a) State how the equation shows that the reaction is reversible.

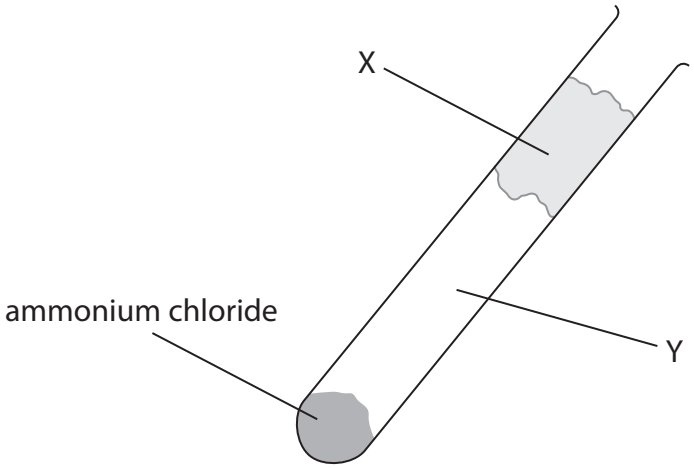
(1)

.....

.....

(b) Some ammonium chloride is heated gently in a test tube.

The diagram shows the test tube after it has been heated gently for a short time.



(i) Identify solid **X** and the two gases formed in region **Y** of the test tube.

(2)

Solid **X** .....

Gases in region **Y** .....

.....

(ii) Which change of state occurs in the test tube during heating?

(1)

- ☒ **A** condensing
- ☒ **B** evaporating
- ☒ **C** melting
- ☒ **D** subliming

(c) An experiment involving ammonium chloride can be used to show the process of diffusion.

The diagram shows the apparatus at the start of the experiment.

At the end of the experiment, a white solid forms in the test tube.

Explain which position, **A**, **B** or **C**, shows where the white solid forms.

(3)

.....

.....

.....

.....

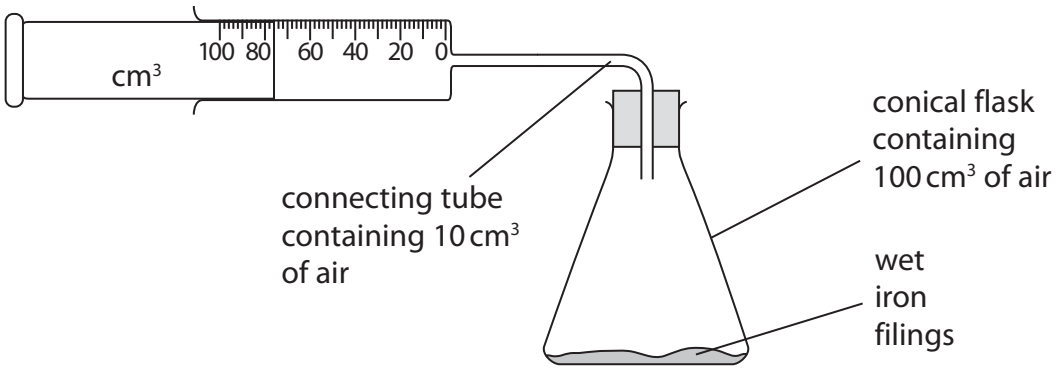
.....

.....

(Total for Question 3 = 7 marks)

4 The percentage by volume of oxygen in air can be found by using the rusting of iron.

A student sets up this apparatus to measure the volume of oxygen in a sample of air.

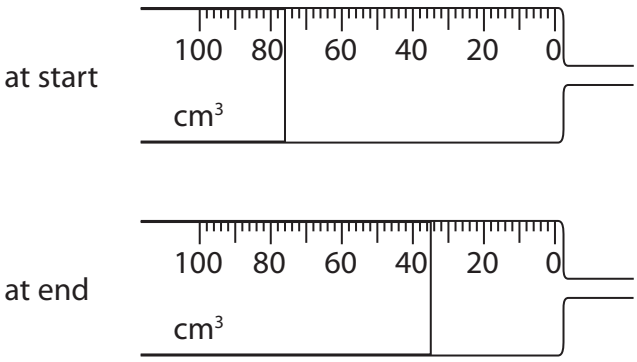


An excess of wet iron filings is used.

At the start of each experiment, the reading on the syringe is recorded and the apparatus is then left for a week so that the reaction is complete.

The reading on the syringe is then recorded again.

(a) The diagram shows the readings in one experiment.



Complete the table to show:

- the syringe reading at the end of this experiment
- the volume of oxygen used in the experiment.

(2)

syringe reading at start / cm^3	76
syringe reading at end / cm^3	
volume of oxygen used / cm^3	

(b) The table shows the results recorded by a different student in her experiment.

volume of air in conical flask / cm^3	100
volume of air in connecting tube / cm^3	10
original volume of air in syringe / cm^3	80
final volume of air in syringe / cm^3	43

Calculate the percentage of oxygen in air using these results.

(3)

percentage of oxygen = ... %

(c) The table shows some possible causes of anomalous results in this experiment.

Use terms from the box to complete the table, showing possible causes and their effects on the volume of oxygen used in this experiment.

decreased	increased	no effect

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

(3)

Possible cause	Effect on volume of oxygen used
wet iron filings not in excess	
apparatus left for 1 hour instead of 1 week	
apparatus left in a warmer place for 1 week	

(Total for Question 4 = 8 marks)

5 A metal is added to copper(II) sulfate solution.

A displacement reaction only occurs if the metal added is more reactive than copper.

$$\text{metal} + \text{copper(II) sulfate} \rightarrow \text{metal sulfate} + \text{copper}$$

Displacement reactions are exothermic. The more reactive the metal added, the greater the temperature rise.

A student uses the following method in an experiment to compare the reactivities of different metals:

- pour some copper(II) sulfate solution into a boiling tube and record its temperature using a thermometer
- add some metal to the tube and stir with the thermometer
- record the maximum temperature of the contents of the tube.

He repeats the method using the same amount, in moles, of different metals.

(a) To make the experiment valid, he starts with the copper(II) sulfate solution and the added metal at the same temperature.

State **two** other variables that must be controlled if the experiment is to be valid.

(2)

1 .....

.....

2 .....

.....

(b) Another student uses the same method three times for each of the metals **E**, **F**, **G** and **H**. The table shows her results for these metals.

Metal	Temperature increase / °C			Mean temperature increase / °C
	1	2	3	
E	7.0	4.0	8.0	7.5
F	0.0	0.0	0.0	0.0
G	6.0	5.0	5.4	
H	5.5	11.0	12.0	

(i) The student calculates the mean temperature increase for metals **E** and **F**. She does not include anomalous values in her calculations.

Calculate the mean temperature increase for metals **G** and **H**, ignoring any anomalous values. Write your answers in the table.

(2)

(ii) Explain which metal is the most reactive.

(2)

.....

.....

(iii) Explain which metal is less reactive than copper.

(2)

.....

.....

(Total for Question 5 = 8 marks)

6 This question is about the elements in Group 1 of the Periodic Table and their reactions with water.

(a) State why sodium and potassium are in Group 1 of the Periodic Table.

(1)

.....

.....

(b) A reaction occurs when a small piece of sodium is added to a large volume of water in a trough.

(i) Give **two** observations that you would make during this reaction.

(2)

1 .....

.....

2 .....

.....

(ii) After the reaction has finished, a few drops of universal indicator are added to the solution in the trough.

Explain the final colour of the universal indicator.

(2)

.....

.....

.....

(iii) What is the most likely pH value of the solution in the trough after the reaction is complete?

(1)

☒ **A** 2

☒ **B** 5

☒ **C** 8

☒ **D** 12

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(c) Give the name of a Group 1 metal that is less reactive than sodium.

(1)

.....

(d) A small piece of potassium is added to a large volume of water in a trough.

Give **one** observation that is made when potassium is added to water that is **not** made when sodium is added to water.

(1)

.....

.....

(e) Complete the equation for the reaction of rubidium with water.
State symbols are not required.

(1)

.....Rb + ...H_2O → .....RbOH + ...H_2

(Total for Question 6 = 9 marks)

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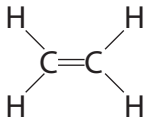
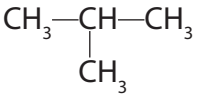
7 This question is about hydrocarbons.

(a) The table shows the formulae of some hydrocarbons.

A CH_4	**B** 	**C** $CH_3—CH_2—CH_3$
D 	**E** $CH_3CH{=}CH_2$	**F** $CH_3CH_2CH_2CH_3$

(i) Give the letters that represent hydrocarbons with the general formula C_nH_{2n}

(1)

.....

.....

(ii) State why **B** is the only hydrocarbon shown as a displayed formula.

(1)

.....

(iii) Explain which **two** letters represent isomers.

(3)

.....

.....

.....

.....

(iv) How many of the hydrocarbons are members of the homologous series of alkanes?

(1)

.....

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(b) Many hydrocarbons are used as fuels. There are problems associated with this use.

(i) Explain how the combustion of a hydrocarbon can lead to the formation of a poisonous gas.

(2)

(ii) State why this gas is poisonous to humans.

(1)

(c) Fuels used in cars often have sulfur compounds removed.

Explain how the combustion of these fuels in car engines still leads to the formation of acid rain.

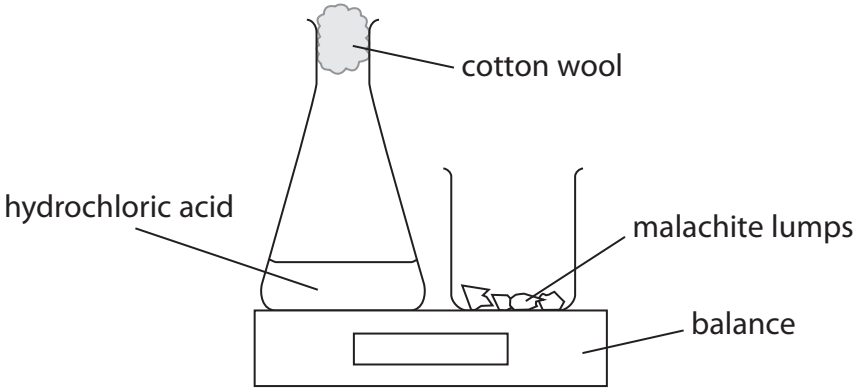
(4)

(Total for Question 7 = 13 marks)

8 The copper(II) carbonate in the mineral, malachite, reacts with hydrochloric acid according to this equation.

$$CuCO_3(s) + 2HCl(aq) \rightarrow CuCl_2(aq) + H_2O(g) + CO_2(g)$$

Some students investigate the effect of changing the concentration of acid on the rate of this reaction. The diagram shows the apparatus they use.



This is the method they use:

- set the balance to zero
- add an excess of malachite lumps to the conical flask and replace the cotton wool
- start a timer and record the balance reading after one minute.

The experiment is repeated using different concentrations of hydrochloric acid. The mass and number of malachite lumps are kept the same in each experiment.

(a) The table shows the results obtained in one series of experiments.

concentration of hydrochloric acid / mol/dm^3	0.6	0.8	1.0	1.6	1.8	2.0
balance reading / g	–0.20	–0.27	–0.44	–0.54	–0.60	–0.67

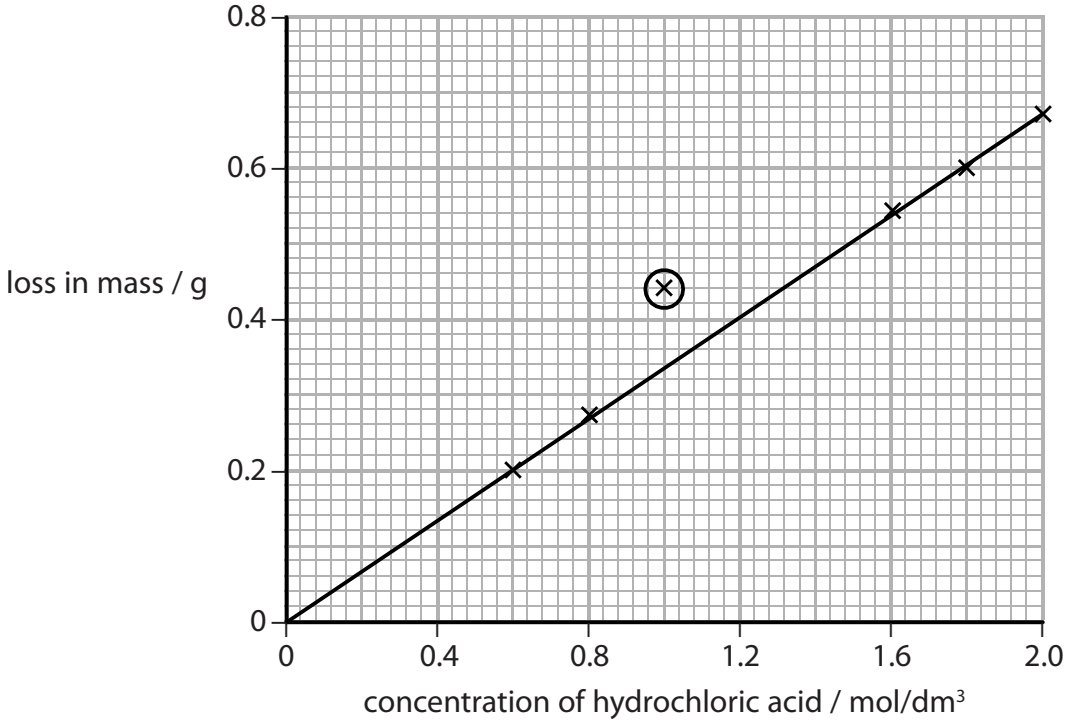
State why the balance readings have negative values.

(1)

.....

.....

(b) The graph shows the results of this series of experiments.



The circled point indicates an anomalous result.

(i) Suggest **one** mistake the students could have made to produce this result.

(1)

.....

(ii) State the relationship shown by the graph.

(1)

.....

.....

(c) Explain why an increase in the concentration of the acid causes an increase in the rate of the reaction. You should use the particle collision theory in your answer.

(2)

.....

.....

.....

.....

(Total for Question 8 = 5 marks)

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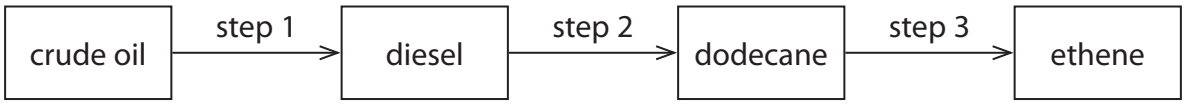
9 The flow chart shows how ethene can be obtained industrially from crude oil.



(a) Step 1 involves the use of a tall column.

Describe how the diesel fraction is obtained from the crude oil in step 1.

(5)

(b) In step 2, saturated compounds such as dodecane are obtained from the mixture of hydrocarbons in the diesel fraction.

Explain why dodecane is described as a **saturated hydrocarbon**.

(3)

(c) Which of these formulae is that of an alkane?

(1)

☒ **A** C_7H_{12}

☒ **B** C_9H_{18}

☒ **C** $C_{11}H_{24}$

☒ **D** $C_{13}H_{30}$

(d) In step 3, cracking is used to convert alkanes into alkenes.

Complete the equation to show the reaction in which one molecule of dodecane is converted into two molecules of ethene and one molecule of another hydrocarbon.

(1)

$$C_{12}H_{26} \rightarrow 2C_2H_4 + \text{.....}$$

(e) Alkanes and alkenes both react with halogens, but in different ways.
The equations for two examples of these different reactions are shown.

equation 1 $C_2H_6 + Cl_2 \rightarrow C_2H_5Cl$ + compound X

equation 2 $C_2H_4 + Br_2 \rightarrow C_2H_4Br_2$

(i) State the condition needed for the reaction in equation 1 to occur.

(1)

.....

(ii) Deduce the formula of compound X.

(1)

.....

(iii) Draw a dot-and-cross diagram to represent a molecule of C_2H_5Cl

Show only the outer electrons of each atom.

(2)

(iv) Equation 2 shows an example of an addition reaction.

State the type of reaction shown by equation 1.

(1)

.....

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(f) Alkenes can be distinguished from alkanes using bromine water.

(i) What colour change occurs in the reaction between propene and bromine water?

(1)

☒ **A** colourless to orange

☒ **B** colourless to green

☒ **C** green to colourless

☒ **D** orange to colourless

(ii) A compound formed in the reaction between propene and bromine water has the percentage composition by mass:

C = 25.9%, H = 5.0%, Br = 57.6% and O = 11.5%

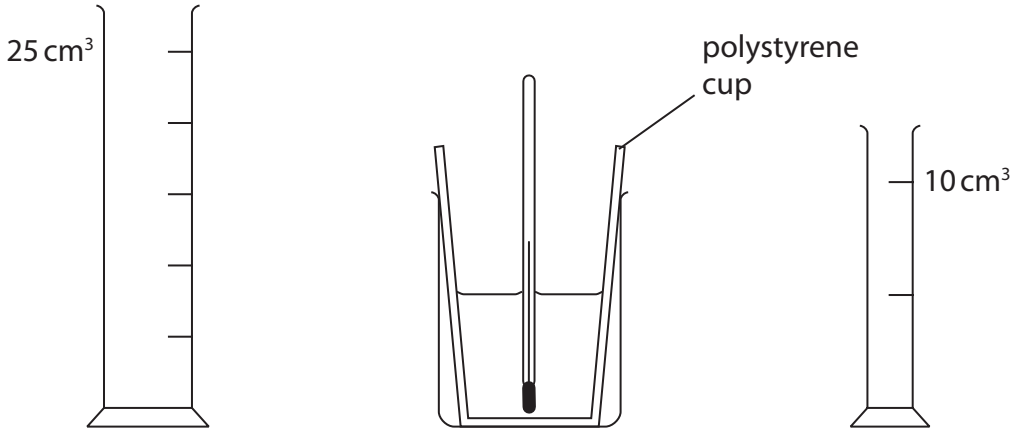
Calculate the empirical formula of this compound.

(3)

empirical formula = ...

(Total for Question 9 = 19 marks)

10 When aqueous solutions of potassium hydroxide and nitric acid are mixed together, an exothermic reaction occurs. The diagram shows the apparatus used in an experiment to measure the temperature increase.



This is the student's method:

- use the larger measuring cylinder to add 25 cm^3 of aqueous potassium hydroxide to the polystyrene cup
- record the steady temperature
- use the smaller measuring cylinder to add 5 cm^3 of dilute nitric acid to the cup, stir the mixture with the thermometer
- record the highest temperature of the mixture
- continue adding further 5 cm^3 portions of dilute nitric acid to the cup, stirring and recording the temperature, until a total volume of 35 cm^3 has been added.

(a) A teacher advises the student to use a 50 cm^3 burette instead of the 10 cm^3 measuring cylinder.

Suggest **two** reasons why it would be better to use a burette instead of a measuring cylinder to add the acid in this experiment.

(2)

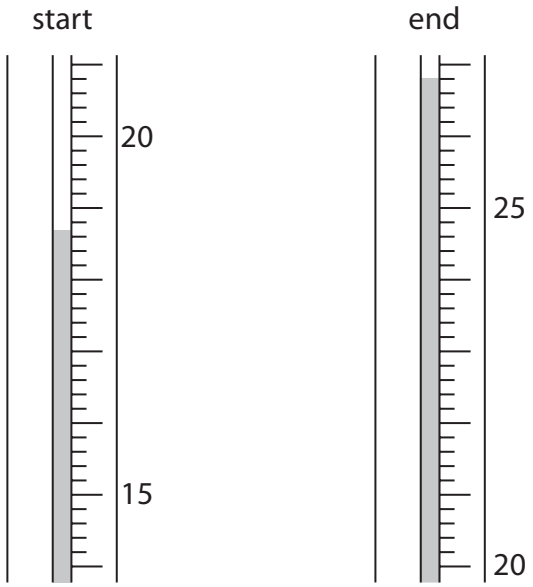
1 .....

.....

2 .....

.....

(b) The diagram shows the thermometer readings at the start and at the end of one experiment.



Complete the table to show:

- the thermometer reading at the start of the experiment
- the temperature rise in the experiment.

(2)

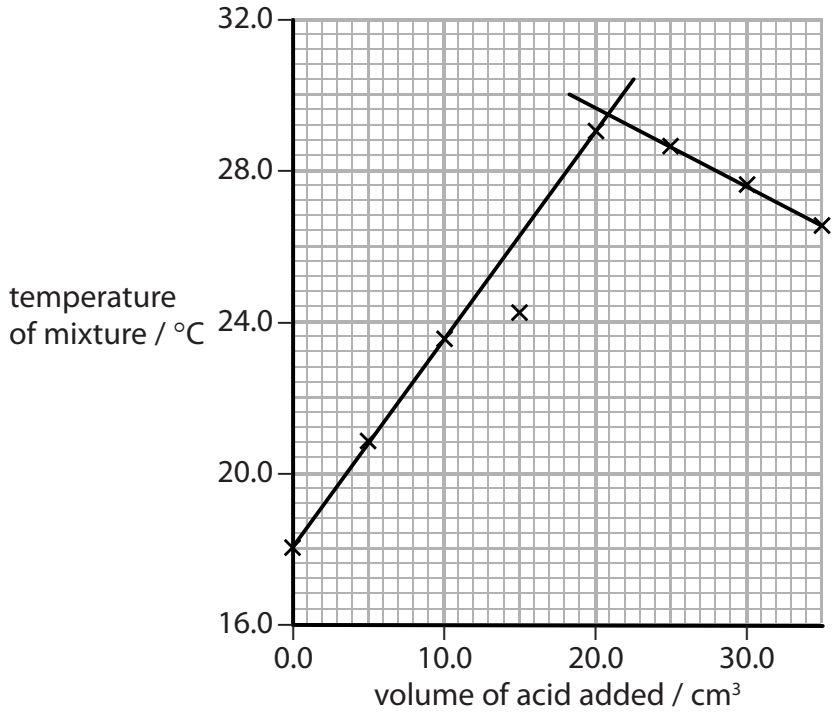
thermometer reading at end / °C	26.8
thermometer reading at start / °C	
thermometer rise / °C	

(c) Another student uses the same method, adding the dilute nitric acid from a burette.

The table shows his results.

volume of acid added / cm^3	0.0	5.0	10.0	15.0	20.0	25.0	30.0	35.0
temperature of mixture / °C	18.0	20.8	23.5	24.2	29.0	28.6	27.6	26.5

This is the student's graph.



The point where the lines cross represents complete neutralisation.

(i) Identify the maximum temperature reached during the experiment.

(1)

maximum temperature = ... °C

(ii) Identify the volume of dilute nitric acid that exactly neutralises the 25 cm^3 of aqueous potassium hydroxide.

(1)

volume = ... cm^3

(d) Another student records these results.

volume of aqueous potassium hydroxide = 20.0 cm^3

starting temperature of aqueous potassium hydroxide = 18.5 °C

maximum temperature of mixture = 30.0 °C

volume of dilute nitric acid = 20.0 cm^3

Calculate the heat energy released in this experiment.

c = 4.2 J/g / °C

mass of 1 cm^3 of mixture = 1 g

(4)

heat energy = ... J

(e) In another experiment, the heat energy released is 1600 J when 0.040 mol of potassium hydroxide is neutralised.

Calculate the value of ΔH, in kJ/mol, for the neutralisation of potassium hydroxide.

(2)

ΔH = ... kJ/mol

(Total for Question 10 = 12 marks)

11 Many different salts can be prepared from acids.

(a) The table shows the reactants used in two salt preparations.

Complete the table to show the name of the salt formed and the other product(s) in each case.

(4)

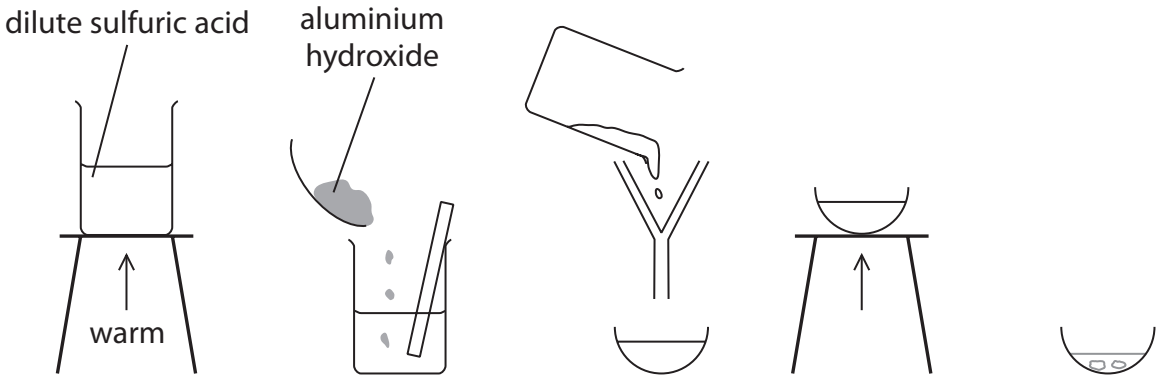
Reactants	Name of salt formed	Other product(s)
zinc + hydrochloric acid		
calcium carbonate + nitric acid		

(b) A student uses the reaction between aluminium hydroxide and dilute sulfuric acid to prepare a pure, dry sample of aluminium sulfate crystals.

The equation for the reaction used to prepare this salt is:

$$2Al(OH)_3 + 3H_2SO_4 \rightarrow Al_2(SO_4)_3 + 6H_2O$$

The diagram shows the steps in the student's method.



(i) State **two** ways to make sure that all the acid is reacted in step 2.

(2)

1 .....

.....

2 .....

.....

(ii) State the purpose of filtration in step 3.

(1)

.....

.....

(iii) In step 5, the basin is left to cool to room temperature to allow crystals of aluminium sulfate to form.

State **one** method of drying these crystals.

(1)

.....

.....

(c) The student records this information about the reagents she uses in her preparation.

mass of aluminium hydroxide = 3.9 g

amount of sulfuric acid = 0.090 mol

Determine which reagent is in excess, making use of this information and the equation in part (b).

(3)

reagent used in excess = ...

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DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

(d) Another student prepares 0.25 mol of aluminium sulfate. The formula of aluminium sulfate is $Al_2(SO_4)_3$

Calculate the mass of aluminium sulfate prepared.

(3)

mass = ... g

(e) The equation for another reaction used to prepare a sample of a salt is:

$$PbO + 2HNO_3 \rightarrow Pb(NO_3)_2 + H_2O$$

In one experiment, the amount of lead(II) oxide used was 0.75 mol and the amount of nitric acid used was 1.5 mol. At the end of the experiment, the mass of lead(II) nitrate obtained was 209 g.

Calculate the percentage yield of lead(II) nitrate in this experiment.

[M_r of lead(II) nitrate = 331]

(3)

percentage yield = ... %

(Total for Question 11 = 17 marks)

TOTAL FOR PAPER = 110 MARKS

Paper 1 (4CH1/1C and 4SD0/1C)

Question number	Answer	Mark
1(a)	Nucleus	1

Question number	Answer	Mark
1(b)	Proton	1

Question number	Answer	Additional guidance	Mark
1(c)	Equal numbers of protons and electrons	accept equal numbers of positive and negative particles/charges	1

Question number	Answer	Mark
1(d)	5	1

Question number	Answer	Mark
1(e)	Lithium	1

Total for Question 1 = 5 marks

Question number	Answer	Additional guidance	Mark
2(a)(i)	An explanation that makes reference to the following two points: • boxes 1 and 2 (1) • because they both have only one type of atom/molecule (1)	accept other indications, e.g. only He and only H-H accept species in place of atom/molecule second mark can be awarded if only box 1 or box 2 identified	**2**

Question number	Answer	Additional guidance	Mark
2(a)(ii)	An explanation that makes reference to the following two points: • boxes 3 and 5 (1) • because they both have two different molecules (1)	second mark can be awarded if only box 3 or box 5 identified	**2**

Question number	Answer	Mark
2(b)(i)	Simple distillation	**1**

Question number	Answer	Mark
2(b)(ii)	Chromatography	**1**

Question number	Answer	Mark
2(b)(iii)	Crystallisation	**1**

Total for Question 2 = 7 marks

Question number	Answer	Mark
3(a)	Reversible arrow	**1**

Question number	Answer	Additional guidance	Mark
3(b)(i)	• (X) ammonium chloride (1) • (Y) ammonia and hydrogen chloride (1)	accept formulae	**2**

Question number	Answer	Mark
3(b)(ii)	D (subliming)	**1**

Question number	Answer	Additional guidance	Mark
3(c)	An explanation that makes reference to the following three points: • C (1) • because ammonia molecules have lower mass or smaller M_r (hence travel faster) (1) • and so travel further in the same time (1)	accept reverse arguments for hydrogen chloride	**3**

Total for Question 3 = 7 marks

Question number	Answer	Additional guidance	Mark
4(a)	• 35 (1) • 41 (1)	final answer consequential on syringe readings	**2**

Question number	Answer	Additional guidance	Mark
4(b)	• Calculation of volume of oxygen used • Calculation of original volume of air • Calculation of percentage Example calculation: 80 − 43 = 37 (cm^3) (1) 100 + 10 + 80 = 190 (cm^3) (1) $\underline{(37 \times 100) \div 190}$ (= 19.47%) = 19% (1)	accept 19.47% or 19.5%	**3**

question number	answer	mark
4(c)	• Decreased (1) • Decreased (1) • No effect (1)	**3**

Total for Question 4 = 8 marks

Question number	Answer	Mark
5(a)	Any two of: • concentration of copper(II) sulfate solution (1) • volume of copper(II) sulfate solution (1) • particle size of metal (1)	**2**

Question number	Answer	Additional guidance	Mark
5(b)(i)	• (G) 5.5 (°C) (1) • (H) 11.5 (°C) (1)	accept 5.47	**2**

Question number	Answer	Mark
5(b)(ii)	An explanation that makes reference to the following two points: • H (1) • because of the biggest temperature increase (1)	**2**

Question number	Answer	Additional guidance	Mark
5(b)(iii)	An explanation that makes reference to the following two points: • F (1) • because there is no temperature increase (1)	accept there is no reaction	**2**

Total for Question 5 = 8 marks

Question number	Answer	Additional guidance	Mark
6(a)	The atoms of both elements have one electron in the outer shell	accept highest energy level in place of outer shell	**1**

Question number	Answer	Additional guidance	Mark
6(b)(i)	A description that makes reference to any two of the following points: • sodium floats/moves across the water (1) • sodium melts (1) • sodium disappears/gets smaller (1) • effervescence/fizzing/bubbles/gas given off (1) • white trail (1)	accept highest energy level in place of outer shell accept forms a ball accept sodium dissolves ignore name of gas	**2**

Question number	Answer	Additional guidance	Mark
6(b)(ii)	An explanation that makes reference to the following points: • (final colour is) purple/blue (1) • because the solution is alkaline (1)	accept sodium hydroxide forms/ solution has high pH	**2**

Question number	Answer	Mark
6(b)(iii)	D (12)	**1**

Question number	Answer	Mark
6(c)	Lithium	**1**

Question number	Answer	Additional guidance	Mark
6(d)	Potassium catches fire	accept lilac/purple/violet flame	**1**

Question number	Answer	Additional guidance	Mark
6(e)	**2**Rb + **2**H_2O → **2**RbOH + H_2 (1)	accept multiples and fractions	**1**

Total for Question 6 = 9 marks

Question number	Answer	Mark
7(a)(i)	B and E	**1**

Question number	Answer	Mark
7(a)(ii)	(the only one that shows) All atoms and all bonds	**1**

Question number	Answer	Mark
7(a)(iii)	• D and F (1) • they have the same molecular formula/the same number of each type of atom (1) • but different structures/atoms joined together in different ways/different structural formulae (1)	**3**

Question number	Answer	Mark
7(a)(iv)	4	**1**

Question number	Answer	Mark
7(b)(i)	An explanation that makes reference to the following points: • incomplete combustion/lack of oxygen (1) • leads to the formation of carbon monoxide (1)	**2**

Question number	Answer	Mark
7(b)(ii)	It reduces the capacity of blood to transport oxygen	**1**

Question number	Answer	Additional guidance	Mark
7(c)	An explanation that makes reference to the following points: • nitrogen in the air and oxygen react (1) • at high temperatures (1) • which causes the formation of nitrogen oxide(s) (1) • oxides then react with water (vapour) in the atmosphere to form nitric acid (1)	accept equation and formulae such as $NO/NO_2/NO_x$ accept nitrous acid and formulae	**4**

Total for Question 7 = 13 marks

Question number	Answer	Mark
8(a)	One reaction product is a gas and so escapes from the flask	**1**

Question number	Answer	Mark
8(b)(i)	Any one of: • balance reading recorded too late • acid concentration greater than recorded	**1**

Question number	Answer	Mark
8(b)(ii)	Loss in mass directly proportional to acid concentration	**1**

Question number	Answer	Additional guidance	Mark
8(c)	An explanation that makes reference to the following two points: • more particles in the same volume (1) • so collide more frequently (with malachite) (1)	accept particles closer together	**2**

Total for Question 8 = 5 marks

Question number	Answer	Mark
9(a)	A description that makes reference to five of the following points: • crude oil is heated/vaporised (1) • the vapour enters the lower part of the column (1) • there is a temperature gradient up the column (1) • the vapour in the diesel fraction rises up the column until it condenses (1) • at a height where its boiling point is lower than the temperature in the column (1) • so the diesel fraction is removed (1)	**5**

Question number	Answer	Additional guidance	Mark
9(b)	An explanation that makes reference to the following three points: • dodecane contains hydrogen and carbon (1) • only/and no other elements (1) • and contains only single bonds (1)	accept does not contain double bonds/multiple bonds	**3**

Question number	Answer	Mark
9(c)	C	**1**

Question number	Answer	Mark
9(d)	C_8H_{18}	**1**

Question number	Answer	Additional guidance	Mark
9(e)(i)	Ultraviolet radiation	accept ultraviolet light	**1**

Question number	Answer	Mark
9(e)(ii)	HCl	**1**

Question number	Answer	Additional guidance	Mark
9(e)(iii)	• All 6 atoms with a dot and cross representing each bonding pair of electrons (1) • 3 lone pairs of electrons on Cl and none on any of the H atoms (1)	accept 2 dots or 2 crosses for each bond accept any combination of dots and crosses	**2**

Question number	Answer	Mark
9(e)(iv)	Substitution	**1**

Question number	Answer	Mark
9(f)(i)	D	**1**

Question number	Answer	Mark
9(f)(ii)	• Dividing percentages by atomic masses (1) • Dividing results by smallest value **OR** obtaining ratio (1) • Writing empirical formula (1) Example calculation: C: 25.9 / 12 = 2.16 : 3 H: 5.0 / 1 = 5.0 : 7 Br: 57.6 / 80 = 0.72 : 1 O: 11.5 / 16 = 0.72 : 1 C_3H_7BrO accept symbols in any order	**3**

Total for Question 9 = 19 marks

Question number	Answer	Mark
10(a)	• Increment in volume smaller/more precise (1) • Avoids refilling the measuring cylinder (1)	2

Question number	Answer	Additional guidance	Mark
10(b)	<table><tr><td>thermometer reading at end/°C</td><td>(26.8)</td></tr><tr><td>thermometer reading at start/°C</td><td>18.7</td></tr><tr><td>temperature rise/°C</td><td>8.1</td></tr></table>	1 mark for temperature at start 1 mark for temperature rise consequential on readings	2

Question number	Answer	Mark
10(c)(i)	29.5	1

Question number	Answer	Mark
10(c)(ii)	20.8	1

Question number	Answer	Mark
10(d)	• Calculation of volume/mass of mixture • Calculation of temperature increase • Substitution of values into $q=mc\Delta T$ • Calculation of heat energy released with unit Example calculation: 20.0 + 20.0 = 40.0 (cm^3) (1) 30.0–18.5 = 11.5 (°C) (1) q = 40.0 × 4.2 × 11.5 (1) q = 1900 J (1) (accept 1932 J)	4

Question number	Answer	Mark
10(e)	• Setting out of ΔH calculation • Division by 1000 to obtain answer in kJ/mol Example calculation: 1600 ÷ 0.040 (1) = −40 (kJ/mol) (1)	2

Total for Question 10 = 12 marks

Question number	Answer	Mark
11(a)	1 mark for each box completed correctly Reactants: (zinc + hydrochloric acid) — Name of salt formed: zinc chloride — Other product(s): hydrogen Reactants: (calcium carbonate + nitric acid) — Name of salt formed: calcium nitrate — Other product(s): water + carbon dioxide	**4**

Question number	Answer	Mark
11(b)(i)	• Use excess aluminium hydroxide (1) • Stir (thoroughly) (1)	**2**

Question number	Answer	Mark
11(b)(ii)	To remove unreacted aluminium hydroxide/solid	**1**

Question number	Answer	Mark
11(b)(iii)	Any one of: • leave in a warm place (1) • use filter paper or paper towel (1)	**1**

Question number	Answer	Mark
11(c)	• Calculation of M_r of aluminium hydroxide • Calculation of amount of aluminium hydroxide • Reference to 2 : 3 ratio in equation AND statement that sulfuric acid is in excess Example calculation: $27 + (3 \times 17) = 78$ (1) $3.9 \div 78 = 0.05$ mol (1) This is more than 3/2 times amount of aluminium hydroxide, so sulfuric acid is in excess (1) (accept other valid methods of calculation)	**3**

Question number	Answer	Mark
11(d)	Calculation of M_r of aluminium sulfate setting out calculation of mass final answer Example calculation: (27 × 2) + (32 × 3) + (16 × 12) = 342 (1) mass = 342 x 0.25 (1) 85.5 g (1)	**3**

Question number	Answer	Additional guidance	Mark
11(e)	• Calculation of amount of lead(II) nitrate • Percentage method • Percentage answer Example calculation: 209 ÷ 331 = 0.631 mol (1) $\frac{0.631 \times 100}{0.75}$ (1) = 84% (1)	allow full credit for calculations using masses	**3**

Total for Question 11 = 17 marks

TOTAL FOR PAPER = 110 MARKS

Write your name here

Surname	Other names

Pearson Edexcel International GCSE (9 - 1)

Centre Number	Candidate Number

Chemistry

Paper 2

Sample Assessment Materials for first teaching September 2017

Time: 1 hour 15 minutes

Paper Reference

4CH1/2C

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.*
- Calculators may be used.
- 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 ☒.

Information

- The total mark for this paper is 70.
- 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.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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1/1/1/1/

S 5 2 9 1 6 A 0 1 2 4

PEARSON

The Periodic Table of the Elements

1	2											3	4	5	6	7	0
							1 **H** hydrogen 1										4 **He** helium 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
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
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
85 **Rb** rubidium 37	88 **Sr** strontium 38	89 **Y** yttrium 39	91 **Zr** zirconium 40	93 **Nb** niobium 41	96 **Mo** molybdenum 42	[98] **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
133 **Cs** caesium 55	137 **Ba** barium 56	139 **La*** lanthanum 57	178 **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	[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	Elements with atomic numbers 112–116 have been reported but not fully authenticated						

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

**** The lanthanoids (atomic numbers 58–71) and the actinoids (atomic numbers 90–103) have been omitted.***

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

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Answer ALL questions. Write your answers in the spaces provided.

1 The table shows some properties of four substances, **P**, **Q**, **R** and **S**.

Substance	Melting point /°C	Boiling point /°C	Conducts electricity when	
			solid	liquid
P	3410	5930	yes	yes
Q	734	1435	no	yes
R	−95	69	no	no
S	2507	3900	no	no

Use the information in the table to answer the following questions.
You may use each letter once, more than once or not at all.

Choose a substance that:

(a) is a solid at 3000 °C.

(1)

☒ **A** substance **P**

☒ **B** substance **Q**

☒ **C** substance **R**

☒ **D** substance **S**

(b) is a liquid at 25 °C.

(1)

☒ **A** substance **P**

☒ **B** substance **Q**

☒ **C** substance **R**

☒ **D** substance **S**

(c) is an ionic compound.

(1)

☒ **A** substance **P**

☒ **B** substance **Q**

☒ **C** substance **R**

☒ **D** substance **S**

(d) is a metal.

(1)

☒ **A** substance **P**

☒ **B** substance **Q**

☒ **C** substance **R**

☒ **D** substance **S**

(Total for Question 1 = 4 marks)

2 This is a method used to measure the solubility of a solid in water:

- add an excess of solid to some water in a boiling tube and stir
- measure the temperature of the saturated solution formed
- weigh an empty evaporating basin
- pour some of the saturated solution into the evaporating basin
- weigh the basin and contents
- heat the evaporating basin to remove all of the water
- weigh the evaporating basin and remaining solid.

(a) The table shows the results of an experiment using this method.

mass of evaporating basin / g	89.6
mass of evaporating basin + saturated solution / g	115.8
mass of evaporating basin + solid / g	94.9

Calculate the mass of solid obtained and the mass of water removed.

(2)

mass of solid = ... g

mass of water = ... g

(b) In another experiment, at a different temperature, the mass of solid obtained is 10.5 g and the mass of water removed is 16.8 g.

Calculate the solubility of the solid, in g per 100 g of water, at this temperature.

(2)

solubility = ... g per 100 g of water

(c) If the evaporating basin is heated too strongly, some of the solid decomposes to form a gas.

Explain how this strong heating would affect the value of the calculated solubility of the solid.

(3)

.....

.....

.....

.....

.....

.....

(Total for Question 2 = 7 marks)

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3 Astatine, bromine, chlorine, fluorine and iodine are all halogens.
They are found in Group 7 of the Periodic Table.

(a) Predict which halogen has the lightest colour.

(1)

.....

(b) Name a halogen that is a solid at room temperature.

(1)

.....

(c) Bromine can be obtained from the bromide ions in sea water.
Chlorine is bubbled into sea water.
The chlorine oxidises the bromide ions to bromine atoms.
The bromine atoms then form bromine molecules.

(i) Complete the equation to show how bromine **atoms** are formed from bromide ions.

(1)

$$Cl_2 + \text{.....} Br^- \rightarrow 2Cl^- + \text{.....} Br$$

(ii) State why this reaction is described as the oxidation of bromide ions.

(1)

.....

.....

(iii) Write an equation to show how bromine atoms form bromine molecules.

(1)

.....

(d) Boron and fluorine form a covalent compound that has the molecular formula BF_3

Draw a dot-and-cross diagram to show the arrangement of the outer electrons in a molecule of BF_3

Use crosses (✕) to represent the outer electrons of boron. Use dots (•) to represent the outer electrons of fluorine.

(2)

(Total for Question 3 = 7 marks)

4 A technician finds a white solid in an unlabelled beaker.

She knows that the solid is one of the following substances:

- potassium chloride
- potassium sulfate
- sodium chloride
- sodium sulfate.

Describe how the technician can use chemical tests to identify the solid in the beaker.

(6)

(Total for Question 4 = 6 marks)

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5 Zinc metal is obtained from sulfide ores.
The most common ore of zinc is sphalerite, which contains zinc sulfide (ZnS) and a small amount of cadmium sulfide (CdS).

The stages involved in the extraction of zinc from sphalerite are:

Stage 1 Sphalerite is strongly heated in air.

$$2ZnS(s) + 3O_2(g) \rightarrow 2ZnO(s) + 2SO_2(g)$$

$$2CdS(s) + 3O_2(g) \rightarrow 2CdO(s) + 2SO_2(g)$$

Stage 2 The mixture of oxides is reacted with sulfuric acid.

$$ZnO(s) + H_2SO_4(aq) \rightarrow ZnSO_4(aq) + H_2O(l)$$

$$CdO(s) + H_2SO_4(aq) \rightarrow CdSO_4(aq) + H_2O(l)$$

Stage 3 Zinc dust is added to the solution containing zinc sulfate and cadmium sulfate to remove the cadmium ions.

$$Cd^{2+}(aq) + Zn(s) \rightarrow Cd(s) + Zn^{2+}(aq)$$

Stage 4 The solid cadmium is filtered off and the pure zinc sulfate solution is electrolysed.

(a) State how the reaction in stage 3 shows that zinc is more reactive than cadmium.

(1)

.....

.....

(b) (i) During the electrolysis in stage 4, zinc is deposited on the cathode.

Write an ionic half-equation for the reaction that occurs.

(1)

.....

(ii) Complete the ionic half-equation for the reaction occurring at the anode.

..... $H_2O \rightarrow$ .....$H^+ + O_2 +$ ..... e^-

(1)

(iii) Explain how the pH of the solution surrounding the anode changes during the electrolysis.

(2)

.....

.....

.....

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(c) Zinc is mixed with copper to make the alloy brass.

Explain why brass is harder than pure copper.

(3)

.....

.....

.....

.....

.....

.....

(Total for Question 5 = 8 marks)

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6 The mineral nesquehonite is a form of hydrated magnesium carbonate.

The formula, $MgCO_3.xH_2O$, shows that nesquehonite contains water of crystallisation.

When a sample of nesquohonite is heated gently, the water of crystallisation is given off and anhydrous magnesium carbonate is left.

Six students are each given a sample of nesquehonite of mass 6.1 g. The students heat their samples for different times. The samples are then allowed to cool before being reweighed.

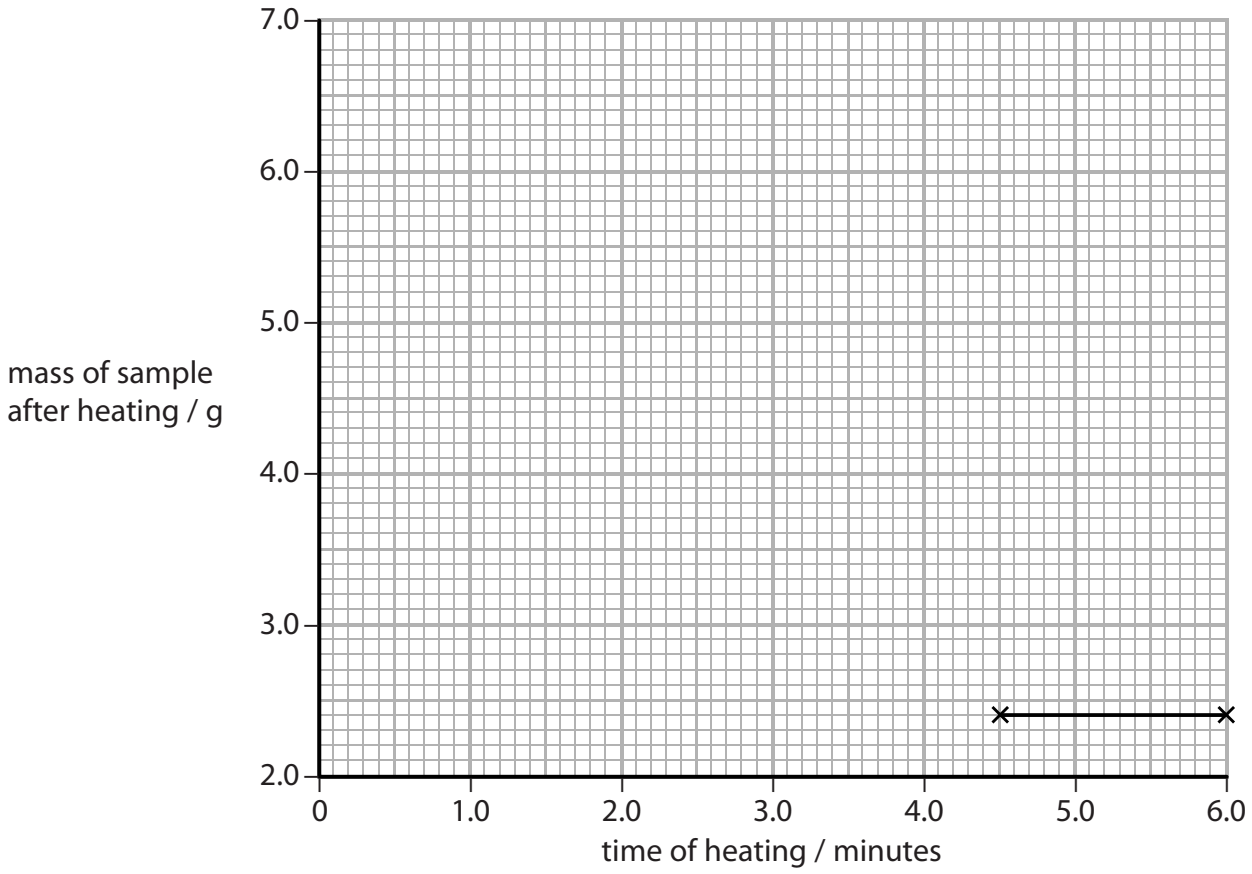
The table shows their results.

time of heating / minutes	0	1.0	2.0	3.0	4.0	4.5	6.0
mass of sample after heating / g	6.1	5.3	4.5	3.7	2.8	2.4	2.4

(a) Plot these results on the grid provided. The last two points have been plotted for you.

Draw a straight line of best fit for the points you have plotted.

(2)



(b) Predict the mass of sample remaining after heating for 2.5 minutes.

Show on the graph how you obtain your answer.

(2)

mass after 2.5 minutes = ... g

(c) State why the last two masses in the table are exactly the same.

(1)

.....

.....

(d) A sample of nesquehonite contains 1.68 g of $MgCO_3$ and 1.08 g of H_2O.

Calculate the value of x in the formula $MgCO_3.xH_2O$
[M_r of $MgCO_3$ = 84; M_r of H_2O = 18]

(3)

x = ...

(e) When anhydrous magnesium carbonate is heated strongly, it decomposes.
The equation for the reaction is:

$$MgCO_3(s) \rightarrow MgO(s) + CO_2(g)$$

Calculate the volume of carbon dioxide formed in cm^3, at rtp, when 4.2 g of anhydrous magnesium carbonate are completely decomposed.
[M_r of $MgCO_3$ = 84]
[Assume that the molar volume at rtp of carbon dioxide is 24 dm^3]

(3)

volume = ... cm^3

(Total for Question 6 = 11 marks)

7 Ammonia is manufactured on a large scale and is used to make fertilisers such as ammonium nitrate (NH_4NO_3).

(a) The first stage in the manufacture of ammonium nitrate is to react ammonia gas with oxygen gas.

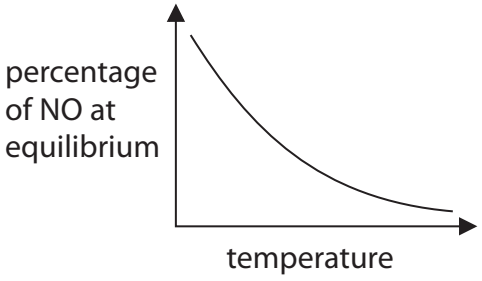
$$4NH_3(g) + 5O_2(g) \rightleftharpoons 4NO(g) + 6H_2O(g) \qquad \Delta H = -907\,kJ/mol$$

The reaction is carried out at a pressure of about 10 atm and at a temperature of 800 °C, in the presence of a catalyst.

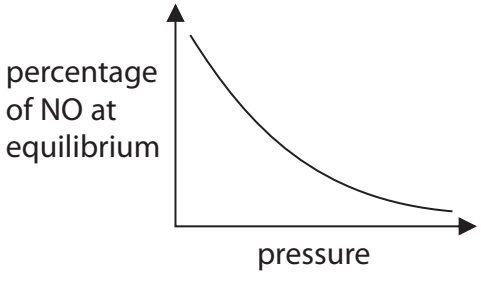
If the mixture is left for long enough in a sealed container, the reaction reaches a position of dynamic equilibrium.

Graph A shows how the percentage of nitrogen monoxide (NO) in the equilibrium mixture varies with temperature at constant pressure.

Graph B shows how the percentage of nitrogen monoxide (NO) in the equilibrium mixture varies with pressure at constant temperature.



graph A



graph B

(i) Explain why the percentage of NO at equilibrium decreases in each case.

(4)

Graph A .....

.....

.....

.....

Graph B .....

.....

.....

.....

.....

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

(ii) Explain why the use of a catalyst has no effect on the position of equilibrium in a reversible reaction.

(2)

.....

.....

.....

.....

(b) The second stage in the manufacture of ammonium nitrate is to convert the nitrogen monoxide into nitric acid. The nitric acid is then reacted with concentrated aqueous ammonia as shown in this equation.

$$HNO_3(aq) + NH_3(aq) \rightarrow NH_4NO_3(aq)$$

(i) State, in terms of proton transfer, why this reaction is classified as an acid-base reaction.

(1)

.....

.....

(ii) Calculate the volume of 14.8 mol / dm^3 aqueous ammonia that is required to exactly neutralise 150 dm^3 of a solution of nitric acid of concentration 15.8 mol / dm^3.

(2)

volume of aqueous ammonia = ... dm^3

(Total for Question 7 = 9 marks)

8 Polymers can be classified as addition polymers or condensation polymers.

(a) An addition polymer can be formed from the monomer $CH_2{=}CHCl$

(i) Name this monomer.

(1)

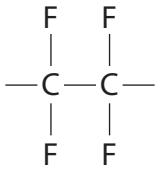
.....

(ii) Name the addition polymer formed from this monomer.

(1)

.....

(b) The diagram shows the repeat unit of a different addition polymer.

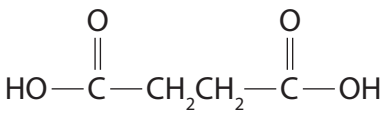


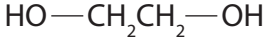
Draw the displayed formula of the monomer used to make this polymer.

(1)

(c) Polyesters are condensation polymers.

The structures of two monomers that are used to make a polyester are:





(i) Draw the structure of the repeat unit of the polyester formed from these two monomers.

(2)

(ii) Identify the small molecule formed when these two monomers form the polyester.

(1)

.....

(Total for Question 8 = 6 marks)

9 Grapes contain glucose that can be fermented to make ethanol.

(a) The grapes are collected and crushed to produce an aqueous solution containing glucose. Yeast is added to the solution and the mixture is left to ferment at a temperature of about 30 °C in the absence of air.

(i) State why yeast is added.

(2)

.....

.....

.....

.....

(ii) Explain why another organic compound may also be formed if fermentation is carried out in the presence of air.

(2)

.....

.....

.....

.....

(iii) Explain why 30 °C is considered to be an optimum temperature for this reaction.

(2)

.....

.....

.....

.....

(b) Ethanol can also be manufactured by reacting ethene with steam.

(i) Write the chemical equation for this reaction.

(1)

.....

(ii) Name the type of reaction that occurs.

(1)

.....

(iii) State **two** conditions used for this reaction in industry.

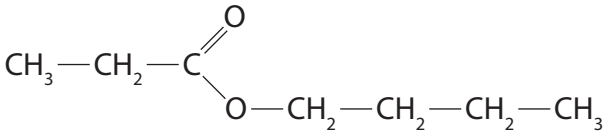
(2)

1 .....

2 .....

(c) Grapes also contain esters.

The formula of an ester is shown.



Deduce the name of the carboxylic acid and the alcohol that can react together to make this ester.

(2)

carboxylic acid .....

alcohol .....

(Total for Question 9 = 12 marks)

TOTAL FOR PAPER = 70 MARKS

Paper 2 (4CH1/2C)

Question number	Answer	Mark
1(a)	A	**1**

Question number	Answer	Mark
1(b)	C	**1**

Question number	Answer	Mark
1(c)	B	**1**

Question number	Answer	Mark
1(d)	A	**1**

Total for Question 1 = 4 marks

Question number	Answer	Mark
2(a)	• (mass of solid) 5.3 (g) (1) • (mass of water) 20.9 (g) (1)	**2**

Question number	Answer	Mark
2(b)	• (10.5 ÷ 16.8) × 100 (1) • 62.5 (grams of solid per 100 g of water) (1)	**2**

Question number	Answer	Mark
2(c)	An explanation that links together the following three points: • the gas will escape (1) • the mass of solid remaining will be less (than it should be) (1) • the value of the calculated solubility will be lower (than it should be) (1)	**3**

Total for Question 2 = 7 marks

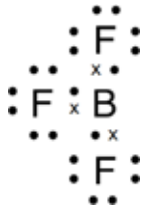
Question number	Answer	Mark
3(a)	Fluorine	**1**

Question number	Answer	Mark
3(b)	Iodine OR astatine	**1**

Question number	Answer	Mark
3(c)(i)	Cl_2 + **2**Br^- → 2Cl^- + **2**Br	**1**

Question number	Answer	Additional guidance	Mark
3(c)(ii)	(they are) Losing electrons	accept oxidation number (of bromine) increases accept oxidation number (of bromine) changes from −1 to 0	**1**

Question number	Answer	Additional guidance	Mark
3(c)(iii)	2Br → Br_2	accept Br + Br = Br_2	**1**

Question number	Answer	Mark
3(d)	A diagram that shows: • all three bonding pairs correct (1) • all non-bonding pairs (1) Example: 	**2**

Total for Question 3 = 7 marks

Question number	Answer	Additional guidance	Mark
4	A description that makes reference to the following six points: Test for cation: • do a flame test (1) • if flame is yellow then cation is sodium (1) • if flame is lilac then cation is potassium (1) Test for anion: • dissolve solid in water (1) **EITHER** • add (dilute nitric acid and) aqueous silver nitrate (1) • if (white) precipitate forms the anion is chloride/if no precipitate forms then anion is sulfate (1) **OR** • add (dilute hydrochloric acid and) aqueous barium chloride (1) • if (white) precipitate forms the anion is sulfate/if no precipitate forms then anion is chloride (1)	accept any combination of hydrochloric acid/nitric acid and barium chloride/barium nitrate	**6**

Total for Question 4 = 6 marks

Question number	Answer	Mark
5(a)	Zinc has displaced cadmium	**1**

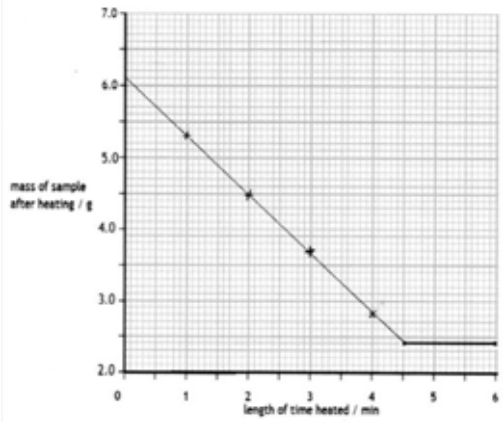
Question number	Answer	Mark
5(b)(i)	$Zn^{2+} + 2e^{(-)} \rightarrow Zn$ (1)	**1**

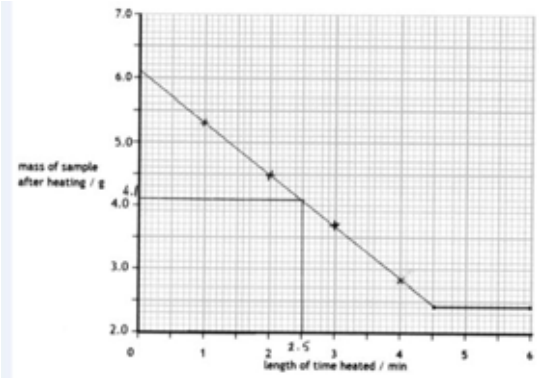
Question number	Answer	Mark
5(b)(ii)	$\mathbf{2}H_2O \rightarrow \mathbf{4}H^+ + O_2 + \mathbf{4}e^-$	**1**

Question number	Answer	Additional guidance	Mark
5(b)(iii)	An explanation that links the following two points: • pH decreases • hydrogen ion/H^+ (ion) concentration increases	accept hydrogen ions are formed	**2**

Question number	Answer	Additional guidance	Mark
5(c)	An explanation that links three of the following points: • the ions of (pure) copper are the same size (1) • the layers (of ions) can easily slide over one another (1) • the ions of zinc and copper have different sizes (1) • this disrupts the layers/structure/arrangement of the copper ions (1) • hence it is more difficult for the layers (of ions) to slide over one another (1)	accept atoms/particles for ions reject molecules once only	**3**

Total for Question 5 = 8 marks

Question number	Answer	Additional guidance	Mark
6(a)	• All points plotted correctly (1) • Best fit line drawn (1)  	must be drawn with the aid of a ruler	2

Question number	Answer	Mark
6(b)	• Answer read correctly from graph drawn/4.1 (g) (1) • Appropriate horizontal or vertical line drawn (1)  	2

Question number	Answer	Mark
6(c)	All of the water has been removed/there is no more water left	1

Question number	Answer	Mark
6(d)	• Calculate the amount of magnesium carbonate • Calculate the amount of water • Evaluation Example calculation: $n(MgCO_3)$ = (1.68 ÷ 84) = 0.02(0)(mol) (1) $n(H_2O)$ = (1.08 ÷ 18) = 0.06(0)(mol) (1) x = 3 (1)	3

Question number	Answer	Additional guidance	Mark
6(e)	• Calculate the amount of magnesium carbonate (1) • Calculate the volume of carbon dioxide in dm^3 (1) • Calculate the volume of carbon dioxide in cm^3 (1) Example calculation: $n(MgCO_3) = 4.2 \div 84 = 0.050$ mol (1) vol(CO_2) = $0.050 \times 24 = 1.2\ dm^3$ (1) vol(CO_2) = (1.2×1000) $= 1200\ (cm^3)$ (1)	give full credit for alternative methods	**3**

Total for Question 6 = 11 marks

Question number	Answer	Additional guidance	Mark
7(a)(i)	Graph A An explanation that links the following two points: • the backward/reverse reaction is endothermic (1) • so an increase in temperature shifts the equilibrium to the left (hence the percentage of NO decreases) (1) Graph B An explanation that links the following two points: • there are fewer molecules/moles of gas on the left (1) • so an increase in pressure shifts the equilibrium to the left (hence the percentage of NO decreases) (1)	ignore any references to or arguments based on Le Chatelier's principle accept the (forward) reaction is exothermic	**4**

Question number	Answer	Additional guidance	Mark
7(a)(ii)	• (The catalyst/it) increases the rate of both the forward and reverse reactions (1) • To the same extent (1)	second mark is dependent on the first	**2**

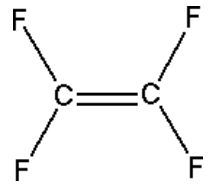
Question number	Answer	Mark
7(b)(i)	Because a proton is transferred from HNO_3 to NH_3	**1**

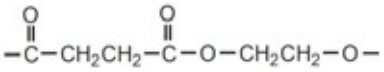
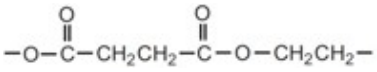
Question number	Answer	Mark
7(b)(ii)	• Calculate the amount of nitric acid • Calculate the volume of aqueous ammonia Example calculation: $n(HNO_3)$ = 15.8 × 150 mol (= 2370 mol) (1) vol(NH_3) required = (2370 ÷ 14.8) = 160(dm^3) (1)	**2**

Total for Question 7 = 9 marks

Question number	Answer	Additional guidance	Mark
8(a)(i)	Chloroethene	accept vinyl chloride	1

Question number	Answer	Additional guidance	Mark
8(a)(ii)	Poly(chloroethene)	accept polyvinyl chloride ignore PVC	1

Question number	Answer	Additional guidance	Mark
8(b)		ignore bond angles	1

Question number	Answer	Additional guidance	Mark
8(c)(i)	• Correct ester link (1) • Rest of unit correct (1) Example: 	accept 	2

Question number	Answer	Additional guidance	Mark
8(c)(ii)	Water/H_2O	if both name and formula given, both must be correct	1

Total for Question 8 = 6 marks

Question number	Answer	Mark
9(a)(i)	• To provide an enzyme/zymase (1) • To increase the rate of the reaction (1)	2

Question number	Answer	Additional guidance	Mark
9(a)(ii)	An explanation that links the following two points: • Oxygen (from the air) reacts with ethanol (1) • To form ethanoic acid (1)	accept the ethanol undergoes microbial oxidation to ethanoic acid for 2 marks	2

Question number	Answer	Additional guidance	Mark
9(a)(iii)	An explanation that links the following two points: • reaction is too slow at lower temperatures (1) • zymase/the enzyme is denatured at higher temperatures (1)	accept the yeast is killed ignore yeast is denatured ignore zymase is killed	2

Question number	Answer	Mark
9(b)(i)	$C_2H_4 + H_2O \rightarrow C_2H_5OH$	1

Question number	Answer	Additional guidance	Mark
9(b)(ii)	Addition	accept hydration	1

Question number	Answer	Mark
9(b)(iii)	Any two from the following: • phosphoric acid catalyst (1) • 300 °C (1) • 60–70 atm (1)	2

Question number	Answer	Additional guidance	Mark
9(c)	• (Carboxylic acid) propanoic acid (1) • (Alcohol) butanol-1-ol/butanol (1)	accept propionic acid accept (n-)butyl alcohol	2

Total for Question 9 = 12 marks

TOTAL FOR PAPER = 70 MARKS

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ISBN 978-1-4469-3118-9