Please check the examination details below before entering your candidate information

| Candidate surname | Other names |
|---|---|
| | |

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

Centre Number | Candidate Number

# Thursday 14 May 2020

Morning (Time: 2 hours) | Paper Reference **4CH1/1CR 4SD0/1CR**

# Chemistry

**Unit: 4CH1**

**Science (Double Award) 4SD0**

**Paper: 1CR**

**You must have:**
Calculator, ruler

Total Marks

## Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*
- Show all the steps in any calculations and state the units.
- 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.
- Write your answers neatly and in good English.
- Try to answer every question.
- Check your answers if you have time at the end.

*Turn over* ▶

P62046A



1/1/1/1/1/

P 6 2 0 4 6 A 0 1 2 8

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.***

**Answer ALL questions.**

**1** (a) The box gives some methods used in the separation of mixtures.

| | | |
|---|---|---|
| chromatography | crystallisation | evaporation |
| filtration | fractional distillation | simple distillation |

Use words from the box to answer these questions.

(i) Identify the method used to obtain pure water from sea water.

**(1)**

.....

(ii) Identify the method used to separate the dyes in a food colouring.

**(1)**

.....

(iii) Identify the method used to obtain ethanol from a mixture of ethanol and water.

**(1)**

.....

(b) Complete the sentences by writing a suitable word in each blank space.

**(3)**

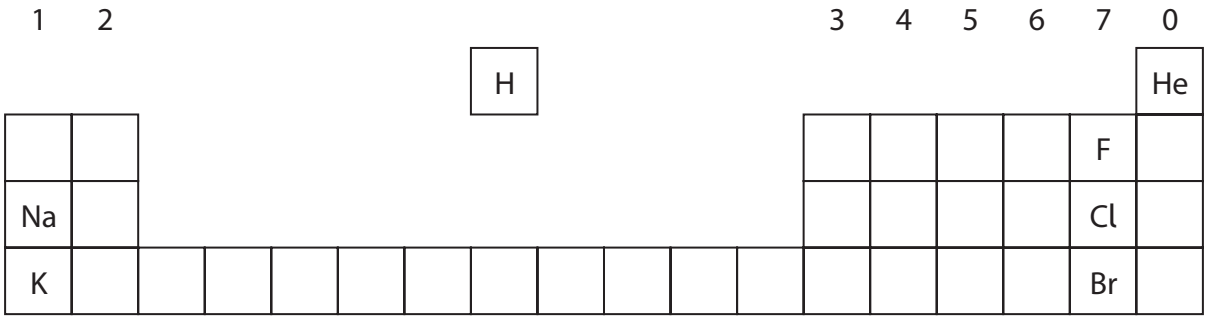
When salt is added to water and stirred until no more will ..... ,
a saturated solution forms.

The salt is the ..... .

The water is the ..... .

**(Total for Question 1 = 6 marks)**

**2** The diagram shows the positions of some elements in the Periodic Table.




(a) Use symbols from this table to answer these questions.

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

(i) Give the symbol of a metal.

**(1)**

.....

(ii) Give the symbol of a noble gas.

**(1)**

.....

(iii) Give the symbol of a liquid at room temperature.

**(1)**

.....

(iv) Give the symbols of the two elements in Period 3

**(1)**

..... and .....

(b) Deduce the electronic configuration of Na

**(1)**

.....

**(Total for Question 2 = 5 marks)**

**3** This question is about alkenes and alkanes.

(a) Complete the table by giving the missing information about the alkene with the molecular formula $C_3H_6$

**(4)**

| | |
|---|---|
| **Molecular formula** | $C_3H_6$ |
| **Name** | |
| **Empirical formula** | |
| **General formula** | |
| **Displayed formula** | |

(b) Alkenes are unsaturated compounds.

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

**(1)**

.....

.....

(ii) Describe a test to show that a compound is unsaturated.

**(2)**

.....

.....

.....

.....

(c) When the alkane methane reacts with chlorine, the products are chloromethane ($CH_3Cl$) and hydrogen chloride gas.

(i) Give a chemical equation for this reaction.

**(1)**

.....

(ii) What is the name of this type of reaction?

**(1)**

- ☒ **A** addition
- ☒ **B** decomposition
- ☒ **C** neutralisation
- ☒ **D** substitution

(iii) State the condition needed for this reaction to occur.

**(1)**

.....

(d) When ethane reacts with chlorine, one of the products of the reaction has the formula $C_2H_4Cl_2$

There are two isomers with this formula.

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

**(2)**

.....

.....

.....

.....

(ii) Draw the displayed formulae of the two isomers with the formula $C_2H_4Cl_2$

**(2)**

| isomer 1 | isomer 2 |
|---|---|
| | |

**(Total for Question 3 = 14 marks)**

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**4** A solution of hydrogen peroxide decomposes when a catalyst of manganese(IV) oxide is added.

The products of the reaction are water and oxygen.

(a) Complete the chemical equation for this reaction.

**(1)**

..... $H_2O_2$ → ..... $H_2O$ + ..... $O_2$

(b) Give a test for oxygen.

**(1)**

.....

.....

(c) State the reason for adding a catalyst.

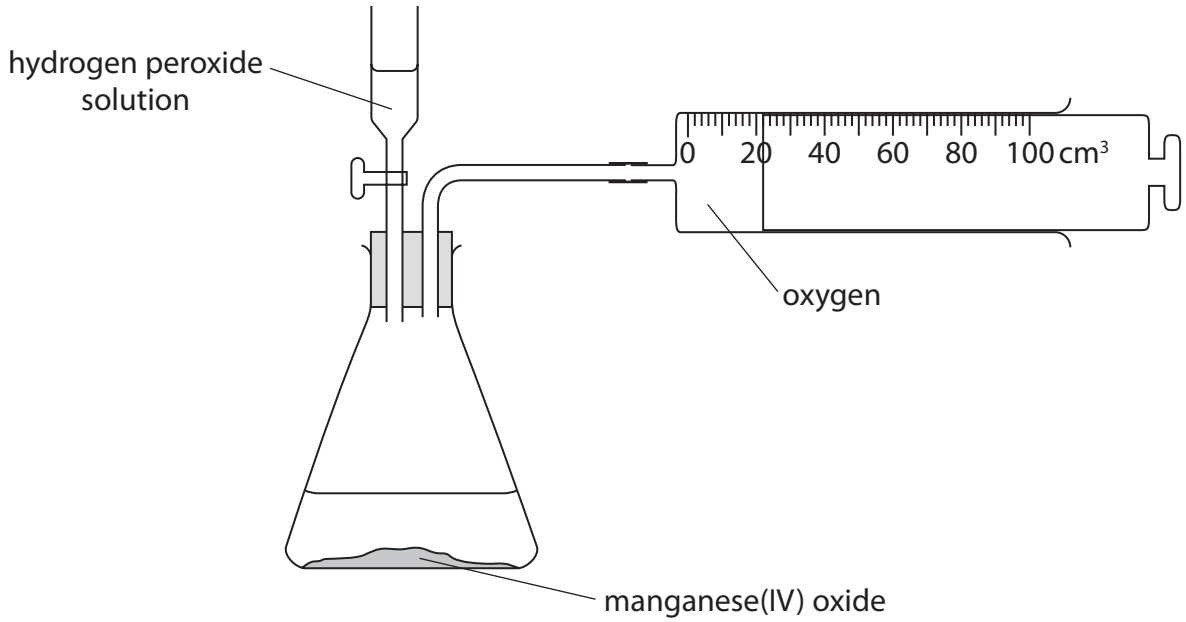
**(1)**

.....

.....

(d) A student investigates how changing the concentration of the hydrogen peroxide solution affects the rate of this reaction.

She uses this apparatus.



The student records the volume of oxygen that collects every 2 minutes for 16 minutes.

The table shows her results.

| **Time in minutes** | 0 | 2 | 4 | 6 | 8 | 10 | 12 | 14 | 16 |
|---|---|---|---|---|---|---|---|---|---|
| **Volume of oxygen in cm³** | 0 | 22 | 38 | 50 | 55 | 69 | 76 | 80 | 80 |

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

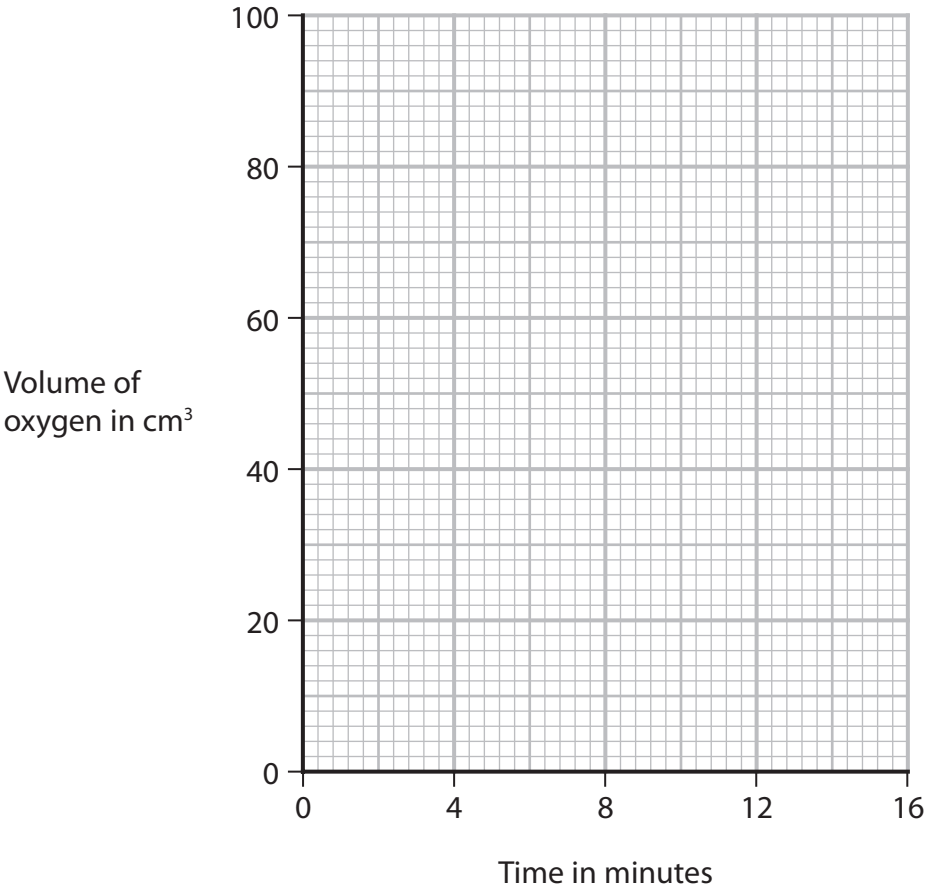
**(1)**

(ii) Draw a circle on the grid around the anomalous result.

**(1)**

(iii) Draw a curve of best fit through the points, ignoring the anomalous result.

**(1)**



(iv) Suggest a mistake that the student might have made to cause the anomalous result.

**(1)**

.....

.....

.....

(v) Determine the volume of oxygen collected during the first 3 minutes.

Show on your graph how you obtain your answer.

**(2)**

volume of oxygen = ..... $cm^3$

(e) The student repeats the experiment using hydrogen peroxide solution of half the concentration of the original solution.

She keeps the volume of the hydrogen peroxide solution and all other conditions the same.

(i) Draw on the grid the curve you would expect the student to obtain.

**(2)**

(ii) Explain how using hydrogen peroxide solution of half the concentration affects the rate of the reaction.

Refer to particle collision theory in your answer.

**(3)**

.....

.....

.....

.....

.....

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.....

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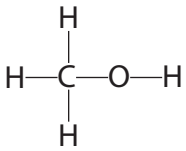
.....

**(Total for Question 4 = 14 marks)**

**5** (a) The diagram shows the displayed formula of the organic compound methanol, $CH_3OH$



(i) Determine the number of atoms in one molecule of methanol.

**(1)**

.....

(ii) State why methanol is not a hydrocarbon.

**(1)**

.....

.....

(b) The atoms in methanol are held together by covalent bonds.

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

**(2)**

.....

.....

.....

.....

(ii) Draw a dot-and-cross diagram to show the bonding in a molecule of methanol.

Show only the outer electrons of each atom.

**(2)**

(c) Another organic compound has the percentage composition by mass

C = 38.7% H = 9.7% O = 51.6%

(i) Calculate the empirical formula of this compound.

**(3)**

empirical formula = .....

(ii) The relative molecular mass ($M_r$) of the compound is 62

Determine the molecular formula of the compound.

**(2)**

molecular formula = .....

**(Total for Question 5 = 11 marks)**

**6** This question is about elements in Group 7 of the Periodic Table and their compounds.

(a) (i) Give the name of this group of elements.

**(1)**

.....

(ii) State the colour of chlorine gas.

**(1)**

.....

(iii) Give a test for chlorine gas.

**(2)**

.....

.....

.....

.....

(b) Give a test to show that a solution contains iodide ions.

**(3)**

test .....

.....

.....

.....

result .....

.....

.....

.....

(c) A student compares the reactivity of the elements bromine, chlorine and iodine.

He mixes these pairs of solutions and observes the reactions that occur.

- chlorine solution and potassium bromide solution
- bromine solution and potassium iodide solution

Explain how the reactions can be used to show the order of reactivity of the three elements.

Include the colour change that the student would observe in each reaction.

**(6)**

**(Total for Question 6 = 13 marks)**

**7** A student uses the reaction between zinc and dilute sulfuric acid to prepare some zinc sulfate crystals.

(a) (i) Complete the equation for this reaction by giving the correct state symbols.

**(1)**

$$Zn\ (\ldots\ldots) + H_2SO_4\ (\ldots\ldots) \rightarrow ZnSO_4\ (\ldots\ldots) + H_2\ (\ldots\ldots)$$

(ii) State what would be observed during this reaction.

**(1)**

.....

.....

(b) The student adds excess zinc to a beaker of dilute sulfuric acid.

(i) Explain why it is necessary to add excess zinc.

**(2)**

.....

.....

.....

.....

(ii) Draw a diagram of the apparatus the student should use to remove the unreacted zinc and collect the zinc sulfate solution.

**(2)**

(c) The student obtains a pure, dry sample of zinc sulfate crystals.

The formula of zinc sulfate crystals is $ZnSO_4.7H_2O$

(i) Calculate the relative molecular mass ($M_r$) of zinc sulfate crystals.

**(2)**

$M_r$ = .....

(ii) The student uses 0.0200 mol of dilute sulfuric acid in her preparation.

Show that the maximum mass of zinc sulfate crystals that the student could obtain is about 6 g.

**(2)**

(iii) The student obtains a mass of 4.28 g of zinc sulfate crystals.

Calculate the percentage yield of the zinc sulfate crystals.

Give your answer to three significant figures.

**(3)**

percentage yield = .....%

**(Total for Question 7 = 13 marks)**

**8** (a) A piece of magnesium ribbon is ignited and placed in a gas jar of oxygen.

The equation for the reaction is

$$2Mg + O_2 \rightarrow 2MgO$$

(i) Give two observations that would be made in this reaction.

**(2)**

1 .....

.....

2 .....

.....

(ii) State why this is an oxidation reaction.

**(1)**

.....

.....

(b) A second piece of magnesium ribbon is ignited and placed in a gas jar of carbon dioxide.

A very exothermic reaction occurs, forming magnesium oxide and carbon.

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

**(1)**

.....

.....

(ii) Give the chemical equation for this reaction.

**(1)**

.....

(iii) A fire starts in a warehouse where magnesium is stored.

Suggest why it would **not** be suitable to use a carbon dioxide fire extinguisher to put out this fire.

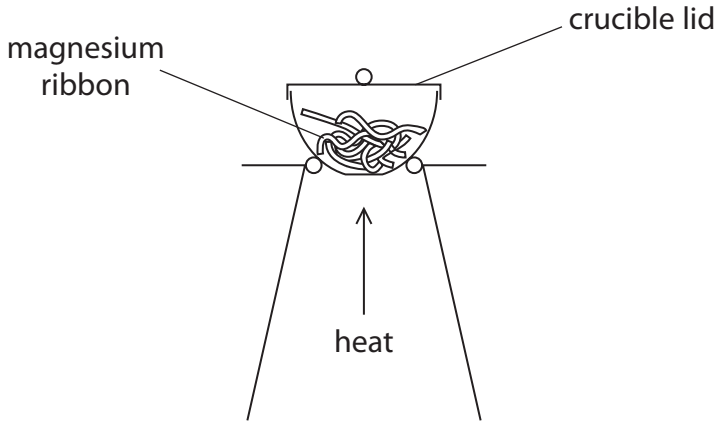
**(1)**

.....

.....

.....

(c) A student uses this apparatus to find the mass of magnesium oxide that forms when a known mass of magnesium is heated.




This is his method.

- find the mass of the crucible and lid
- place some magnesium ribbon in the crucible
- find the mass of the crucible, lid and magnesium
- heat the crucible with the lid on for a few minutes
- find the mass of the crucible, lid and magnesium oxide

Using this method, the mass of magnesium oxide formed is less than expected.

Explain two changes that the student should make to his method to obtain a mass of magnesium oxide closer to the expected mass.

**(4)**

1 .....

.....

.....

.....

2 .....

.....

.....

.....

**(Total for Question 8 = 10 marks)**

**9** This question is about some compounds of the elements in Group 4 of the Periodic Table.

(a) When carbon dioxide dissolves in water, a weak acid forms.

(i) Which of these could be the pH of this weak acid?

**(1)**

- ☒ **A** 1
- ☒ **B** 5
- ☒ **C** 7
- ☒ **D** 9

(ii) Which of these is a correct statement about acids?

**(1)**

- ☒ **A** acids contain $OH^-$ ions
- ☒ **B** acids are electron donors
- ☒ **C** acids are proton acceptors
- ☒ **D** acids are proton donors

(b) When lead(II) carbonate is heated, lead(II) oxide and carbon dioxide form.

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

**(1)**

.....

(ii) Complete the equation for this reaction.

**(1)**

$PbCO_3 \rightarrow$ ..... + .....

(c) Silicon dioxide, $SiO_2$, and silicon(IV) chloride, $SiCl_4$, are both covalently bonded compounds.

The table shows the melting and boiling points of these two compounds, and the physical state of silicon dioxide at room temperature.

| Compound | Melting point in °C | Boiling point in °C | Physical state at room temperature |
|---|---|---|---|
| $SiO_2$ | 1710 | 2230 | solid |
| $SiCl_4$ | –69 | 58 | |

(i) Complete the table by giving the physical state of silicon(IV) chloride at room temperature.

**(1)**

(ii) Explain, in terms of structure and bonding, why silicon dioxide has a much higher melting point than silicon(IV) chloride.

**(6)**

**(Total for Question 9 = 11 marks)**

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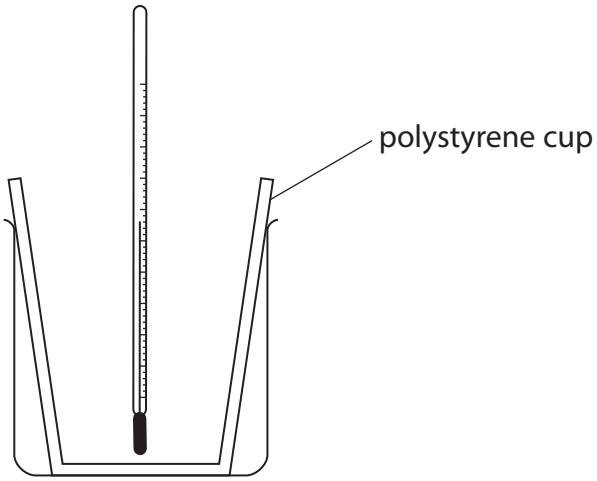
**10** A student uses this apparatus to investigate the reaction between potassium hydroxide solution and dilute hydrochloric acid.




This is her method.

- pour 25 $cm^3$ of potassium hydroxide solution into a polystyrene cup and record the temperature of the solution
- pour 25 $cm^3$ of dilute hydrochloric acid into a measuring cylinder and record the temperature of the acid
- add the acid to the polystyrene cup and stir the mixture
- record the highest temperature reached

(a) (i) Give a word equation for the reaction between potassium hydroxide and hydrochloric acid.

**(1)**

.....

(ii) Explain why the student needs to stir the mixture.

**(2)**

.....

.....

.....

.....

(b) The table gives the temperatures of the solutions before the student mixes them.

| | |
|---|---|
| potassium hydroxide solution | 17.8 °C |
| dilute hydrochloric acid | 18.4 °C |

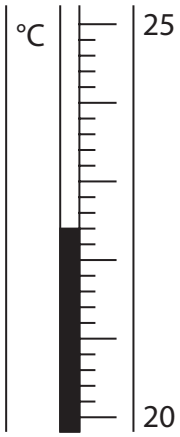
Calculate the mean (average) temperature of the two solutions.

**(2)**

mean temperature = ..... °C

(c) The student repeats the experiment on a different day, using 25 $cm^3$ of potassium hydroxide solution and 25 $cm^3$ of dilute hydrochloric acid.

The thermometer shows the highest temperature reached at the **end** of the experiment.




(i) Complete the table by giving the missing information.

Give both temperatures to the nearest 0.1 °C.

**(2)**

| | |
|---|---|
| mean temperature at start in °C | |
| temperature at end in °C | |
| temperature rise in °C | 5.2 |

(ii) Show that the heat energy change, *Q*, in the student's experiment is about 1100 J.

[for the mixture, c = 4.2 J/g/°C]

[mass of 1.0 $cm^3$ of mixture = 1.0 g]

**(3)**

(iii) The student uses 0.020 mol of potassium hydroxide in his experiment.

Calculate the enthalpy change ($\Delta H$) in kJ/mol, for 1.0 mol of potassium hydroxide.

Include a sign in your answer.

**(3)**

$\Delta H$ = ..... kJ/mol

**(Total for Question 10 = 13 marks)**

**TOTAL FOR PAPER = 110 MARKS**

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