

Please check the examination details below before entering your candidate information

Candidate surname

Other names

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

Centre Number

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Candidate Number

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**Wednesday 10 June 2020**

Afternoon (Time: 1 hour 15 minutes)

Paper Reference **4CH1/2C**

**Chemistry**

**Unit: 4CH1**

**Paper 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.*
- 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 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.
- 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 ►

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# The Periodic Table of the Elements

1      2                          3                          4                          5                          6                          7                          0

|   |                             |       |                              |       |                                   |       |                                 |       |                                 |       |                                 |       |                                 |       |                                  |
|---|-----------------------------|-------|------------------------------|-------|-----------------------------------|-------|---------------------------------|-------|---------------------------------|-------|---------------------------------|-------|---------------------------------|-------|----------------------------------|
| 7   | <b>Li</b><br>lithium<br>3   | 9     | <b>Be</b><br>beryllium<br>4  | 11    | <b>B</b><br>boron<br>5            | 12    | <b>C</b><br>carbon<br>6         | 14    | <b>N</b><br>nitrogen<br>7       | 16    | <b>O</b><br>oxygen<br>8         | 19    | <b>F</b><br>fluorine<br>9       | 20    | <b>Ne</b><br>neon<br>10          |
| 23  | <b>Na</b><br>sodium<br>11   | 24    | <b>Mg</b><br>magnesium<br>12 | 27    | <b>Al</b><br>aluminium<br>13      | 28    | <b>Si</b><br>silicon<br>14      | 31    | <b>P</b><br>phosphorus<br>15    | 32    | <b>S</b><br>sulfur<br>16        | 35.5  | <b>Cl</b><br>chlorine<br>17     | 40    | <b>Ar</b><br>argon<br>18         |
| 39  | <b>K</b><br>potassium<br>19 | 40    | <b>Ca</b><br>calcium<br>20   | 55    | <b>Mn</b><br>manganese<br>25      | 56    | <b>Fe</b><br>iron<br>26         | 59    | <b>Co</b><br>cobalt<br>27       | 59    | <b>Ni</b><br>nickel<br>28       | 63.5  | <b>Cu</b><br>copper<br>29       | 70    | <b>Ga</b><br>gallium<br>31       |
| 85  | <b>Rb</b><br>rubidium<br>37 | 88    | <b>Sr</b><br>strontium<br>38 | [98]  | <b>Tc</b><br>technetium<br>43     | 101   | <b>Ru</b><br>ruthenium<br>44    | 103   | <b>Rh</b><br>rhodium<br>45      | 106   | <b>Pd</b><br>palladium<br>46    | 108   | <b>Ag</b><br>silver<br>47       | 112   | <b>Cd</b><br>cadmium<br>48       |
| 133   | <b>Cs</b><br>caesium<br>55  | 137   | <b>Ba</b><br>barium<br>56    | 178   | <b>Hf</b><br>hafnium<br>72        | 181   | <b>Ta</b><br>tantalum<br>73     | 186   | <b>Re</b><br>rhenium<br>75      | 190   | <b>Os</b><br>osmium<br>76       | 192   | <b>Ir</b><br>iridium<br>77      | 195   | <b>Pt</b><br>platinum<br>78      |
| [223]   | <b>Fr</b><br>francium<br>87 | [226] | <b>Ra</b><br>radium<br>88    | [261] | <b>Rf</b><br>rutherfordium<br>104 | [262] | <b>Db</b><br>dubnium<br>105     | [264] | <b>Bh</b><br>bohrium<br>107     | [266] | <b>Sg</b><br>seaborgium<br>106  | [268] | <b>Mt</b><br>meitnerium<br>109  | [271] | <b>Ds</b><br>darmstadtium<br>110 |
|   |                             |       |                              | [227] | <b>Ac*</b><br>actinium<br>89      | [227] | <b>La*</b><br>lanthanum<br>57   | 139   | <b>Y</b><br>yttrium<br>39       | 178   | <b>Hf</b><br>hafnium<br>72      | 181   | <b>Ta</b><br>tantalum<br>73     | 190   | <b>Os</b><br>osmium<br>76        |
|   |                             |       |                              | [277] | <b>Hs</b><br>hassium<br>108       | [277] | <b>Hs</b><br>hassium<br>108     | [277] | <b>Hs</b><br>hassium<br>108     | [277] | <b>Hs</b><br>hassium<br>108     | [277] | <b>Hs</b><br>hassium<br>108     | [277] | <b>Hs</b><br>hassium<br>108      |
|   |                             |       |                              | [272] | <b>Rg</b><br>roentgenium<br>111   | [272] | <b>Rg</b><br>roentgenium<br>111 | [272] | <b>Rg</b><br>roentgenium<br>111 | [272] | <b>Rg</b><br>roentgenium<br>111 | [272] | <b>Rg</b><br>roentgenium<br>111 | [272] | <b>Rg</b><br>roentgenium<br>111  |
|   |                             |       |                              | [209] | <b>Po</b><br>polonium<br>84       | [209] | <b>Po</b><br>polonium<br>84     | [209] | <b>Po</b><br>polonium<br>84     | [209] | <b>Po</b><br>polonium<br>84     | [209] | <b>Po</b><br>polonium<br>84     | [209] | <b>Po</b><br>polonium<br>84      |
|   |                             |       |                              | [210] | <b>At</b><br>astatine<br>85       | [210] | <b>At</b><br>astatine<br>85     | [210] | <b>At</b><br>astatine<br>85     | [210] | <b>At</b><br>astatine<br>85     | [210] | <b>At</b><br>astatine<br>85     | [210] | <b>At</b><br>astatine<br>85      |
|   |                             |       |                              | [222] | <b>Rn</b><br>radon<br>86          | [222] | <b>Rn</b><br>radon<br>86        | [222] | <b>Rn</b><br>radon<br>86        | [222] | <b>Rn</b><br>radon<br>86        | [222] | <b>Rn</b><br>radon<br>86        | [222] | <b>Rn</b><br>radon<br>86         |
| Elements with atomic numbers 112-116 have been reported but not fully authenticated |                             |       |                              |       |                                   |       |                                 |       |                                 |       |                                 |       |                                 |       |                                  |

|   |                           |
|---|---------------------------|
| 1 | <b>H</b><br>hydrogen<br>1 |
|---|---------------------------|

## 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.**

1 A student is given a mixture of salt solution and sand.

She wants to obtain pure water from the mixture.

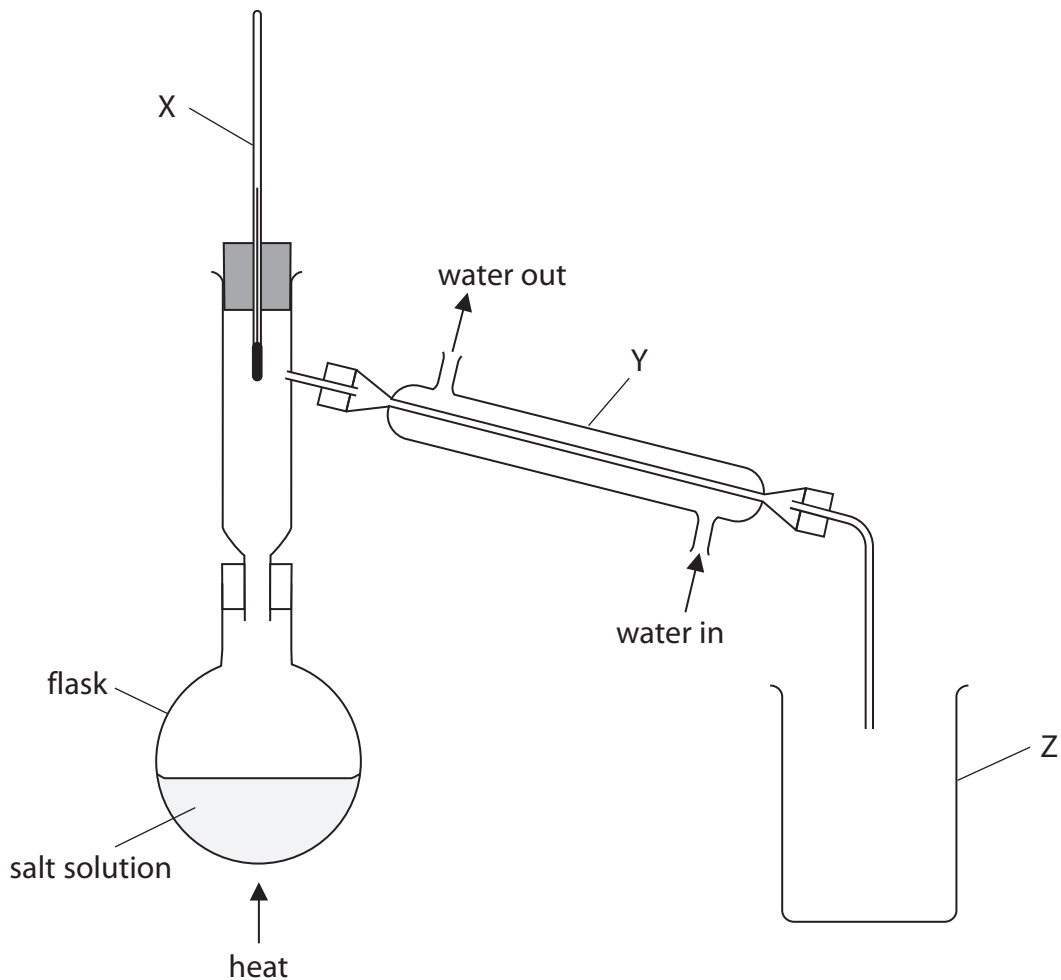
(a) She separates the sand from the salt solution.

Which method of separation should she use?

(1)

- A crystallisation
- B filtration
- C fractional distillation
- D simple distillation

(b) The student then uses this apparatus to obtain pure water from the salt solution.



(i) Name the pieces of apparatus labelled X, Y and Z.

(3)

X .....

Y .....

Z .....

(ii) State what remains in the flask when the separation is complete.

(1)

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**(Total for Question 1 = 5 marks)**

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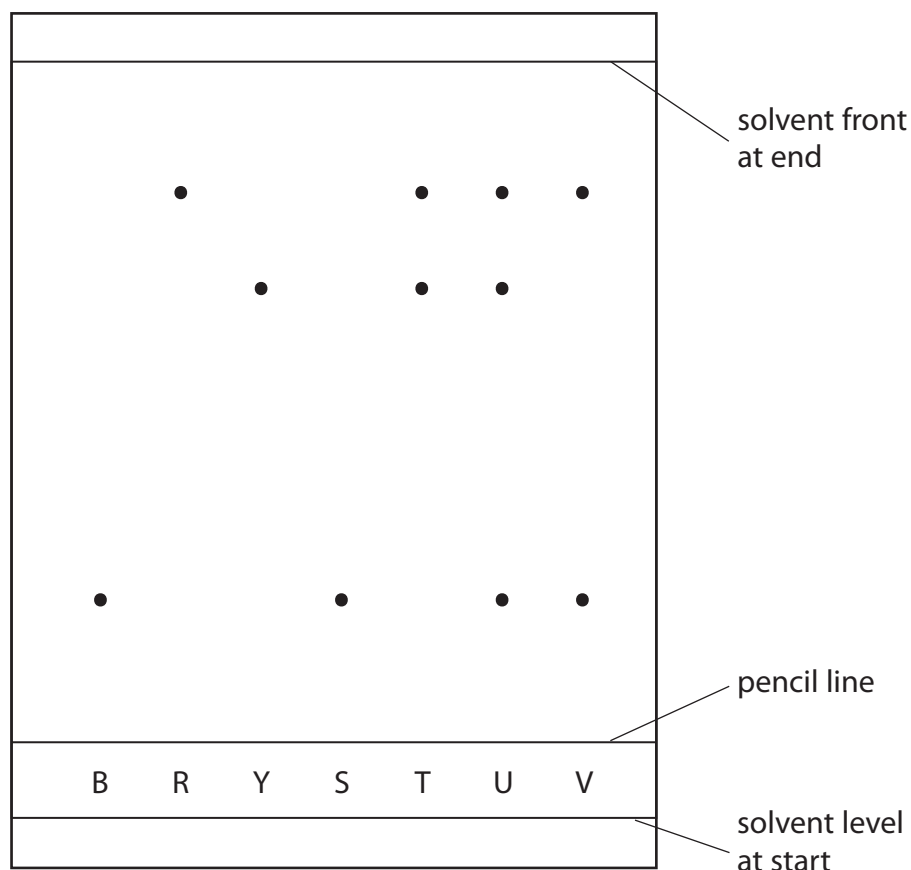
Turn over

2 In a chromatography experiment a student uses samples of three pure food dyes, blue (B), red (R) and yellow (Y).

He also uses samples of four unknown substances, S, T, U and V.

The student puts a small drop of each substance on the pencil line.

The diagram shows the student's chromatogram at the end of the experiment.



(a) Which of the unknown substances contains only one food dye?

(1)

- A substance S
- B substance T
- C substance U
- D substance V

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(b) Explain which pure food dyes are in substance V.

(2)

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(c) (i) Calculate the  $R_f$  value of the yellow food dye Y.

(3)

$R_f =$  .....

(ii) State how the chromatogram suggests that the yellow food dye Y is less soluble in the solvent than the red food dye R.

(1)

.....

.....

**(Total for Question 2 = 7 marks)**



Turn over

3 (a) The box gives the names of some metals.

calcium    copper    iron    magnesium    silver    zinc

(i) Identify the metal from the box that burns with a bright white flame.

(1)

(ii) In the Earth, metals are found either in ores or as uncombined elements.

Explain which metal from the box is most likely to be found as an uncombined element.

(2)





(b) This is the order of reactivity of four metals.

|                |           |
|----------------|-----------|
| most reactive  | aluminium |
| ↓              | iron      |
| ↓              | lead      |
| least reactive | copper    |

The method used to obtain a metal from its oxide depends on the reactivity of the metal.

Two possible methods are

Method 1 heating the metal oxide with carbon

Method 2 electrolysis

Explain which method should be used to obtain lead from lead(II) oxide, PbO

Include an equation for the formation of lead in your answer.

(3)

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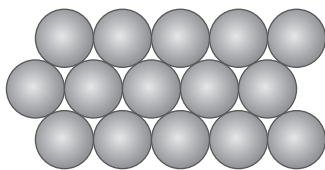
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Turn over

(c) The diagram shows the arrangement of the particles in a pure metal.



Metals are often made into alloys to make them harder.

Explain why alloys are harder than pure metals.

Draw a diagram to support your answer.

(4)

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**(Total for Question 3 = 10 marks)**



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4 Alcohols contain the functional group —OH

(a) Give the structural formula of the alcohol that contains one carbon atom.

(1)

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(b) Ethanol (C<sub>2</sub>H<sub>5</sub>OH) is an alcohol that can be obtained from glucose (C<sub>6</sub>H<sub>12</sub>O<sub>6</sub>).

(i) Name the process that converts glucose into ethanol.

(1)

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(ii) Explain why this process is carried out in the absence of air and at a temperature below 40 °C.

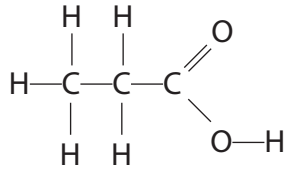
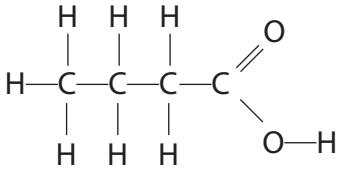
(4)

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Turn over

(c) The table gives information about some organic compounds in the same homologous series.

| Compound       | Molecular formula | Displayed formula  |
|----------------|-------------------|--|
| ethanoic acid  | $C_2H_4O_2$       |  |
| propanoic acid |                   |    |
|                | $C_4H_8O_2$       |  |

- (i) Complete the table by giving the missing information. (3)
- (ii) Name the homologous series that contains these compounds. (1)



(d) The compounds in the table can react with alcohols to form esters.

When preparing esters, a small amount of concentrated sulfuric acid is also used.

(i) State the purpose of the acid. (1)

(ii) Draw the displayed formula of the ester that forms when propanoic acid reacts with ethanol. (2)

(iii) Esters have particular uses that depend on their properties.  
Give an example of a property and use of esters. (2)

property.....

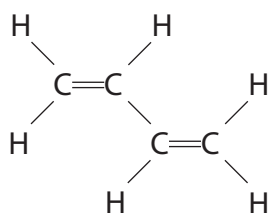
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**(Total for Question 4 = 15 marks)**



- 5 The organic compound butadiene is a colourless gas used in the manufacture of synthetic rubber for tyres.

The displayed formula of butadiene is



- (a) Explain why butadiene is described as an unsaturated hydrocarbon.

(3)

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- (b) (i) Butadiene reacts with bromine water.

State the colour change that occurs during this reaction.

(1)

from ..... to .....

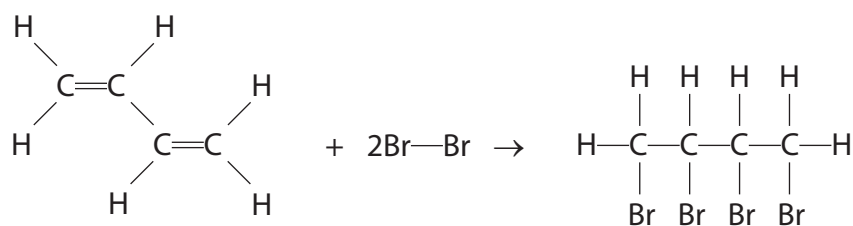
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- (ii) The equation for the reaction between butadiene and bromine can be shown using displayed formulae.



The table gives some bond energies.

|                       |     |     |       |     |      |
|-----------------------|-----|-----|-------|-----|------|
| Bond                  | C—H | C=C | Br—Br | C—C | C—Br |
| Bond energy in kJ/mol | 412 | 612 | 193   | 348 | 276  |

Use this information to calculate the enthalpy change,  $\Delta H$ , for the reaction.

Include a sign in your answer.

(4)

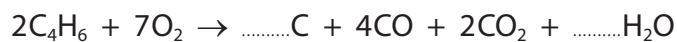
$\Delta H = \dots\dots\dots$  kJ/mol



- (c) A scientist does an investigation to find out if butadiene would be a good fuel.  
He burns a sample of butadiene gas and observes that carbon forms as black soot.

(i) Complete the equation to explain the scientist's observation.

(1)



(ii) Explain how one of the products, other than carbon, may cause a problem.

(2)

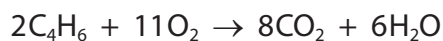
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(iii) The equation for the combustion of butadiene in excess oxygen is

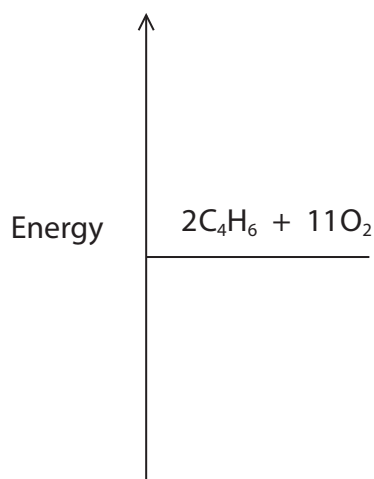


The enthalpy change for this reaction,  $\Delta H$ , is  $-3446$  kJ/mol.

Complete the energy profile diagram for the reaction.

Label the enthalpy change for this reaction,  $\Delta H$ , and the activation energy.

(4)



(Total for Question 5 = 15 marks)





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6 A student is provided with a bottle containing a colourless solution X.

Solution X is thought to be dilute sulfuric acid of concentration  $0.10 \text{ mol/dm}^3$ .

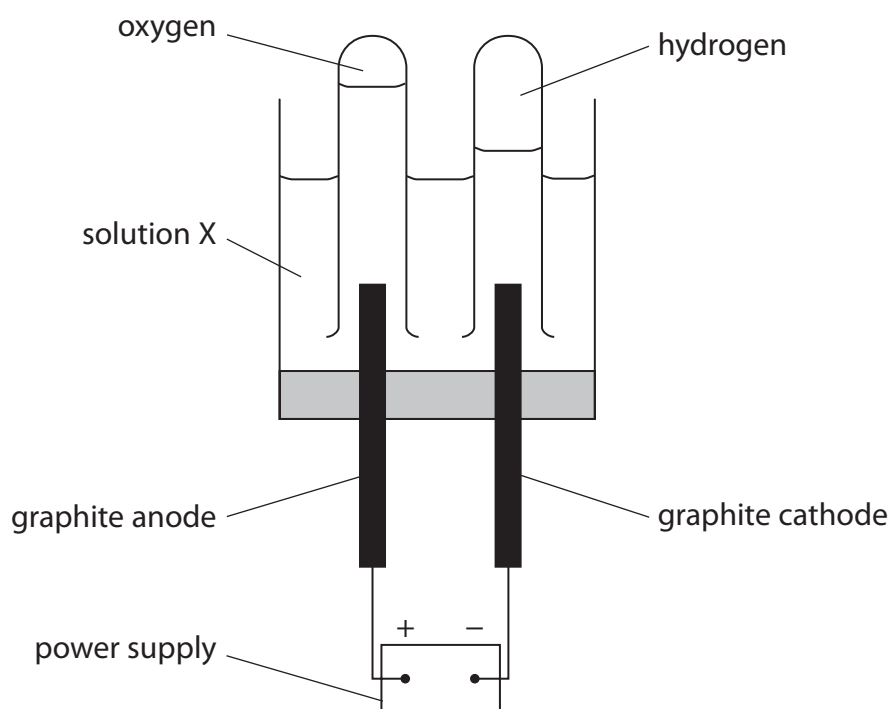
The student does some experiments on samples of solution X to try to show that it is dilute sulfuric acid.

The student adds a few drops of litmus to a sample of solution X.

The litmus turns red.

(a) The student knows that the products of the electrolysis of dilute sulfuric acid are hydrogen and oxygen.

She carries out the electrolysis using this apparatus.



(i) Suggest why the student does not use zinc electrodes in her experiment. (1)

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.....

(ii) State what is observed at both the anode and the cathode during the electrolysis. (1)

.....

(iii) Which of these tests shows that the gas formed at the cathode is hydrogen? (1)

- A a glowing splint relights
- B a burning splint gives a squeaky pop
- C a burning splint goes out
- D limewater turns cloudy

(b) Describe a test to show that solution X contains sulfate ions. (2)

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Turn over

- (c) The student then does a titration to see if the concentration of the dilute sulfuric acid is  $0.10 \text{ mol/dm}^3$ .

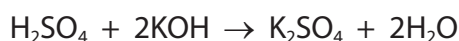
She measures  $25.0 \text{ cm}^3$  of potassium hydroxide solution into a conical flask, and then adds a few drops of indicator solution.

- (i) Name the piece of apparatus the student should use to measure  $25.0 \text{ cm}^3$  of the potassium hydroxide solution. (1)

- (ii) The concentration of potassium hydroxide in the solution is  $0.125 \text{ mol/dm}^3$ . Calculate the amount, in mol, of KOH in  $25.0 \text{ cm}^3$  of this solution. (2)

amount = ..... mol

- (iii) The equation for the reaction in the titration is



- Calculate the volume, in  $\text{cm}^3$ , of  $0.10 \text{ mol/dm}^3$  sulfuric acid needed to neutralise  $25.0 \text{ cm}^3$  of the potassium hydroxide solution. (3)

volume of sulfuric acid = .....  $\text{cm}^3$

**(Total for Question 6 = 11 marks)**



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*Turn over*

7 This question is about reactions involving gases.

(a) Potassium carbonate reacts with dilute hydrochloric acid to produce carbon dioxide gas.

The equation for the reaction is



Calculate the volume, in  $\text{cm}^3$ , of carbon dioxide gas produced when 6.9 g of potassium carbonate reacts with excess dilute hydrochloric acid.

[ $M_r$  of  $\text{K}_2\text{CO}_3 = 138$ ]

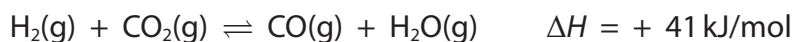
[molar volume of  $\text{CO}_2$  at rtp =  $24 \text{ dm}^3$ ]

(3)

volume = .....  $\text{cm}^3$



(b) This reaction involving gases is in dynamic equilibrium at a temperature of 225 °C.



- (i) Predict the effect on the yield of CO(g) at equilibrium when the temperature is increased without changing the pressure.

Give a reason for your answer.

(2)

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.....

- (ii) Predict the effect on the yield of CO(g) at equilibrium when the pressure is increased without changing the temperature.

Give a reason for your answer.

(2)

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

**TOTAL FOR PAPER = 70 MARKS**



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