Write your name here

Surname	Other names

Pearson Edexcel International GCSE

Centre Number	Candidate Number

Chemistry

Unit: 4CH0
Paper: 2CR

Wednesday 13 June 2018 – Morning
Time: 1 hour

Paper Reference
4CH0/2CR

You must have:
Ruler, calculator

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided – *there may be more space than you need.*
- Show all the steps in any calculations and state the units.
- 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 60.
- 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

1/1/1/1/1/1/

P 5 3 1 4 7 A 0 1 2 0

Pearson

THE PERIODIC TABLE

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

Key

Relative atomic mass
Symbol
Name
Atomic number

Answer ALL questions.

1 The table shows some information about five gases.

Gas	Formula of molecule	Boiling point in °C
chlorine	Cl_2	−35
oxygen	O_2	−183
carbon monoxide	CO	−191
nitrogen	N_2	−196
hydrogen	H_2	−253

Choose gases from the table to answer this question.

You may use each gas once, more than once, or not at all.

(a) Name the gas that is a compound.

(1)

Carbon monoxide

(b) Name the gas necessary for rusting to occur.

(1)

Oxygen

(c) Name the gas that bleaches moist litmus paper.

(1)

Chlorine

(d) Name the gas that has the highest percentage by volume in air.

(1)

Nitrogen

(e) Name the gas that has the highest boiling point.

(1)

Chlorine

(f) Determine the two gases that have the same relative formula mass.

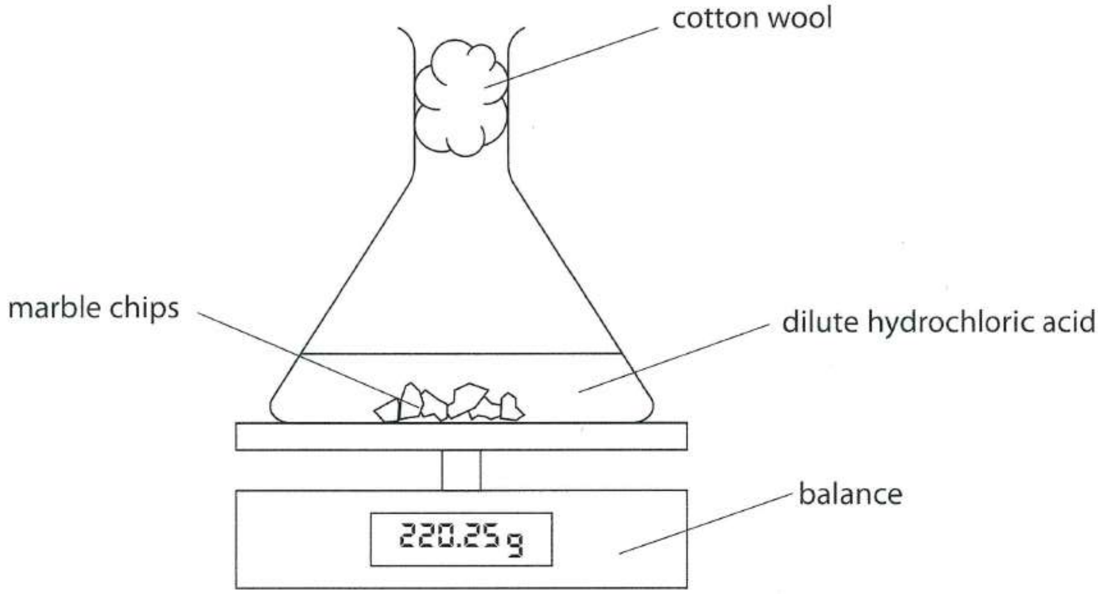
(1)

1 Nitrogen

2 Carbon monoxide

(Total for Question 1 = 6 marks)

2 A student uses this apparatus to study the rate of the reaction between marble chips and dilute hydrochloric acid.



She uses this method.

- place a conical flask on a balance
- put 15 g of large marble chips in the flask
- add 25 cm^3 of dilute hydrochloric acid to the flask
- record the mass of the flask and contents, and start a timer
- record the mass of the flask and contents every 30 seconds until the reaction ends

The equation for the reaction is

$$CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + CO_2(g) + H_2O(l)$$

(a) (i) Explain what happens to the mass of the flask and contents during the reaction.

(2)

Mass decreases as CO_2 leaves the flask.

(ii) State why the reaction ends, even though some marble chips remain in the flask.

(1)

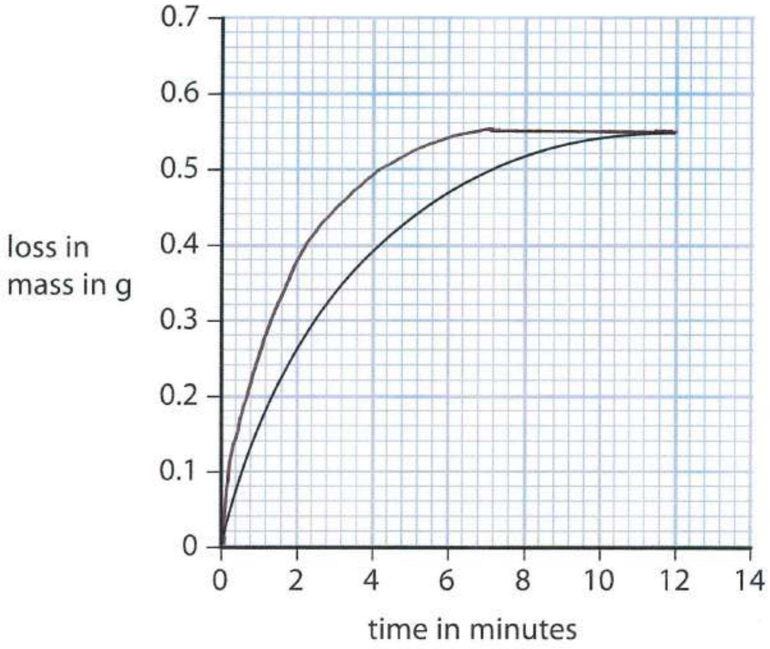
All the HCl has reacted.

(iii) State how the student would know when the reaction has ended.

(1)

Mass of the flask and contents reaches a constant.

(b) The student plots her results on a grid.



(i) At which time is the rate of reaction greatest?

(1)

- ☒ **A** 1 minute
- ☐ **B** 4 minutes
- ☐ **C** 6 minutes
- ☐ **D** 8 minutes

(ii) The student repeats the experiment with the same volume and concentration of acid, but with 15 g of smaller marble chips.

On the grid, sketch the curve you would expect for this experiment.

(2)

(c) Explain how decreasing the concentration of the hydrochloric acid affects the rate of reaction.

Refer to particle collision theory in your answer.

(3)

Fewer acid particles in the same volume.
Fewer successful collisions per second.
Lower rate of reaction.

(Total for Question 2 = 10 marks)

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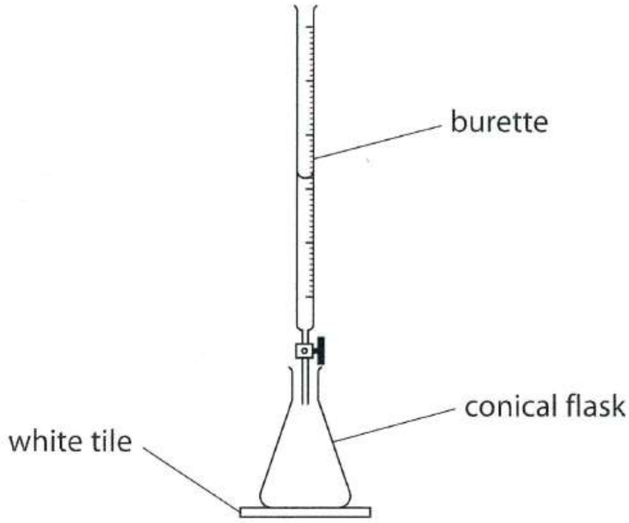
3 A student is provided with a solution of sodium hydroxide, $NaOH$, and a solution of 0.0200 mol/dm^3 phosphoric(V) acid, H_3PO_4

She does a titration to find the volume of the phosphoric(V) acid that reacts with 25.0 cm^3 of the sodium hydroxide.



This is the student's method.

- add phosphoric(V) acid to a clean burette until it is nearly full
- record the burette reading
- use a measuring cylinder to add 25.0 cm^3 of the sodium hydroxide to a clean conical flask
- add a few drops of phenolphthalein indicator to the flask
- place the flask on a white tile
- add phosphoric(V) acid from the burette until the indicator changes colour
- record the burette reading
- wash the flask using distilled water and then dry the flask
- repeat the titration

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(a) (i) Name a piece of apparatus that would give a more precise measurement of the volume of sodium hydroxide.

(1)

Pipette

(ii) Suggest why the student places the flask on a white tile.

(1)

To see the colour change more clearly.

(iii) Give the colour change of the phenolphthalein indicator during the titration.

(2)

at start Pink

at end Colowless

(iv) The student dries the flask after washing it with distilled water.
Suggest why it is not necessary to dry the flask before repeating the titration.

(1)

Water does not affect number of moles of NaOH.

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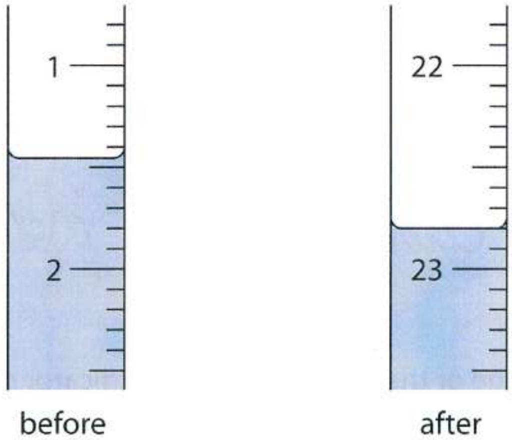
(b) The diagram shows the student's burette readings for her titration, before and after adding the acid.



Use the readings to complete the table, giving all values to the nearest 0.05 cm^3.

(2)

burette reading after adding the acid	22.80
burette reading before adding the acid	1.45
volume in cm^3 of acid added	21.35

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(c) Another student does the experiment four times.

The table shows his results.

Volume in cm^3 of acid added	21.80	21.50	21.35	21.40
Concordant results (✓)		✓	✓	✓

Concordant results are those within 0.20 cm^3 of each other.

(i) Place ticks in the table to show which results are concordant.

(1)

(ii) Use the concordant results to calculate the average (mean) volume of acid added.

(2)

$$\frac{21.50 + 21.35 + 21.40}{3} = 21.42$$

average volume = 21.42 cm^3

(d) The titration is repeated many times.

The average result from all these titrations shows that 25.0 cm^3 sodium hydroxide reacts with 21.30 cm^3 of 0.0200 mol/dm^3 phosphoric(V) acid.

The equation for the reaction is

$$H_3PO_4 + 3NaOH \rightarrow Na_3PO_4 + 3H_2O$$

Calculate the concentration, in mol/dm^3, of the sodium hydroxide solution.

(3)

$H_3PO_4 + 3NaOH \rightarrow Na_3PO_4 + 3H_2O$

V 0.0213 0.025

C 0.02 0.05112

n 4.26×10^{-4} 1.278×10^{-3}

$n=cV$ $c=\frac{n}{V}$

concentration of sodium hydroxide solution = 0.051 mol/dm^3

(Total for Question 3 = 13 marks)

4 The box shows the molecular formulae of some organic compounds.

P CH_4	**Q** C_2H_4	**R** C_2H_6
S C_3H_6	**T** $C_2H_4Br_2$	**U** C_4H_8

(a) Choose compounds from the box to answer this question.

You may use each compound once, more than once or not at all.

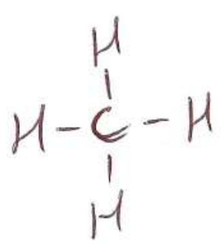
(i) Identify a compound that is not a hydrocarbon. **(1)**

T

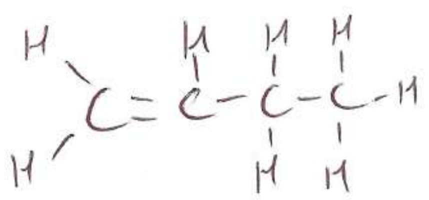
(ii) Identify a compound that has the same empirical formula as its molecular formula. **(1)**

P

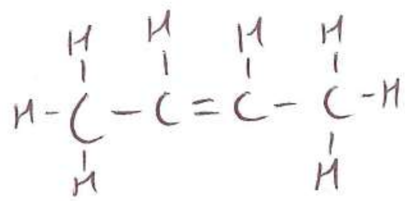
(b) (i) Draw the displayed formula for compound P. **(1)**



(ii) Draw the displayed formula for two straight-chain isomers of compound U. **(2)**



Isomer 1



Isomer 2

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(c) (i) Compound Q reacts with bromine to form compound T.

Describe the observation that would be made during this reaction.

(1)

Bromine changes from red-brown to colourless.

(ii) Suggest how compound R could be converted into compound T.

(2)

React with Bromine and UV Light.

(d) Compound Q is used as the starting material in the manufacture of polymers such as poly(ethene) and poly(chloroethene).

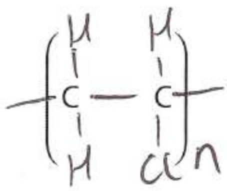
(i) What type of polymers are poly(ethene) and poly(chloroethene)?

(1)

Addition polymers

(ii) Complete the diagram to show the displayed formula of poly(chloroethene).

(2)



(e) Nylon is a polymer formed by a different polymerisation process.

(i) Give the name of this polymerisation process.

(1)

Condensation polymerisation

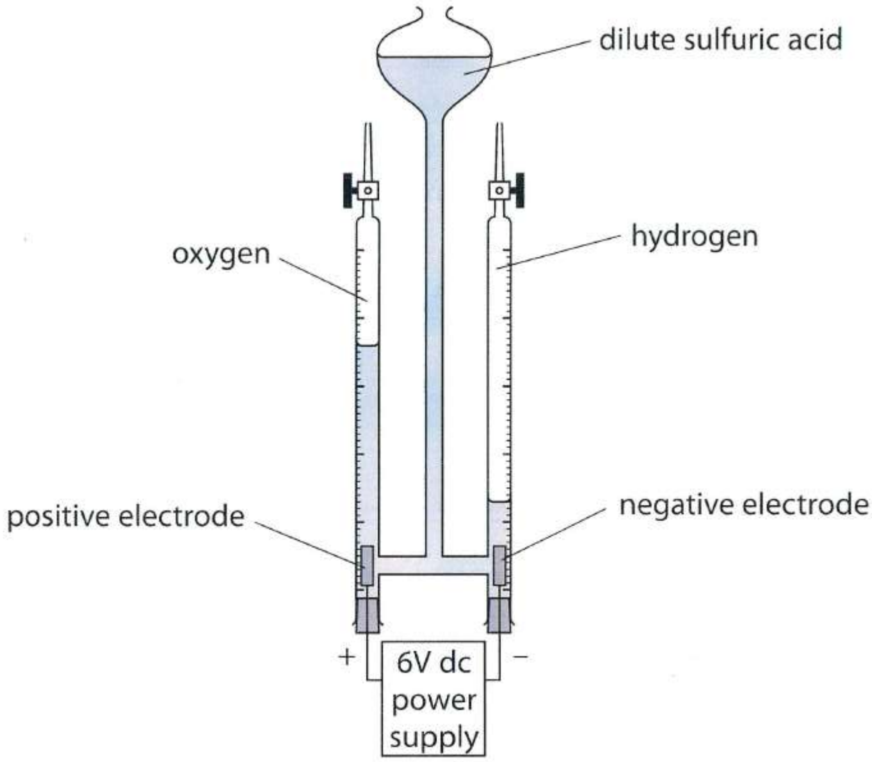
(ii) State a difference between the two polymerisation processes.

(1)

In condensation polymerisation a small molecule is formed. This doesn't happen in addition polymerisation.

(Total for Question 4 = 13 marks)

5 This apparatus is called a Hofmann voltameter. It is used to collect the gases produced when an electric current passes through a solution of dilute sulfuric acid.



(a) (i) Name the process that takes place in the Hofmann voltameter.

(1)

Electrolysis

(ii) State why zinc should not be used for the electrodes.

(1)

Zinc reacts with sulfuric acid.

(b) (i) Describe a test to show that the gas produced at the positive electrode is oxygen.

(1)

Glowing splint relights.

(ii) Write an ionic half-equation to represent the reaction that produces hydrogen at the negative electrode.

(1)

$2H^+ + 2e^- \rightarrow H_2$

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(c) An ionic half-equation for the reaction at the positive electrode is

$$2H_2O \rightarrow O_2 + 4H^+ + 4e^-$$

Calculate the maximum volume of oxygen that could be formed at room temperature and pressure (rtp) if a charge of 0.010 faraday is passed through the dilute sulfuric acid.

[molar volume of oxygen gas is 24 000 cm^3 at rtp]

(3)

4 Faraday gives 1 mol O_2

0.010 Faraday gives 0.0025 mol O_2

$0.0025 \times 24000 = 60 cm^3$ O_2

maximum volume of oxygen = 60 cm^3

(d) The ionic half-equation for the reaction at the positive electrode is sometimes shown as

$$4OH^- \rightarrow O_2 + 2H_2O + 4e^-$$

Suggest why this half-equation is not the best way to show the reaction at the positive electrode when an electric current is passed through a solution of dilute sulfuric acid.

(1)

Very low concentration of OH^- ions present in Sulfuric acid.

(Total for Question 5 = 8 marks)

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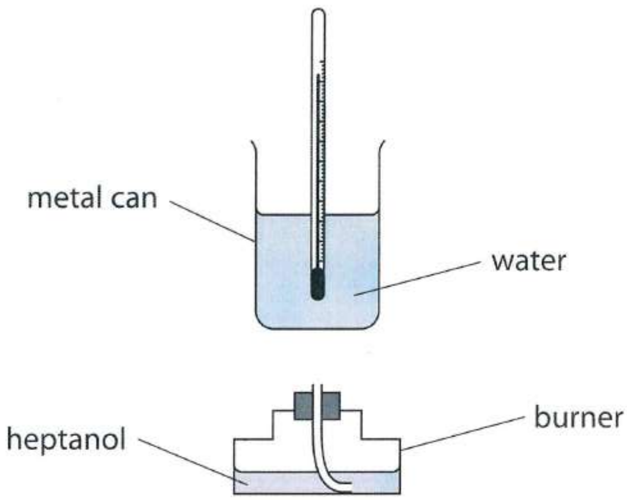
6 Heptanol and hydrogen are both used as fuels.

(a) A student uses this apparatus to find the heat energy released from the combustion of heptanol.



He uses this formula

$$Q = m \times 4.18 \times \Delta T$$

[Q = heat energy released, m = mass of water in g, ΔT = change in temperature of water]

1.00 cm^3 water has a mass of 1.00 g.

(i) State the measurements that the student needs to record to find a value for the heat energy released.

(2)

Volume of water heated.

Temperature of water before and after heating.

(ii) The student burns 0.75 g of heptanol and calculates Q to be 19 kJ.

Use this information to calculate the molar enthalpy change, in kJ/mol, for the combustion of heptanol.
[M_r of heptanol = 114]

(3)

$n = \frac{m}{M_r}$ $\frac{0.75}{114} = 6.58 \times 10^{-3}$ mol

$\frac{19}{6.58 \times 10^{-3}} = 2888$ kJmol^{-1}

molar enthalpy change = 2900 kJ/mol

(b) The equation for the combustion of hydrogen is

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

(i) This equation shows the reaction, including the covalent bonds in the molecules.

$$2H{-}H + O{=}O \rightarrow 2H{-}O{-}H$$

The table gives the average (mean) bond energies.

Bond	**Average bond energy in kJ/mol**
H—H	436
O═O	498
H—O	464

Use the values in the table to calculate the enthalpy change, ΔH, for the reaction.

Include the sign in your answer.

(3)

$\sum$(bonds broken) $= 2(436) + 498$
$= 1370$ kJ ~~mol~~$^{-1}$

$\sum$(bonds formed) $= 4(464)$
$= 1856$ kJ ~~mol~~$^{-1}$

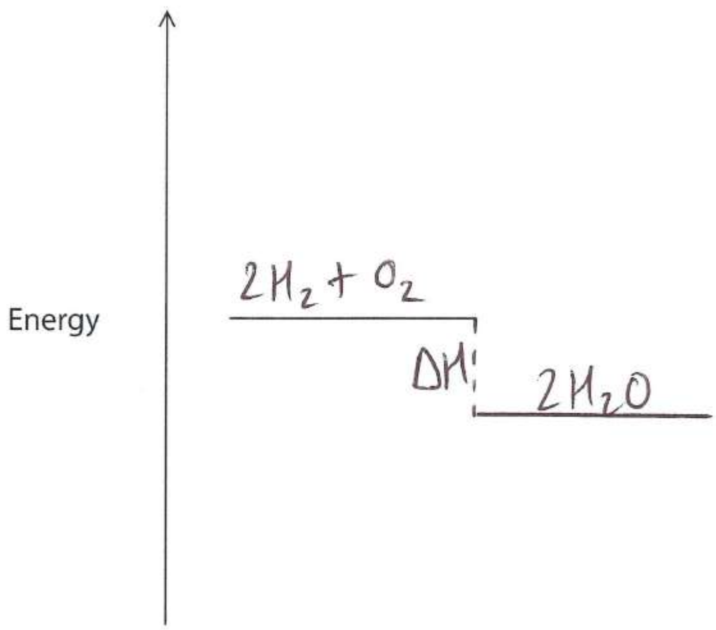
$\Delta H = 1370 - 1856$
$= -486$ kJ

$\Delta H =$ -486 kJ

(ii) Complete the energy level diagram for the reaction between hydrogen and oxygen by showing the reactants and products.

Label the enthalpy change, ΔH, for the reaction.

(2)



(Total for Question 6 = 10 marks)

TOTAL FOR PAPER = 60 MARKS

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