Write your name here

Surname	Other names

Pearson Edexcel International GCSE

Centre Number	Candidate Number

Chemistry

Unit: 4CH0
Paper: 2C

Wednesday 13 June 2018 – Morning **Time: 1 hour**	Paper Reference **4CH0/2C**

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 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 ▶

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THE PERIODIC TABLE

Period	Group 1	2											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

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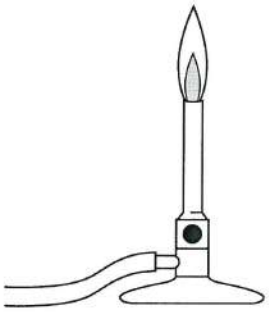
Answer ALL questions.

1 The diagram shows a Bunsen burner.



(a) The Bunsen burner uses methane as a fuel.

Methane has the formula CH_4

Give the names of the two elements in methane.

(2)

Carbon and Hydrogen

(b) When methane burns it reacts with a gas in the air.

Give the name of this gas.

(1)

Oxygen

(c) (i) Name the two substances that form when methane burns in plenty of air.

(2)

1 Carbon Dioxide

2 Water

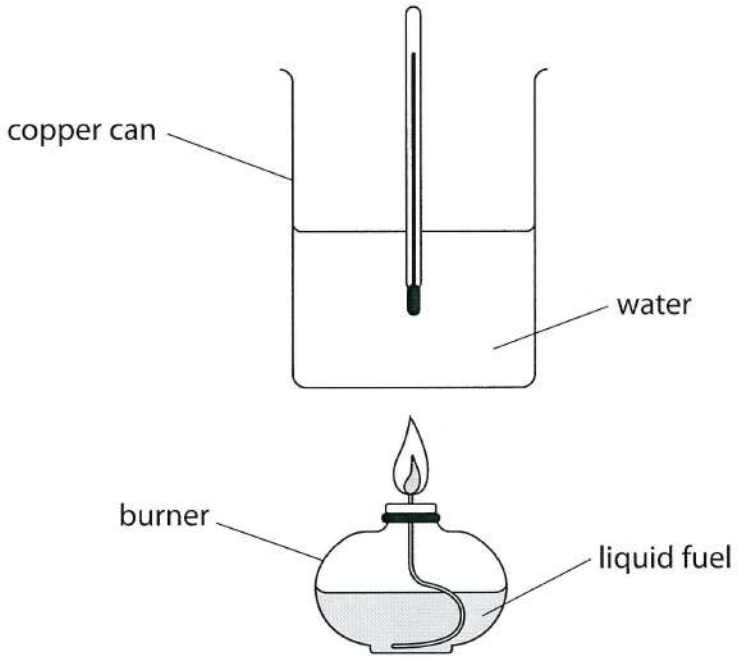
(ii) Name the poisonous gas that forms when methane burns in a shortage of air.

(1)

Carbon monoxide

(Total for Question 1 = 6 marks)

2 A student uses this apparatus to investigate the burning of four different liquid fuels, W, X, Y and Z.



The table shows the student's results.

Fuel	Initial temperature in °C	Final temperature in °C	Increase in temperature in °C
W	19.0	31.3	12.3
X	18.4	28.7	10.3
Y	19.5	35.4	15.9
Z	18.7	29.8	11.1

(a) Complete the table by giving the increase in temperature for fuels X, Y and Z.

(1)

(b) The student uses the same mass of water and burns each fuel for the same period of time.

Explain which fuel releases the most heat energy.

(2)

Fuel Y, because it produces the largest temperature rise.

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(c) What is the name given to reactions that release heat energy?

(1)

☒ **A** decomposition

☒ **B** endothermic

☒ **C** exothermic

☒ **D** reduction

(Total for Question 2 = 4 marks)

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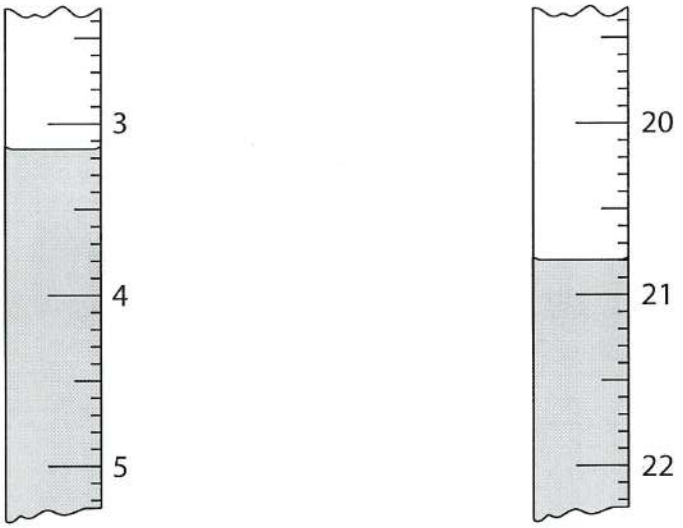
3 A student makes an alkali solution by dissolving a small volume of cleaning liquid in deionised water.

He then titrates a sample of this solution with an acid until neutralisation is complete.

(a) The diagram shows the burette readings for his titration.



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

(2)

Burette reading after adding the acid	20.80
Burette reading before adding the acid	3.15
Volume of acid added in cm^3	17.65

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(b) Another student does a titration using a solution of a different cleaning liquid.

The table shows her results.

Burette reading after adding the acid	29.65	28.70	29.25	29.10	28.55
Burette reading before adding the acid	3.40	3.60	3.50	3.80	3.35
Volume of acid added in cm^3	26.25	25.10	25.75	25.30	25.20
Concordant results (✓)		✓		✓	✓

Concordant results are those that differ by 0.20 cm^3 or less.

(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.

(1)

$$\frac{25.10 + 25.30 + 25.20}{3} = 25.20\ cm^3$$

average volume of acid = 25.20 cm^3

(Total for Question 3 = 4 marks)

4 Bromine, chlorine, fluorine and iodine are elements in Group 7 of the Periodic Table.

(a) Which element is the most reactive?

(1)

- ☐ **A** bromine
- ☐ **B** chlorine
- ☒ **C** fluorine
- ☐ **D** iodine

(b) Which element is a solid at room temperature?

(1)

- ☐ **A** bromine
- ☐ **B** chlorine
- ☐ **C** fluorine
- ☒ **D** iodine

(c) Which element has the darkest colour at room temperature?

(1)

- ☐ **A** bromine
- ☐ **B** chlorine
- ☐ **C** fluorine
- ☒ **D** iodine

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(d) Bromine reacts with hydrogen to form hydrogen bromide.

The equation for the reaction is

$$H_2(g) + Br_2(g) \rightarrow 2HBr(g)$$

The table shows some average bond energies.

Bond	H—H	Br—Br	H—Br
Average bond energy in kJ/mol	436	193	366

Use the values in the table to calculate the enthalpy change for the reaction between hydrogen and bromine.

(3)

Σ Bonds broken = 436 + 193 = 629

Σ Bonds made = 2 × 366 = 732

ΔH = Σ Bonds broken − Σ bonds made

= 629 − 732

= −103 kJ/mol

enthalpy change = −103 kJ/mol

(Total for Question 4 = 6 marks)

5 Ethanol can be manufactured by fermentation or by the direct hydration of ethene.

(a) In Brazil, the main source of sugar for fermentation is sugar cane.

- sugar cane is added to water
- sugar cane contains sucrose ($C_{12}H_{22}O_{11}$) that dissolves in the water
- during the fermentation process the sucrose is broken down into glucose ($C_6H_{12}O_6$)
- this glucose is then converted into ethanol (C_2H_5OH) and carbon dioxide

(i) Name the substance that is added to the sucrose solution to allow fermentation to take place.

(1)

Yeast

(ii) Complete the equation for the conversion of sucrose into glucose.

(1)

$$C_{12}H_{22}O_{11} + H_2O \rightarrow 2C_6H_{12}O_6$$

(iii) Write a chemical equation for the conversion of glucose into ethanol and carbon dioxide.

(1)

$C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$

(iv) Fermentation produces a solution that is a mixture of ethanol and water.

Which of these is the most effective method of obtaining ethanol from this mixture?

(1)

- ☐ **A** crystallisation
- ☐ **B** filtration
- ☒ **C** fractional distillation
- ☐ **D** simple distillation

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(b) In the direct hydration method, ethene reacts with steam.

The equation for the reaction is

$$C_2H_4 + H_2O \rightarrow C_2H_5OH$$

(i) Name the catalyst used in this reaction.

(1)

Phospharic acid

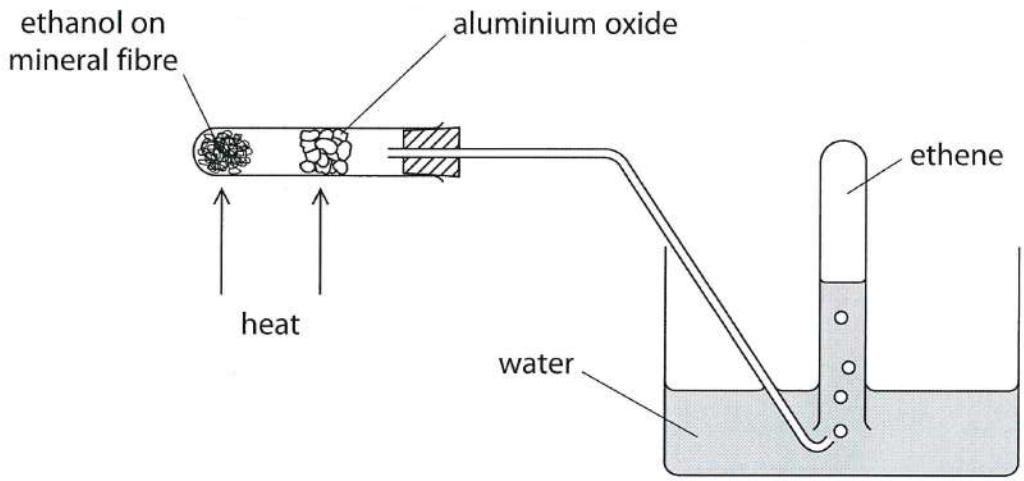
(ii) State the temperature and pressure used in this reaction.

(2)

temperature 300°C

pressure 60-70 atm

(c) This apparatus is used to convert ethanol into ethene.



(i) Name the type of reaction taking place.

(1)

Dehydration

(ii) State the function of the aluminium oxide in this reaction.

(1)

Catalyst

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(d) Ethene belongs to a homologous series of unsaturated hydrocarbons called alkenes.

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

(1)

Contains a Carbon to carbon double bond.

(ii) State the colour change that is observed when bromine water is shaken with ethene in a test tube.

(2)

from Orange to Colourless

(Total for Question 5 = 12 marks)

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6 Phosgene ($COCl_2$) is used in industry to make polymers.

(a) Phosgene is formed when carbon monoxide reacts with chlorine.

$$CO(g) + Cl_2(g) \rightleftharpoons COCl_2(g) \qquad \Delta H = -108\,kJ/mol$$

(i) The reaction mixture is kept at temperatures between 50 and 150 °C. If a temperature above 200 °C is used, only a small amount of phosgene is formed.

Suggest why only a small amount of phosgene is formed at temperatures above 200 °C.

(2)

Equilibrium shifts left as the temperature increases because the forward reaction is exothermic.

(ii) Predict how the yield of phosgene will change if the reaction is carried out at a higher pressure.

Give a reason for your answer.
[assume the reaction reaches a position of equilibrium]

(2)

Yield increases as there are more molecules of gas on the left of the equation.

(b) Phosgene reacts with water to form hydrochloric acid and carbon dioxide.

Write a chemical equation for this reaction.

(1)

$COCl_2 + H_2O \rightarrow 2HCl + CO_2$

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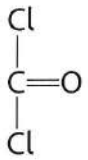
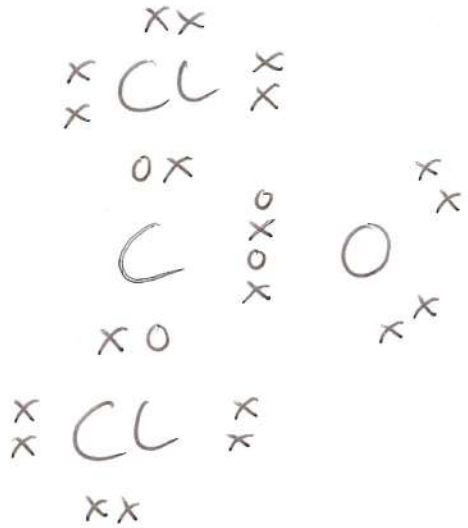
(c) The diagram shows the displayed formula of phosgene.



Draw a dot and cross diagram to show the arrangement of all the outer electrons in a molecule of phosgene.

(3)



(Total for Question 6 = 8 marks)

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7 Magnesium carbonate decomposes when heated to form magnesium oxide and carbon dioxide. The equation for the reaction is

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

A student uses this method to investigate the reaction.

Step 1 weigh a clean, dry crucible and record the mass

Step 2 add some magnesium carbonate

Step 3 reweigh the crucible and contents and record the new mass

Step 4 heat the crucible and contents for five minutes

Step 5 allow the crucible and contents to cool and then reweigh

Step 6 repeat steps 4 and 5 until the mass of the crucible and contents does not change

The student does the experiment four times.

The table shows her results.

	Mass in g			
	Experiment 1	Experiment 2	Experiment 3	Experiment 4
mass of empty crucible	19.20	21.31	19.83	20.45
mass of crucible and magnesium carbonate before heating	23.40	24.94	24.65	26.92
mass of crucible and contents after heating for 5 minutes	22.85	23.21	22.13	24.02
mass of crucible and contents after heating for a total of 10 minutes	21.94	23.04	22.13	23.53
mass of crucible and contents after heating for a total of 15 minutes	21.60	23.04	22.13	23.53

(a) State why the mass of the crucible and contents decreases during heating.

(1)

Carbon dioxide gas is lost.

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(b) (i) State the reason for Step 6.

(1)

To check that the magnesium carbonate has fully decomposed.

(ii) Explain in which experiment the student should have heated for a fourth period of five minutes.

(2)

Experiment 1, as the mass is not constant.

(Total for Question 7 = 4 marks)

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8 Acid indigestion is caused by having too much hydrochloric acid in the stomach.

A suspension of magnesium hydroxide, $Mg(OH)_2$, in water, can be used to cure acid indigestion.

The equation for the reaction between magnesium hydroxide and hydrochloric acid is

$$Mg(OH)_2(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + 2H_2O(l)$$

A student investigates how much magnesium hydroxide is needed to neutralise 100 cm^3 of hydrochloric acid with a concentration of 0.0968 mol/dm^3.

He uses 0.29 g of magnesium hydroxide to neutralise the hydrochloric acid.

(a) Calculate the amount, in moles, of HCl in the hydrochloric acid.

(2)

$100 cm^3 \rightarrow 0.1 dm^3$

$n = CV$

$0.0968 \times 0.1 = 0.00968$ mol

amount of HCl 0.00968 mol

(b) Calculate the amount, in moles, of $Mg(OH)_2$ used by the student.
[M_r of $Mg(OH)_2$ = 58]

(2)

$n = \frac{m}{Mr}$ $\frac{0.29}{58} = 0.005$ mol

amount of $Mg(OH)_2$ 0.005 mol

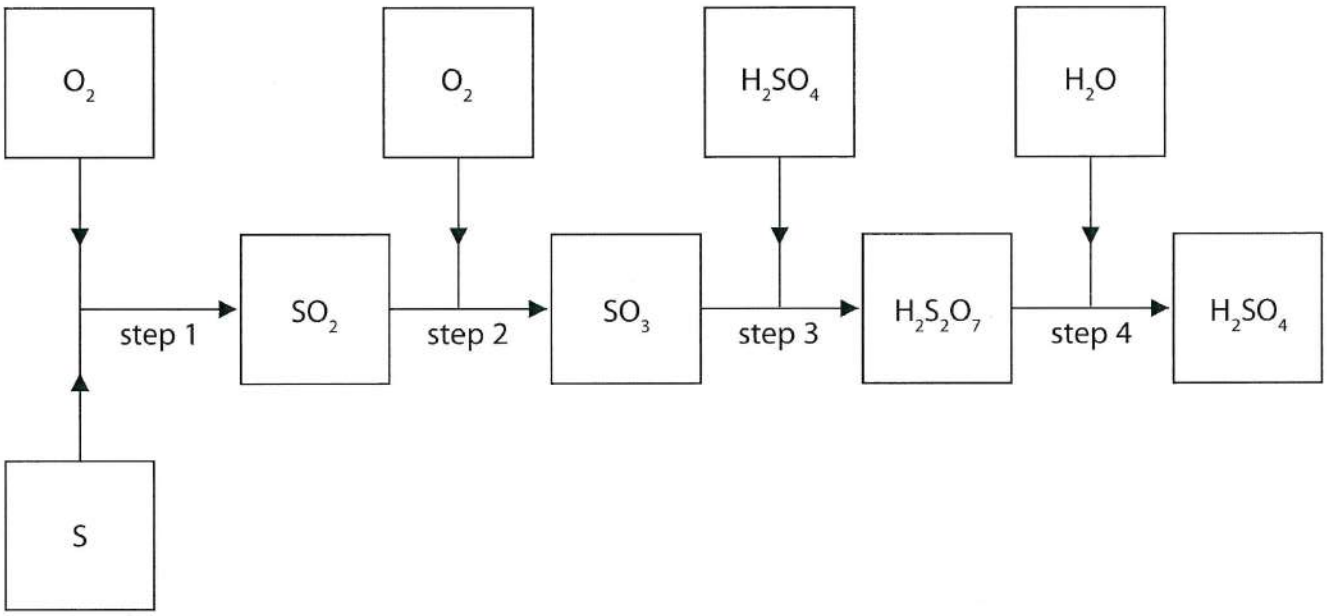
(c) Explain whether the student used the right amount of magnesium hydroxide to neutralise the hydrochloric acid.

(2)

Yes, he used the right amount of magnesium hydroxide as 1 mol of $Mg(OH)_2$ neutralises 2 mol of HCl.

(Total for Question 8 = 6 marks)

9 The flow chart shows the steps in the manufacture of sulfuric acid.



(a) The equation for the reaction in step 2 is

$$SO_2(g) + \tfrac{1}{2}O_2(g) \rightleftharpoons SO_3(g) \qquad \Delta H = -96\,kJ/mol$$

(i) State what the symbols $\rightleftharpoons$ and ΔH represent.

(2)

$\rightleftharpoons$ The reaction is reversible

ΔH Enthalpy change of reaction.

(ii) Name the catalyst used in step 2.

(1)

Vanadium (V) oxide

(iii) State the temperature and pressure used in the reaction in step 2.

(2)

temperature 450°C

pressure 2 atm

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(b) Sulfur trioxide reacts with water to form sulfuric acid.
This reaction is very exothermic.

$$SO_3(g) + H_2O(l) \rightarrow H_2SO_4(aq) \qquad \Delta H = -228\,kJ/mol$$

(i) State why the sulfur trioxide is not dissolved in water to form sulfuric acid in step 3.

(1)

Fumes of sulfuric acid would be formed.

(ii) Write chemical equations for the reactions that take place in step 3 and step 4.

(2)

step 3 $H_2SO_4 + SO_3 \rightarrow H_2S_2O_7$

step 4 $H_2S_2O_7 + H_2O \rightarrow 2H_2SO_4$

(c) Give two industrial uses for sulfuric acid.

(2)

1 Making detergents.

2 Making ferhlisers.

(Total for Question 9 = 10 marks)

TOTAL FOR PAPER = 60 MARKS

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