Write your name here

Surname	Other names

Pearson Edexcel International GCSE

Centre Number | | | | | |

Candidate Number | | | | |

Chemistry

Unit: 4CH0
Paper: 2CR

Tuesday 10 June 2014 – Afternoon
Time: 1 hour

Paper Reference
4CH0/2CR

You must have:
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.
- Keep an eye on the time.
- 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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P 4 3 5 3 1 A 0 1 2 0

PEARSON

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 Neon is an element with atomic number 10.

(a) Which sub-atomic particles are present in the nucleus of a neon atom?

(1)

- ☒ **A** electrons and neutrons
- ☒ **B** electrons and protons
- ☒ **C** electrons and neutrons and protons
- ☒ **D** neutrons and protons

(b) Use words from the box to complete the sentences about the particles in a neon atom.

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

(3)

electrons	neutrons	nuclei	protons

The particles with the smallest mass are .....

An atom of neon has no overall charge because it contains equal numbers

of ..... and .....

The chemical properties of neon depend on the number of

..... in the outer shell.

(c) What is the electronic configuration of a neon atom?

(1)

- ☒ **A** 2.8
- ☒ **B** 2.2.6
- ☒ **C** 2.8.8
- ☒ **D** 2.8.8.2

(d) Neon has two main isotopes that can be represented as ^{20}Ne and ^{22}Ne.

(i) Explain, with reference to sub-atomic particles, what is meant by the term **isotopes**.

(2)

(ii) The relative atomic mass of neon is 20.2

How does this information support the fact that a sample of neon contains more ^{20}Ne than ^{22}Ne?

(1)

(e) Neon belongs to the family of noble gases and is inert.

(i) What is meant by the term **inert**?

(1)

(ii) Why are noble gases inert?

(1)

(Total for Question 1 = 10 marks)

2 This question is about the reactions of some metals and their compounds.

(a) A student adds a sample of four metals R, S, T and U separately to water and to dilute sulfuric acid.

The table shows the observations in each experiment.

Metal	Observation with water	Observation with dilute sulfuric acid
R	no change	bubbles form slowly
S	bubbles form quickly	bubbles form very quickly
T	no change	no change
U	bubbles form slowly	bubbles form quickly

(i) State two properties of the metals that the student should keep the same in all of the experiments in order to compare their reactivity.

(2)

1 .....

.....

2 .....

.....

(ii) Which is the least reactive metal?

(1)

☒ **A** metal R

☒ **B** metal S

☒ **C** metal T

☒ **D** metal U

(iii) Which gas forms during the reactions with dilute sulfuric acid?

(1)

☒ **A** carbon dioxide

☒ **B** hydrogen

☒ **C** oxygen

☒ **D** sulfur dioxide

(b) The student carries out a test to show that the solution formed when metal U reacts with dilute sulfuric acid contains sulfate ions.

Use words from the box to complete the sentence about this test.

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

(2)

brown precipitate	solution of barium chloride	solution of silver nitrate
solution of sodium hydroxide	white precipitate	yellow precipitate

He adds a ..... and observes

the formation of a .....

(c) The student observes a lilac colour in a flame test on a small sample of a different metal compound.

Which metal ions cause the formation of this colour?

(1)

☒ **A** copper

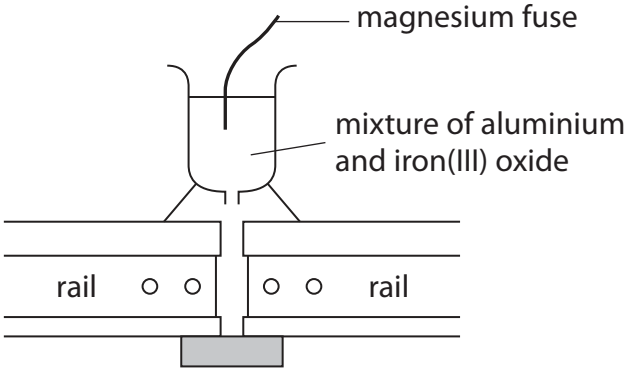
☒ **B** magnesium

☒ **C** potassium

☒ **D** zinc

(Total for Question 2 = 7 marks)

3 The thermite reaction is used on railways to produce molten iron for joining rails together. The diagram shows how this is done.



The equation for this thermite reaction is

$$2Al + Fe_2O_3 \rightarrow Al_2O_3 + 2Fe$$

(a) What does this reaction show about the reactivity of iron compared to the reactivity of aluminium?

(1)

.....

.....

(b) Why is this reaction described as displacement?

(1)

.....

.....

(c) State two reasons why the term oxidation applies to aluminium in this reaction.

(2)

1 .....

.....

2 .....

.....

(d) Although the thermite reaction is exothermic, it only begins after a lot of heat energy is supplied.

How is this heat energy supplied?

(1)

.....

.....

(Total for Question 3 = 5 marks)

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4 (a) Ethanol can be manufactured by two different processes.

Process 1 sucrose $\xrightarrow{\text{stage 1}}$ glucose $\xrightarrow{\text{stage 2}}$ ethanol

Process 2 ethene $\longrightarrow$ ethanol

(i) What is the general name for compounds such as sucrose and glucose?

(1)

.....

(ii) What type of reaction occurs in stage 2?

(1)

.....

(iii) What is the catalyst used in stage 2?

(1)

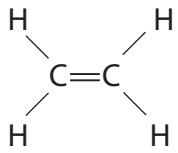
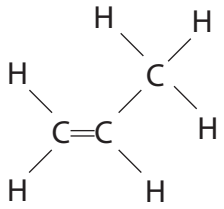
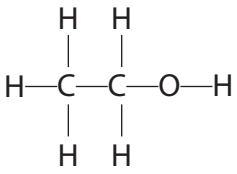
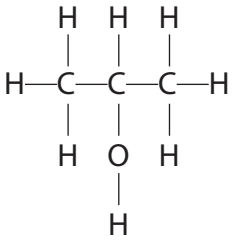
.....

(iv) What type of reaction occurs in process 2?

(1)

.....

(b) The table shows the displayed formulae of four organic compounds.

ethene	propene
	
ethanol	**compound D**
	

Ethanol and compound D are members of the homologous series of alcohols.

(i) The first member of this homologous series is methanol.

Draw the displayed formula of methanol.

(1)

(ii) Suggest the name of compound D.

(1)

.....

(c) In industry, the conversion of propene to compound D uses the same conditions as those used in the conversion of ethene to ethanol.

Identify a suitable catalyst and temperature for these conversions.

(2)

catalyst .....

temperature ..... °C

(d) Ethene and acetylene can both be used for welding metals.

The equations for the reactions of these gases in welding are

ethene $C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O$

acetylene $C_2H_2 + 2.5O_2 \rightarrow 2CO_2 + H_2O$

One problem with using hydrocarbons as fuels is incomplete combustion.

(i) Incomplete combustion is a bigger problem with ethene than with acetylene.

Suggest why.

(1)

.....

.....

.....

(ii) One of the gases produced during incomplete combustion is dangerous to humans.

Identify this gas and explain how it is dangerous.

(3)

.....

.....

.....

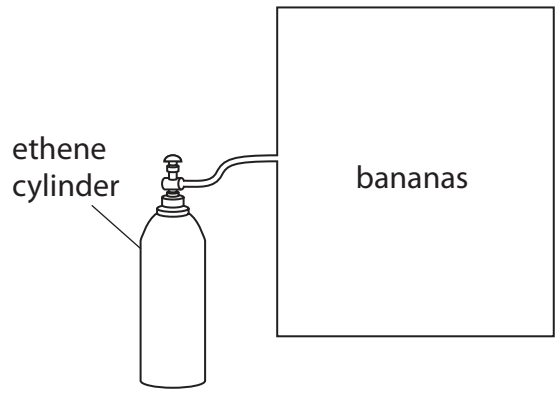
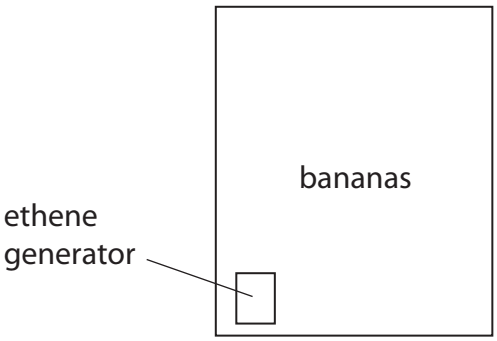
.....

.....

.....

(e) Ethene can be used to ripen bananas.

Bananas are placed in a large container and ethene is added. The ethene can be added in two different ways.

Method 1	Method 2
	

(i) In method 1, ethene is stored under pressure and passed through a pipe into the container.

Suggest one risk in using this method.

(1)

.....

.....

(ii) In method 2, the generator contains a known quantity of ethanol that is slowly decomposed to ethene using a catalyst.

Write a chemical equation for this decomposition.

(1)

.....

(Total for Question 4 = 14 marks)

5 Solutions of lead(II) nitrate and sodium sulfate react together to form the insoluble salt lead(II) sulfate.

(a) A student wrote this plan to prepare a pure dry sample of lead(II) sulfate.

step 1 pour some lead(II) nitrate solution into a beaker

step 2 add sodium sulfate solution until the reaction is complete

step 3 filter the mixture

step 4 heat the filtrate to evaporate some of the water

step 5 cool the filtrate and remove the crystals

(i) How will the student know when the reaction in step 2 is complete?

(1)

.....

.....

(ii) Which compound could the student use in this preparation instead of sodium sulfate?

(1)

☒ **A** lead(II) hydroxide

☒ **B** nitric acid

☒ **C** sodium hydroxide

☒ **D** sulfuric acid

(iii) State why the student should not have included steps 4 and 5 in his plan.

(1)

.....

.....

(iv) Suggest replacement steps to obtain a pure dry sample of lead(II) sulfate.

(2)

step 4 .....

.....

step 5 .....

.....

(v) Lead(II) carbonate cannot be used instead of lead(II) nitrate in this preparation.

This is because lead(II) carbonate

(1)

- ☒ **A** contains ionic bonding
- ☒ **B** has a high relative formula mass
- ☒ **C** is insoluble in water
- ☒ **D** is toxic

(b) The equation for the reaction in the student's plan is

$$Pb(NO_3)_2(aq) + Na_2SO_4(aq) \rightarrow PbSO_4(s) + 2NaNO_3(aq)$$

(i) Deduce the amount of each reactant needed to form 0.150 mol of lead(II) sulfate.

(1)

$Pb(NO_3)_2$ ..... mol

Na_2SO_4 ..... mol

(ii) What volume of 0.500 mol/dm^3 lead(II) nitrate solution is needed to form 0.150 mol of lead(II) sulfate?

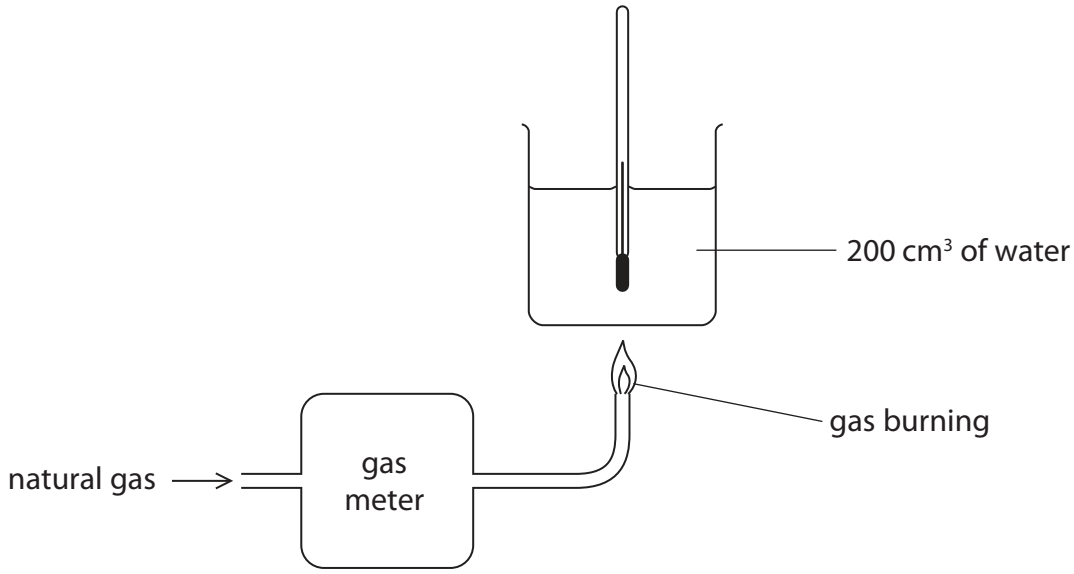
(2)

volume = ...

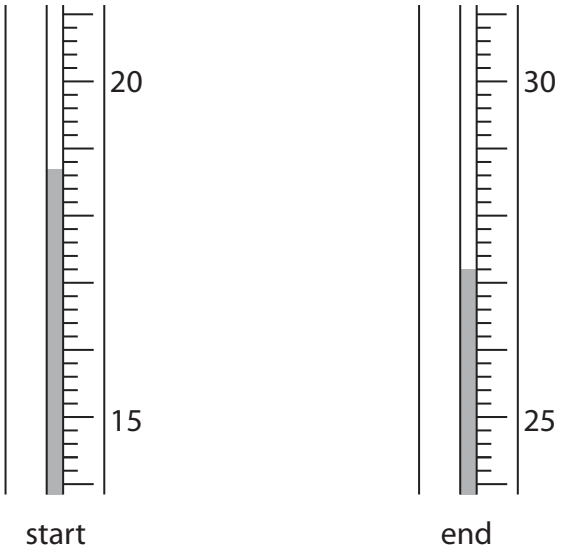
(Total for Question 5 = 9 marks)

6 A student does some experiments to find the heat energy released when natural gas burns.

She uses this apparatus.



(a) The diagram shows the thermometer readings in one of her experiments.



Use these readings to complete the table, entering all values to the nearest 0.1 °C.

(3)

temperature of water at start in °C	
temperature of water at end in °C	
temperature change in °C	

(b) The student repeats the experiment three times.

The table shows her results.

Experiment	Volume of gas burned in cm^3	Temperature rise of water in °C
1	1450	34.8
2	1875	41.2
3	1620	37.7

(i) Calculate the amount, in moles, at room temperature and pressure, of methane burned in experiment 1.

Assume that natural gas contains only methane.

(The volume of 1 mol of a gas at room temperature and pressure is 24 000 cm^3)

(2)

amount = ... mol

(ii) The quantity of heat energy released in experiment 1 is 29 200 J.

Calculate the molar enthalpy change, in kJ/mol, for the combustion of methane.

(2)

molar enthalpy change = ... kJ/mol

(iii) The temperature rise in experiment 2 is 41.2 °C.

Calculate the heat energy change in experiment 2 using the expression

heat energy change = volume of water × 4.2 × temperature change
(in J) (in cm^3) (in °C)

(2)

heat energy change = ... J

(iv) The student uses the results from experiment 3 to calculate the molar enthalpy change, in kJ/mol, for the combustion of methane.

She compares her value with the value in a data book.

student's value	$\Delta H = -510$ kJ/mol
data book value	$\Delta H = -890$ kJ/mol

Which is the best explanation for the large difference between these two values?

(1)

☒ **A** natural gas contains other gases that release heat energy when burned

☒ **B** not all of the heat energy is transferred to the water

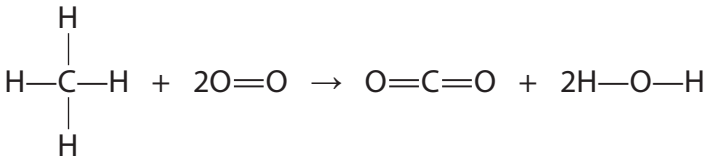
☒ **C** some of the water evaporates during the experiment

☒ **D** the student measures the gas by volume instead of by mass

(c) The student uses a table of average bond energies to calculate another value for the molar enthalpy of combustion of methane.

Bond	C—H	O═O	C═O	H—O
Average bond energy in kJ/mol	412	496	743	463

The equation for the combustion can be shown using displayed formulae.



(i) Use values from the table to calculate the energy taken in when the bonds in the reactants are broken.

(2)

energy taken in = ... kJ

(ii) Use values from the table to calculate the energy given out when the bonds in the products are formed.

(2)

energy given out = ... kJ

(iii) Use your answers to (i) and (ii) to calculate the molar enthalpy change for the combustion of methane.

(1)

molar enthalpy change = ... kJ/mol

(Total for Question 6 = 15 marks)

TOTAL FOR PAPER = 60 MARKS

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