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.*
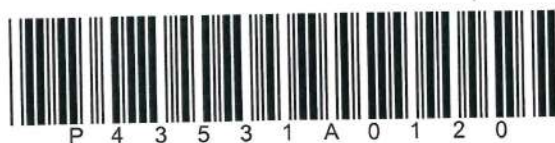
Advice

- 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 ▶

PEARSON

THE PERIODIC TABLE

Period / **Group**

| | 1 | 2 | | | | | | | | | | | | 3 | 4 | 5 | 6 | 7 | 0 |

Key

| Relative atomic mass |
| Symbol |
| Name |
| Atomic number |

| 1 |
| H |
| Hydrogen |
| 1 |

| 4 |
| He |
| Helium |
| 2 |

Period 2

7	9													11	12	14	16	19	20
Li	Be													B	C	N	O	F	Ne
Lithium 3	Beryllium 4													Boron 5	Carbon 6	Nitrogen 7	Oxygen 8	Fluorine 9	Neon 10

Period 3

23	24													27	28	31	32	35.5	40
Na	Mg													Al	Si	P	S	Cl	Ar
Sodium 11	Magnesium 12													Aluminium 13	Silicon 14	Phosphorus 15	Sulfur 16	Chlorine 17	Argon 18

Period 4

39	40	45	48	51	52	55	56	59	59	63.5	65	70	73	75	79	80	84
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Potassium 19	Calcium 20	Scandium 21	Titanium 22	Vanadium 23	Chromium 24	Manganese 25	Iron 26	Cobalt 27	Nickel 28	Copper 29	Zinc 30	Gallium 31	Germanium 32	Arsenic 33	Selenium 34	Bromine 35	Krypton 36

Period 5

86	88	89	91	93	96	99	101	103	106	108	112	115	119	122	128	127	131
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Rubidium 37	Strontium 38	Yttrium 39	Zirconium 40	Niobium 41	Molybdenum 42	Technetium 43	Ruthenium 44	Rhodium 45	Palladium 46	Silver 47	Cadmium 48	Indium 49	Tin 50	Antimony 51	Tellurium 52	Iodine 53	Xenon 54

Period 6

133	137	139	179	181	184	186	190	192	195	197	201	204	207	209	210	210	222
Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
Caesium 55	Barium 56	Lanthanum 57	Hafnium 72	Tantalum 73	Tungsten 74	Rhenium 75	Osmium 76	Iridium 77	Platinum 78	Gold 79	Mercury 80	Thallium 81	Lead 82	Bismuth 83	Polonium 84	Astatine 85	Radon 86

Period 7

223	226	227
Fr	Ra	Ac
Francium 87	Radium 88	Actinium 89

BLANK PAGE

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 .... *electrons* ....

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

of .... *protons* .... and .... *electrons* ....

The chemical properties of neon depend on the number of

.... *electrons* .... 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)

Same no. of protons different no. of neutrons

1.16

(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)

1.16

Ar closer to 20

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

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

(1)

1.24

Unreactive

(ii) Why are noble gases inert?

(1)

1.24

Do not easily lose/gain electrons OR 8 electrons in outer shell

(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 .... Amount ....

2 .... Surface area ....

(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

6

(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 _____Solution of barium chloride_____ and observes

the formation of a _____white precipitate_____

2.48

(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)

2.46

☐ **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.
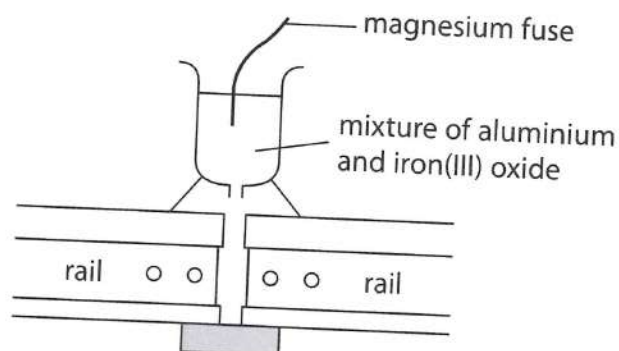
The equation for this thermite reaction is

$$2Al + Fe_2O_3 \rightarrow Al_2O_3 + 2Fe$$
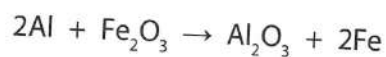
(a) What does this reaction show about the reactivity of iron compared to the reactivity of aluminium?

(1)

Iron less reactive than aluminium

(b) Why is this reaction described as displacement?

(1)

Aluminium ~~displaces~~ replaces Iron

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

ANY 2

(2)

1 • Gain of oxygen

2 • Loss of electrons

• Increase in oxidation no.

(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)

Magnesium reacting with oxygen/air

(Total for Question 3 = 5 marks)

8

BLANK PAGE

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

4.32C
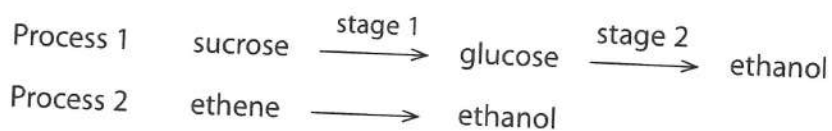
(i) What is the general name for compounds such as sucrose and glucose?

(1)

Sugar

4.32C

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

(1)

fermentation

4.32C

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

(1)

Zymase

4.32C

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

(1)

Hydration

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

ethene	propene
H—C=C—H (with H atoms above and below each carbon)	H—C=C—C(H₃) structure with H atoms

ethanol	compound D
H—C—C—O—H (with H atoms)	H—C—C—C—H with O—H below middle carbon

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)

4.30C

H — C — O — H (with H above and H below the carbon)
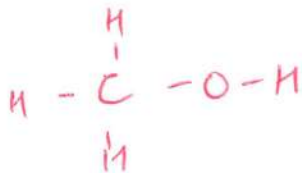
(ii) Suggest the name of compound D.

(1)

4.30C

Propan-2-ol

(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)

4.32C

catalyst .... Phosphoric acid ....

temperature .... 300 .... °C
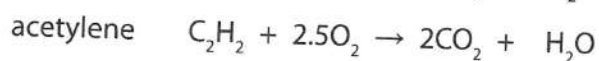
P 4 3 5 3 1 A 0 1 1 2 0

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

The equations for the reactions of these gases in welding are

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

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

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)

Needs more oxygen

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

Identify this gas and explain how it is dangerous.

(3)

CO, it is poisonous, reduces capacity of blood to transport oxygen

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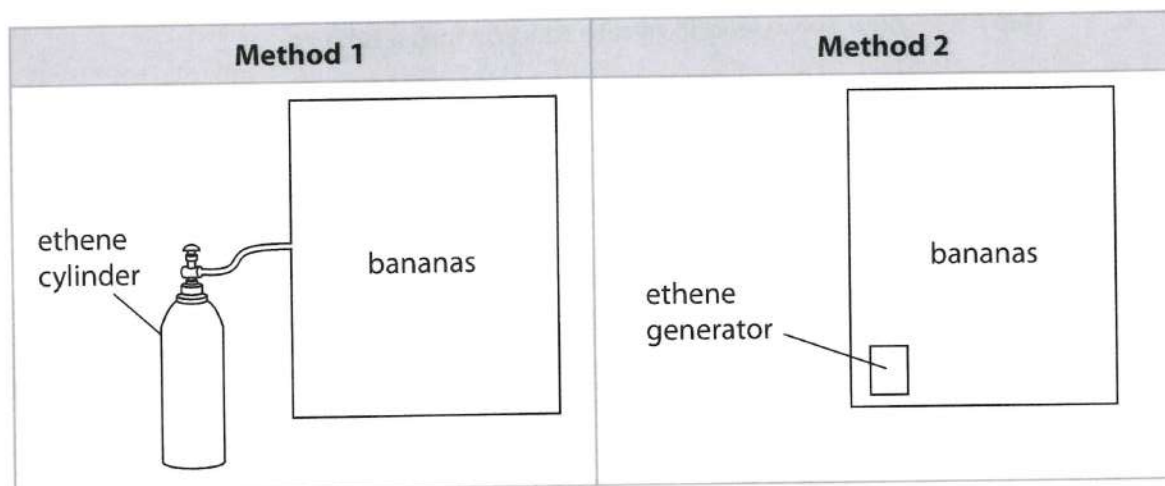
(i) In method 1, ethene is stored under pressure and passed through a pipe into the container.

Suggest one risk in using this method.

(1)

May explode / gas leak

(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)

$C_2H_5OH \rightarrow C_2H_4 + H_2O$

(Total for Question 4 = 14 marks)

P 4 3 5 3 1 A 0 1 3 2 0

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)

NO more ppt forms

(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)

Obtain Sodium nitrate instead / lead (II) Sulfate already obtained in step 3

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

(2)

step 4   Wash water over the solid

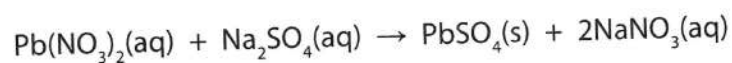step 5   Leave to dry in a warm place

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

This is because lead(II) carbonate

(1)

2.34

☐ **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)

1.28

$Pb(NO_3)_2$ .... 0.150 .... mol

Na_2SO_4 .... 0.150 .... mol

(ii) What volume of 0.500 mol/dm³ lead(II) nitrate solution is needed to form 0.150 mol of lead(II) sulfate?

(2)

1.34C

$$v = \frac{0.15}{0.5}$$
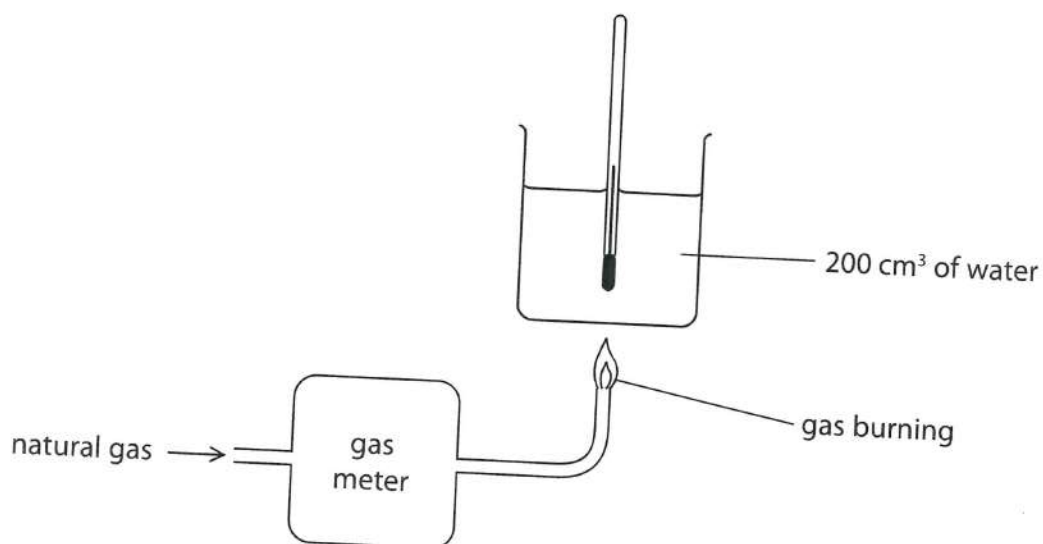
$$= 0.30 dm^3$$

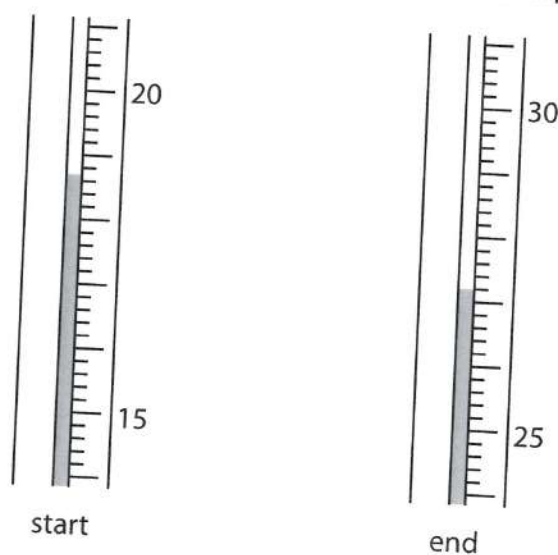volume = ... 0.30 dm³ ....

(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.

200 cm³ of water

gas burning

natural gas →

gas meter

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

start   end

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

(3)

temperature of water at start in °C	18.7
temperature of water at end in °C	27.2
temperature change in °C	8.5

3.08

(b) The student repeats the experiment three times.

The table shows her results.

Experiment	Volume of gas burned in cm³	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 cm³)

(2)

1.35C

$$n(CH_4) = \frac{1450}{24000}$$

$$= 0.0604$$

amount = 0.0604 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)

3.04

$$\Delta H = - \frac{29200}{0.0604 \times 1000}$$

$$= -483 \, kJ/mol$$

molar enthalpy change = (-) 483 kJ/mol

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

3.03

Calculate the heat energy change in experiment 2 using the expression

heat energy change = volume of water × 4.2 × temperature change
(in J)   (in cm³)   (in °C)

(2)

$$Q = 200 \times 4.2 \times 41.2$$

$$= 34608$$

heat energy change = 34608 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.

$$\underset{\underset{H}{|}}{\overset{\overset{H}{|}}{H-C-H}} + 2O=O \rightarrow O=C=O + 2H-O-H$$
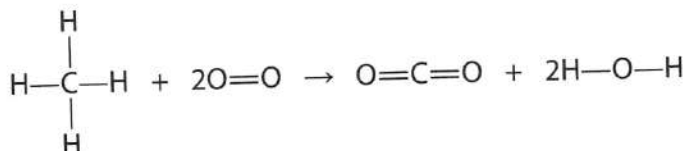
(i) Use values from the table to calculate the energy taken in when the bonds in the reactants are broken.

(2)

$= (4 \times 412) + 2(496)$

$= 2640$

energy taken in = 2640 kJ

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

(2)

$= 2(743) + 4(463)$

$= 3338$

energy given out = ... kJ

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

(1)

$= 2640 - 3338$

$= -698$

molar enthalpy change = −698 kJ/mol

(Total for Question 6 = 15 marks)

TOTAL FOR PAPER = 60 MARKS

3.07C

BLANK PAGE