Pearson Edexcel Certificate

Pearson Edexcel International GCSE

Centre Number

Candidate Number

Chemistry

Unit: KCH0/4CH0
Science (Double Award) KSC0/4SC0
Paper: 1C

Monday 18 January 2016 – Afternoon
Time: 2 hours

Paper Reference
KCH0/1C 4CH0/1C
KSC0/1C 4SC0/1C

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 120.
- 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 ▶

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

P 4 6 8 1 4 A 0 2 3 2

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Answer ALL questions.

1 Use the the Periodic Table on page 2 to answer this question.

(a) (i) The symbol for silver is

(1)

☒ **A** Ag ☒ **B** As ☒ **C** S ☒ **D** Si

(ii) The element with an atomic number of 40 is

(1)

☒ **A** Al ☒ **B** Ar ☒ **C** Ca ☒ **D** Zr

(b) An atom of an element has the electronic configuration 2.8.3

(i) State the number of the group in the Periodic Table in which this element is found.

(1)

....

(ii) Explain your answer in terms of the atom's electronic configuration.

(1)

....

....

(iii) State the number of the period in the Periodic Table in which this element is found.

(1)

....

(iv) Explain your answer in terms of the atom's electronic configuration.

(1)

....

....

(v) Identify the element.

(1)

....

(c) Complete the diagram to show the electronic configuration of an atom of fluorine, using x to represent an electron.
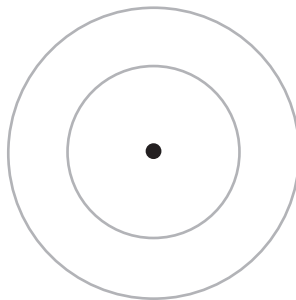
(Total for Question 1 = 8 marks)

2 Bromine is an element in Group 7 of the Periodic Table.

(a) What is the name given to the Group 7 elements?

(1)

☒ **A** alkali metals   ☒ **B** alkaline earth metals   ☒ **C** halogens   ☒ **D** noble gases

(b) The symbols of two isotopes of bromine are $^{79}_{35}Br$ and $^{81}_{35}Br$.

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

(2)

....

....

....

....

(ii) Complete the table to show the number of protons, neutrons and electrons in one atom of $^{79}_{35}Br$ and in one atom of $^{81}_{35}Br$.

(3)

Isotope	Number of protons	Number of neutrons	Number of electrons
$^{79}_{35}Br$			
$^{81}_{35}Br$			

(c) Bromine water can be used to distinguish between ethane and ethene.

$$H-\underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C}}-\underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C}}-H \qquad \underset{H}{\overset{H}{>}}C=C\underset{H}{\overset{H}{<}}$$
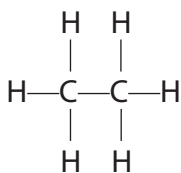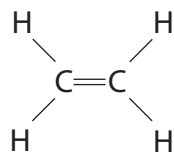
ethane   ethene

Describe what you would observe when orange bromine water is added separately to ethane and ethene, in the absence of UV light.

(2)

observation with ethane..

observation with ethene..

(Total for Question 2 = 8 marks)

3 The table shows the percentage composition of the mixture of gases in the exhaust fumes of a car.

Name of gas	Percentage of the gas in the exhaust fumes
carbon dioxide	14.0
carbon monoxide	2.0
hydrocarbons	0.3
nitrogen oxides	0.2
sulfur dioxide	trace amounts
water vapour	12.0
gas Z	71.5

(a) Identify gas Z.

(1)

....

(b) The carbon dioxide is produced from the combustion of hydrocarbons such as octane.

Complete the word equation for the complete combustion of octane.

(1)

octane + ... → carbon dioxide + ...

(c) How is the carbon monoxide in the exhaust fumes produced?

(1)

....

....

(d) (i) Write a chemical equation to show how nitrogen dioxide (NO_2) is produced in a car engine.

(1)

....

(ii) State one problem caused by nitrogen dioxide in the atmosphere.

(1)

....

(Total for Question 3 = 5 marks)

4 A sample of air is passed through the apparatus shown in the diagram.
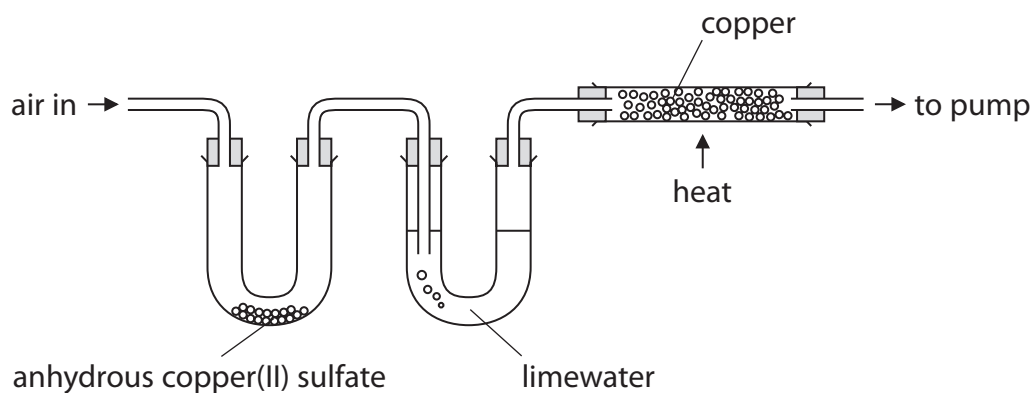
The anhydrous copper(II) sulfate turns from white to blue.

The limewater turns milky.

The copper turns black.

(a) Name the substance that turns anhydrous copper(II) sulfate blue.

(1)

....

(b) Name the substance that reacts with limewater to make it turn milky.

(1)

....

(c) Explain why the copper turns black.

(2)

....

....

....

....

(Total for Question 4 = 4 marks)

5 A student carries out an investigation into the reaction between magnesium carbonate and dilute sulfuric acid. He uses this apparatus.
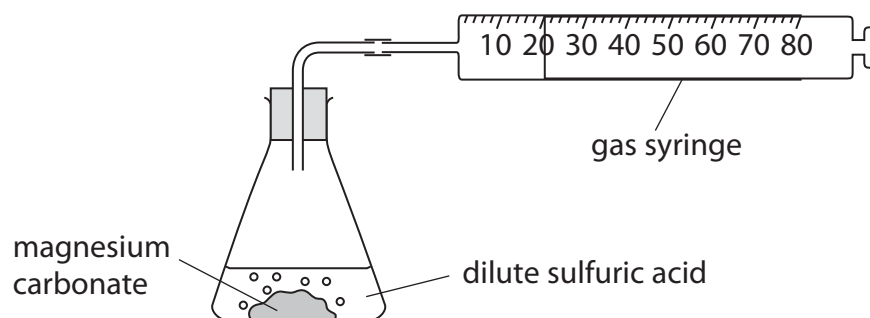
The student carries out seven experiments. In each experiment he uses the same mass of magnesium carbonate but a different volume of acid. He measures the total volume of carbon dioxide collected in each experiment. The table shows his results.

Volume of sulfuric acid used in cm³	0	5	15	20	25	30	35	40
Volume of carbon dioxide collected in cm³	0	16	47	61	64	78	80	80

(a) Plot the results on the grid and draw a curve of best fit.

(3)

Volume of carbon dioxide in cm³

Volume of sulfuric acid in cm³

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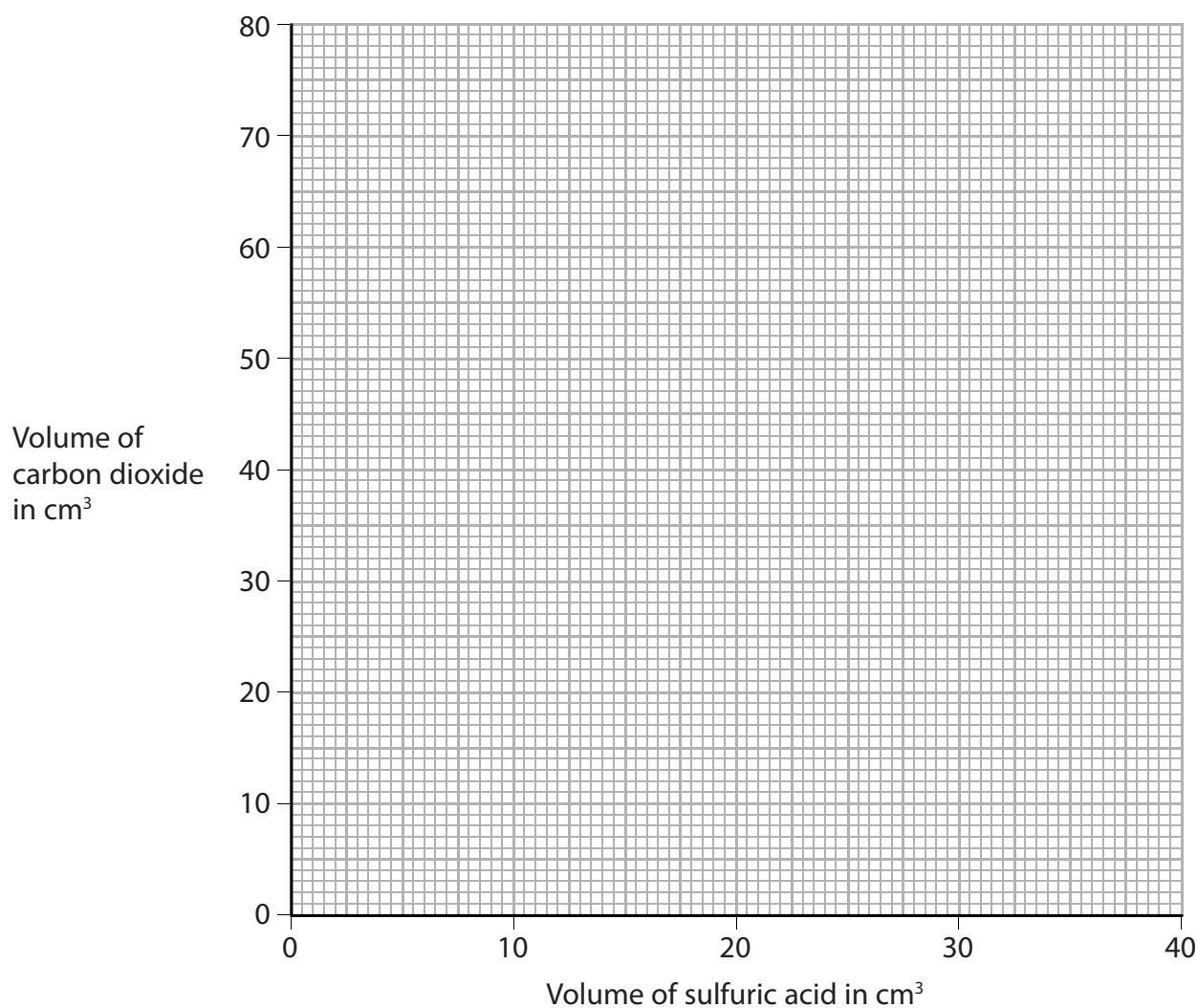
(b) (i) Which volume of sulfuric acid produces an anomalous result?

(1)

....

(ii) Explain what the results with 35 cm^3 and 40 cm^3 of sulfuric acid indicate about the reaction.

(2)

....

....

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....

(iii) Use the graph to find the volume of carbon dioxide that would be collected if 10 cm^3 of acid were used.

(1)

volume of carbon dioxide = ... cm^3

(iv) Use the graph to find the volume of sulfuric acid that would result in 55 cm^3 of carbon dioxide being collected.

(1)

volume of sulfuric acid = ... cm^3

(Total for Question 5 = 8 marks)

6 In 1774, the scientist Joseph Priestley produced oxygen by heating mercury(II) oxide, (HgO). When heated, mercury(II) oxide breaks down into its elements.

(a) (i) Write a chemical equation for the breakdown of mercury(II) oxide into its elements.

(1)

....

(ii) What name is given to this type of reaction?

(1)

....

(b) Priestley's method of producing oxygen is no longer used because of the high toxicity of mercury and mercury compounds.

A student prepares oxygen by adding hydrogen peroxide solution to solid manganese(IV) oxide.

The diagram shows the apparatus used.

The equation for the reaction is

$$2H_2O_2(aq) \rightarrow 2H_2O(l) + O_2(g)$$
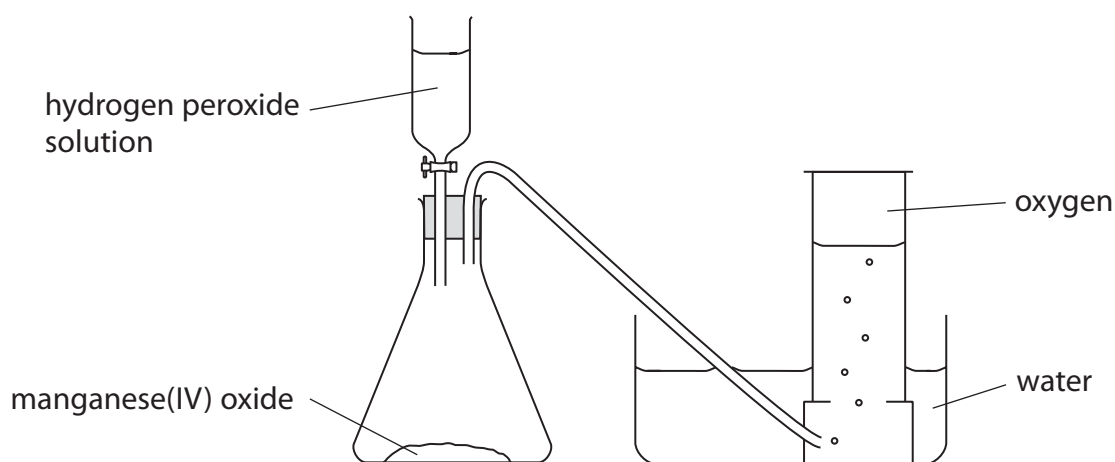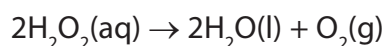
(i) Give the name of the apparatus that contains the hydrogen peroxide solution.

(1)

....

(ii) Suggest how the first sample of gas collected may be different from the samples collected later.

(1)

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....

....

(c) A catalyst increases the rate of decomposition of the hydrogen peroxide.

Describe a method you could use to show that the manganese(IV) oxide is acting as a catalyst in this reaction.

(4)

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(d) Sulfur burns in oxygen to produce sulfur dioxide (SO_2).

Sulfur dioxide is very soluble in water.

(i) Write a chemical equation for the reaction that takes place when sulfur dioxide dissolves in water.

(1)

....

(ii) Universal indicator is added to the solution formed in (d)(i).

Explain the effect that the solution has on the universal indicator.

(2)

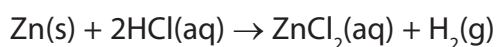..

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(Total for Question 6 = 11 marks)

7 Zinc is added to dilute hydrochloric acid. The equation for the reaction is
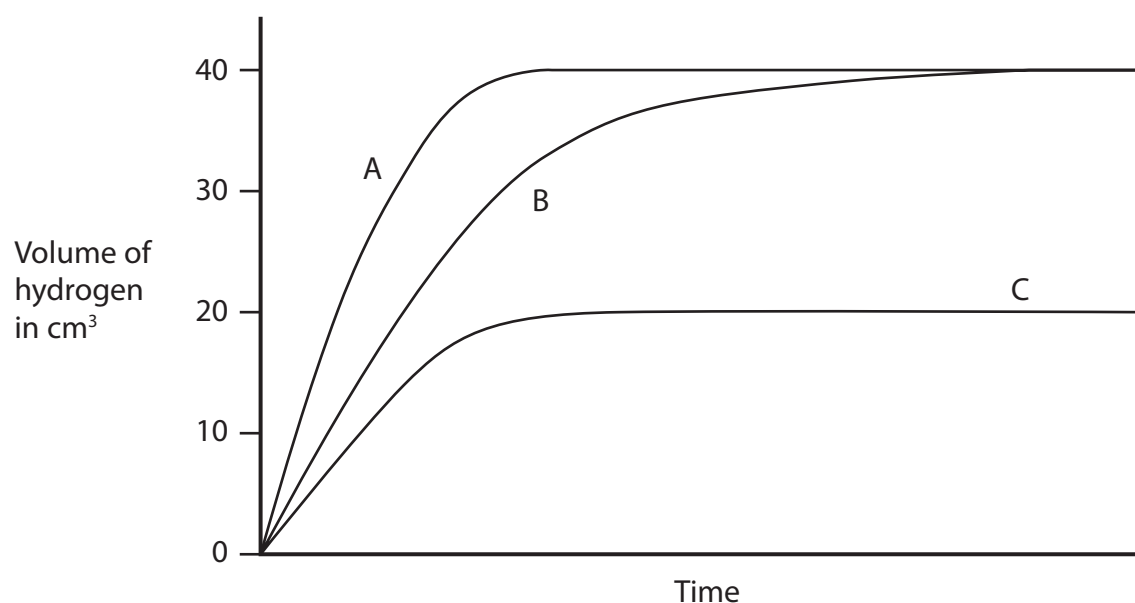
$$Zn(s) + 2HCl(aq) \rightarrow ZnCl_2(aq) + H_2(g)$$

An experiment is carried out using

- 0.12 g of powdered zinc
- an excess of 0.2 mol/dm³ hydrochloric acid
- a temperature of 20 °C

The volume of hydrogen collected in the experiment is measured at regular time intervals.

Curve B shows the results obtained.

(a) The experiment is repeated using

- 0.12 g of powdered zinc
- an excess of 0.2 mol/dm³ hydrochloric acid
- a temperature of 40 °C

Explain which curve, A, B or C, shows the results obtained.

(3)

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(b) The experiment is repeated again, using

- 0.06 g of powdered zinc
- an excess of 0.2 mol/dm^3 hydrochloric acid
- a temperature of 20 °C

Explain which curve, A, B or C, shows the results obtained.

(3)

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....

(Total for Question 7 = 6 marks)

8 Three aqueous solutions are sodium chloride, sodium iodide and silver nitrate. They are in containers labelled X, Y and Z. It is not known which solution is in each container.

The solutions are mixed together as shown in the table, and the observations recorded.

Experiment	Observation
solution X added to solution Y	yellow precipitate formed
solution X added to solution Z	no change
solution Y added to solution Z	white precipitate formed

(a) Explain how the results show that Y is aqueous silver nitrate.

(1)

....

....

(b) Explain how the results can be used to identify both X and Z.

(2)

....

....

....

....

....

(c) Aqueous chlorine is added to separate aqueous solutions of sodium chloride and sodium iodide.

Explain how the observations made can be used to distinguish between sodium chloride and sodium iodide.

(2)

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(Total for Question 8 = 5 marks)

9 Iron is extracted from its ore using a blast furnace.
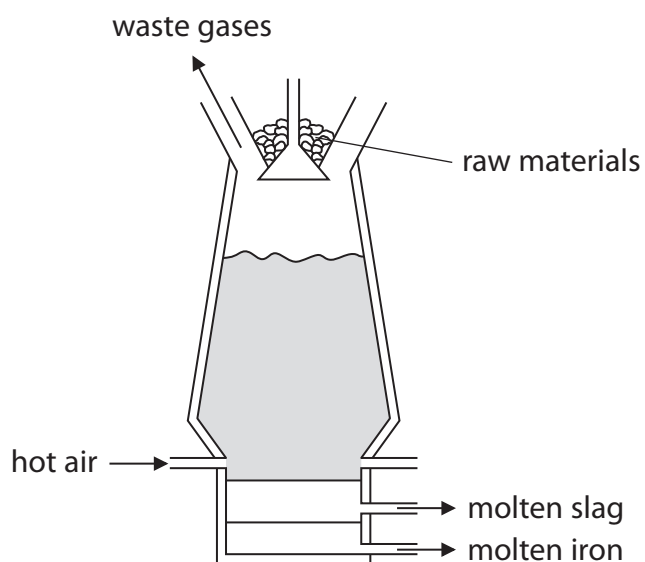
(a) The iron ore is mixed with two other raw materials and put into the top of the furnace.

Give the names of the two other raw materials.

(2)

1 ....

2 ....

(b) The most common ore used is haematite, which contains iron(III) oxide, Fe_2O_3

The oxide is converted into iron by reaction with carbon monoxide, CO

(i) Write a chemical equation for the reaction between iron(III) oxide and carbon monoxide.

(2)

....

(ii) Explain which element is reduced in this reaction.

(2)

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....

(c) The iron from the blast furnace contains about 10% by mass of impurities.

Two of the impurities are carbon and silicon.

The diagram shows a method of decreasing the amounts of carbon and silicon in the iron.

oxygen and
powdered calcium oxide

molten slag

molten iron from
the blast furnace
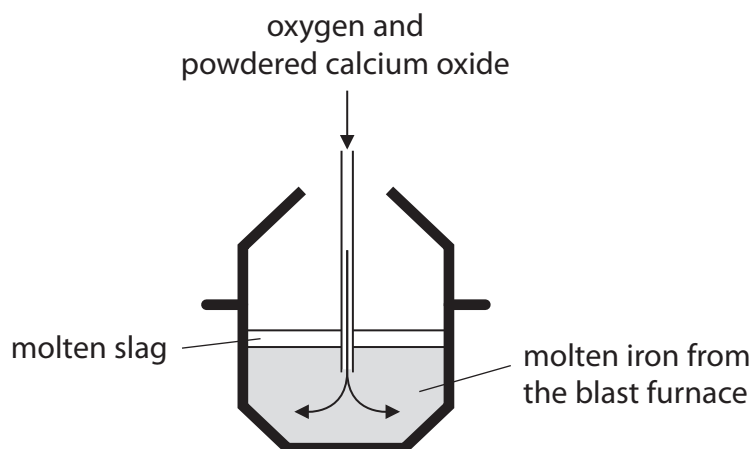
The oxygen converts carbon and silicon into their oxides.

The carbon dioxide escapes as a gas. Silicon dioxide reacts with the calcium oxide to form molten slag.

(i) Write a chemical equation for the reaction between carbon and oxygen to form carbon dioxide.

(1)

....

(ii) The equation for the reaction between silicon dioxide and calcium oxide to form slag is

$$SiO_2(s) + CaO(s) \rightarrow CaSiO_3(l)$$
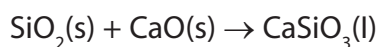
What type of reaction is this?

(1)

⊠ **A** combustion

⊠ **B** decomposition

⊠ **C** neutralisation

⊠ **D** redox

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P 4 6 8 1 4 A 0 1 8 3 2

(d) One problem with using iron is rusting.

(i) Name the two substances that must be present for iron to rust.

(2)

1 ....

2 ....

(ii) One method of preventing iron from rusting is to paint it.

State how this method of rust prevention works.

(1)

....

....

(e) Iron can also be protected from rusting by coating it with zinc.

(i) Give the name of this type of protection.

(1)

....

(ii) Explain how this method of protection works, even when the surface of the zinc is scratched to expose the iron underneath.

(2)

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(f) Aluminium is extracted from its oxide using electrolysis.

(i) Why is aluminium **not** extracted by heating its oxide with carbon monoxide?

(1)

....

....

(ii) Why is iron **not** extracted from its oxide using electrolysis?

(1)

....

....

(Total for Question 9 = 16 marks)

10 Alkenes are unsaturated hydrocarbons.

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

(1)

....

....

(b) One method of producing alkenes is by cracking alkanes.

(i) Complete the equation for the cracking of decane into octane (C_8H_{18}) and ethene.

(1)

$$C_{10}H_{22} \rightarrow \text{.....................................} + \text{.....................................}$$
decane

(ii) State two conditions used for cracking alkanes in industry.

(2)

....

....

....

....

(c) The diagram shows two alkenes that are isomers of each other.

(i) Explain why these two compounds are isomers.

(2)

....

....

....

....

(ii) Draw a diagram to show the structure of an alkene that is another isomer of these two compounds.

(1)

(d) The structure of propene is

$$CH_3 \quad\quad H$$
$$C = C$$
$$H \quad\quad\quad H$$
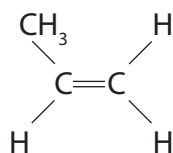
Propene can be polymerised.

(i) Give the name of the polymer formed from propene.

(1)

(ii) Draw the repeat unit for this polymer.

(2)

(e) The repeat unit of an addition polymer used in a type of glue is shown in the diagram.

$$H \quad\ COOCH_3$$
$$| \quad\quad |$$
$$-C-C-$$
$$| \quad\quad |$$
$$H \quad\ CN$$
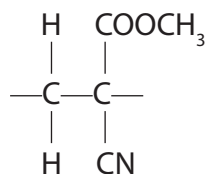
Draw the structure of the monomer used to make this polymer.

(1)

(Total for Question 10 = 11 marks)

11 The apparatus shown in the diagram can be used to investigate the colours of the cobalt(II) ion (Co^{2+}) and the chromate ion (CrO_4^{2-}) in cobalt(II) chromate.

power supply

electrode A

electrode B

water

cobalt(II) chromate solution
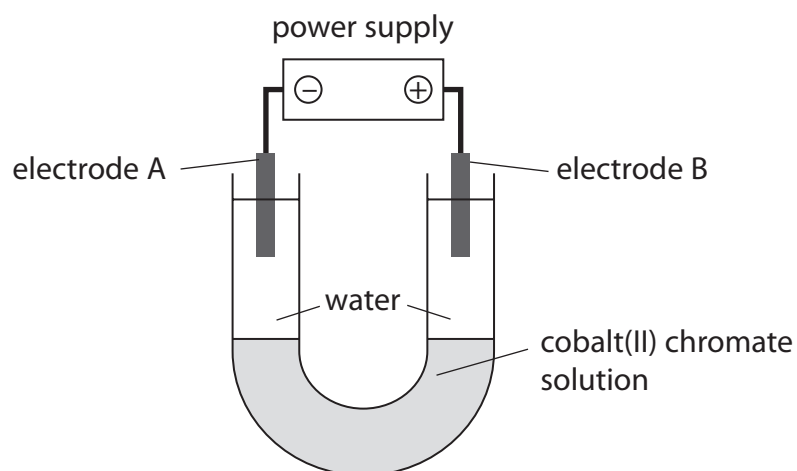
These are the results of the experiment.

• a pink colour moves towards electrode A

• a yellow colour moves towards electrode B

(a) Explain how the results show that the chromate ion is yellow.

(2)

....

....

....

....

(b) (i) Chromate ions in aqueous solution can be converted into dichromate ions ($Cr_2O_7^{2-}$) by the addition of hydrogen ions.

Balance the equation that represents this reaction.

(1)

...............$CrO_4^{2-}(aq)$ + ...$H^+(aq)$ → ....$Cr_2O_7^{2-}(aq)$ + ...$H_2O(l)$
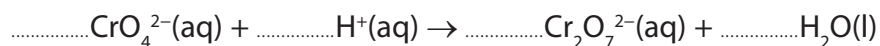
(ii) Which solution is a source of hydrogen ions for this reaction?

(1)

☒ **A** $H_2O_2(aq)$

☒ **B** $HCl(aq)$

☒ **C** $NaOH(aq)$

☒ **D** $NH_3(aq)$

(c) When aqueous potassium chromate is added to aqueous lead(II) nitrate, a bright yellow precipitate is formed.

(i) Complete the equation for the reaction by inserting the missing state symbols.

$$K_2CrO_4(\text{..............}) + Pb(NO_3)_2(\text{..............}) \rightarrow 2KNO_3(aq) + PbCrO_4(\text{..............})$$

(1)
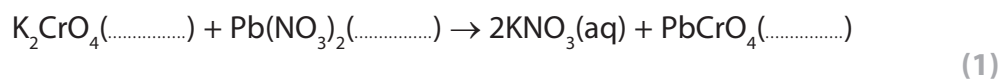
(ii) Describe how you could obtain a pure, dry sample of the insoluble solid from the final reaction mixture.

(3)

....

....

....

....

....

....

....

(Total for Question 11 = 8 marks)

Turn over ▶

12 A student uses this apparatus to determine the volume of one mole of carbon dioxide gas.

delivery tube
bung
250 cm³ measuring cylinder
water
dilute nitric acid
sodium carbonate
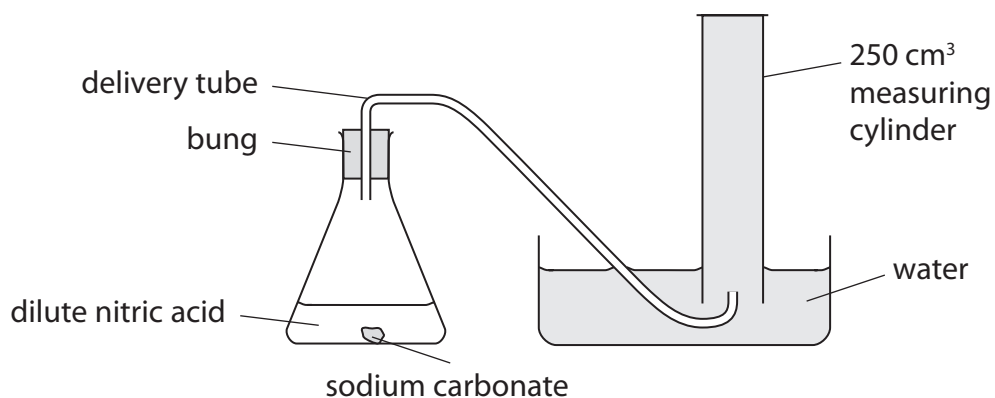
This is the student's method.

● a solid lump of sodium carbonate of mass 0.53 g is placed into the conical flask
● an excess of dilute nitric acid is added and the bung is put in place
● when all of the sodium carbonate has reacted, the volume of carbon dioxide collected is measured

The equation for the reaction is

$$Na_2CO_3 + 2HNO_3 \rightarrow 2NaNO_3 + H_2O + CO_2$$
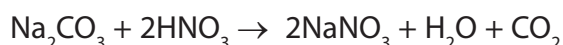
(a) (i) Calculate the amount, in moles, of sodium carbonate that reacts.
[M_r: $Na_2CO_3 = 106$]

(2)

amount of sodium carbonate = ... mol

(ii) The volume of carbon dioxide collected is 110 cm³.

Use this information and your answer to (a)(i) to calculate the volume, in cm³, of one mole of carbon dioxide.

(2)

volume of one mole of carbon dioxide = ... cm³

(b) The correct value for the volume of one mole of carbon dioxide, under the conditions used in the experiment, is 24000 cm^3.

Suggest two reasons why the volume calculated from the experiment is less than the correct value.

(2)

1 ....

....

....

2 ....

....

....

(Total for Question 12 = 6 marks)

13 This question is about different metals.

The list shows part of the reactivity series of metals.

potassium   most reactive
sodium
magnesium
zinc
iron
lead
copper   least reactive

(a) Name a metal from the list that is extracted by electrolysis.

(1)

....

(b) Uranium is a metal that is in between magnesium and zinc in the reactivity series.

Equal sized pieces of these three metals are placed in separate solutions of dilute hydrochloric acid of the same concentration and at the same temperature.

The observations for magnesium and zinc are shown in the table.

Complete the table by stating the observations that would be made for uranium.

(2)

Metal	Observations
magnesium	Bubbles of gas produced very rapidly. Solid disappears very quickly.
zinc	Bubbles of gas produced slowly. Solid disappears slowly.
uranium	

(c) (i) Metals high in the reactivity series react readily with water.

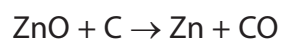Name the compound formed when potassium reacts with water.

(1)

....

(ii) Give the formula of the compound formed when magnesium reacts with steam.

(1)

....

(d) Zinc can be extracted by heating zinc oxide with carbon.

The equation for the reaction is

$$ZnO + C \rightarrow Zn + CO$$

(i) Explain whether zinc or carbon is the more reactive element.

(1)

....

....

....

(ii) Explain which element is acting as a reducing agent in this reaction.

(2)

....

....

....

....

(Total for Question 13 = 8 marks)

14 Nitrogen dioxide (NO_2) and dinitrogen tetraoxide (N_2O_4) exist together in equilibrium.

$$2NO_2(g) \rightleftharpoons N_2O_4(g)$$
$$\text{brown} \qquad \text{colourless}$$
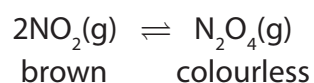
(a) The gas syringe contains a sample of an equilibrium mixture of the two gases.
The mixture is brown in colour.
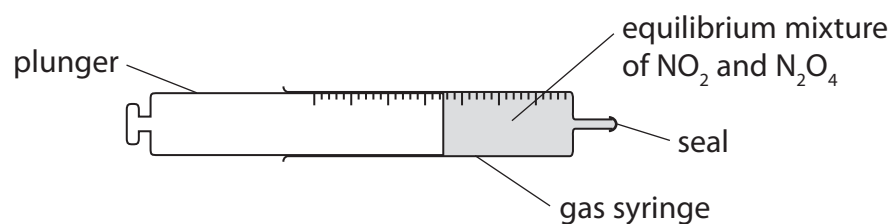
The plunger is pulled out to reduce the pressure of the gaseous mixture.
When the equilibrium is reached the mixture is darker in colour.

Explain this observation.

(3)

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P 4 6 8 1 4 A 0 2 8 3 2

(b) (i) A sealed tube containing an equilibrium mixture of NO_2 and N_2O_4 at room temperature is plunged into water at 0°C. The colour of the mixture changes from brown to pale yellow.

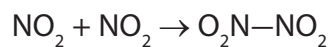Explain whether the forward reaction is exothermic or endothermic.

(2)

....

....

....

....

(ii) In the forward reaction, a bond is formed between the two nitrogen dioxide molecules.
$$NO_2 + NO_2 \rightarrow O_2N{-}NO_2$$

Explain whether this information supports your answer in (b)(i).

(1)

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....

....

(Total for Question 14 = 6 marks)

15 Lithium and magnesium both react with nitrogen.

The chemical equation for the reaction between lithium and nitrogen is

$$6Li + N_2 \rightarrow 2Li_3N$$
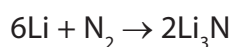
(a) Write the chemical equation for the reaction between magnesium and nitrogen.

(2)

....

(b) The equation for the reaction between lithium nitride and water is

$$Li_3N(s) + 3H_2O(l) \rightarrow 3LiOH(aq) + NH_3(g)$$
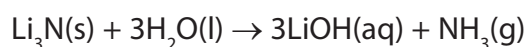
(i) Describe a chemical test to show that the gas given off is ammonia.

(2)

....

....

....

....

(ii) A sample of 1.40 g of lithium nitride is added to an excess of water.

Calculate the amount, in moles, of Li_3N in the sample of lithium nitride.

(2)

amount of Li_3N = ... mol

(iii) Calculate the amount, in moles, of LiOH in the lithium hydroxide formed.

(1)

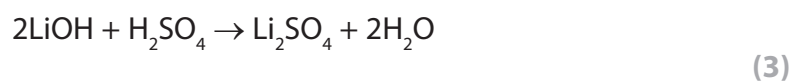amount of LiOH = ... mol

(iv) Calculate the volume of 0.500 mol/dm^3 sulfuric acid required to neutralise exactly the amount of lithium hydroxide calculated in (b)(ii).

Give an appropriate unit.

The equation for the reaction is

$$2LiOH + H_2SO_4 \rightarrow Li_2SO_4 + 2H_2O$$

(3)

volume of sulfuric acid = ... unit ....

(Total for Question 15 = 10 marks)

TOTAL FOR PAPER = 120 MARKS

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