Write your name here

Surname	Other names

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 ▶

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PEARSON

THE PERIODIC TABLE

Period	1	2											3	4	5	6	7	0
	Group																	
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 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)

3

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

(1)

3 electrons in its outer shell

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

(1)

3

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

(1)

Atom has 3 shells

(v) Identify the element.

(1)

Al

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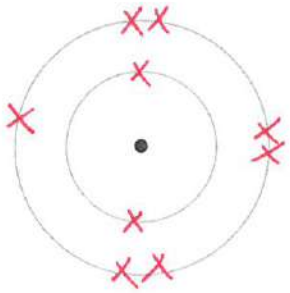
(c) Complete the diagram to show the electronic configuration of an atom of fluorine, using x to represent an electron.

(1)



(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)

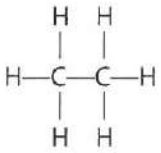
Atoms of the same element with a different number of neutrons

(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 $^{81}_{35}Br$.

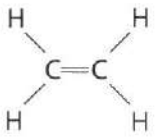
(3)

Isotope	Number of protons	Number of neutrons	Number of electrons
$^{79}_{35}Br$	35	44	35
$^{81}_{35}Br$	35	46	35

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



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 No change

observation with ethene Orange → colourless

(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)

N_2

(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 + oxygen → carbon dioxide + water

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

(1)

incomplete combustion

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

(1)

$N_2 + O_2 \longrightarrow 2NO_2$

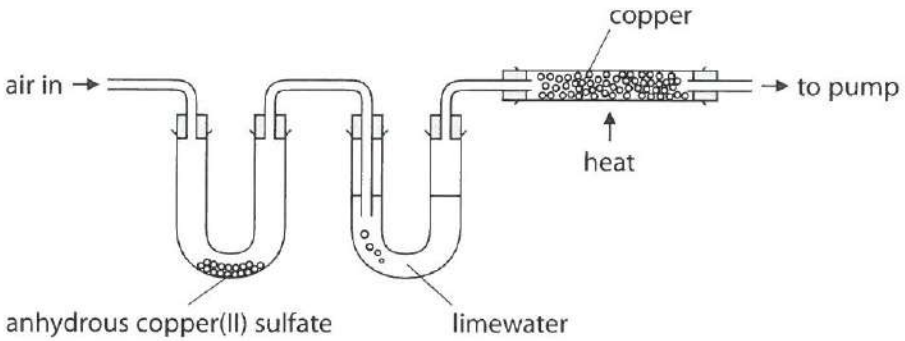
(ii) State one problem caused by nitrogen dioxide in the atmosphere.

(1)

Acid rain.

(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)

water

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

(1)

carbon dioxide

(c) Explain why the copper turns black.

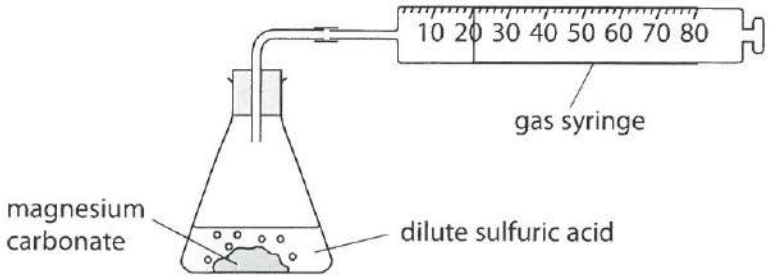
(2)

· Copper reacts with oxygen

· form copper oxide which is black

(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.

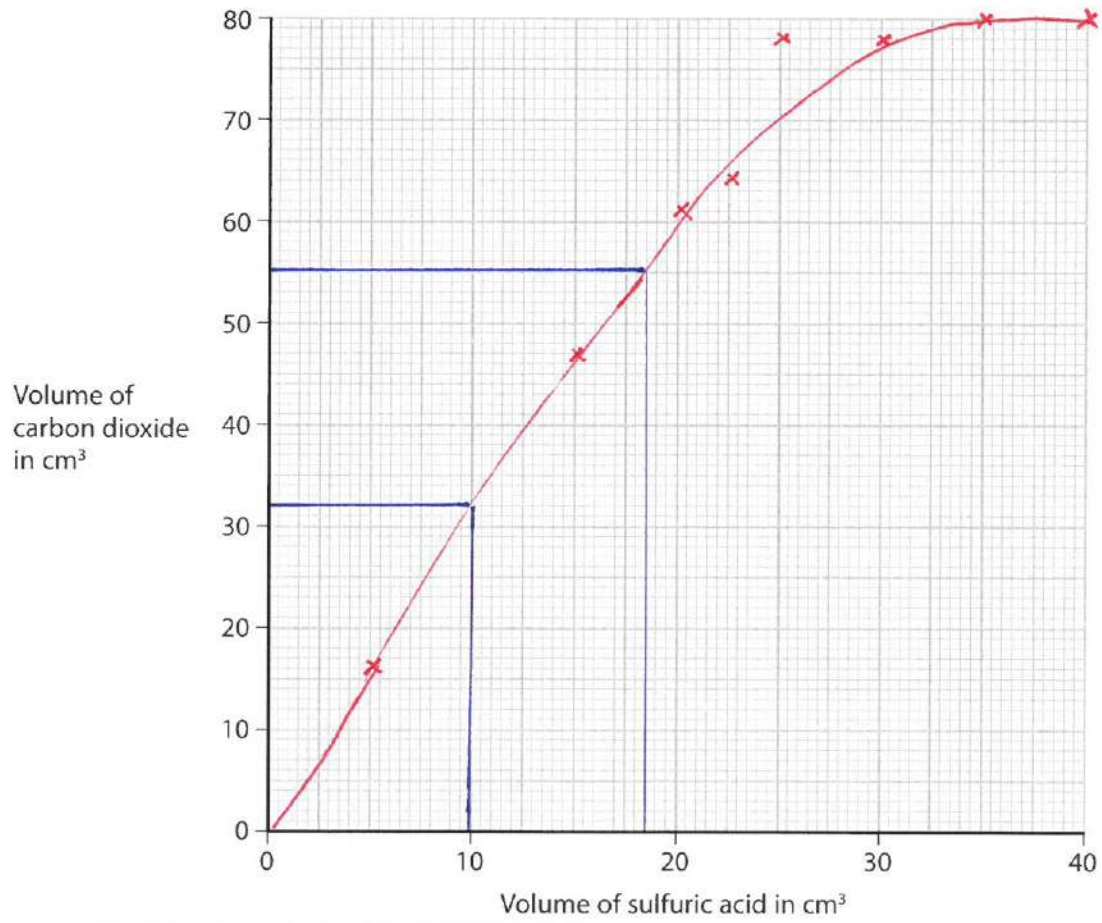


The student carries out seven experiments. In each experiment he uses the same mass of magnesium carbonate but a different volume of acid. He measures the total volume of carbon dioxide collected in each experiment. The table shows his results.

Volume of sulfuric acid used in cm^3	0	5	15	20	25	30	35	40
Volume of carbon dioxide collected in cm^3	0	16	47	61	64	78	80	80

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

(3)



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

(1)

25 cm^3

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

(2)

· The volumes of gas are the same
· Therefore the reaction has finished

(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 = 32 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 = 18.5 cm^3

(Total for Question 5 = 8 marks)

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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)

$2HgO \rightarrow Hg + O_2$

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

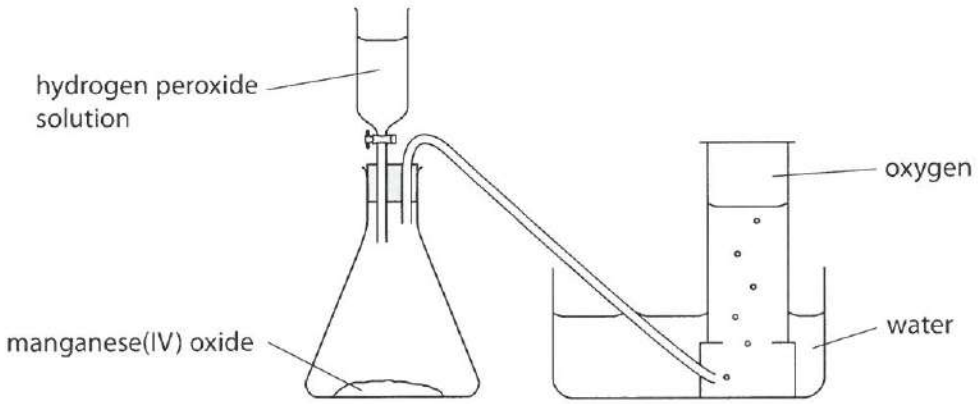
(1)

Decomposition or Redox

(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)

Separating funnel

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

(1)

It contains air.

(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)

- Perform the reaction with and with Manganese oxide
- Keep conentration of H_2O_2 the same
- Measure the time
- O_2 produced more quickly will be with catalyst.

(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)

$SO_2 + H_2O \rightarrow H_2SO_3$

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

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

(2)

- Turns red
- because its acidic.

(Total for Question 6 = 11 marks)

7 Zinc is added to dilute hydrochloric acid. The equation for the reaction is

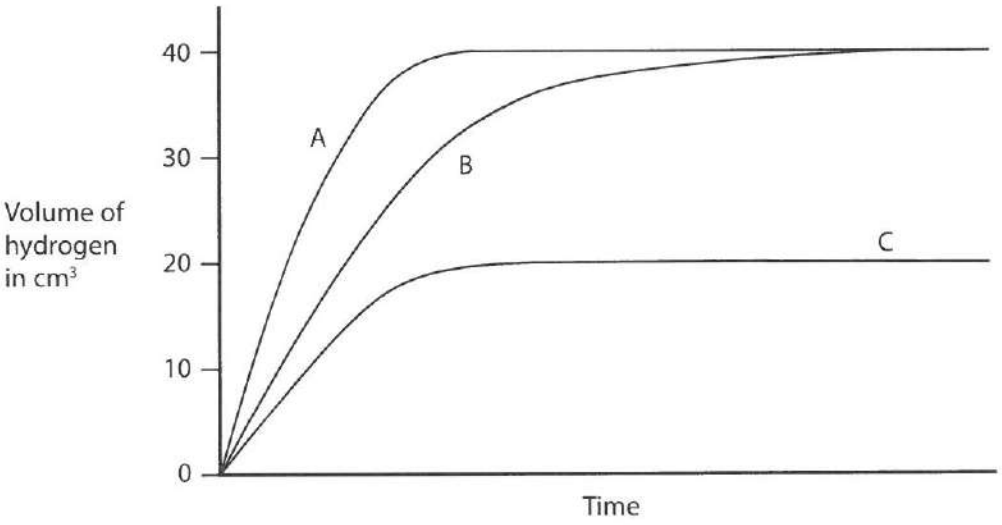
$$Zn(s) + 2HCl(aq) \rightarrow ZnCl_2(aq) + H_2(g)$$

An experiment is carried out using

- 0.12 g of powdered zinc
- an excess of 0.2 mol/dm^3 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/dm^3 hydrochloric acid
- a temperature of 40 °C

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

(3)

. A
. fastes rate of reaction
. therefore the curve is steeper

(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)

· C
· Only half the mass of zinc used
· therefore only half the volume of hydrogen produced.

(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)

Precipitate was formed each time Y was used.

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

(2)

X is NaI became a yellow precipitate was formed.
Y is NaCl became a white precipitate was formed.

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

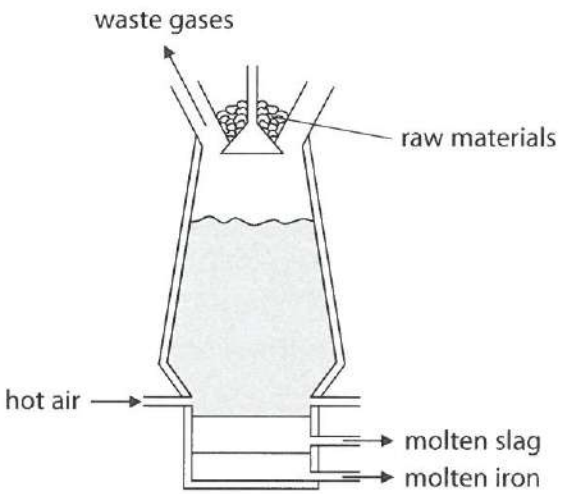
Explain how the observations made can be used to distinguish between sodium chloride and sodium iodide.

(2)

No reaction with NaCl
(Chlorine cannot displace itself)
forms a brown solution with NaI
($Cl_2 + 2NaI \rightarrow 2NaCl + I_2$)

(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 Coke

2 Limestone

(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)

$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$

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

(2)

- Iron
- lost oxygen

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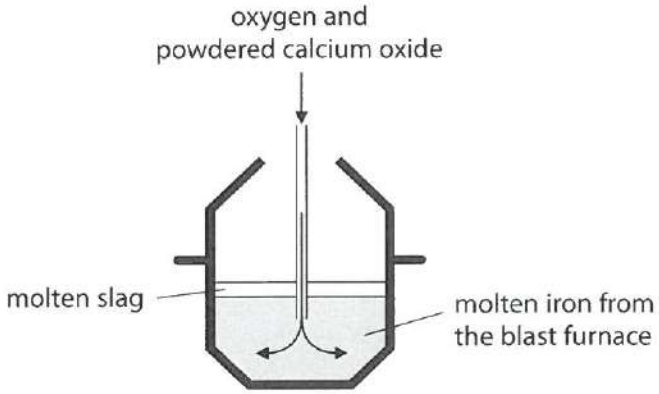
(c) The iron from the blast furnace contains about 10% by mass of impurities.

Two of the impurities are carbon and silicon.

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



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)

$C + O_2 \rightarrow CO_2$

(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

(d) One problem with using iron is rusting.

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

(2)

1 Water

2 Oxygen

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

State how this method of rust prevention works.

(1)

Prevents oxygen from coming into contact with iron

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

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

(1)

galvanising

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

(2)

· Zinc is more reactive than iron
· oxygen reacts with zinc first.

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

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

(1)

More reactive than carbon

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

(1)

Electricity is expensive

(Total for Question 9 = 16 marks)

10 Alkenes are unsaturated hydrocarbons.

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

(1)

molecule has a double bond

(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)

$C_{10}H_{22} \rightarrow$ C_8H_{18} + C_2H_4

decane

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

(2)

· 600°C

· Al_2O_3 catalyst.

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

(i) Explain why these two compounds are isomers.

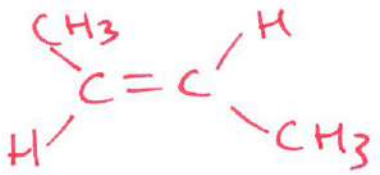
(2)

· Same molecular formula but

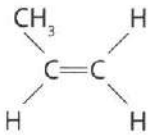
different structure.

(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



Propene can be polymerised.

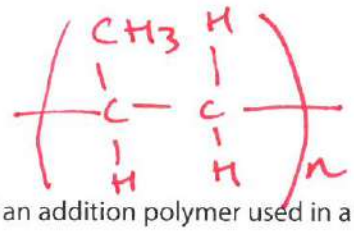
(i) Give the name of the polymer formed from propene.

(1)

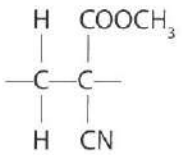
polypropene

(ii) Draw the repeat unit for this polymer.

(2)

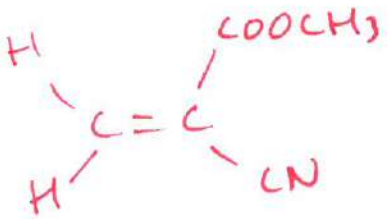


(e) The repeat unit of an addition polymer used in a type of glue is shown in the diagram.



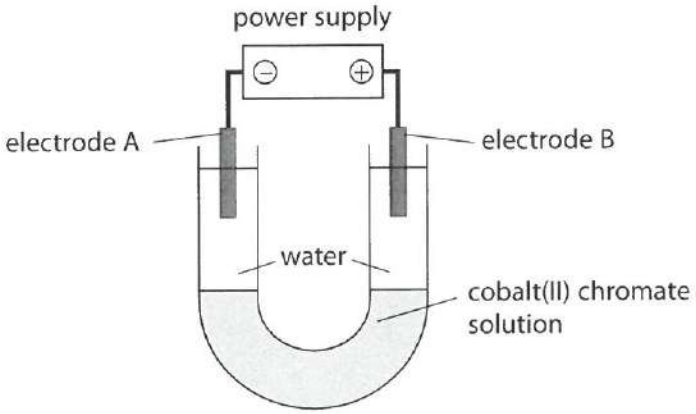
Draw the structure of the monomer used to make this polymer.

(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.



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)

· Cromate ions are negative
· Move to positive electrode.

(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)

2 $CrO_4^{2-}(aq)$ + 1 $H^+(aq)$ → ..... $Cr_2O_7^{2-}(aq)$ + ... $H_2O(l)$

(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.

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

(1)

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

(3)

- filter
- wash with distilled water
- dry in warm place

(Total for Question 11 = 8 marks)

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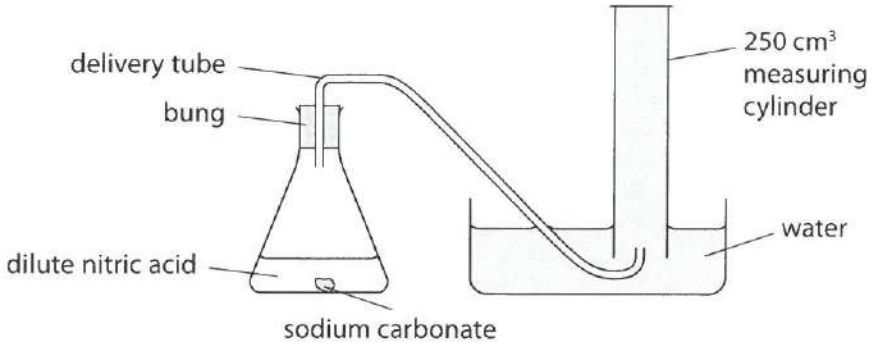
12 A student uses this apparatus to determine the volume of one mole of carbon dioxide gas.



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)

$$\frac{0.53}{106}$$

amount of sodium carbonate = 0.005 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)

$$\frac{110}{0.005}$$

volume of one mole of carbon dioxide = 22000 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 Bung not on tight enough

2 CO_2 dissolves in water

(Total for Question 12 = 6 marks)

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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)

K/Na/Mg/Zn

(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	Bubbles produced quickly solid disappears quickly

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

Name the compound formed when potassium reacts with water.

(1)

Potassium hydroxide

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

(1)

MgO

(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)

Carbon as it displaces Zn

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

(2)

Carbon as it removes oxygen from zinc oxide

(Total for Question 13 = 8 marks)

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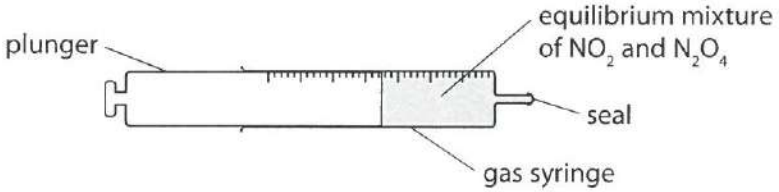
14 Nitrogen dioxide (NO_2) and dinitrogen tetraoxide (N_2O_4) exist together in equilibrium.

$$2NO_2(g) \rightleftharpoons N_2O_4(g)$$
brown 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)

- More NO_2 is formed.
- Because equilibrium shifts to left
- because there are more molecules on the left.

(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)

• The equilibrium has shifted right

• Because its an exothermic reaction

(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)

Yes, because bond making is exothermic.

(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)

$3Mg + N_2 \longrightarrow Mg_3N_2$

(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)

Turns damp red litmus blue

(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)

$\frac{1.40}{35}$

amount of Li_3N = 0.04 mol

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

(1)

Ratio 1:3

0.04 x 3

amount of LiOH = 0.12 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)

moles of H_2SO_4 = $\frac{0.12}{2}$ = 0.06 mol

vol = $\frac{0.06}{0.5}$

volume of sulfuric acid = 0.12 unit dm^3

(Total for Question 15 = 10 marks)

TOTAL FOR PAPER = 120 MARKS

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