



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE
NAME

CENTRE
NUMBER

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CANDIDATE
NUMBER

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CHEMISTRY

0620/22

Paper 2

October/November 2011

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name in the spaces at the top of this page.

Write in dark blue or black pen.

You may need to use a pencil for any diagrams, graphs or rough working.

Do not use staples, paper clips, highlighters, glue or correction fluid.

DO NOT WRITE IN ANY BARCODES.

Answer **all** questions.

A copy of the Periodic Table is printed on page 20.

At the end of the examination, fasten all your work securely together.

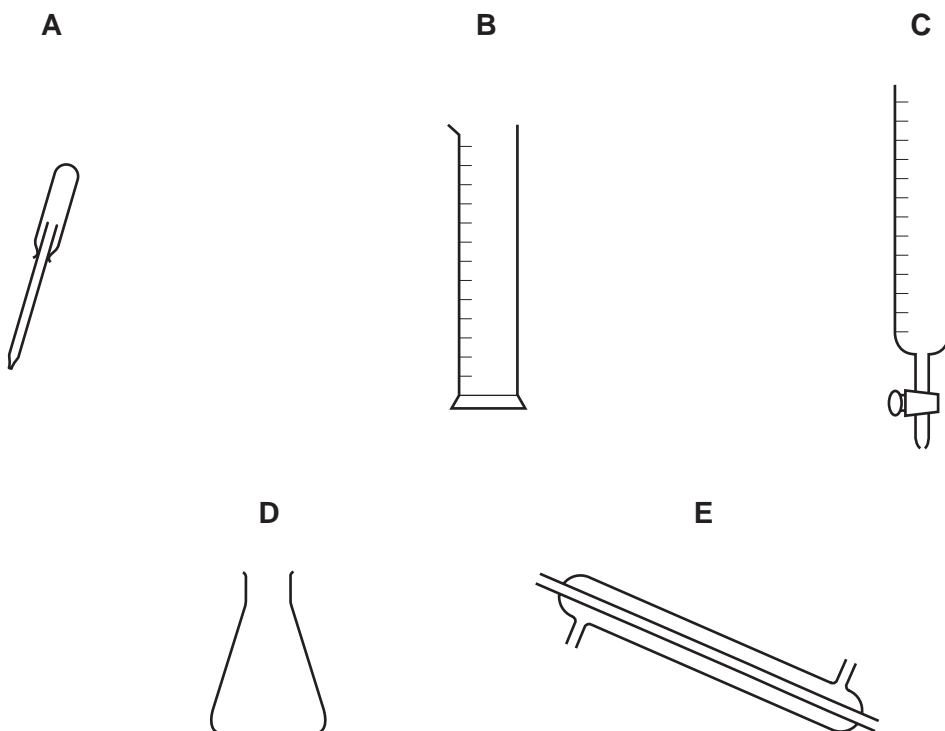
The number of marks is given in brackets [] at the end of each question or part question.

For Examiner's Use

1	
2	
3	
4	
5	
6	
7	
Total	

This document consists of **19** printed pages and **1** blank page.

1 The diagram shows five different pieces of laboratory glassware, **A**, **B**, **C**, **D** and **E**.



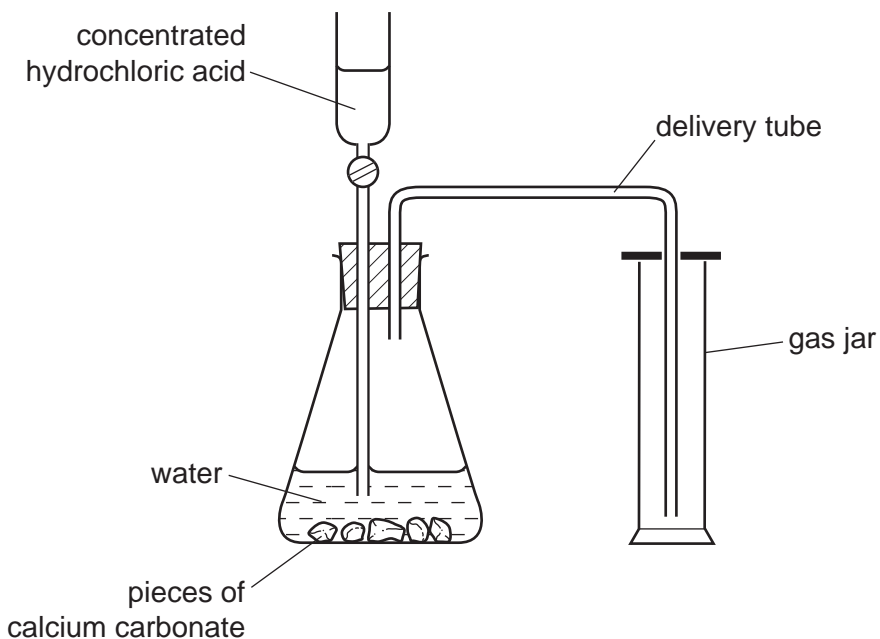
(a) Choose from **A**, **B**, **C**, **D** or **E** to answer the following questions. Each letter may be used once, more than once or not at all.

Which piece of glassware is best used to

- | | |
|--|--------------------------|
| (i) measure out a volume of liquid accurately, | <input type="checkbox"/> |
| (ii) place a spot of liquid on chromatography paper, | <input type="checkbox"/> |
| (iii) condense a liquid with a low boiling point, | <input type="checkbox"/> |
| (iv) shake two solutions together to mix them, | <input type="checkbox"/> |
| (v) deliver a variable volume of solution when performing a titration? | <input type="checkbox"/> |

[5]

(b) The diagram shows the apparatus used to prepare carbon dioxide in the laboratory.



(i) State the name of a rock which is made up largely of calcium carbonate.

..... [1]

(ii) Which one of these statements about carbon dioxide is correct?
Tick **one** box.

Carbon dioxide is lighter than air.

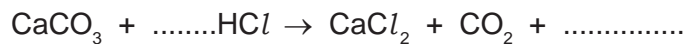
Carbon dioxide is a liquid at room temperature.

Carbon dioxide is heavier than air.

Carbon dioxide has the same density as air.

[1]

(iii) Complete the equation for the reaction of calcium carbonate with hydrochloric acid.



[2]

[Total: 9]

2 Many of the elements in the Periodic Table are metals.

(a) State **one** common use for each of the following metals.

(i) copper [1]

(ii) platinum [1]

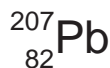
(iii) aluminium [1]

(b) Lead is a metal in Group IV of the Periodic Table.

(i) State **one** adverse effect of lead on health.

..... [1]

(ii) Lead has several isotopes.
One isotope of lead is



State the number of protons and neutrons in this isotope of lead.

number of protons [1]

number of neutrons [1]

(c) Sodium is a very reactive metal.

(i) A student added a few drops of litmus solution to a large beaker of water. She then dropped a small piece of sodium into the beaker.
Describe what the student would observe during the reaction.

.....
.....
..... [3]

(ii) Complete the word equation for the reaction of sodium with water.

sodium + water → +
..... [2]

- (iii) Sodium chloride is formed when sodium burns in chlorine.
Sodium chloride is an ionic compound.

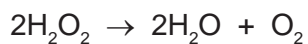
Complete the following sentences about this reaction using words from the list.

electron	gains	ion	loses
molecule	negative	positive	proton

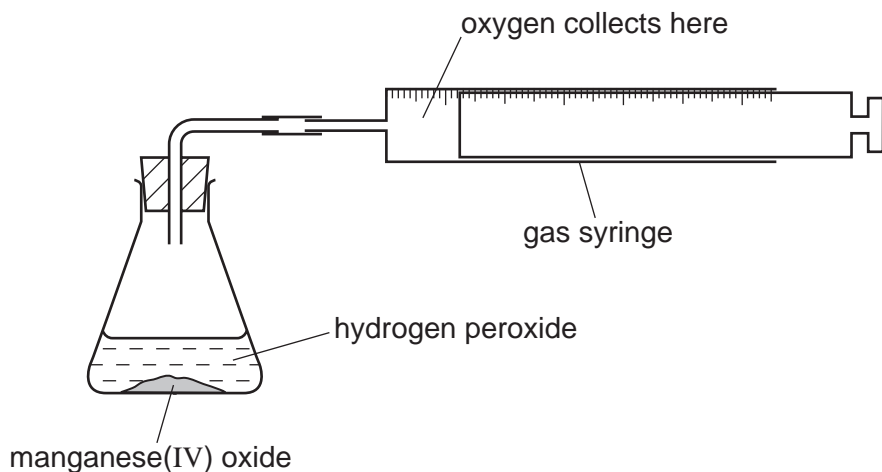
When sodium burns in chlorine, each sodium atom loses an and becomes a sodium Each chlorine atom an electron and becomes a ion. [4]

[Total: 15]

- 3 Hydrogen peroxide decomposes slowly at room temperature to form water and oxygen. The reaction is catalysed by manganese(IV) oxide.



A student used the apparatus shown below to study how changing the concentration of hydrogen peroxide affects the speed of this reaction.

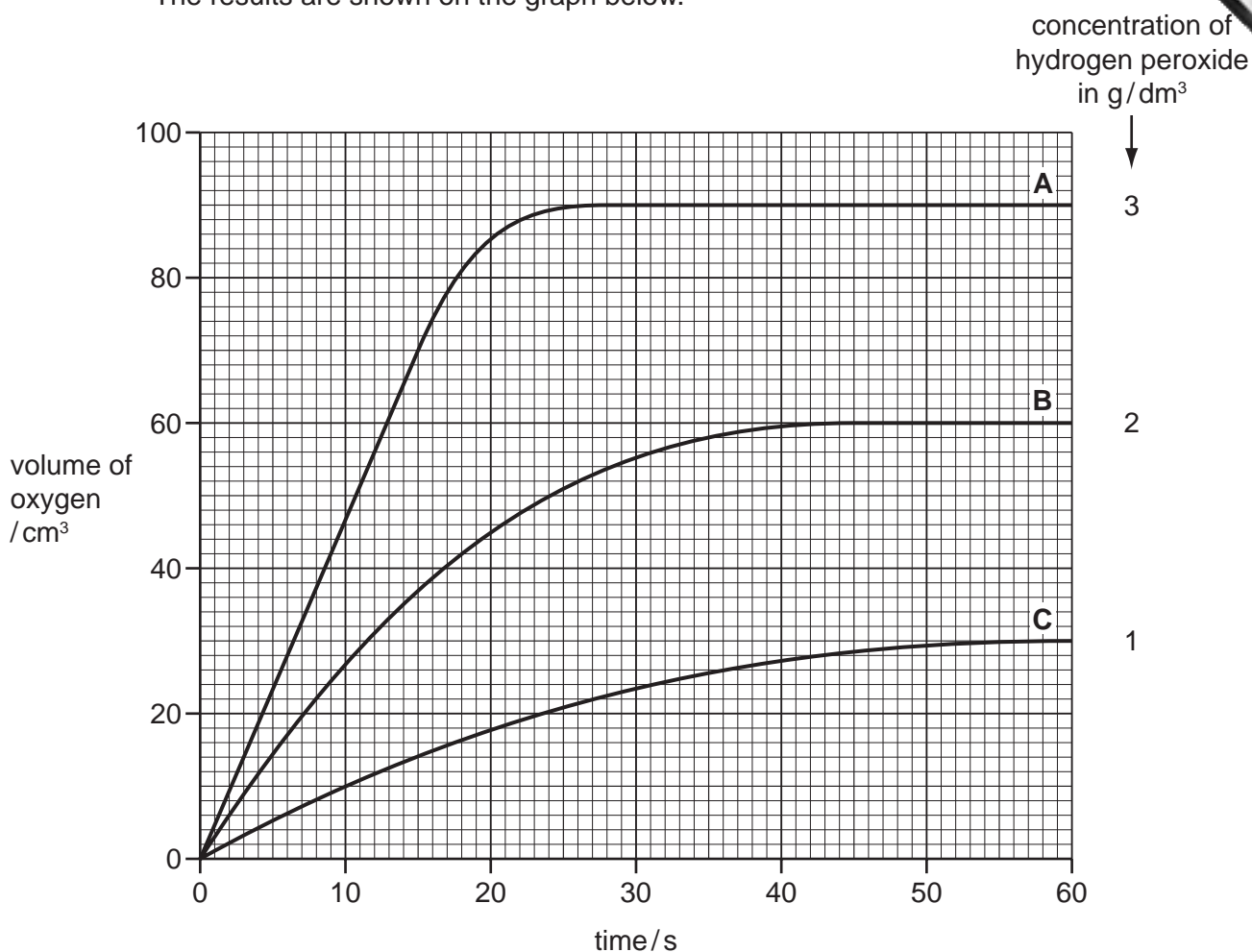


- (a) Apart from the volume of hydrogen peroxide, state two things that the student must keep the same in each experiment.

1.

2. [2]

- (b) The student measured the volume of oxygen produced using three different concentrations of hydrogen peroxide. The results are shown on the graph below.



- (i) Describe how the speed of the reaction varies with the concentration of hydrogen peroxide.

..... [1]

- (ii) Explain why the final volume of oxygen given off is less for graph B than for graph A.

.....
..... [1]

- (iii) From the graph, determine

the time taken for the reaction to be completed when 3 g/dm³ hydrogen peroxide (line A) was used.

..... [1]

the volume of oxygen produced by 2 g/dm³ hydrogen peroxide (line B) in the first 15 seconds.

..... [1]

- (c) The student then tested various compounds to see how well they catalysed the reaction. He used the same concentration of hydrogen peroxide in each experiment. The table shows the time taken to produce 20 cm³ of oxygen using each compound as a catalyst.

compound	time taken to produce 20 cm ³ of oxygen / s
copper(II) oxide	130
lead(IV) oxide	15
magnesium oxide	did not produce any oxygen
manganese(IV) oxide	18

Put these compounds in order of their effectiveness as catalysts.

worst catalyst \longrightarrow best catalyst

--	--	--	--

[1]

[Total: 7]

4 Natural gas and the hydrocarbons obtained from the distillation of petroleum are important fuels.

(a) State the name of the main substance present in natural gas.

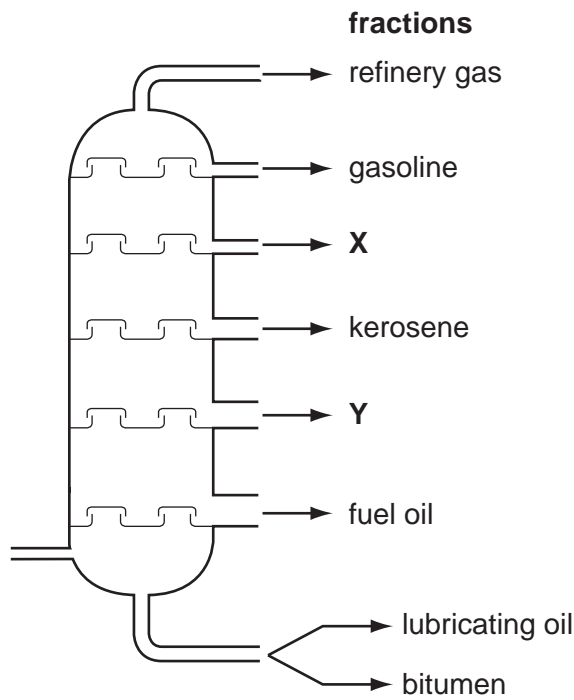
..... [1]

(b) Petroleum is a thick liquid.
Describe the liquid state in terms of

- how close the particles are to each other,
- the arrangement of the particles,
- the movement of the particles.

.....
.....
.....
..... [3]

(c) The diagram shows a distillation column used to separate petroleum into fractions.



(i) On the diagram, draw an arrow to show where the petroleum vapour enters the column. [1]

(ii) What do you understand by the term *fraction*?

.....
..... [2]

- (iii) In the diagram on page 9, two fractions have not been named.
State the name of

fraction X

fraction Y [2]

- (iv) One of the refinery gases is ethane.
Draw the structure of ethane showing all atoms and bonds.

[1]

- (v) Which one of these phrases describes ethane correctly?
Tick **one** box.

Ethane is an unsaturated hydrocarbon.

Ethane is a saturated hydrocarbon.

Ethane polymerises to form poly(ethene).

Ethane is an alkene.

[1]

[Total: 11]

- 5 (a) Match the phrases on the left with the definitions on the right.
The first one has been done for you.

relative formula mass	an atom that has become charged
molecule	the smallest part of an element which can take part in a chemical change
atom	two or more atoms covalently bonded together
ion	the sum of the relative atomic masses in a compound

[3]

- (b) Sodium hydroxide, NaOH, is an ionic compound which dissolves in water to form a strongly alkaline solution.

- (i) Which **one** of the following best describes the pH of a concentrated aqueous solution of sodium hydroxide?
Put a ring around the correct answer.

pH 2

pH 5

pH 7

pH 8

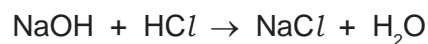
pH 13

[1]

- (ii) Calculate the relative formula mass of sodium hydroxide.

[1]

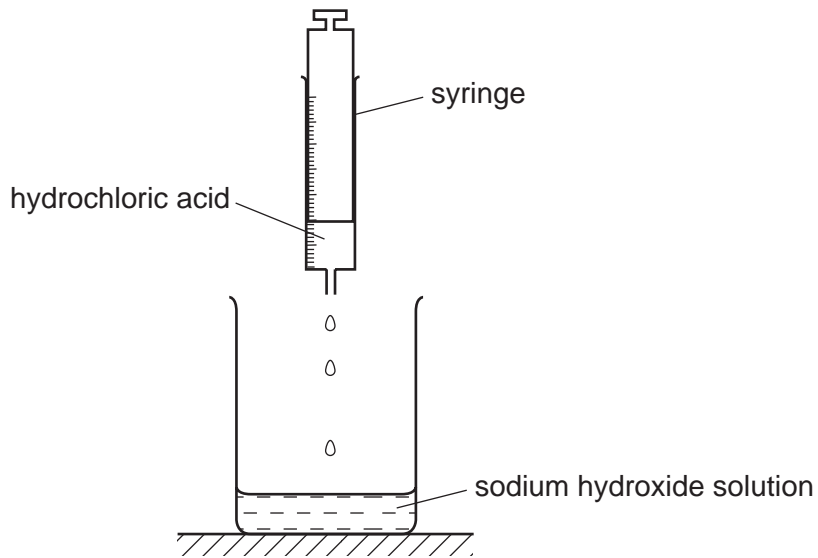
- (iii) The equation describes how sodium hydroxide reacts with hydrochloric acid.



What type of chemical reaction is this?

..... [1]

- (iv) A student used a syringe to add 1 cm^3 portions of hydrochloric acid to an aqueous solution of sodium hydroxide.



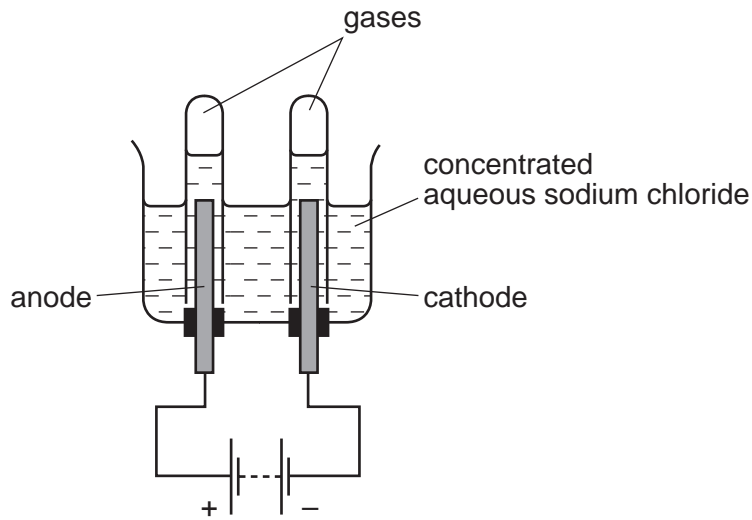
Describe how the pH of the solution in the beaker changes as the hydrochloric acid is added until the acid is in excess.

.....

.....

..... [2]

(c) The diagram shows the apparatus used to electrolyse concentrated aqueous chloride.



Give a description of this electrolysis.
In your description include

- what substance the electrodes are made from and the reason for using this substance
- what you would observe during the electrolysis
- the names of the substances produced at each electrode.

.....

.....

.....

.....

.....

.....

.....

.....

.....

[6]

[Total: 14]

6 When coal is heated in the absence of air, coke is formed together with a gas called *coal gas* and a liquid which contains ammonia.

(a) Coke is largely carbon.
State **one** use of coke in industry.

..... [1]

(b) Two other forms of carbon are diamond and graphite.

(i) Use your knowledge of the structure of diamond and graphite to explain why graphite is a good lubricant.

..... [1]

why diamond is very hard.

..... [1]

(ii) Give **one** use of diamond that depends on its hardness.

..... [1]

(c) The liquid which contains ammonia can be reacted with sulfuric acid.

(i) Complete the word equation for this reaction

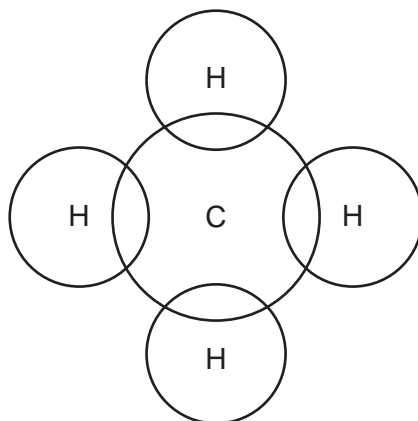
ammonia + sulfuric acid → [1]

(ii) Which **one** of the following elements do most fertilisers contain?
Put a ring around the correct answer.

chlorine **nitrogen** **sodium** **sulfur** [1]

(d) Coal gas contains methane.

Complete the diagram to show how the electrons are arranged in a molecule of methane.



[1]

- (e) When coal is burnt, sulfur dioxide is given off.
Which two of the following statements about sulfur dioxide are correct?
Tick **two** boxes.

Sulfur dioxide is an acidic oxide.

About 20% of the air is sulfur dioxide.

Most of the sulfur dioxide in the air comes from car exhausts.

Sulfur dioxide contributes to acid rain.

[2]

[Total: 9]

7 Ethanol, C_2H_5OH , is a member of the alcohol homologous series.

(a) (i) Give **two** characteristics of a homologous series.

1.
2. [2]

(ii) Draw the structure of ethanol showing all atoms and bonds.

[1]

(b) One use of ethanol is as a solvent.

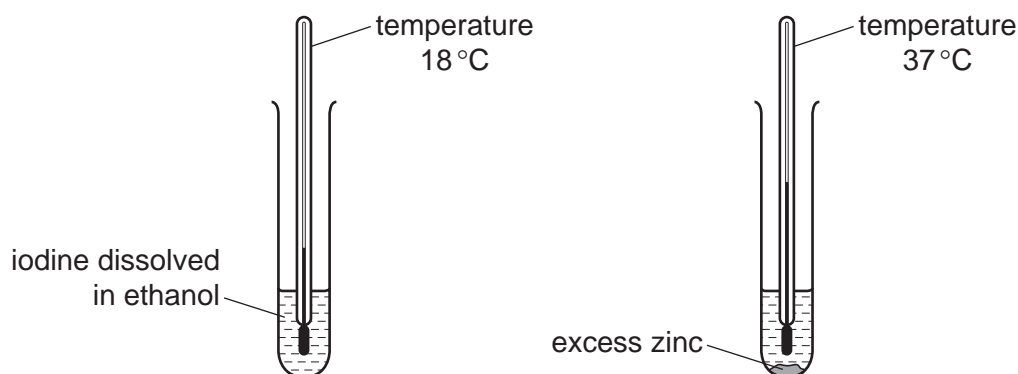
A pupil studied the reaction of iodine with zinc.

She first dissolved a few crystals of iodine in ethanol and recorded the temperature of the solution.

The temperature was $18^\circ C$.

She then added excess powdered zinc and recorded the temperature again.

The new temperature was $37^\circ C$.



(i) Is this reaction endothermic or exothermic?
Explain your answer.

.....
..... [1]

(ii) What colour is solid iodine?

..... [1]

- (c) The equation for the reaction is



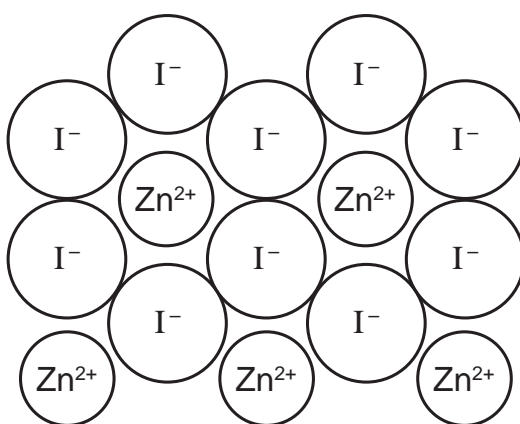
When the reaction is complete, the mixture contains zinc iodide dissolved in ethanol and unreacted zinc powder.

Suggest how you can get crystals of zinc iodide from the reaction mixture.

.....

 [2]

- (d) The diagram shows the structure of zinc iodide.



- (i) What is the simplest formula for zinc iodide?

..... [1]

- (ii) The list below shows four different types of structure.
 What type of structure is zinc iodide?
 Put a ring around the correct answer.

giant covalent

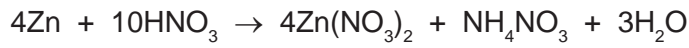
giant ionic

metallic

molecular

[1]

(e) The equation for the reaction of zinc with dilute nitric acid is



Write a word equation for this reaction.

..... [3]

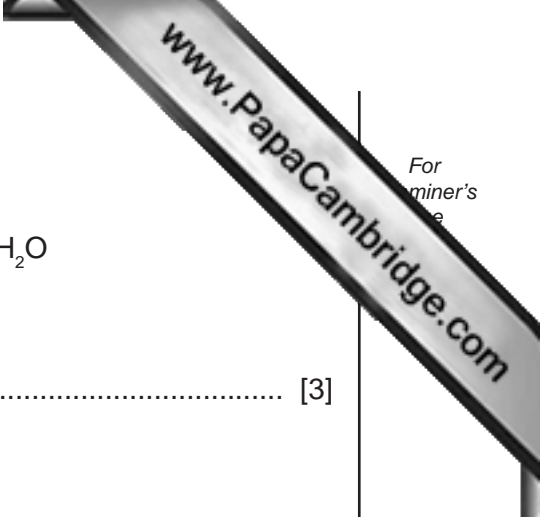
(f) Describe a test for ammonium ions.

test

result

..... [3]

[Total: 15]



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DATA SHEET
The Periodic Table of the Elements

		Group											
I	II	III	IV	V	VI	VII	0						
7 Li Lithium 3	9 Be Beryllium 4	1 H Hydrogen 1	11 B Boron 5	12 C Carbon 6	13 Al Aluminium 13	14 Si Silicon 14	15 P Phosphorus 15	16 S Sulfur 16	17 Cl Chlorine 17	18 Ar Argon 18	19 F Fluorine 9	20 Ne Neon 10	
23 Na Sodium 11	24 Mg Magnesium 12	27 Fe Iron 26	28 Ni Nickel 28	29 Cu Copper 29	30 Zn Zinc 30	31 Ga Gallium 31	32 Ge Germanium 32	33 As Arsenic 33	34 Se Selenium 34	35 Br Bromine 35	36 Kr Krypton 36	40 Ca Calcium 20	
39 K Potassium 19	40 Ca Calcium 20	41 Ti Titanium 22	42 V Vanadium 23	43 Cr Chromium 24	44 Mn Manganese 25	45 Fe Iron 26	46 Co Cobalt 27	47 Ni Nickel 28	48 Cu Copper 29	49 Zn Zinc 30	50 Ga Gallium 31	54 Xe Xenon 54	
85 Rb Rubidium 37	88 Sr Strontium 38	91 Zr Zirconium 40	93 Nb Niobium 41	94 Mo Molybdenum 42	95 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	127 I Iodine 53	
133 Cs Caesium 55	137 Ba Barium 56	178 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	209 Po Polonium 84	
87 Fr Francium	226 Ra Radium	227 Ac Actinium											86 Rn Radon
													175 Lu Lutetium 71
													103 Lr Lawrencium
													102 No Nobelium
													101 Md Mendelevium
													100 Fm Fermium
													85 At Astatine
													84 Po Polonium
													83 Bi Bismuth
													82 Pb Lead
													81 Tl Thallium
													80 Hg Mercury
													79 Au Gold
													78 Pt Platinum
													77 Ir Iridium
													76 Os Osmium
													75 Re Rhenium
													74 W Tungsten
													73 Ta Tantalum
													72 Hf Hafnium
													71 Lu Lutetium
													70 Yb Ytterbium
													69 Tm Thulium
													68 Er Erbium
													67 Ho Holmium
													66 Dy Dysprosium
													65 Tb Terbium
													64 Gd Gadolinium
													63 Eu Europium
													62 Sm Samarium
													61 Pm Promethium
													60 Nd Neodymium
													59 Pr Praseodymium
													58 Ce Cerium
													99 Es Einsteinium
													98 Cf Californium
													97 Bk Berkelium
													96 Cm Curium
													95 Am Americium
													94 Pu Plutonium
													93 Np Neptunium
													92 U Uranium
													91 Pa Protactinium
													90 Th Thorium
													89 La Lanthanum
													88 Sr Strontium
													87 Rb Rubidium
													86 Kr Krypton
													85 At Astatine
													84 Po Polonium
													83 Bi Bismuth
													82 Pb Lead
													81 Tl Thallium
													80 Hg Mercury
													79 Au Gold
													78 Pt Platinum
													77 Ir Iridium
													76 Os Osmium
													75 Re Rhenium
													74 W Tungsten
													73 Ta Tantalum
													72 Hf Hafnium
													71 Lu Lutetium
													70 Yb Ytterbium
													69 Tm Thulium
													68 Er Erbium
													67 Ho Holmium
													66 Dy Dysprosium
													65 Tb Terbium
													64 Gd Gadolinium
													63 Eu Europium
													62 Sm Samarium
													61 Pm Promethium
													60 Nd Neodymium
													59 Pr Praseodymium
													58 Ce Cerium
													57 La Lanthanum

*58-71 Lanthanoid series
†90-103 Actinoid series

Key

a	X
b	

a = relative atomic mass
X = atomic symbol
b = proton (atomic) number

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).

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