



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS  
International General Certificate of Secondary Education

CANDIDATE  
NAME

CENTRE  
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.

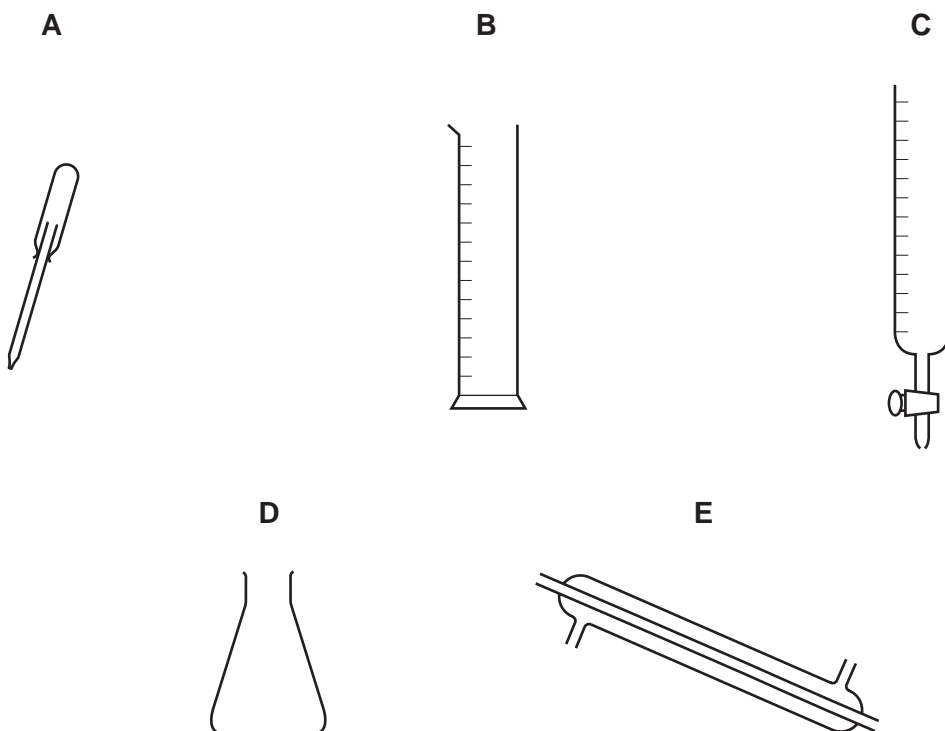
The number of marks is given in brackets [ ] at the end of each question or part question.

| For Examiner's Use |  |
|--------------------|--|
| 1                  |  |
| 2                  |  |
| 3                  |  |
| 4                  |  |
| 5                  |  |
| 6                  |  |
| 7                  |  |
| <b>Total</b>       |  |

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**.



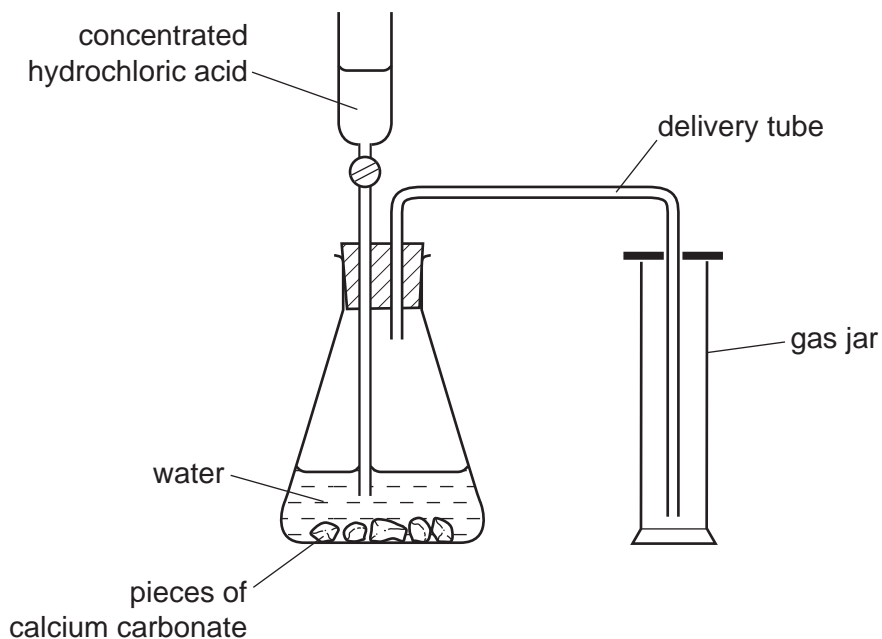
(a) Choose from **A**, **B**, **C**, **D** or **E** to answer the following questions. Each letter may be used once, more than once or not at all.

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.



[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]

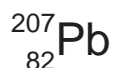
(b) Lead is a metal in Group IV of the Periodic Table.

(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]

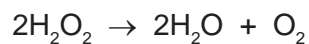
- (iii) Sodium chloride is formed when sodium burns in chlorine.  
Sodium chloride is an ionic compound.  
Complete the following sentences about this reaction using words from the list.

**electron**      **gains**      **ion**      **loses**  
**molecule**    **negative**    **positive**    **proton**

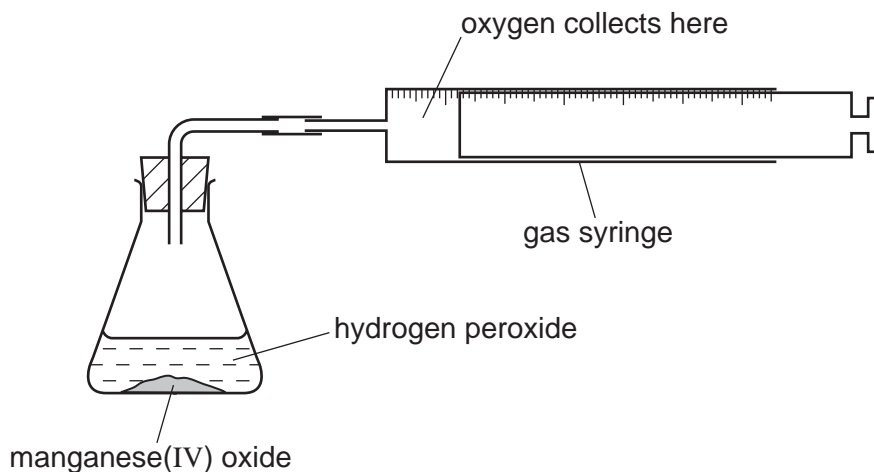
When sodium burns in chlorine, each sodium atom loses an ..... and becomes a sodium ..... . Each chlorine atom ..... an electron and becomes a ..... ion. [4]

[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.

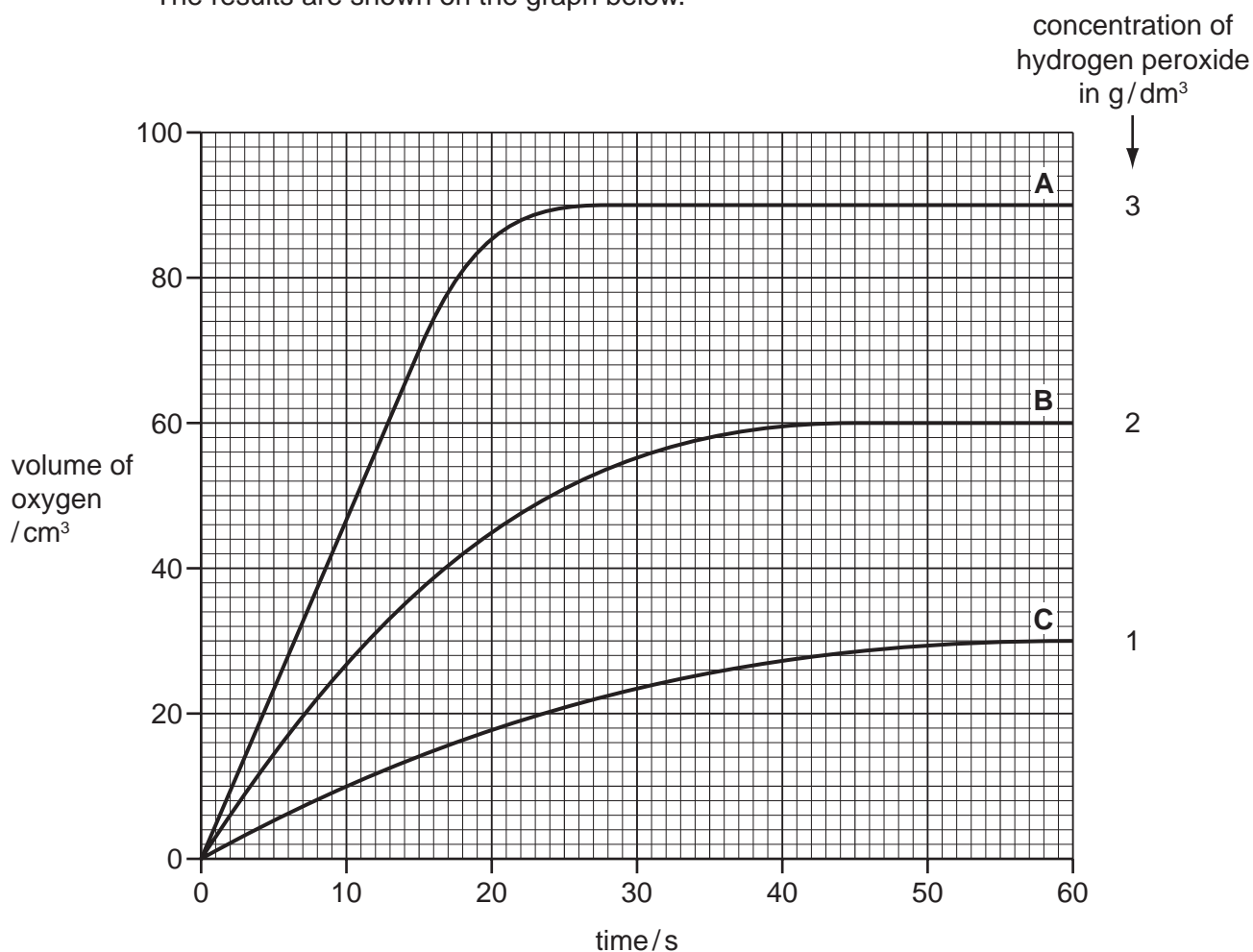


- (a) Apart from the volume of hydrogen peroxide, state two things that the student must keep the same in each experiment.

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/dm<sup>3</sup> hydrogen peroxide (line **A**) was used.
- ..... [1]
- the volume of oxygen produced by 2 g/dm<sup>3</sup> 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 cm<sup>3</sup> of oxygen using each compound as a catalyst.

| compound            | time taken to produce 20 cm <sup>3</sup> 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.

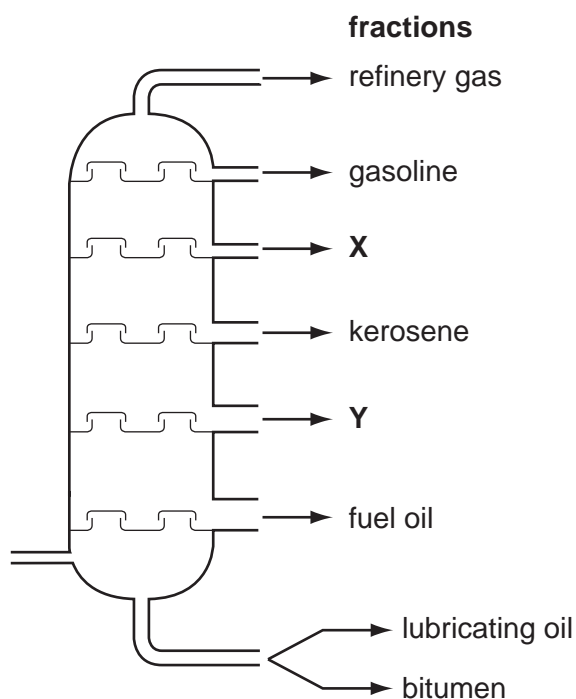
..... [1]

(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.

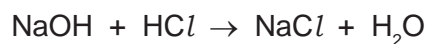
- (i) Which **one** of the following best describes the pH of a concentrated aqueous solution of sodium hydroxide?  
Put a ring around the correct answer.

pH 2      pH 5      pH 7      pH 8      pH 13      [1]

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

[1]

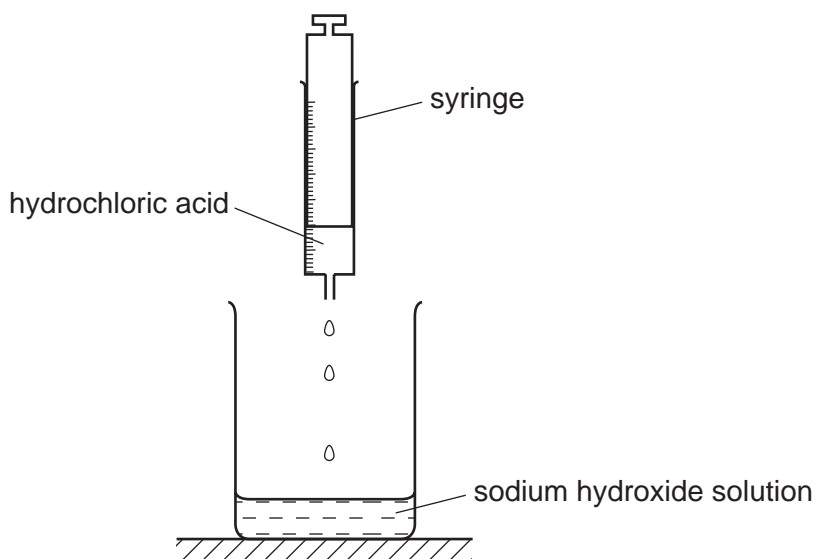
- (iii) The equation describes how sodium hydroxide reacts with hydrochloric acid.



What type of chemical reaction is this?

..... [1]

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



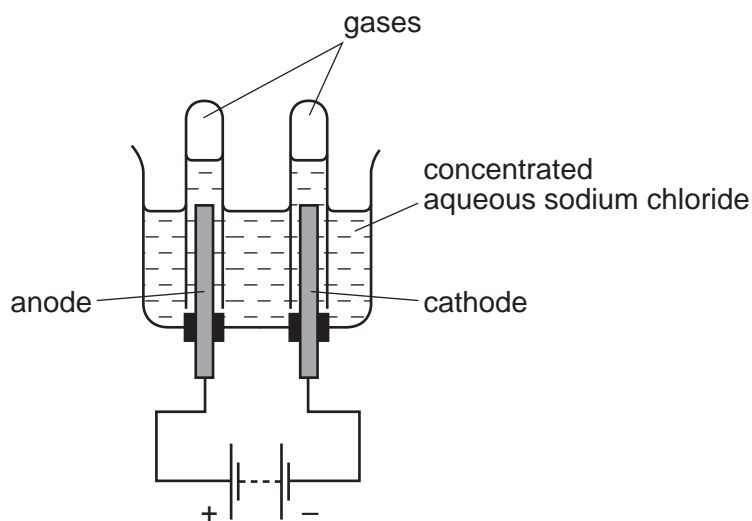
Describe how the pH of the solution in the beaker changes as the hydrochloric acid is added until the acid is in excess.

.....

.....

..... [2]

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

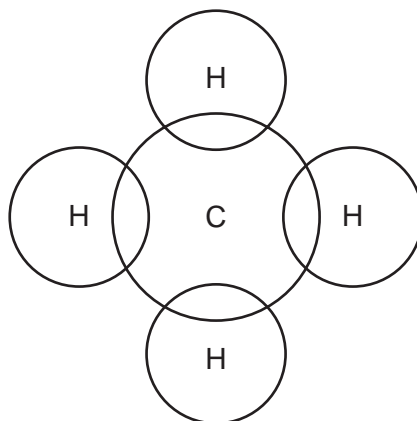
ammonia + sulfuric acid → ..... [1]

(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.

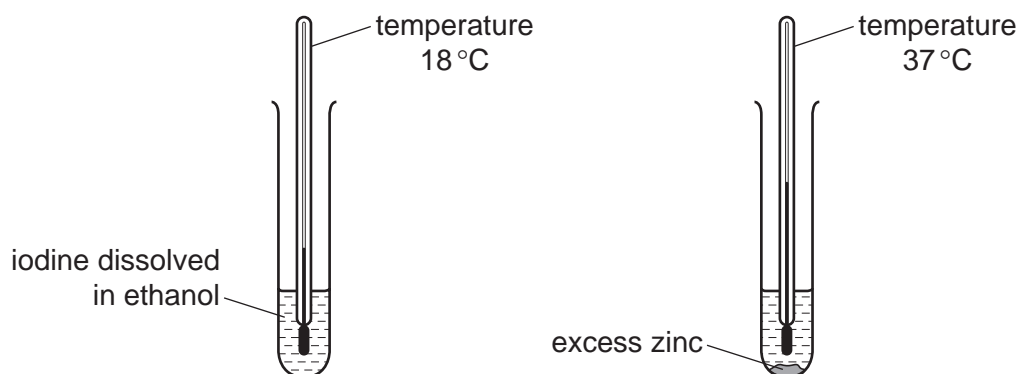
A pupil studied the reaction of iodine with zinc.

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.

.....

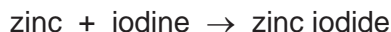
..... [1]

(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.

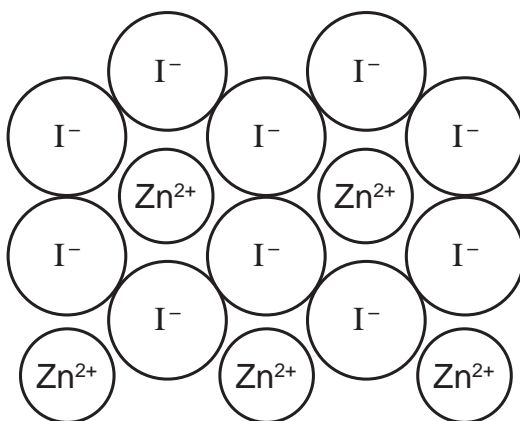
Suggest how you can get crystals of zinc iodide from the reaction mixture.

.....

.....

..... [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**

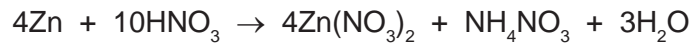
**giant ionic**

**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]



