



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

May/June 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 16.

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

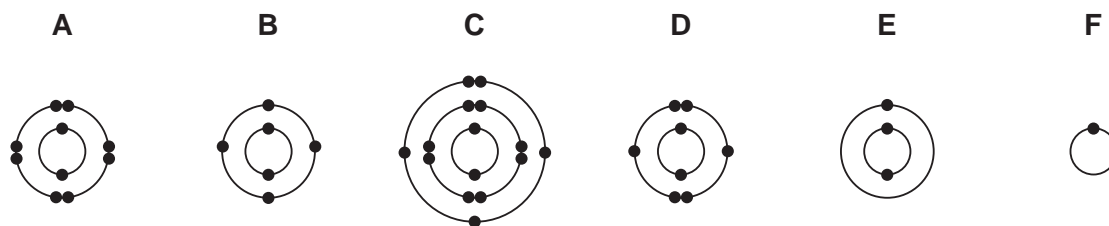
The number of marks is given in brackets [] at the end of each question or part question.

For Examiner's Use	
1	
2	
3	
4	
5	
6	
7	
Total	

This document consists of **14** printed pages and **2** blank pages.



1 The diagram shows the electronic structures of six atoms.



(a) Answer the following questions by choosing from the structures **A**, **B**, **C**, **D**, **E** or **F**. You can use each structure once, more than once or not at all.

Which structure represents

- (i) an atom in Period 3 of the Periodic Table,
- (ii) an atom containing six protons,
- (iii) an atom of a Group I metal,
- (iv) an atom of phosphorus,
- (v) an atom with six electrons in its outer shell,
- (vi) an atom with a complete outer shell of electrons?

[6]

(b) Atoms **D** and **F** can combine to form a covalent molecule.

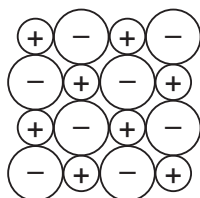
(i) Complete the following sentence using words from the list.

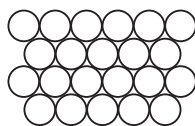
atoms electrons ions neutrons solids

A covalent bond is formed when a pair of is shared between two

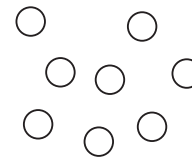
[2]

(ii) Which one of the following structures represents an ionic compound? Tick **one** box.









[1]

[Total: 9]

- 2 Many metal oxides can be reduced with carbon.
The table shows the temperatures required to produce different metals from their oxides by heating with carbon.

reaction	temperature/°C
aluminium oxide → aluminium	2100
iron oxide → iron	425
nickel oxide → nickel	475
zinc oxide → zinc	925

- (a) (i) Use the information in the table to arrange aluminium, iron, nickel and zinc in order of their reactivity.

least reactive $\xrightarrow{\hspace{15em}}$ most reactive

[1]

- (ii) Suggest why aluminium is extracted by electrolysis rather than by heating with carbon.

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

- (iii) State the name of the main ore of aluminium.

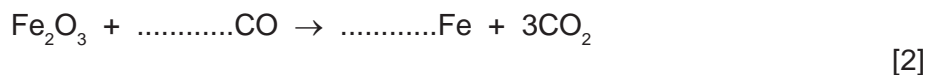
..... [1]

- (b) Iron is extracted by heating iron ore with carbon in a blast furnace.

- (i) Apart from iron ore and carbon (coke), state the names of **two** other raw materials used in the blast furnace for the extraction of iron.

..... and [2]

- (ii) Complete this equation for the reaction of iron(III) oxide with carbon.



- (iii) In the blast furnace, carbon dioxide reacts with red hot carbon to form carbon monoxide.



Which substance gets reduced during this reaction? Explain your answer.

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

(iv) State **one** adverse effect of carbon monoxide on health.

..... [1]

(v) The reaction between carbon dioxide and red hot carbon is endothermic.
What do you understand by the term *endothermic*?

..... [1]

(c) Iron is usually made into steel alloys.

(i) What do you understand by the term *alloy*?

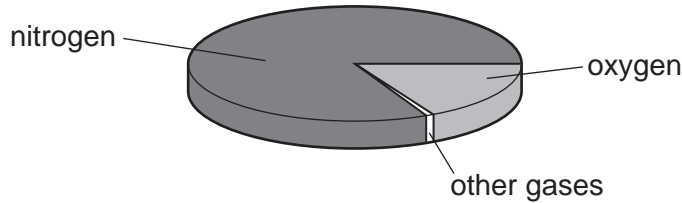
.....
..... [1]

(ii) Mild steel is an alloy.
State **one** use of mild steel.

..... [1]

[Total: 13]

3 The pie chart shows the composition of air.



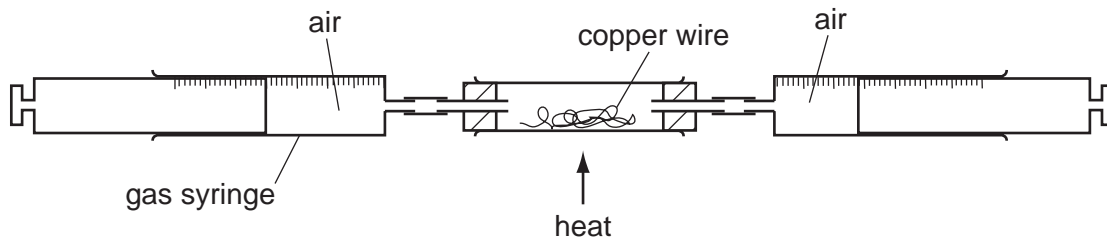
(a) (i) What is the percentage of nitrogen in the air?

..... [1]

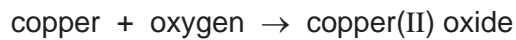
(ii) Apart from nitrogen and oxygen, state the names of **two** gases present in unpolluted air.

..... and [2]

(b) The percentage of oxygen in air can be found using the apparatus shown below.



Air is passed backwards and forwards over the heated copper using the syringes. The copper reacts with oxygen in the air.



As the experiment proceeds, suggest what happens to

(i) the total volume of air in the gas syringes,

..... [1]

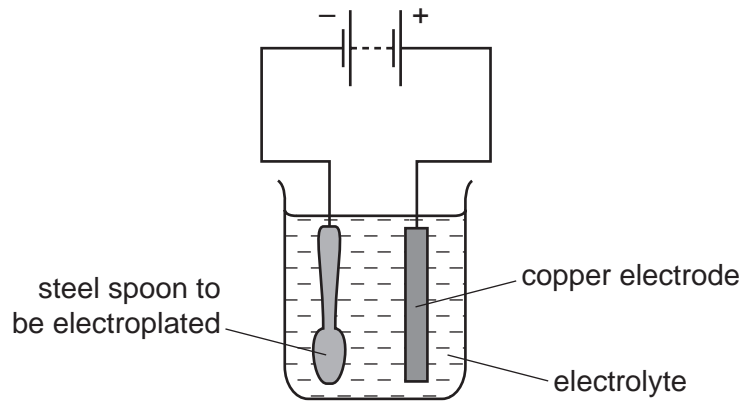
(ii) the mass of the wire in the tube.

..... [1]

(c) State **one** use of copper.

..... [1]

(d) A steel spoon can be electroplated using the apparatus shown.



Give a description of this electroplating.
In your answer, refer to:

- a suitable electrolyte that can be used;
- the anode and the cathode;
- changes to the spoon.

.....

.....

.....

.....

.....

..... [3]

[Total: 9]

4 Ethanol can be produced by fermentation or by the catalytic addition of steam to ethene.

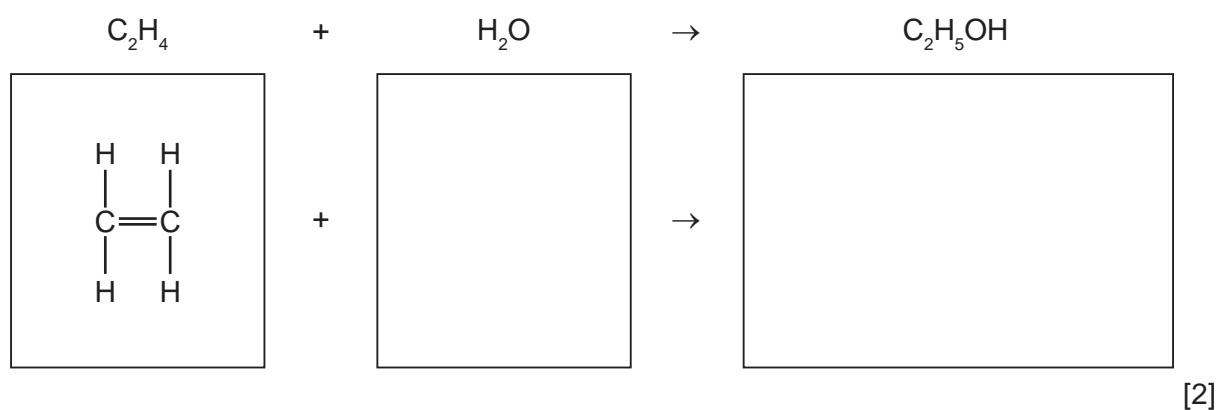
(a) (i) Complete the word equation for fermentation.

glucose \rightarrow + ethanol [1]

(ii) State the conditions needed for fermentation.

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

(b) (i) Complete the equation for the catalytic addition of steam to ethene by drawing the structures of water and ethanol in the boxes.



(ii) Ethene is an unsaturated hydrocarbon.
Describe a test for an unsaturated hydrocarbon.

test

result [2]

(c) Ethanol can be used as a fuel.

State the names of the products formed when ethanol undergoes complete combustion.

..... and [2]

(d) Complete these sentences using words from the list.

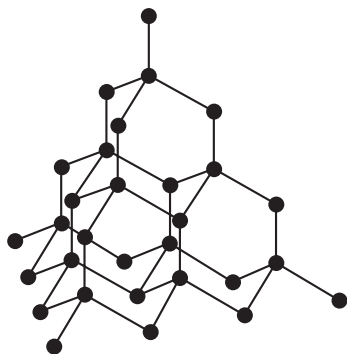
different functional homologous similar unreactive unsaturated

Ethanol is a member of the alcohol series.

All alcohols have chemical properties because they contain the same
..... group. [3]

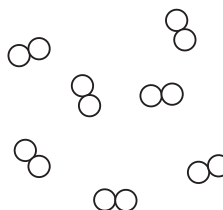
[Total: 12]

- 5 The structures of diamond and chlorine are shown below.



diamond

● = carbon atom



chlorine

○ = chlorine atom

- (a) Describe the structure of these two substances.
Use the list of words to help you.

covalent diatomic giant macromolecule molecule structure

diamond

.....

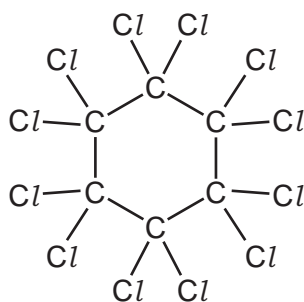
.....

chlorine

.....

..... [4]

- (b) The structure of a compound containing carbon and chlorine is shown below.



What is the molecular formula of this compound?

..... [1]

(c) Chlorine is a halogen.

(i) State the colour of chlorine.

..... [1]

The table shows some properties of the halogens.

element	boiling point/°C	density in liquid state/g per cm ³	colour
fluorine	-188	1.51	yellow
chlorine	-35	1.56	
bromine	-7		red-brown
iodine	+114	4.93	grey-black

Use the information in the table to answer the following questions.

(ii) Predict the density of liquid bromine.

..... [1]

(iii) Describe the trend in boiling point of the halogens down the group.

..... [1]

(d) (i) Complete the word equation for the reaction of bromine with aqueous potassium iodide.

bromine + potassium iodide → +

.....

[2]

(ii) Explain why bromine does **not** react with aqueous potassium chloride.

..... [1]

(e) Potassium chloride is an ionic substance but iodine is a molecular substance. How do most ionic and molecular substances differ in their

solubility in water,

.....

electrical conductivity?

..... [2]

[Total: 13]

6 Iron(II) sulfate is a light green salt.

(a) Describe how you can prepare pure dry crystals of iron(II) sulfate from iron powder and dilute sulfuric acid.

.....

.....

.....

.....

..... [3]

(b) The formula for iron(II) sulfate is $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$.

(i) What is the meaning of the symbol (II) in this formula?

..... [1]

(ii) Describe a test for iron(II) ions.

test

result [3]

(iii) A student warmed a sample of iron(II) sulfate, $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$, in a test-tube. Drops of a colourless liquid appeared at the mouth of the test-tube and the iron(II) sulfate turned white.

Explain these observations.

..... [1]

(iv) The reaction in part (iii) can be reversed.

Write down the symbol which shows that a reaction is reversible.

[1]

(c) Many centuries ago, sulfuric acid was made from iron(II) sulfate. Sulfuric acid is a typical acid.

(i) Describe what you would observe when sulfuric acid is added to

blue litmus paper,

iron powder. [2]

- (ii) Farmers can add a solution of dilute sulfuric acid to their fields if the soil is too alkaline.

Explain why farmers do **not** want their fields to become too alkaline.

..... [1]

- (iii) Which **one** of the following pH values best describes a solution which is slightly alkaline?

Put a ring around the correct answer.

pH 1

pH 6

pH 7

pH 8

pH 14

[1]

- (iv) Give the name of a compound which farmers add to the soil to make it less acidic.

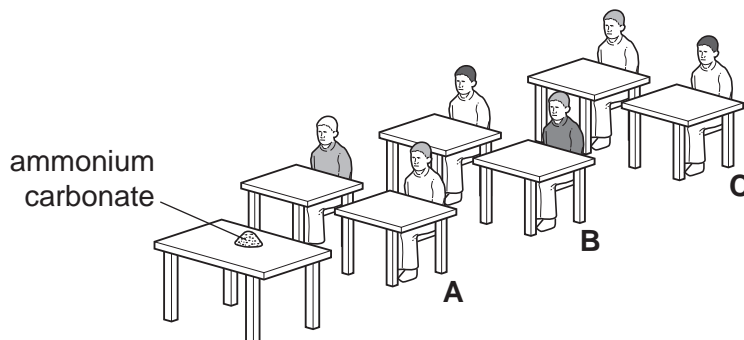
..... [1]

[Total: 14]

- 7 Smelling salts are sometimes used to 'wake up' people who feel faint. The main chemical in smelling salts is ammonium carbonate. Ammonium carbonate breaks down slowly at room temperature to release ammonia gas.



- (a) A few crystals of ammonium carbonate were put on a bench at the front of a classroom.



The students in row **A** could smell the ammonia 10 seconds after the smelling salts had been put on the bench. The students in row **C** could smell the ammonia after 40 seconds.

- (i) Suggest how long it took the students in row **B** to smell the ammonia.

..... [1]

- (ii) Explain these results using ideas about moving particles.

.....

.....

..... [3]

- (b) Ammonium carbonate has the formula $(\text{NH}_4)_2\text{CO}_3$. Calculate the relative formula mass of ammonium carbonate.

[1]

- (c) Ammonia is used to make fertilisers such as ammonium sulfate.

- (i) State the names of the **three** chemical elements, essential for plant growth, that are present in fertilisers.

..... [3]

- (ii) Which one of the following statements about ammonium sulfate is correct?
Tick **one** box.

When ammonium sulfate is heated with sodium hydroxide, carbon dioxide is given off.

When ammonium sulfate is added to a solution of barium chloride, a blue precipitate is formed.

Ammonium sulfate can be made by adding sulfuric acid to ammonia.

Farmers add ammonium sulfate to the soil to make it alkaline.

[1]

- (d) Ammonium carbonate is made by heating ammonium sulfate with excess calcium carbonate.

ammonium sulfate + calcium carbonate \rightarrow ammonium carbonate + calcium sulfate

When 132 g of ammonium sulfate is reacted with calcium carbonate, 96 g of ammonium carbonate is formed.

Calculate the mass of ammonium sulfate needed to make 240 g of ammonium carbonate.

[1]

[Total: 10]

