



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE
NAME

CENTRE
NUMBER

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CHEMISTRY

0620/23

Paper 2

May/June 2012

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 (a) Gases can be identified by carrying out particular tests. Some gases and tests to identify them are shown below.

Match the gases on the left with the tests on the right. The first one has been done for you.

| | |
|----------------|----------------------------------|
| sulfur dioxide | turns limewater milky |
| carbon dioxide | turns potassium dichromate green |
| chlorine | 'pops' with a lighted splint |
| oxygen | relights a glowing splint |
| hydrogen | bleaches damp litmus paper |

[4]

- (b) Chlorine can be prepared by heating hydrochloric acid with manganese(IV) oxide.



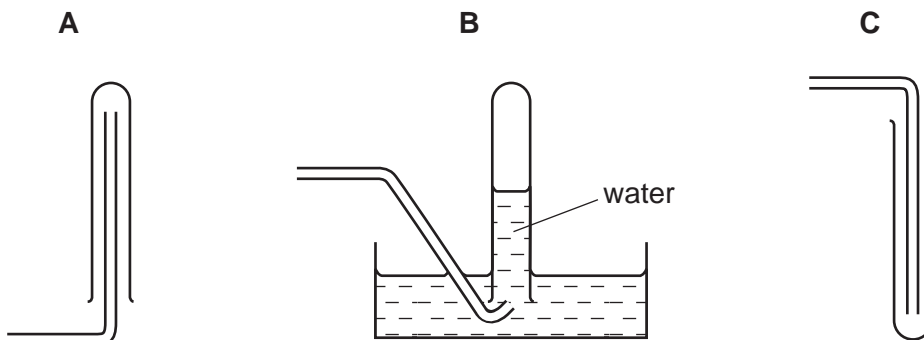
- (i) Write a word equation for this reaction.

[3]

(ii) Chlorine is

- denser than air
- soluble in water.

Which **one** of the following diagrams, **A**, **B** or **C**, best describes how chlorine gas is collected?



Answer = [1]

(c) Hydrogen reacts with oxygen to form water.

(i) Complete the equation for this reaction.



[2]

(ii) State **one** use of

hydrogen,

water. [2]

[Total: 12]

2 Alkalis are soluble bases.

(a) Which **one** of the following is alkaline?
Put a ring around the correct answer.

- | | |
|---------------------------------|----------------------------------|
| distilled water | hydrochloric acid |
| sodium chloride solution | sodium hydroxide solution |

[1]

(b) Suggest a pH value for a solution which is alkaline.

..... [1]

(c) Describe how you would find the pH of a solution.

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

(d) When excess fertilisers are put on the soil, the soil may become acidic.

(i) Why is it important to farmers that the soil does not become too acidic?

..... [1]

(ii) Calcium carbonate is used to decrease the acidity of the soil. Explain how calcium carbonate decreases soil acidity.

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

[Total: 7]

3 The table below shows some properties of the halogens.

| halogen | melting point/°C | boiling point/°C | colour |
|----------|------------------|------------------|---------------|
| chlorine | -101 | -35 | |
| bromine | -7 | +59 | |
| iodine | +114 | +184 | greyish-black |

(a) (i) Complete the spaces in the table to show the colours of chlorine and bromine. [2]

(ii) Room temperature is about 20 °C.
Use the information in the table to explain why

chlorine is a gas at room temperature,

.....

bromine is a liquid at room temperature.

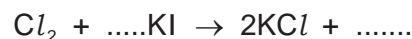
..... [2]

(iii) Astatine is the halogen below iodine in the Periodic Table.
Suggest a value for the melting point of astatine.

..... [1]

(b) Chlorine reacts with an aqueous solution of potassium iodide.

(i) Complete the balanced equation for this reaction.



[2]

(ii) State the names of the products of this reaction.

..... [2]

(iii) To which period in the Periodic Table does chlorine belong?

..... [1]

(c) Complete the following sentences about the test for iodide ions using words from the list below.

hydrochloric

nitric

potassium

precipitate

silver

solution

white

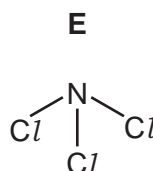
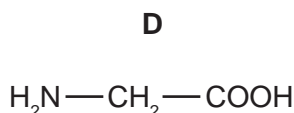
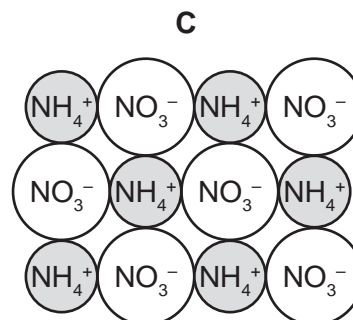
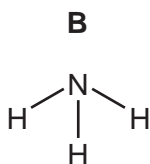
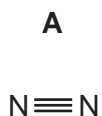
yellow

A small volume of solution containing aqueous iodide ions is put into a test-tube. Dilute
..... acid is added followed by a few drops of nitrate solution.

A coloured is formed if iodide ions are present. [4]

[Total: 14]

4 The diagram below shows the structure of some substances containing nitrogen.



- (a) (i) Which one of these substances, **A**, **B**, **C**, **D** or **E**, is an alkaline gas?
- (ii) Which one of these substances is an ionic salt?
- (iii) Which one of these substances contains a carboxylic acid functional group?

[3]

- (b) Oxides of nitrogen such as nitrogen dioxide, NO_2 , are atmospheric pollutants. Give **one** source of nitrogen oxides in the air.

..... [1]

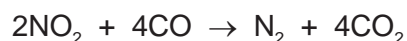
- (c) State **one** harmful effect of nitrogen dioxide.

..... [1]

- (d) Calculate the relative formula mass of nitrogen dioxide, NO_2 .

[1]

- (e) In the presence of a catalyst, nitrogen dioxide reacts with carbon monoxide.



- (i) Which substance gets oxidised during this reaction? Explain your answer.

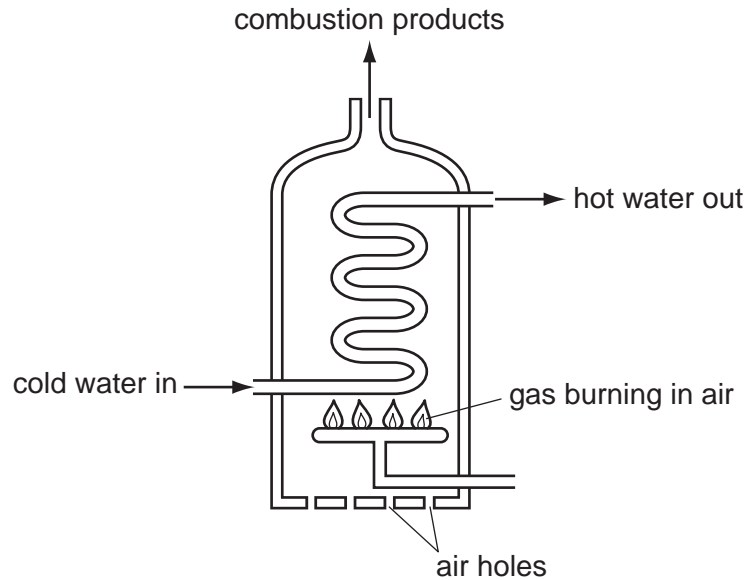
.....

..... [2]

(ii) What is the meaning of the term *catalyst*?

..... [1]

(iii) Carbon monoxide is formed when some of the air holes in a water heater get blocked. The diagram shows a water heater.



Explain why carbon monoxide is formed when some of the air holes in a water heater get blocked.

..... [2]

(iv) Explain why carbon monoxide is dangerous.

..... [1]

[Total: 12]

5 Iron is a shiny metallic solid. Iron is a transition element.

(a) State **three** other physical properties of a transition element.

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

(b) Iron reacts with sulfuric acid.



(i) Write a word equation for this reaction.

..... [2]

(ii) Describe, with the aid of a diagram, how you could measure the speed of this reaction.

In your answer describe:

- the apparatus you would use
- the measurements you would take.

.....
.....
.....
..... [4]

(c) When iron reacts with sulfur, energy is released.

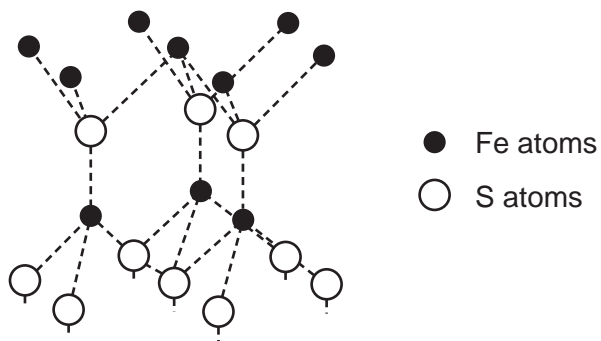
(i) What is the name given to a reaction which releases energy?

..... [1]

- (ii) The compound formed in this reaction is iron(II) sulfide.
What do you understand by the term *compound*?

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

- (iii) The diagram below shows the structure of iron(II) sulfide.

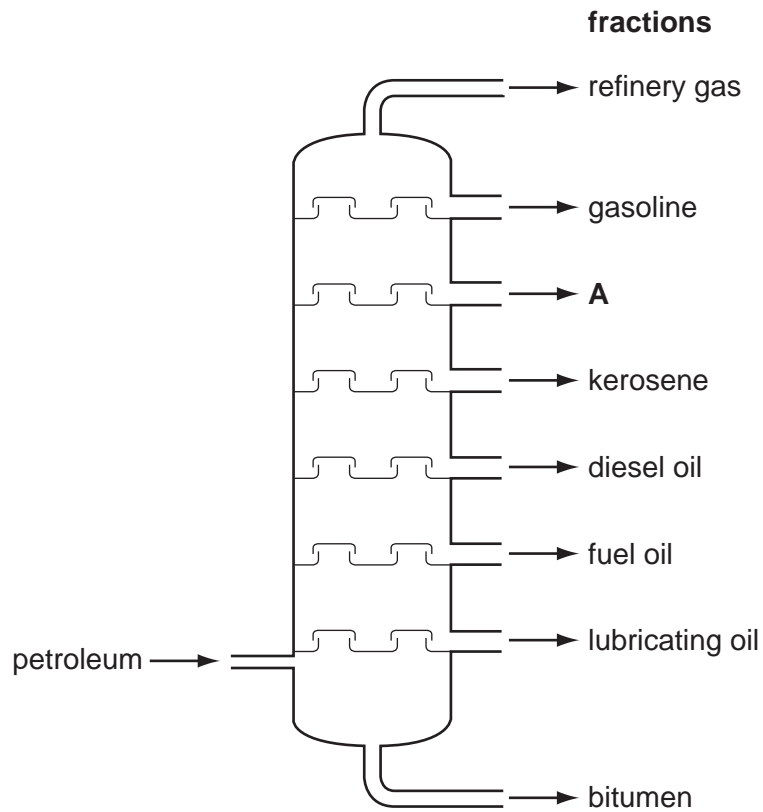


What is the simplest formula for iron(II) sulfide?

..... [1]

[Total: 12]

- 6 The diagram shows a fractionating column used to separate different hydrocarbon fractions in an oil refinery.



- (a) On the diagram, draw an X to show the place in the column where the temperature is the highest. [1]

- (b) State the name of the fraction labelled **A**.
..... [1]

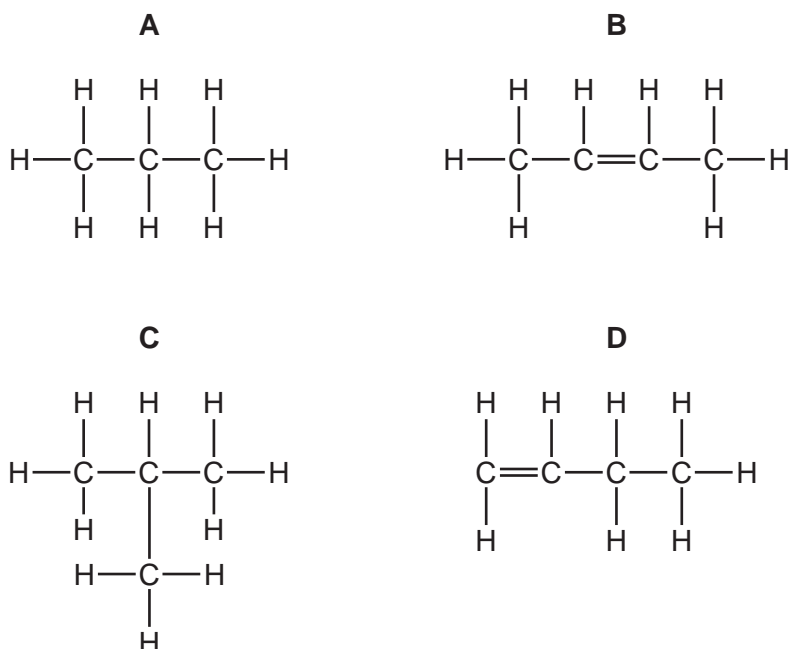
- (c) State a use for
the kerosene fraction,
the diesel oil fraction. [2]

- (d) Complete the following sentences about fractional distillation using words from the list below.

boiling condenses cooled heated higher
lower melting mixture pressure vaporises

Petroleum is a of hydrocarbons. This mixture is and the hydrocarbons vaporise. The temperature in the fractionating column is at the top than at the bottom. As the vapours move up the column, each hydrocarbon fraction when the temperature in the column falls below the point of the hydrocarbon fraction. [5]

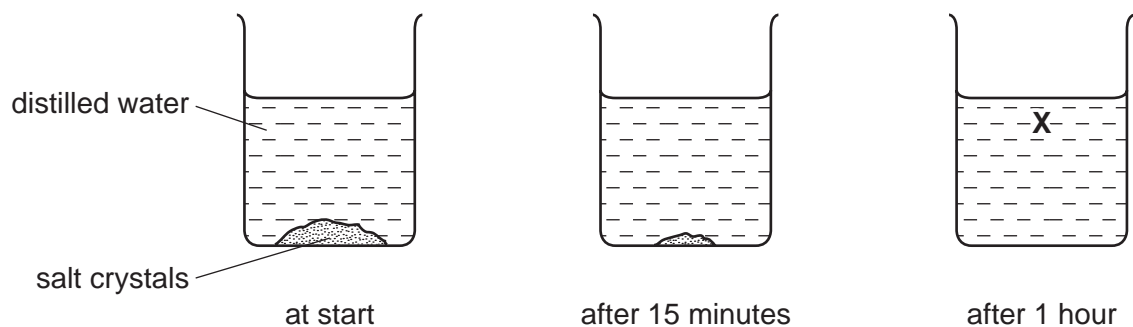
- (e) The structures of four hydrocarbons, **A**, **B**, **C** and **D**, are shown below.



- (i) Which **two** of these structures **A**, **B**, **C** or **D** have the same relative molecular mass?
..... and [1]
- (ii) Which **two** of these structures **A**, **B**, **C** or **D** will decolourise aqueous bromine?
..... and [2]

[Total: 12]

- 7 A student placed some crystals of salt at the bottom of a beaker of distilled water. She left the contents of the beaker to stand for one hour. The diagram below shows her observations.



After one hour, all the salt had disappeared but the solution at point **X** tasted salty.

- (a) Use the kinetic particle theory to explain these observations.

.....

.....

.....

.....

.....

..... [4]

- (b) Salt is sodium chloride, NaCl .

- (i) Which one of the following statements about bond formation in sodium chloride is true?

Tick **one** box.

A sodium atom shares one electron with a chlorine atom.

A sodium atom loses its outermost electron and a chlorine atom gains an electron.

A sodium atom shares two electrons with a chlorine atom.

A sodium atom gains an electron and a chlorine atom loses its outermost electrons.

[1]

(ii) Explain why solid sodium chloride does not conduct electricity but molten sodium chloride does conduct.

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

(iii) State the name of the product formed at each electrode when a concentrated aqueous solution of sodium chloride is electrolysed using graphite electrodes.

at the positive electrode
at the negative electrode [2]

(iv) What is the name of the negative electrode?
Put a ring around the correct answer.

anion anode cation cathode electrolyte [1]

(v) Suggest why graphite is a suitable material for an electrode.

..... [1]

[Total: 11]

DATA SHEET
The Periodic Table of the Elements

| Group | | I | II | III | IV | V | VI | VII | 0 | | | | | | | |
|-------|----|--------------------------------|------------------------------|-----|-------------------------------|------------------------------|-------------------------------|------------------------------|-------------------------------|------------------------------|------------------------------|------------------------------|-------------------------------|------------------------------|------------------------------|------------------------------|
| | | 1 H Hydrogen 1 | | | | | | | 2 He Helium 2 | | | | | | | |
| 3 | 4 | 7 Li Lithium | 9 Be Beryllium | | 11 B Boron | 12 C Carbon | 13 Al Aluminium | 14 Si Silicon | 15 P Phosphorus | 16 S Sulfur | 17 Cl Chlorine | 18 Ar Argon | | | | |
| 11 | 12 | 23 Na Sodium | 24 Mg Magnesium | | 27 Fe Iron | 28 Ni Nickel | 29 Cu Copper | 30 Zn Zinc | 31 Ga Gallium | 32 Ge Germanium | 33 As Arsenic | 34 Se Selenium | 35 Br Bromine | 36 Kr Krypton | | |
| 19 | 20 | 39 K Potassium | 40 Ca Calcium | | 44 Ru Ruthenium | 45 Rh Rhodium | 46 Pd Palladium | 47 Ag Silver | 48 Cd Cadmium | 49 In Indium | 50 Sn Tin | 51 Sb Antimony | 52 Te Tellurium | 53 I Iodine | 54 Xe Xenon | |
| 37 | 38 | 85 Rb Rubidium | 88 Sr Strontium | | 101 Ru Ruthenium | 102 Rh Rhodium | 103 Pd Palladium | 104 Ag Silver | 105 Cd Cadmium | 106 In Indium | 107 Sn Tin | 108 Sb Antimony | 109 Te Tellurium | 110 I Iodine | 111 Xe Xenon | |
| 55 | 56 | 133 Cs Caesium | 137 Ba Barium | | 186 Re Rhenium | 187 Rh Rhodium | 188 Pt Platinum | 189 Au Gold | 190 Hg Mercury | 191 Tl Thallium | 192 Pb Lead | 193 Bi Bismuth | 194 Po Polonium | 195 At Astatine | 196 Rn Radon | |
| 87 | 88 | 226 Fr Francium | 226 Ra Radium | | 227 Ac Actinium | 227 Ac Actinium | 227 Ac Actinium | 227 Ac Actinium | 227 Ac Actinium | 227 Ac Actinium | 227 Ac Actinium | 227 Ac Actinium | 227 Ac Actinium | 227 Ac Actinium | 227 Ac Actinium | 227 Ac Actinium |

| | | | | | | | | | | | | |
|-----------------------------|----------------------------------|-------------------------------|-------------------------------|-------------------------------|--------------------------------|--------------------------------|---------------------------------|---------------------------------|-----------------------------|---------------------------------|------------------------------|--------------------------------|
| 140 Ce Cerium | 141 Pr Praseodymium | 144 Nd Neodymium | 150 Sm Samarium | 152 Eu Europium | 157 Gd Gadolinium | 162 Dy Dysprosium | 165 Ho Holmium | 167 Er Erbium | 169 Tm Thulium | 173 Yb Ytterbium | 175 Lu Lutetium | |
| 232 Th Thorium | 232 Pa Protactinium | 238 U Uranium | 238 Pu Plutonium | 238 Am Americium | 238 Cm Curium | 238 Bk Berkelium | 238 Cf Californium | 238 Es Einsteinium | 238 Fm Fermium | 238 Md Mendelevium | 238 No Nobelium | 238 Lr Lawrencium |

| | | |
|---|---|---|
| a | X | b |
|---|---|---|

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