



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

0620/02

Paper 2

October/November 2007

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 **16** printed pages.



1 Some oxides are listed below.

calcium oxide
carbon dioxide
carbon monoxide
phosphorus trioxide
sodium oxide
sulphur dioxide
water

(a) Which one of these oxides is most likely to contribute to acid rain?

..... [1]

(b) Which one of these oxides is a product of the reaction between an acid and a carbonate?

..... [1]

(c) Which one of these oxides is formed by the incomplete combustion of carbon?

..... [1]

(d) Which one of these oxides is a good solvent?

..... [1]

(e) Which one of these oxides is used to neutralise acidic industrial waste products?

..... [1]

(f) Which **two** of these oxides reacts with water to form an alkaline solution?

..... [1]

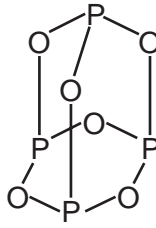
(g) Complete the diagram to show the electronic structure of water.
show hydrogen electrons by 'o'
show oxygen electrons by 'x'



H H

[1]

(h) The structure of phosphorus trioxide is shown below.

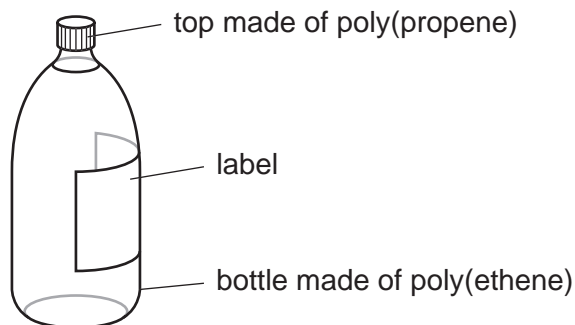


Write the **simplest** formula for phosphorus trioxide.

..... [1]

[Total: 8]

2 The diagram shows a bottle of mineral water.



(a) The poly(propene) top is made by polymerising propene molecules, $\text{CH}_3\text{CH}=\text{CH}_2$.

(i) Which one of the following best describes the propene molecules in this reaction?
Put a ring around the correct answer.

alkanes monomers polymers products salts

[1]

(ii) State the name of the homologous series to which propene belongs.

..... [1]

(iii) Propene is an unsaturated hydrocarbon.
State the meaning of the following terms.

unsaturated

.....

hydrocarbon

..... [2]

(iv) Describe a chemical test to distinguish between an unsaturated hydrocarbon and a saturated hydrocarbon. State the results.

test

result with saturated hydrocarbon

result with unsaturated hydrocarbon [3]

- (b) The poly(ethene) bottle is made by polymerising ethene.



Complete the following sentence about this reaction by filling in the blank space.

The formation of poly(ethene) is an example of an polymerisation reaction. [1]

- (c) The label on the bottle lists the concentration of ions dissolved in the water in milligrams per litre.

| concentration of ions in milligrams per litre | | | |
|-----------------------------------------------|-----|-----------|-----|
| calcium | 32 | nitrate | 1 |
| chloride | 5 | potassium | 0.5 |
| hydrogencarbonate | 133 | sodium | 4.5 |
| magnesium | 8 | sulphate | 7 |

- (i) State the name of **two** negative ions which appear in this list.
..... [1]
- (ii) Which metal ion in this list is present in the highest concentration?
..... [1]
- (iii) Calculate the amount of magnesium ions in 5 litres of this mineral water.
..... [1]
- (iv) Which ion in the list reacts with aqueous silver nitrate to give a white precipitate?
..... [1]
- (v) Which ion in the list gives off ammonia when warmed with sodium hydroxide and aluminium foil?
..... [1]
- (vi) Complete the equation to show the formation of a potassium ion from a potassium atom.



- (d) The pH of the mineral water is 7.8.
Which one of the following best describes this pH?
Tick one box.

slightly acidic

slightly alkaline

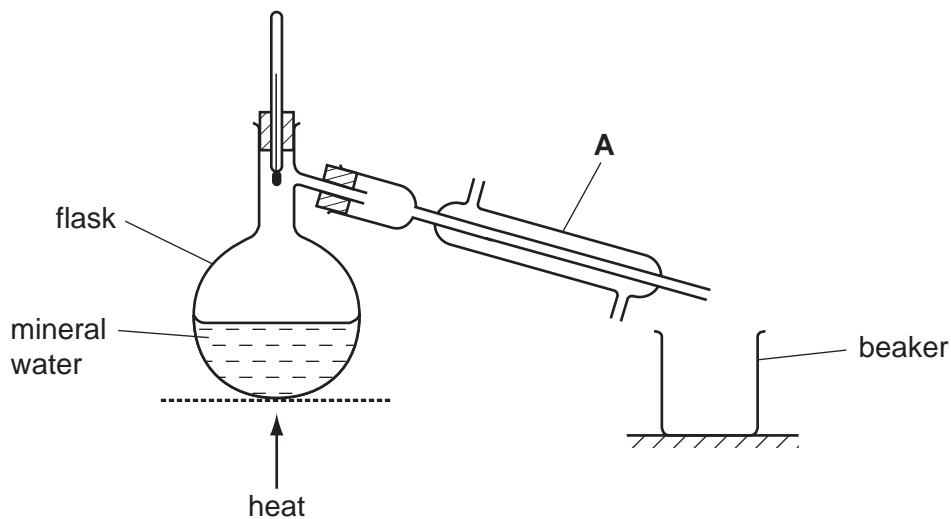
neutral

very acidic

very alkaline

[1]

- (e) Pure water can be obtained by distilling the mineral water using the apparatus shown below.



- (i) State the name of the piece of apparatus labelled **A**.

..... [1]

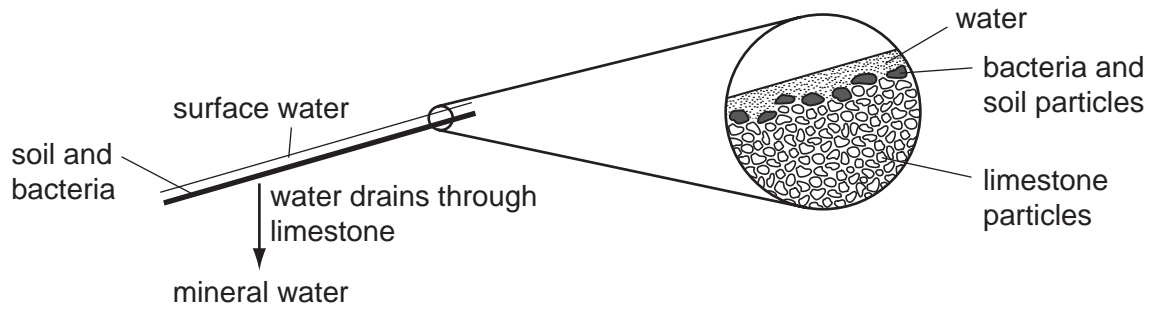
- (ii) Where does the pure water collect?

..... [1]

- (iii) How does the boiling point of the mineral water in the flask compare with the boiling point of pure water?

..... [1]

- (f) The diagram shows how mineral water is formed. Mineral water contains no bacteria or particles of earth.



Use the diagram to explain how the water is purified from bacteria and particles of earth.

.....

..... [2]

[Total: 20]

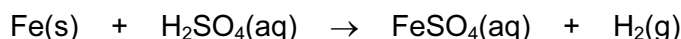
3 This question is about metals.

(a) Match up the metals in the boxes on the left with the descriptions in the boxes on the right. The first one has been done for you.

| | |
|-----------|-----------------------------------------|
| silver | a metal used to make aircraft bodies |
| aluminium | a metal used in jewellery |
| potassium | a metal extracted from haematite |
| platinum | a very soft metal |
| iron | an unreactive metal used for electrodes |

[4]

(b) Iron powder reacts rapidly with sulphuric acid to form aqueous iron(II) sulphate and hydrogen.



Describe **two** things that you would see happening as this reaction takes place.

.....
 [2]

(c) Alloys are often more useful than pure metals.

(i) Complete the following sentences by filling in the blank spaces.

An alloy is a of a metal with other elements. The properties of can be changed by the controlled use of additives to form steel alloys. Increasing the amount of carbon in a steel makes it [3]

(ii) Name one other alloy apart from steel.

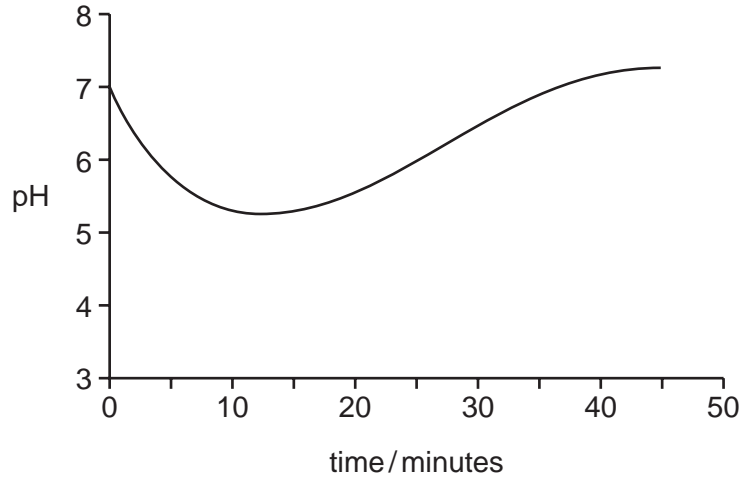
..... [1]

(iii) Iron rusts very easily. Describe two methods of preventing rusting.

1.
 2. [2]

[Total:12]

- 4 The diagram shows the changes in pH in a student's mouth after she has eaten a sweet.



- (a) Describe how the acidity in the student's mouth changes after she has eaten the sweet.

.....
 [2]

- (b) (i) Chewing a sweet stimulates the formation of saliva. Saliva is slightly alkaline. Use this information to explain the shape of the graph.

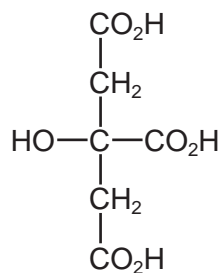
.....

 [2]

- (ii) State the name of the type of reaction which occurs when an acid reacts with an alkali.

..... [1]

- (c) Many sweets contain citric acid. The formula of citric acid is shown below.



- (i) Put a ring around the alcohol functional group on the above formula. [1]

- (ii) State the name of the $-\text{CO}_2\text{H}$ functional group in citric acid.

..... [1]

- (iii) Ethanoic acid also has a $-\text{CO}_2\text{H}$ functional group. Write down the formula for ethanoic acid.

..... [1]

(d) Citric acid can be extracted from lemon juice as follows:

- stage 1: add calcium carbonate to hot lemon juice
- stage 2: filter off the precipitate which is formed (calcium citrate)
- stage 3: wash the calcium citrate precipitate with water
- stage 4: add sulphuric acid to the calcium citrate to make a solution of citric acid
- stage 5: crystallise the citric acid

(i) When calcium carbonate is added to lemon juice a fizzing is observed.
Explain why there is a fizzing.

..... [1]

(ii) Draw a diagram to show step 2. Label your diagram.

[2]

(iii) Suggest why the calcium citrate precipitate is washed with water.

..... [1]

(iv) Describe how you would carry out step 5.

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

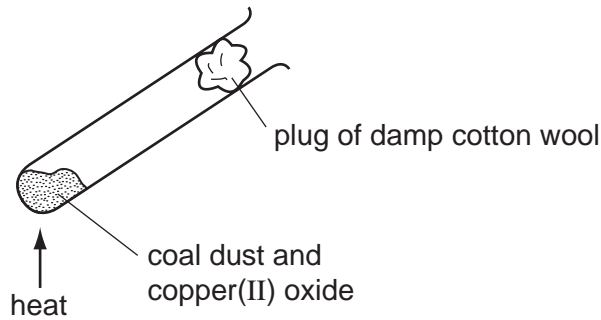
(v) Nowadays, citric acid is usually made by the fermentation of sugars.
Which one of the following is required for fermentation?
Put a ring around the correct answer.

- acid high temperature light microorganisms nitrogen**

[1]

[Total: 14]

5 Some coal dust was heated with copper(II) oxide using the apparatus shown below.



(a) Coal contains carbon and various hydrocarbons. The carbon reduces the copper(II) oxide when heated.

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

..... [1]

(ii) At the end of the experiment a reddish-brown solid remained in the tube. State the name of this reddish-brown solid.

..... [1]

(iii) The reddish brown solid conducts electricity. How could you show that it conducts electricity?

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

(b) During the experiment, water collected on the cooler parts of the test tube.

(i) Suggest where the hydrogen in the water comes from.

..... [1]

(ii) Water is a liquid. Describe the arrangement and motion of the particles in a liquid.

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

[Total: 7]

- 6 The table below shows an early form of the Periodic Table made by John Newlands in 1866.

| | | | | |
|----|----|----|--------|----|
| H | F | Cl | Co, Ni | Br |
| Li | Na | K | Cu | Rb |
| Be | Mg | Ca | Zn | Sr |
| B | Al | Cr | Y | |
| C | Si | Ti | In | |
| N | P | Mn | As | |
| O | S | Fe | Sc | |

- (a) Newlands arranged the elements according to their relative atomic masses. What governs the order of the elements in the modern Periodic Table?

..... [1]

- (b) Use your modern Periodic Table to suggest why Newlands put cobalt and nickel in the same place.

..... [1]

- (c) Which group of elements is missing from Newlands' table?

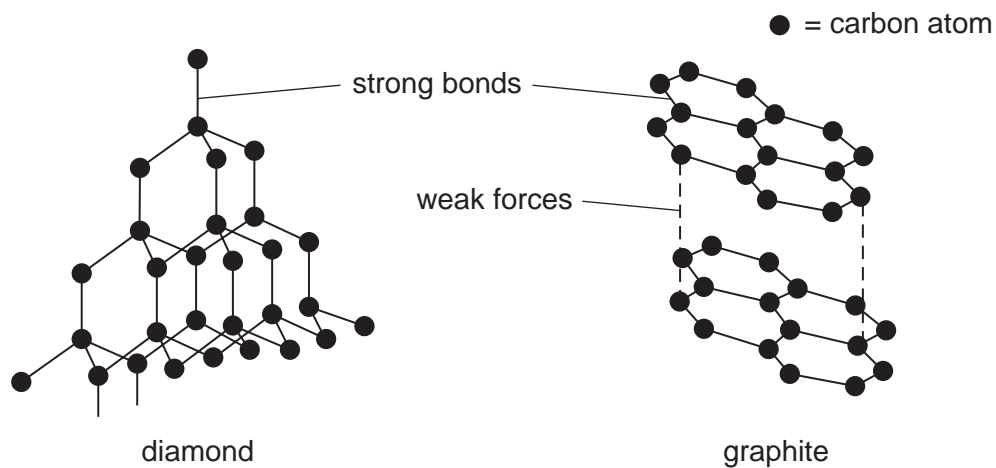
..... [1]

- (d) Describe **three other** differences between Newlands' table and the modern Periodic Table. You must not give any of the answers you mentioned in parts (a), (b) or (c).

.....

 [3]

(e) Carbon exists in two forms, graphite and diamond.



Use ideas about structure and bonding to suggest

(i) why graphite is used as a lubricant,

..... [1]

(ii) why diamond is very hard.

..... [1]

[Total: 8]

- 7 Compounds and elements vary in their volatility, solubility in water and electrical conductivity depending on their bonding.

(a) Place copper, methane and water in order of their volatility.

| | | |
|----------------|---|--|
| most volatile | → | |
| | | |
| least volatile | → | |

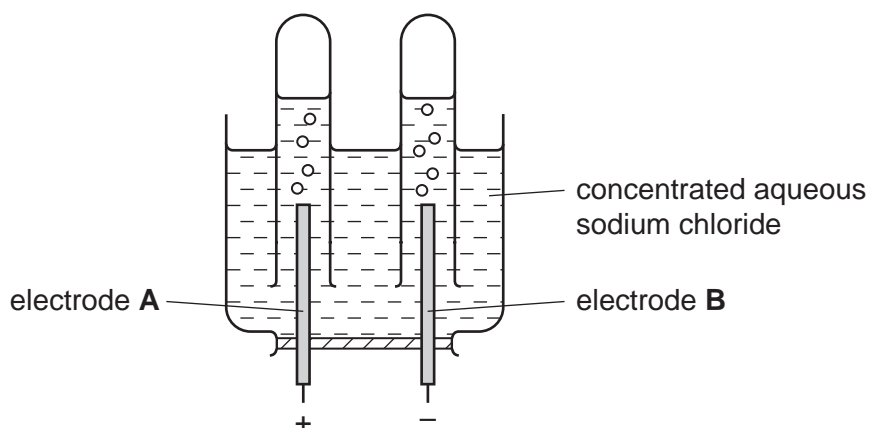
[1]

(b) Complete the table to show the solubility in water and electrical conductivity of various solids.

| solid | structure | soluble or insoluble | does it conduct electricity? |
|-----------------|-----------|----------------------|------------------------------|
| silver | metallic | insoluble | |
| sodium chloride | ionic | | no |
| sulphur | covalent | | no |
| copper sulphate | ionic | soluble | |

[4]

(c) The apparatus shown below is used to electrolyse concentrated aqueous sodium chloride.



(i) Suggest a suitable substance which could be used for the electrodes.

..... [1]

(ii) State the name of the gas given off

at electrode **A**,

at electrode **B**. [2]

(iii) State the name given to electrode **A**.

..... [1]

(iv) Explain why aqueous sodium chloride conducts electricity but solid sodium chloride does not.

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

[Total: 11]

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DATA SHEET
The Periodic Table of the Elements

| | | Group | | | | | | | | | | | |
|-----------------------------------|------------------------------------|------------------------------------|------------------------------------|------------------------------------|-------------------------------------|-------------------------------------|-----------------------------------|------------------------------------|--------------------------------|------------------------------------|------------------------------------|------------------------------------|----------------------------------------|
| I | II | III | IV | V | VI | VII | 0 | | | | | | 0 |
| | | 1 H Hydrogen 1 | | | | | | | | | | | 4 He Helium 2 |
| 7 Li Lithium 3 | 9 Be Beryllium 4 | | | | | | | | | | | 20 Ne Neon 10 | |
| 23 Na Sodium 11 | 24 Mg Magnesium 12 | 27 Al Aluminium 13 | 28 Si Silicon 14 | 31 P Phosphorus 15 | 32 S Sulphur 16 | 35.5 Cl Chlorine 17 | 40 Ar Argon 18 | | | | | | 84 Kr Krypton 36 |
| 39 K Potassium 19 | 40 Ca Calcium 20 | 70 Ga Gallium 31 | 73 Ge Germanium 32 | 75 As Arsenic 33 | 79 Se Selenium 34 | 80 Br Bromine 35 | 131 Xe Xenon 54 | | | | | | 227 Ac Actinium 89 |
| 85 Rb Rubidium 37 | 88 Sr Strontium 38 | 65 Zn Zinc 30 | 64 Cu Copper 29 | 59 Ni Nickel 28 | 106 Pd Palladium 46 | 108 Ag Silver 47 | 112 Cd Cadmium 48 | 115 In Indium 49 | 119 Sn Tin 50 | 122 Sb Antimony 51 | 127 I Iodine 53 | 209 Po Polonium 84 | 87 Fr Francium 87 |
| 133 Cs Caesium 55 | 137 Ba Barium 56 | 201 Hg Mercury 80 | 197 Au Gold 79 | 195 Pt Platinum 78 | 199 Os Osmium 76 | 192 Ir Iridium 77 | 201 Hg Mercury 80 | 204 Tl Thallium 81 | 207 Pb Lead 82 | 209 Bi Bismuth 83 | 210 At Astatine 85 | 226 Ra Radium 88 | 86 Rn Radon 86 |
| | | | | | | | | | | | | | 175 Lu Lutetium 71 |
| | | | | | | | | | | | | | 103 Lr Lawrencium 103 |
| | | | | | | | | | | | | | 102 No Nobelium 102 |
| | | | | | | | | | | | | | 101 Md Mendelevium 101 |
| | | | | | | | | | | | | | 100 Fm Fermium 100 |
| | | | | | | | | | | | | | 99 Es Einsteinium 99 |
| | | | | | | | | | | | | | 98 Cf Californium 98 |
| | | | | | | | | | | | | | 97 Bk Berkelium 97 |
| | | | | | | | | | | | | | 96 Cm Curium 96 |
| | | | | | | | | | | | | | 95 Am Americium 95 |
| | | | | | | | | | | | | | 64 Gd Gadolinium 64 |
| | | | | | | | | | | | | | 63 Eu Europium 63 |
| | | | | | | | | | | | | | 62 Sm Samarium 62 |
| | | | | | | | | | | | | | 61 Pm Promethium 61 |
| | | | | | | | | | | | | | 60 Nd Neodymium 60 |
| | | | | | | | | | | | | | 59 Pr Praseodymium 59 |
| | | | | | | | | | | | | | 58 Ce Cerium 58 |
| | | | | | | | | | | | | | 94 Pu Plutonium 94 |
| | | | | | | | | | | | | | 93 Np Neptunium 93 |
| | | | | | | | | | | | | | 92 U Uranium 92 |
| | | | | | | | | | | | | | 91 Pa Protactinium 91 |
| | | | | | | | | | | | | | 90 Th Thorium 90 |
| | | | | | | | | | | | | | 89 Ac Actinium 89 |

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

| | | | |
|-----|--|---|--|
| a | | X | |
| Key | | 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.).