



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]

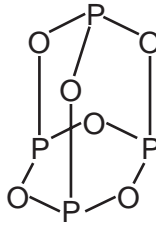
(g) Complete the diagram to show the electronic structure of water.
show hydrogen electrons by 'o'
show oxygen electrons by 'x'



H H

[1]

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

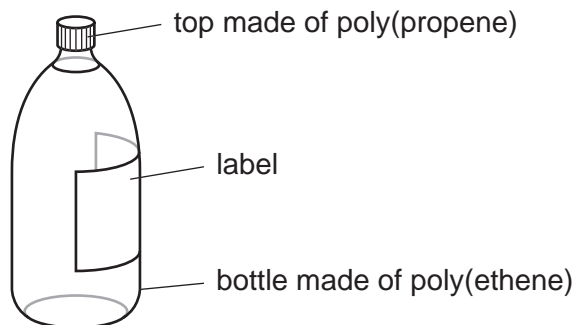


Write the **simplest** formula for phosphorus trioxide.

..... [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

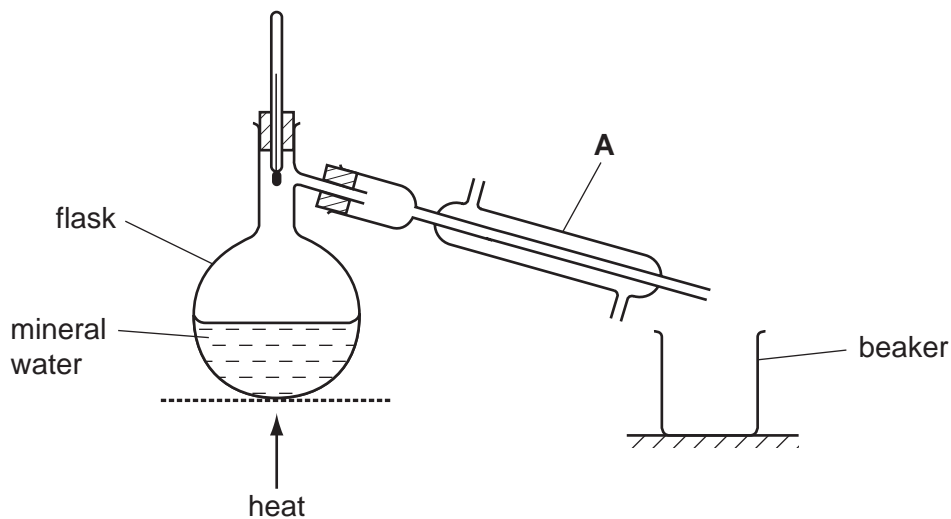
neutral

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]

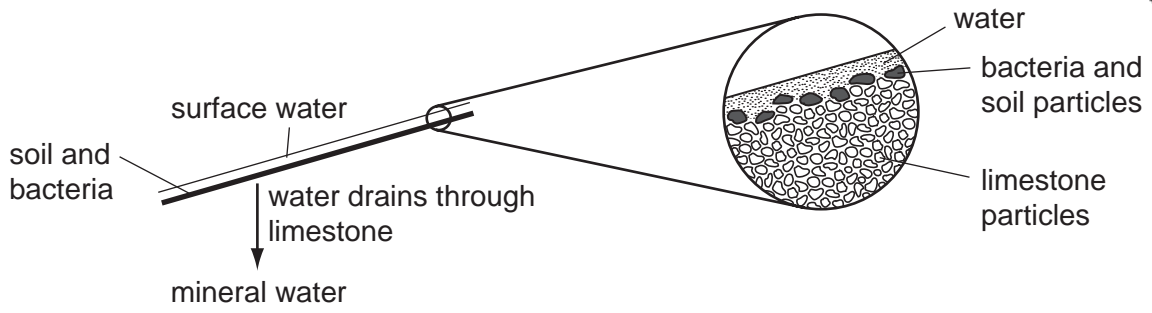
- (ii) Where does the pure water collect?

..... [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 and no particles of earth.



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

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

[Total: 20]

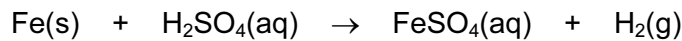
3 This question is about metals.

(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.

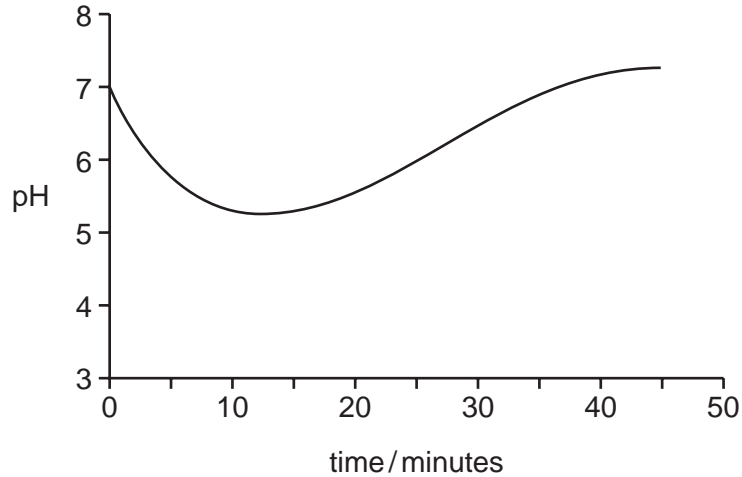
..... [1]

(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.

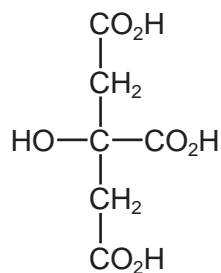
.....

 [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]

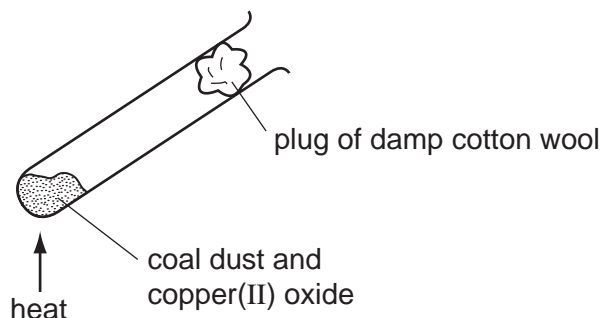
(v) Nowadays, citric acid is usually made by the fermentation of sugars. Which one of the following is required for fermentation? Put a ring around the correct answer.

- 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?

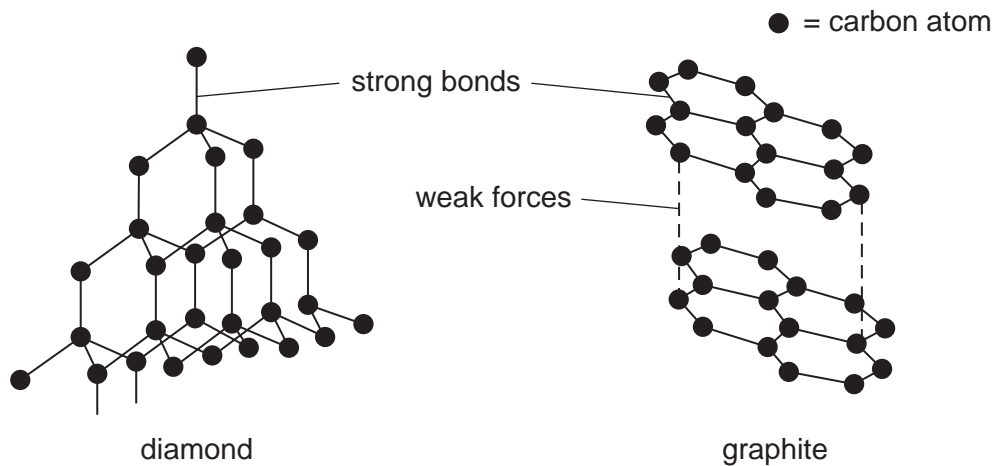
..... [1]

- (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	→	

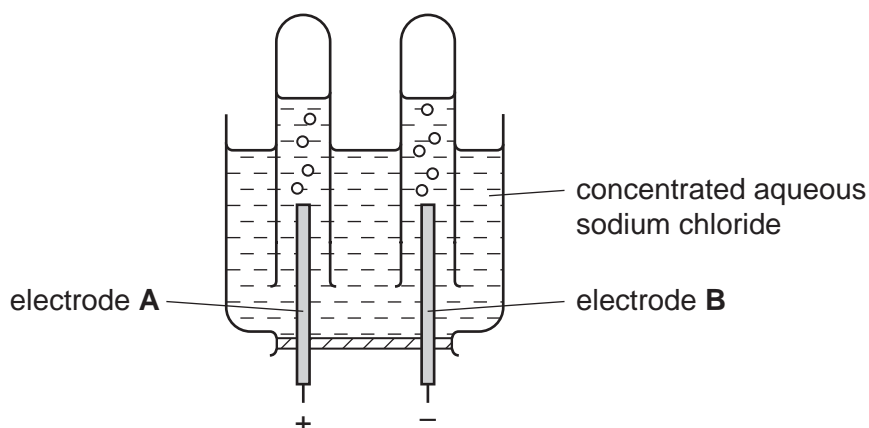
[1]

(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.



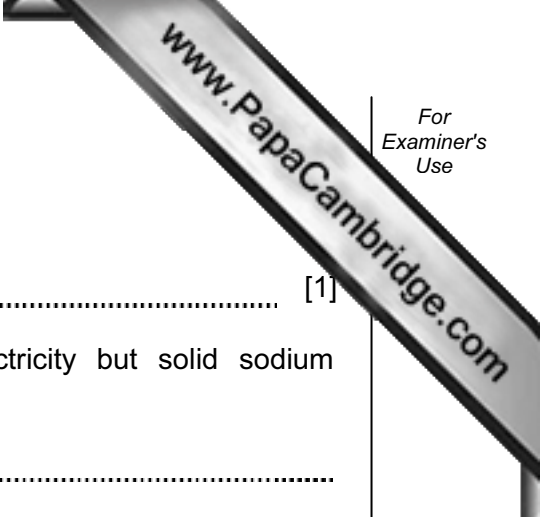
(i) Suggest a suitable substance which could be used for the electrodes.

..... [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]

DATA SHEET The Periodic Table of the Elements

		Group																				
I	II	III	IV	V	VI	VII	0															
		1 H Hydrogen 1																				
7 Li Lithium 3	9 Be Beryllium 4	11 B Boron 5	12 C Carbon 6	13 Al Aluminium 13	14 Si Silicon 14	15 P Phosphorus 15	16 S Sulphur 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											
39 K Potassium 19	40 Ca Calcium 20	45 Sc Scandium 21	46 Ti Titanium 22	47 V Vanadium 23	48 Cr Chromium 24	49 Mn Manganese 25	50 Fe Iron 26	51 Ni Nickel 28	52 Cu Copper 29	53 Zn Zinc 30	54 Ga Gallium 31	55 Ge Germanium 32	56 As Arsenic 33	57 Se Selenium 34	58 Br Bromine 35	59 Kr Krypton 36						
87 Fr Francium	88 Ra Radium	89 Ac Actinium																				

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

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

140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	146 Pm Promethium 61	150 Sm Samarium 62	152 Eu Europium 63	157 Gd Gadolinium 64	162 Dy Dysprosium 66	165 Ho Holmium 67	167 Er Erbium 68	169 Tm Thulium 69	173 Yb Ytterbium 70	175 Lu Lutetium 71	
232 Th Thorium 90	232 Pa Protactinium 91	238 U Uranium 92	238 Np Neptunium 93	238 Pu Plutonium 94	242 Am Americium 95	244 Cm Curium 96	247 Bk Berkelium 97	247 Cf Californium 98	251 Es Einsteinium 99	252 Fm Fermium 100	256 Md Mendelevium 101	259 No Nobelium 102	261 Lr Lawrencium 103

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