

Centre Number	Candidate Number	Name
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UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CHEMISTRY

0620/02

Paper 2

October/November 2004

1 hour 15 minutes

Candidates answer on the Question Paper.
No Additional Materials required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen in the spaces provided on the Question Paper.
You may use a pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.
You may use a calculator.

Answer **all** questions.
The number of marks is given in brackets [] at the end of each question or part question.
A copy of the Periodic Table is provided on page 16.

For Examiner's Use

1	
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3	
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Total	

If you have been given a label, look at the details. If any details are incorrect or missing, please fill in your correct details in the space given at the top of this page.

Stick your personal label here, if provided.

This document consists of **15** printed pages and **1** blank page.

- 1 The table below gives some information about the elements in Group I of the Periodic Table.

<i>element</i>	<i>boiling point / °C</i>	<i>density / g cm⁻³</i>	<i>radius of atom in the metal / nm</i>	<i>reactivity with water</i>
lithium	1342	0.53	0.157	
sodium	883	0.97	0.191	rapid
potassium	760	0.86	0.235	very rapid
rubidium		1.53	0.250	extremely rapid
caesium	669	1.88		explosive

- (a) How does the density of the Group I elements change down the Group?

..... [2]

- (b) Suggest a value for the boiling point of rubidium.

..... [1]

- (c) Suggest a value for the radius of a caesium atom.

..... [1]

- (d) Use the information in the table to suggest how fast lithium reacts with water compared with the other Group I metals.

..... [1]

- (e) State three properties shown by **all** metals.

1.

2.

3. [3]

- (f) When sodium reacts with water, hydrogen is given off.



- (i) State the name of the other product formed in this reaction.

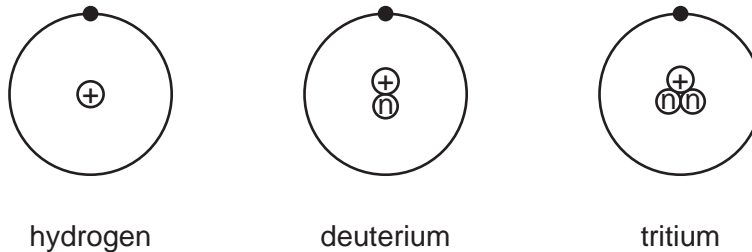
..... [1]

- (ii) Describe a test for hydrogen.

test

result [2]

- (g) The diagrams below show three types of hydrogen atom.



- (i) State the name of the positively charged particle in the nucleus.

..... [1]

- (ii) What is the name given to atoms with the same number of positive charges in the nucleus but different numbers of neutrons?

..... [1]

- (iii) State the number of nucleons in a single atom of tritium.

..... [1]

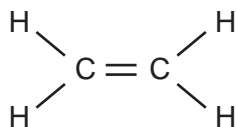
- (iv) Tritium is a radioactive form of hydrogen.

State **one** medical use of radioactivity.

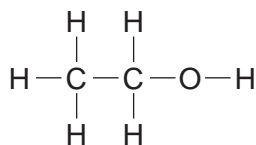
..... [1]

2 The structures of some compounds found in plants are shown below.

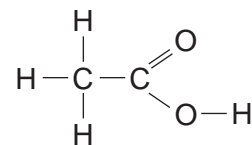
A



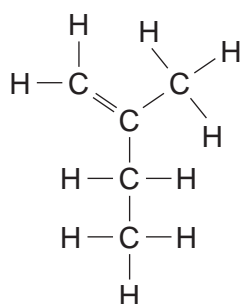
B



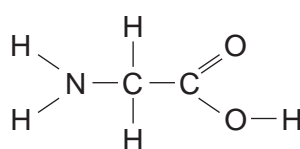
C



D



E



(a) Which **two** of these compounds are unsaturated hydrocarbons?

..... [1]

(b) Which **two** of these compounds contain a carboxylic acid functional group?

..... [1]

(c) Write the molecular formula for compound **D**.

..... [1]

(d) Draw the structure of the product formed when compound **A** reacts with bromine.

Show all atoms and all bonds.

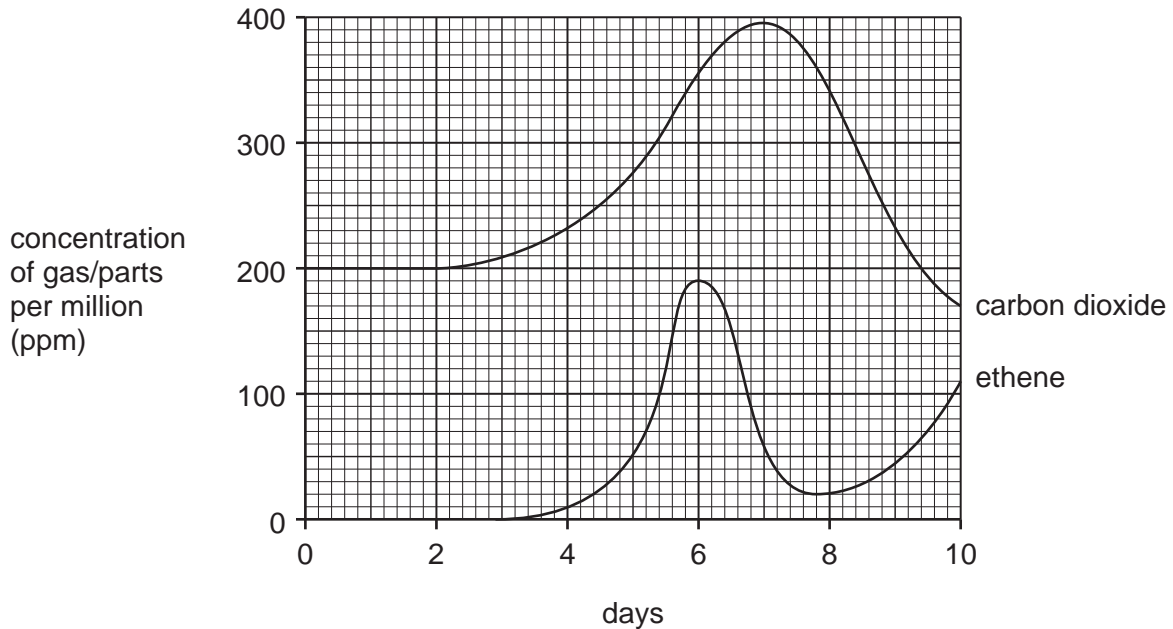
[1]

- (e) Strawberry fruits produce compound **A** (ethene) naturally.

A scientist left some green strawberry fruits to ripen.

The scientist measured the concentration of ethene and carbon dioxide produced by the strawberry fruits over a ten day period.

The graph below shows the results.



- (i) Between which two days does the rate of ethene production increase most rapidly?

..... [1]

- (ii) What is the name given to the process in which carbon dioxide is produced by living organisms?

Put a ring around the correct answer.

acidification **combustion** **neutralization** **respiration** [1]

- (iii) Carbon dioxide concentration over 350 ppm has an effect on ethene production by the fruits.

What effect is this?

..... [1]

- (iv) Ethene gas spreads throughout the fruit by a random movement of molecules.

What is the name given to the random movement of molecules?

Put a ring around the correct answer.

aeration **diffusion** **evaporation** **ionisation** [1]

- (v) Ethene gas promotes the ripening of strawberry fruits.

Ripening of strawberries is slowed down by passing a stream of nitrogen over the fruit.

Suggest why this slows down the ripening process.

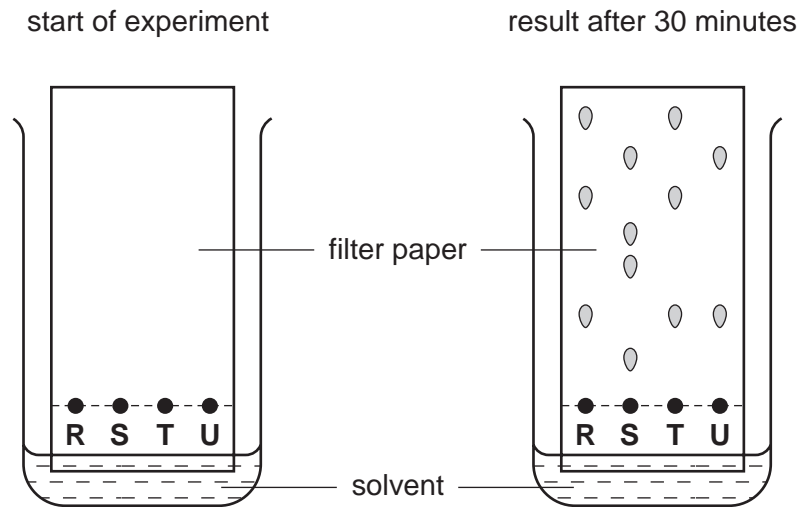
.....
..... [1]

- (vi) Enzymes are involved in the ripening process.

What is an *enzyme*?

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

- (f) Plants make a variety of coloured pigments.
A student extracted red colouring from four different plants, **R, S, T** and **U**.
The student put a spot of each colouring on a piece of filter paper.
The filter paper was dipped into a solvent and left for 30 minutes.
The results are shown below.



- (i) What is name given to the process shown in the diagram?

..... [1]

- (ii) Which plant contained the greatest number of different pigments?

..... [1]

- (iii) Which two plants contained the same pigments?

..... [1]

3 Read the following instructions for the preparation of hydrated nickel(II) sulphate ($\text{NiSO}_4 \cdot 7\text{H}_2\text{O}$), then answer the questions which follow.

- 1 Put 25 cm^3 of dilute sulphuric acid in a beaker.
- 2 Heat the sulphuric acid until it is just boiling then add a small amount of nickel(II) carbonate.
- 3 When the nickel(II) carbonate has dissolved, stop heating, then add a little more nickel carbonate. Continue in this way until nickel(II) carbonate is in excess.
- 4 Filter the hot mixture into a clean beaker.
- 5 Make the hydrated nickel(II) sulphate crystals from the nickel(II) sulphate solution.

The equation for the reaction is



(a) What piece of apparatus would you use to measure out 25 cm^3 of sulphuric acid?

..... [1]

(b) Why is the nickel(II) carbonate added in excess?

..... [1]

(c) When nickel(II) carbonate is added to sulphuric acid, there is a fizzing.

Explain why there is a fizzing.

..... [1]

(d) Draw a diagram to describe step 4.

You must label your diagram.

[3]

- (e) After filtration, which one of the following describes the nickel(II) sulphate in the beaker?

Put a ring around the correct answer.

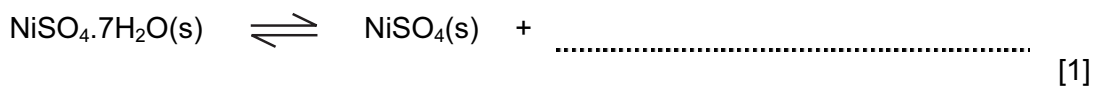
crystals **filtrate** **precipitate** **water** [1]

- (f) Explain how you would obtain pure dry crystals of hydrated nickel(II) sulphate from the solution of nickel(II) sulphate.

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

- (g) When hydrated nickel(II) sulphate is heated gently in a test tube, it changes colour from green to white.

- (i) Complete the symbol equation for this reaction.



- (ii) What does the sign \rightleftharpoons mean?

..... [1]

- (iii) How can you obtain a sample of green nickel(II) sulphate starting with white nickel(II) sulphate?

..... [1]

- 4 The table below shows the composition of the mixture of gases coming from a typical car exhaust.

<i>gas</i>	<i>% of the gas in the exhaust fumes</i>
carbon dioxide	9
carbon monoxide	5
oxygen	4
hydrogen	2
hydrocarbons	0.2
nitrogen oxides	0.2
sulphur dioxide	less than 0.003
gas X	79.6

- (a) State the name of the gas **X**.

..... [1]

- (b) The carbon dioxide comes from the burning of hydrocarbons, such as octane, in the petrol.

- (i) Complete the word equation for the complete combustion of octane.

octane + → carbon dioxide + [2]

- (ii) Which **two** chemical elements are present in hydrocarbons?

..... [1]

- (iii) To which homologous series of hydrocarbons does octane belong?

..... [1]

- (c) Suggest a reason for the presence of carbon monoxide in the exhaust fumes.

..... [1]

(d) Nitrogen oxides are present in small quantities in the exhaust fumes.

(i) Complete the following equation for the formation of nitrogen dioxide.



(ii) State **one** harmful effect of nitrogen dioxide on organisms.

..... [1]

(e) Sulphur dioxide is an atmospheric pollutant which is only found in small amounts in car exhausts.

(i) What is the main source of sulphur dioxide pollution of the atmosphere?

..... [1]

(ii) Sulphur dioxide is oxidised in the air to sulphur trioxide. The sulphur trioxide may dissolve in rainwater to form a dilute solution of sulphuric acid, H_2SO_4 .

State the meaning of the term *oxidation*.

..... [1]

(iii) Calculate the relative molecular mass of sulphuric acid.

..... [1]

(iv) Sulphuric acid reacts with metals such as iron.

Complete the following word equation for the reaction of sulphuric acid with iron.

sulphuric acid + iron \rightarrow +
..... [2]

(v) What effect does acid rain have on buildings made of stone containing calcium carbonate?

..... [1]

5 Fertilizers often contain ammonium nitrate.

(a) (i) What effect do fertilizers have on crops?

..... [1]

(ii) Name **one** metal ion which is commonly present in fertilizers.

..... [1]

(iii) Which **one** of the following ions is commonly present in fertilizers?

Put a ring around the correct answer.

bromide **chloride** **hydroxide** **phosphate** [1]

(b) Describe a test for nitrate ions.

test

.....

result [4]

(c) Ammonium nitrate can be made by adding nitric acid to a solution of ammonia.

(i) What type of reaction is this?

..... [1]

(ii) Complete the symbol equation for this reaction.

..... + HNO₃(aq) → NH₄NO₃(aq) [1]

(d) Which **two** of the following statements about ammonia are true?

Tick **two** boxes.

ammonia is insoluble in water

ammonia turns red litmus blue

a solution of ammonia in water has a pH of 7

ammonia has a molecular structure

[2]

6 The electrolysis of a concentrated solution of sodium chloride, provides us with chemicals.

(a) Sodium chloride has an ionic giant structure.

Which **one** of the following is a correct description of a property of sodium chloride.

Tick **one** box.

sodium chloride has a low melting point

sodium chloride conducts electricity when it is solid

sodium chloride has a high boiling point

sodium chloride is insoluble in water

[1]

(b) (i) Explain what is meant by the term *electrolysis*.

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

(ii) At which electrode is hydrogen produced during the electrolysis of aqueous sodium chloride?

..... [1]

(iii) Name a suitable substance that can be used for the electrodes.

..... [1]

(c) (i) State the name of the particle which is added to a chlorine atom to make a chloride ion.

..... [1]

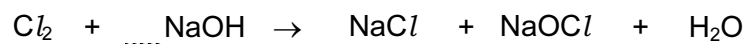
(ii) Describe a test for chloride ions.

test

result [2]

- (d) If chlorine is allowed to mix with sodium hydroxide, sodium chlorate(I), NaOCl is formed.

Balance the equation for this reaction.



[1]

- (e) One tonne (1 000 kg) of a commercial solution of sodium hydroxide produced by electrolysis contains the following masses of compounds.

<i>compound</i>	<i>mass of compound kg/ tonne</i>
sodium hydroxide	510
sodium chloride	10
sodium chlorate(V)	9
water	471
total	1000

- (i) How many kilograms of sodium hydroxide will be present in 5 tonnes of the solution?

[1]

- (ii) All the water from one tonne of impure sodium hydroxide is evaporated.

What would the approximate percentage of the remaining impurities be?

Put a ring around the correct answer.

0.036%

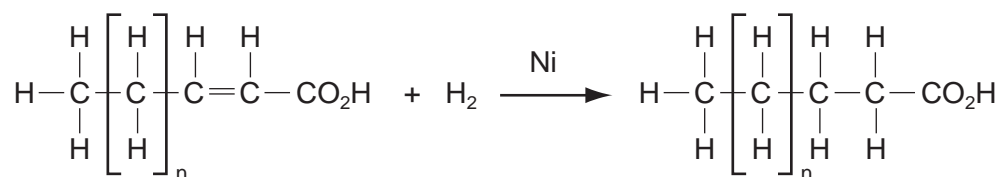
3.6%

36%

96%

[1]

- (f) The hydrogen obtained by electrolysis can be used in the manufacture of margarine.



- (i) Complete the following sentences about this reaction using words from the list.

catalyst
inhibitor
monomeric
saturated
unsaturated

Hydrogen gas is bubbled through carbon compounds
using a nickel which speeds up the reaction.

The margarines produced are compounds. [3]

- (ii) State **one** other use of hydrogen.

..... [1]

DATA SHEET
The Periodic Table of the Elements

		Group									
		I	II	III	IV	V	VI	VII	VIII	IX	X
7	3	9	4	5	6	7	8	9	10	11	12
Li Lithium	Be Beryllium	B Boron	C Carbon	N Nitrogen	O Oxygen	F Fluorine	Ne Neon	Na Sodium	Mg Magnesium	Al Aluminium	Si Silicon
23	11	19	20	27	24	25	26	39	40	45	48
Na Sodium	Mg Magnesium	K Potassium	Ca Calcium	Sc Scandium	Ti Titanium	V Vanadium	Cr Chromium	Mn Manganese	Fe Iron	Co Cobalt	Ni Nickel
85	37	88	38	89	40	41	42	55	56	59	64
Rb Rubidium	Sr Strontium	Y Yttrium	Zr Zirconium	Nb Niobium	Mo Molybdenum	Tc Technetium	Ru Ruthenium	Rh Rhodium	Pd Palladium	Ag Silver	Cd Cadmium
133	55	137	56	139	74	75	76	81	78	79	80
Cs Caesium	Ba Barium	La Lanthanum	Hf Hafnium	Ta Tantalum	W Tungsten	Re Rhenium	Os Osmium	Ir Iridium	Pt Platinum	Au Gold	Hg Mercury
226	87	227	88	227	72	73	77	81	82	83	84
Fr Francium	Ra Radium	Ac Actinium	Po Polonium	At Astatine	Rn Radon	Fr Francium	Ra Radium	Ac Actinium	Po Polonium	At Astatine	Rn Radon
175	71	173	70	169	69	68	67	66	65	64	63
Lu Lutetium	Yb Ytterbium	Tm Thulium	Er Erbium	Ho Holmium	Dy Dysprosium	Ho Holmium	Er Erbium	Tm Thulium	Yb Ytterbium	Lu Lutetium	Fr Francium
103	102	101	100	99	98	97	96	95	94	93	92
Lr Lawrencium	No Nobelium	Md Mendelevium	Fm Fermium	Es Einsteinium	Cf Californium	Bk Berkelium	Cm Curium	Am Americium	Pu Plutonium	Np Neptunium	U Uranium
86	85	84	83	82	81	80	79	78	77	76	75
He Helium	Ne Neon	Ar Argon	Kr Krypton	Xe Xenon	Rn Radon	He Helium	Ne Neon	Ar Argon	Kr Krypton	Xe Xenon	Rn Radon
4	2	18	36	54	86	1	1	1	1	1	1
H Hydrogen	He Helium	Li Lithium	Be Beryllium	B Boron	C Carbon	N Nitrogen	O Oxygen	F Fluorine	Ne Neon	Na Sodium	Mg Magnesium

*58-71 Lanthanoid series
90-103 Actinoid series

Key

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

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