Centre Number	Candidate Number	Name

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.

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.

For Examiner's Use	
1	
2	
3	
4	
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6	
Total	

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.

element	*boiling point / °C*	*density / g cm^{-3}*	*radius of atom in the metal / nm*	*reactivity with water*
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.

$$2Na(s) + 2H_2O(l) \rightarrow 2NaOH(aq) + H_2(g)$$

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

.....

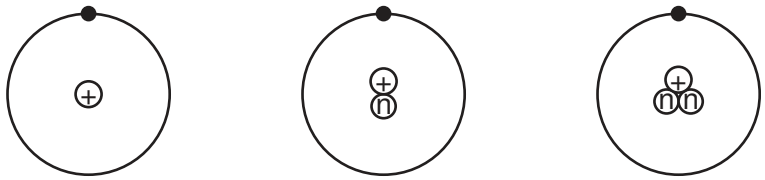
[1]

(ii) Describe a test for hydrogen.

test .....

result ..... [2]

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



hydrogen deuterium tritium

(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.

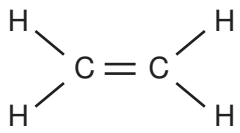
State **one** medical use of radioactivity.

.....

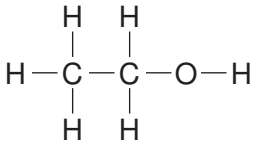
[1]

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

A



B



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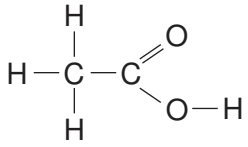
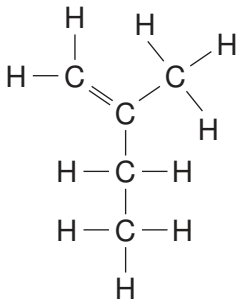
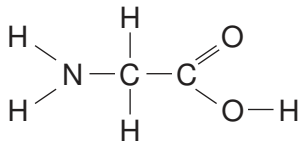


D



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.

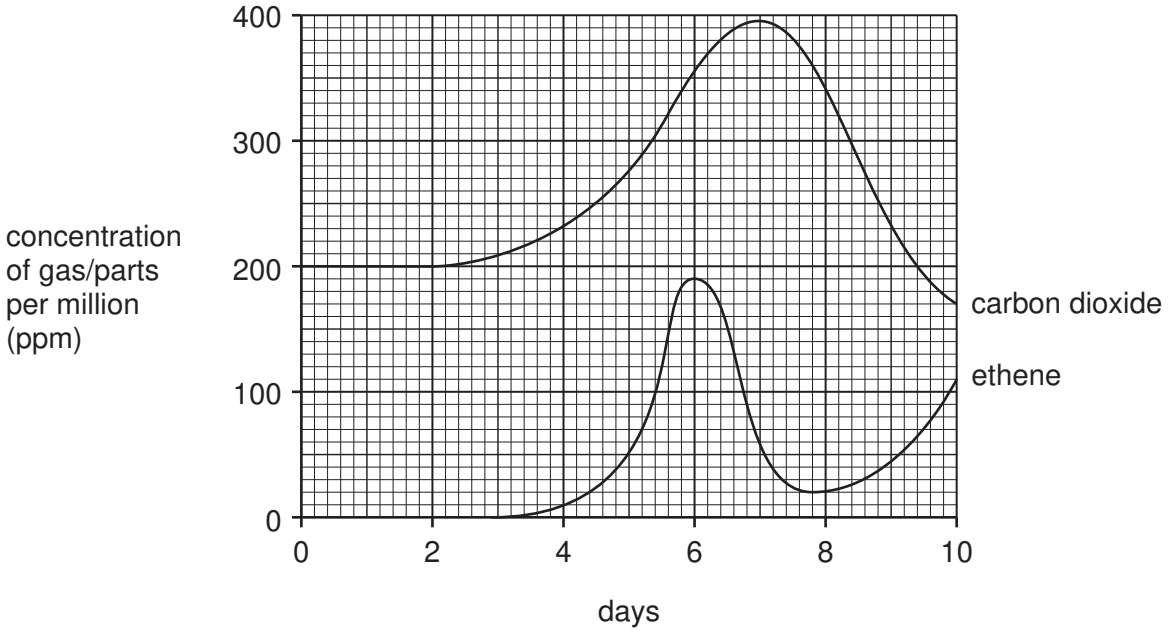
[1]

(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]

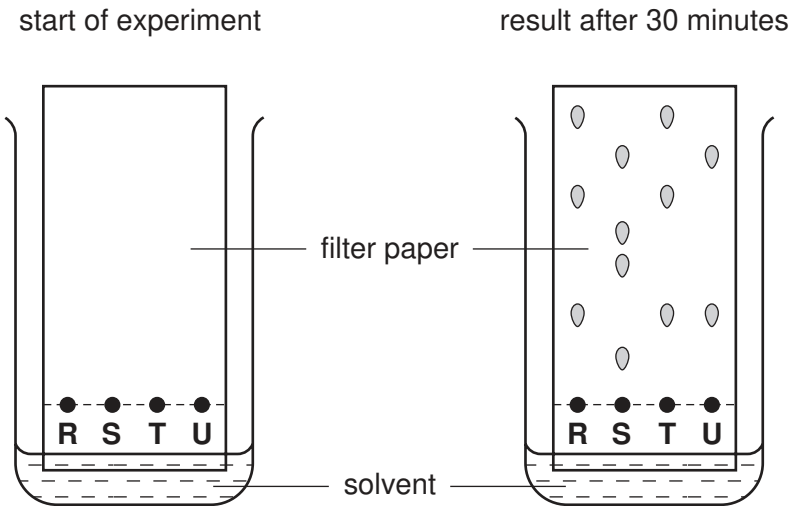
(vi) Enzymes are involved in the ripening process.

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 ($NiSO_4.7H_2O$), 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

$$NiCO_3(s) + H_2SO_4(aq) \rightarrow NiSO_4(aq) + CO_2(g) + H_2O(l)$$

(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.

$NiSO_4.7H_2O(s) \rightleftharpoons NiSO_4(s) +$ ..... [1]

(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.

gas	*% of the gas in the exhaust fumes*
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.

$N_2(g)$ + ... $O_2(g)$ → ..... $NO_2(g)$ [1]

(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 → ..... + ...

..... [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.

..... + $HNO_3(aq)$ $\rightarrow$ $NH_4NO_3(aq)$

[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), NaOC*l* is formed.

Balance the equation for this reaction.

$$Cl_2 + \ldots\ldots NaOH \rightarrow NaCl + NaOCl + H_2O$$

[1]

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

compound	*mass of compound kg/ tonne*
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]

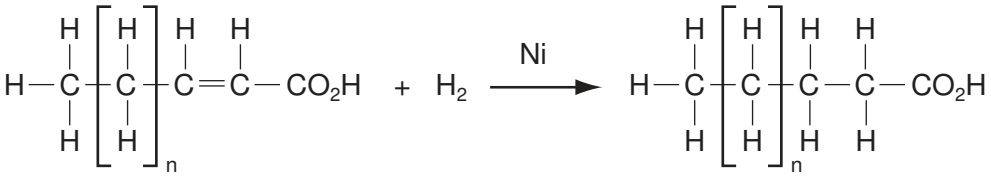
(ii) All the water from one tonne of impure sodium hydroxide is evaporated.

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]

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DATA SHEET
The Periodic Table of the Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H Hydrogen 1										4 He Helium 2
7 Li Lithium 3	9 Be Beryllium 4											11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	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
39 K Potassium 19	40 Ca Calcium 20	45 Sc Scandium 21	48 Ti Titanium 22	51 V Vanadium 23	52 Cr Chromium 24	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	59 Ni Nickel 28	64 Cu Copper 29	65 Zn Zinc 30	70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36
85 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	Tc Technetium 43	101 Ru Ruthenium 44	103 Rh Rhodium 45	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54
133 Cs Caesium 55	137 Ba Barium 56	139 La Lanthanum 57 *	178 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	186 Re Rhenium 75	190 Os Osmium 76	192 Ir Iridium 77	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	Po Polonium 84	At Astatine 85	Rn Radon 86
Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89															

140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	Pm Promethium 61	150 Sm Samarium 62	152 Eu Europium 63	157 Gd Gadolinium 64	159 Tb Terbium 65	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	Pa Protactinium 91	238 U Uranium 92	Np Neptunium 93	Pu Plutonium 94	Am Americium 95	Cm Curium 96	Bk Berkelium 97	Cf Californium 98	Es Einsteinium 99	Fm Fermium 100	Md Mendelevium 101	No Nobelium 102	Lr Lawrencium 103

*58-71 Lanthanoid series
90-103 Actinoid series

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

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).