Centre Number	Candidate Number

Candidate Name _____

International General Certificate of Secondary Education
CAMBRIDGE INTERNATIONAL EXAMINATIONS

CHEMISTRY 0620/3

PAPER 3

MAY/JUNE SESSION 2002

1 hour 15 minutes

Candidates answer on the question paper.
No additional materials are required.

TIME 1 hour 15 minutes

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces at the top of this page.
Answer **all** questions.
Write your answers in the spaces provided on the question paper.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.
A copy of the periodic Table is printed on page 12.

FOR EXAMINER'S USE	
1	
2	
3	
4	
5	
TOTAL	

This question paper consists of 12 printed pages.

University of Cambridge Local Examinations Syndicate

[Turn over

1 In 1886, the modern electrolytic process for the extraction of aluminium was discovered in the USA by C. Hall.

(a) Before this discovery, the only method of extracting the metal was by displacement.

(i) Name a metal that can displace aluminium from aluminium chloride.

.....[1]

(ii) Write a word equation for this displacement reaction.

.....[1]

(iii) Complete the equation for the reaction.

$AlCl_3$ + ... ⟶ ..... + ...[2]

(b) Aluminium is produced by the electrolysis of an electrolyte that contains aluminium oxide.

(i) Write an ionic equation for the reduction of the aluminium ion at the cathode.

.....[2]

(ii) Name the main ore of aluminium.

.....[1]

(iii) Complete the following description of the electrolyte by filling the spaces.

The electrolyte is a ..... mixture of aluminium oxide and ..... which is maintained at 900 °C. [2]

(iv) Explain why the gas given off at the anode is a mixture of oxygen and carbon dioxide.

.....

.....[2]

(c) One property of aluminium is that it resists corrosion because it is covered with a layer of its oxide.

(i) Give **one** use of the metal that depends on this property.

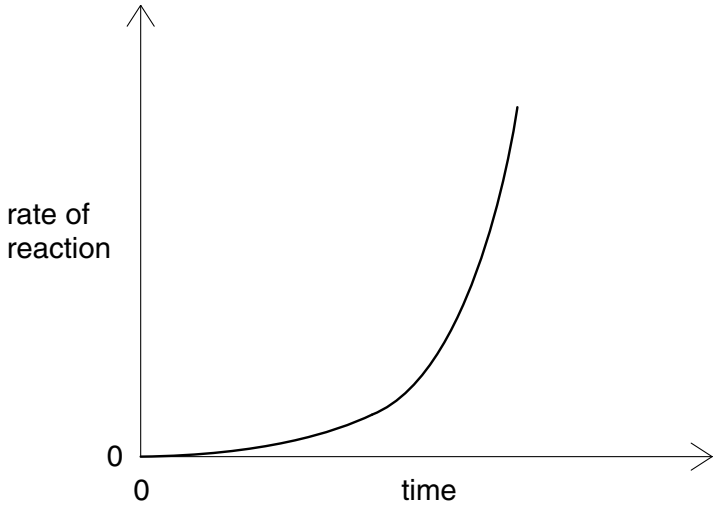
.....[1]

(ii) Give another use of the metal that depends on a different property.

use .....

property.....[2]

(d) The graph shows how the rate of the exothermic reaction between aluminium and hydrochloric acid varies with time.



(i) Suggest a reason why the reaction goes slowly at first.

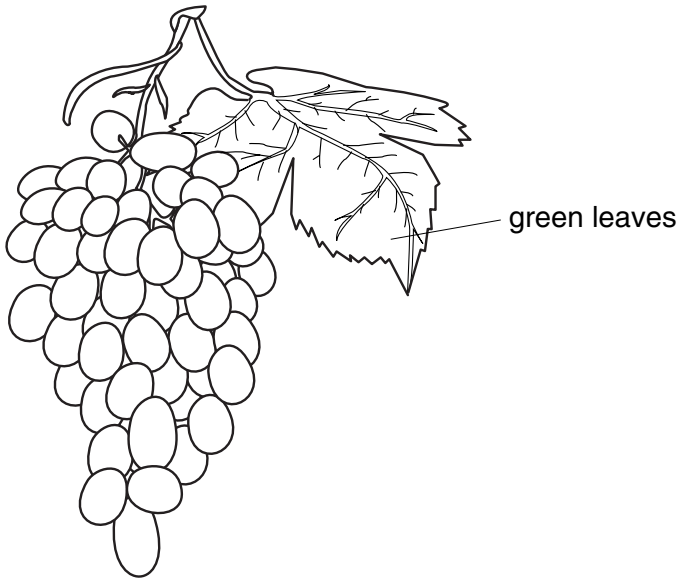
.....[1]

(ii) Suggest **two** reasons for the increase in rate.

.....

.....[2]

2 Fermentation of sugars is one method of making ethanol. Vines produce glucose by photosynthesis. The glucose collects in the grapes which grow in clusters on the vine.



(a) Vines are attacked by a fungus that ruins the grapes. In 1882 it was discovered that spraying the vines with Bordeaux mixture killed the fungus.

The fungicide, Bordeaux mixture, contains water, calcium hydroxide and copper(II) sulphate.

(i) Name the raw material from which calcium hydroxide is made.

.....[1]

(ii) The mixture contains four ions. Complete the list of ions.

Cu^{2+}, OH^-, ... and ..... [2]

(iii) A different fungicide can be made by the reaction between an excess of aqueous ammonia and a copper(II) salt. Describe the **observations** for this reaction.

addition of aqueous ammonia .....

.....

then excess aqueous ammonia .....

.....[3]

(b) Explain how the vine produces glucose by photosynthesis.

.....

.....

.....

.....[4]

(c) The grapes are crushed to extract an aqueous solution of glucose. This solution is fermented to make ethanol. Explain why each of the following is necessary.

(i) yeast

.....[1]

(ii) an absence of oxygen

.....

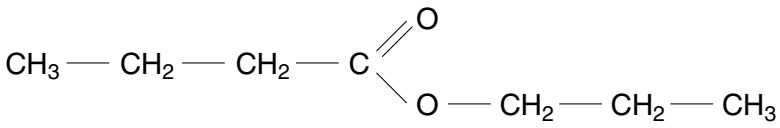
.....[2]

(iii) an optimum temperature of about 35 °C

.....

.....[2]

(d) Plants can make esters as well as sugars. The formula of a typical ester is drawn below. Deduce the names of the organic acid and of the alcohol from which the ester could have been made.



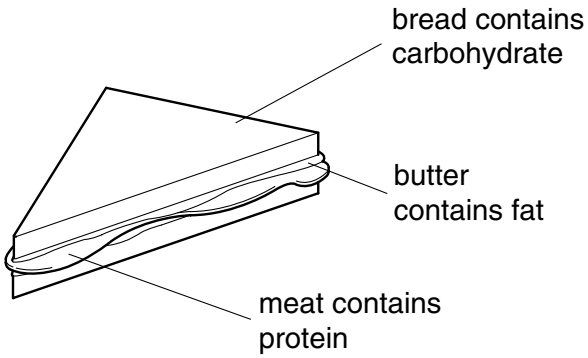
organic acid .....

alcohol.....[2]

[Turn over

3 A major food retailer in the UK is going to distribute sandwiches using hydrogen-powered vehicles.

(a) A sandwich contains three of the main constituents of food.



These constituents of food can all be hydrolysed by boiling with acid or alkali.

constituent of food	linkage	product of hydrolysis
protein		
fat		
complex carbohydrate		

(i) Complete the table. [5]

(ii) What type of synthetic polymer contains the same linkage as

proteins, ...

fats? .....[2]

(iii) Fats can be unsaturated or saturated. A small amount of a fat was dissolved in an organic solvent. Describe how you could find out if this fat was saturated or unsaturated.

reagent .....

result if saturated .....

result if unsaturated .....

.....[3]

(b) One of the reasons for using hydrogen as a fuel is to reduce air pollution. Petroleum-powered vehicles are a major cause of air pollution. This pollution can be decreased by reactions of the type shown below.

$$2CO + 2NO \longrightarrow N_2 + 2CO_2$$

(i) Where in a vehicle does this type of reaction occur?

.....[1]

(ii) Explain how carbon monoxide is formed in the engine.

.....

.....[2]

(iii) Give a reason why the hydrogen-powered vehicle produces less pollution.

.....[1]

(c) Outline how hydrogen is manufactured from water.

.....

.....[2]

[Turn over

4 Bromine is one of the halogens in Group VII.

(a) **(i)** Predict which halogen has the lightest colour.

.....[1]

(ii) Predict which halogens are solids at room temperature.

.....[1]

(b) Bromine is obtained from the bromide ions in sea water. Sea water is concentrated by evaporation. Chlorine gas is bubbled through the solution. Chlorine oxidises the bromide ion to bromine.

(i) Complete the following equation.

Cl_2 + ...Br^- ⟶ ..... + ... [2]

(ii) Explain using the idea of electron transfer why the bromide ion is oxidised by chlorine.

The bromide ion is oxidised because .....

.....

Chlorine is the oxidising agent because .....

.....[2]

(iii) Name a reagent that can be oxidised by bromine molecules.

.....[1]

(c) Bromine reacts with phosphorus to form phosphorus tribromide.
Draw a diagram showing the arrangement of the **valency** electrons in one molecule of this covalent compound. The electron distribution of bromine is:

2 + 8 + 18 + 7.

Use x to represent an electron from phosphorus.
Use o to represent an electron from bromine. [3]

(d) Phosphorus tribromide reacts with water to form two acids.

(i) Balance the equation for this reaction.

$$PBr_3 + ...H_2O \longrightarrow .....HBr + H_3PO_3$$

[1]

(ii) Describe by giving essential details how you could show that phosphorous acid, H_3PO_3, is a weaker acid than hydrogen bromide.

.....

.....

.....[2]

(e) Hydrogen bromide is an acid. When it is dissolved in water the following reaction occurs.

$$HBr + H_2O \longrightarrow H_3O^+ + Br^-$$

(i) Name the particle lost by the hydrogen bromide molecule.

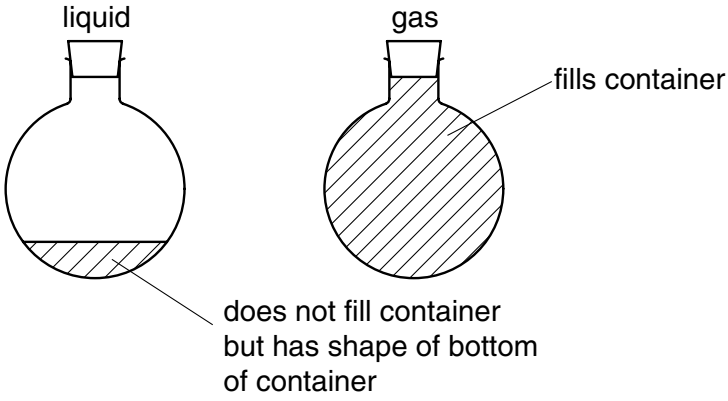
.....[1]

(ii) What type of reagent is the water molecule in this reaction?

.....[1]

5 **(a)** The Kinetic Theory explains the properties of solids, liquids and gases in terms of the movement of particles.

Liquids and gases both take up the shape of the container but a gas always fills the container. Explain this, using the ideas of the Kinetic Theory.



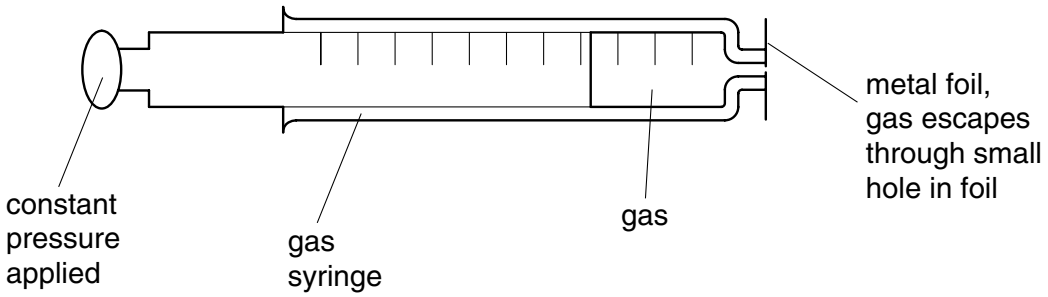
.....

.....

.....

.....[4]

(b) The following apparatus can be used to measure the rate of diffusion of a gas.



(i) What measurements would need to be taken to calculate the rate of diffusion of a gas?

.....[2]

(ii) Which gas, carbon dioxide or sulphur dioxide, would diffuse faster?
Explain your choice.

.....

.....

.....[3]

(c) A 20 cm^3 sample of butyne, C_4H_6, is burnt in 150 cm^3 of oxygen. This is an excess of oxygen.

$$2C_4H_6(g) + 11O_2(g) \longrightarrow 8CO_2(g) + 6H_2O(l)$$

(i) What volume of oxygen reacts?

.....[1]

(ii) What volume of carbon dioxide is produced?

.....[1]

(iii) What is the total volume of gases left at the end of the reaction?

.....[1]

(d) Calculate the mass of water formed when 9.0 g of butyne is burnt. The mass of one mole of butyne is 54 g.

from the above equation, 1 mole of butyne forms 3 moles of water

number of moles of butyne reacted .....

number of moles of water formed .....

mass of water formed ..... g [3]

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
X
b

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.)