Candidate Name	Centre Number	Candidate Number

International General Certificate of Secondary Education

CAMBRIDGE INTERNATIONAL EXAMINATIONS

CHEMISTRY 0620/2

PAPER 2

OCTOBER/NOVEMBER SESSION 2002

1 hour

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

Time 1 hour

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.

You may use a calculator.

A copy of the Periodic Table is printed on page 16.

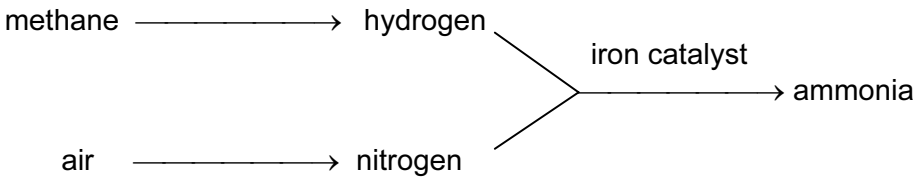
FOR EXAMINER'S USE	
1	
2	
3	
4	
5	
6	
TOTAL	

This question paper consists of 16 printed pages.

UNIVERSITY of CAMBRIDGE
Local Examinations Syndicate

[Turn over

1 Ammonia, NH_3, is synthesised by the following route.



(a) (i) To which group of organic compounds does methane, CH_4, belong?

Put a ring around the correct answer.

alkane **alcohol** **alkene** **carboxylic acid**

[1]

(ii) Draw the formula for methane, showing all atoms and bonds.

[1]

(iii) State the most likely source of methane.

..... [1]

(b) (i) State the percentage of nitrogen in clean air.

..... [1]

(ii) Name another non-metal that is in the same Period as nitrogen.

..... [1]

(c) Ammonia is made by heating hydrogen with nitrogen in the presence of a catalyst.

(i) What is the purpose of the catalyst?

..... [1]

(ii) What happens to the rate of a reaction when the temperature is increased?

..... [1]

(d) **(i)** Complete the following equation which shows the synthesis of ammonia from hydrogen and nitrogen.

$3H_2$ + N_2 $\rightleftharpoons$ ... NH_3 [1]

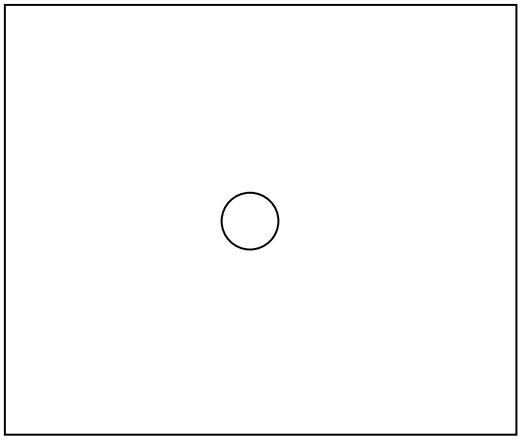
(ii) What does the sign $\rightleftharpoons$ mean?

..... [1]

(e) The ammonia formed in the reaction is liquefied.

Complete the diagram below to show the arrangement of the molecules in liquid ammonia.

○ represents a single molecule of ammonia.



[2]

(f) How would you test for ammonia in the laboratory?

test .....

result ..... [2]

(g) Ammonia is used to make fertilizers.

(i) Why are fertilizers used in agriculture?

..... [1]

(ii) Some fertilizers contain ammonium sulphate.

Complete the word equation to show how ammonium sulphate is formed.

ammonia + ... ⟶ ammonium sulphate

[1]

2 When rain water trickles through rocks, it dissolves some of the minerals present.

This water, which is bottled for drinking, is called mineral water.

The table shows the ions present in a litre of mineral water.

name of ion	formula of ion	mass of ion present in one litre of water/milligrams
calcium	Ca^{2+}	10
chloride	Cl^-	8
hydrogencarbonate	HCO_3^-	64
sodium	Na^+	8
sulphate	SO_4^{2-}	7

(a) What do you understand by the term *ion*?

.....

[1]

(b) Which positive ion has the greatest concentration in this sample of water?

.....

[1]

(c) Complete the following equation to show how a calcium ion is formed from a calcium atom.

$$Ca \longrightarrow Ca^{2+} + \ldots e^-$$

[1]

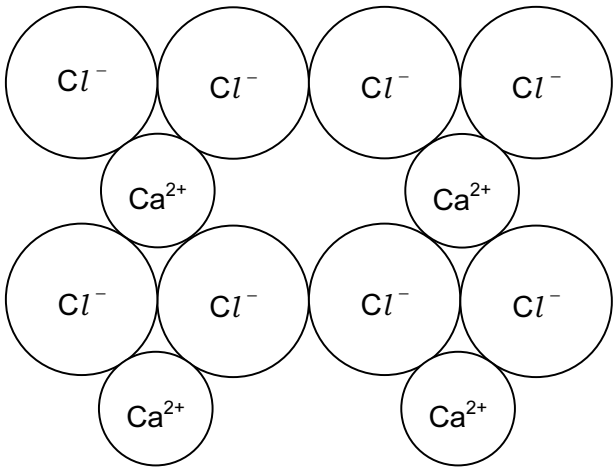
(d) When this sample of mineral water is evaporated to dryness, various compounds are formed. One of these compounds is calcium chloride.

Suggest the name of **two** other compounds which could be formed.

compound 1 .....

compound 2 ..... [2]

(e) Part of the structure of calcium chloride is shown below.



Use this diagram to work out the simplest formula for calcium chloride.

formula ..... [1]

(f) Complete the following table to show the electrical conductivity of calcium and calcium chloride in the solid and liquid states.

Put a ✓ if the substance conducts.

Put a ✗ if the substance does not conduct.

substance	state	electrical conductivity
calcium	solid	
calcium	liquid	
calcium chloride	solid	
calcium chloride	liquid	

[2]

(g) A sample of water was contaminated with clay, which is insoluble in water.

Explain with the help of a labelled diagram, how you would separate the clay from the water.

[3]

3 Fluorine, chlorine, bromine and iodine are halogens.

(a) Complete the table by filling in the blank spaces.

halogen	colour	melting point /°C	boiling point /°C	state at room temperature
fluorine	yellow	-220	-188	
chlorine		-101	-35	gas
bromine	reddish-brown	-7	+59	
iodine		+114		solid

[4]

(b) Predict the boiling point of iodine.

[1]

(c) When chlorine is bubbled through a solution of potassium bromide, the solution turns orange - red.

When iodine is mixed with potassium bromide, no colour change occurs.

(i) Write a word equation for the reaction between chlorine and potassium bromide.

[2]

(ii) Put the elements bromine, chlorine and iodine in order of reactivity.

most reactive → | |

| |

least reactive → | |

[1]

(d) State a use of chlorine.

.....

[1]

(e) In the presence of sunlight, chlorine reacts with methane.

Hydrogen chloride gas, H — C*l*, is given off during this reaction.

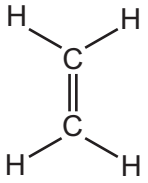
State the type of bonding in a hydrogen chloride molecule.

Put a ring around the correct answer.

covalent **ionic** **metallic** **weak**

[1]

4 Some organic compounds found in ripe fruits are shown below.



A

CH_3CO_2H

B

$CH_3CH_2CH_2CO_2H$

C

CH_3CH_2OH

D

CH_3CH_2CHO

E

(a) What do you understand by the term *organic compound*?

.....

..... [1]

(b) Which **two** of the compounds belong to the same homologous series?

compound ..... and compound ..... [1]

(c) Which **one** of these compounds is an unsaturated hydrocarbon?

..... [1]

(d) Which **one** of these compounds is an alcohol?

..... [1]

(e) Which **one** of these compounds can be formed directly by cracking the paraffin fraction from petroleum?

..... [1]

(f) Compound **D** burns readily.

(i) Burning is an exothermic reaction.

Explain the meaning of the term *exothermic*.

..... [1]

(ii) State the products formed when **D** burns in excess air.

..... [2]

(iii) Name the carbon compound formed when **D** undergoes incomplete combustion.

..... [1]

(g) Write down the molecular formula of compound **C**.

..... [1]

(h) Calculate the relative molecular mass of compound **C**.

..... [1]

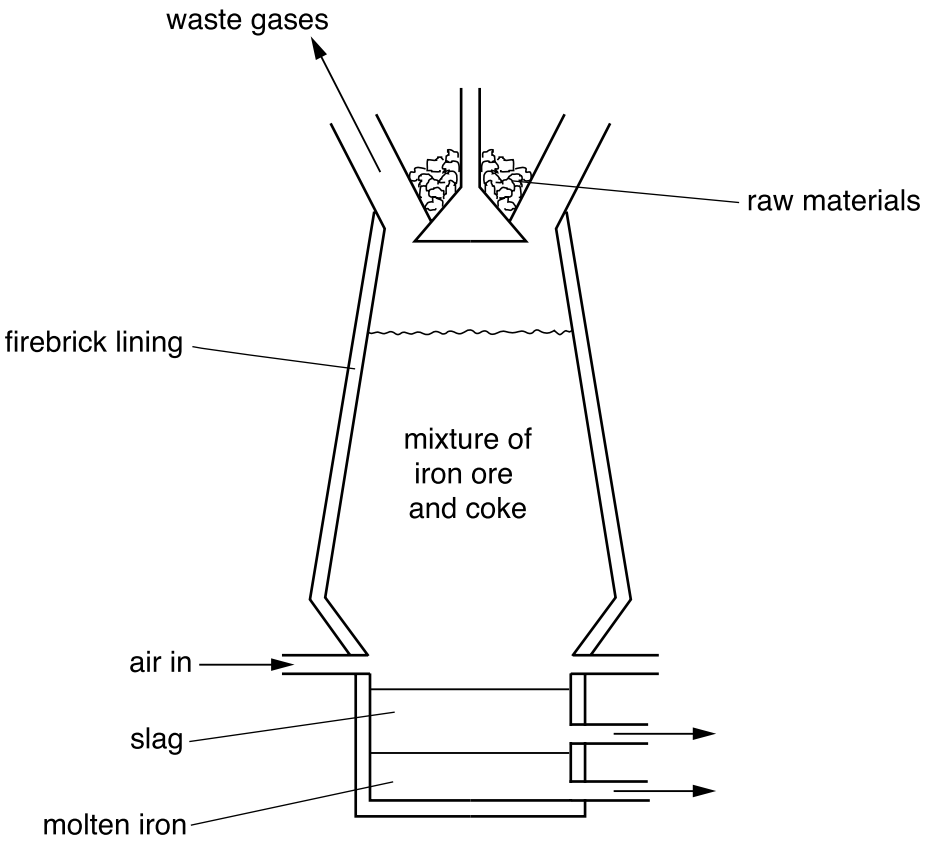
(i) Many fruits contain a variety of different coloured compounds.

What separation technique can you use to separate these different coloured compounds?

..... [1]

5 Iron is extracted from the ore, haematite.

The iron ore is put in a blast furnace with coke and a current of air is blown through the heated mixture.



(a) What do you understand by the term *ore*?

.....

..... [1]

(b) What other raw material needs to be added to the blast furnace?

Put a ring around the correct answer.

cement **limewater** **limestone** **slag**

[1]

(c) Near the bottom of the furnace, iron(III) oxide is reduced by carbon.

$$Fe_2O_3 + 3C \rightarrow 2Fe + 3CO$$

(i) Write a word equation for this reaction.

[1]

(ii) Explain what is meant by the term *reduction*.

.....

..... [1]

(d) The table shows the composition of the waste gases leaving the blast furnace.

gas	percentage of gas in the mixture
carbon dioxide	12
carbon monoxide	24
hydrogen	4
nitrogen	60

(i) The hydrogen in the waste gas is formed by the reaction of hot carbon with water vapour.

There is no water in the materials added to the top of the furnace.

Suggest where this water vapour comes from.

..... [1]

(ii) The reaction of hot carbon with water vapour is endothermic.

What is meant by the term *endothermic*?

..... [1]

(e) Iron can be converted into steel, which is more resistant to corrosion.

(i) Describe briefly how iron is converted into steel.

.....

.....

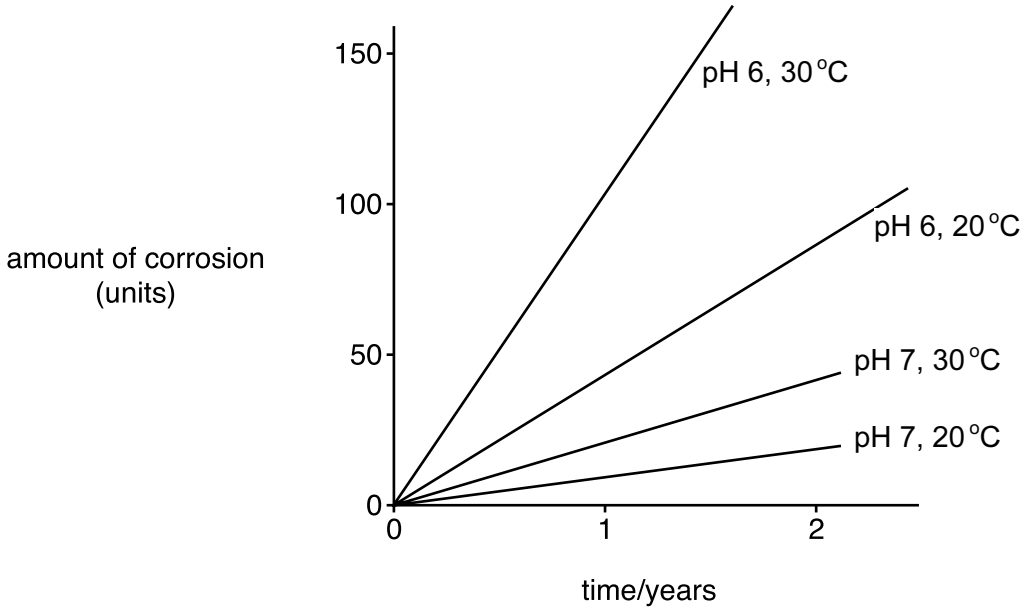
..... [2]

(ii) State **one** use of mild steel.

..... [1]

(f) In some conditions, steel corrodes more quickly than in others.

The graphs show the rate of corrosion of a particular type of steel under different controlled conditions.



(i) How does pH affect the rate of corrosion?

.....

[1]

(ii) How does temperature affect the rate of corrosion?

.....

[1]

Explain this in terms of moving particles.

.....

.....

[2]

(iii) The presence of acidic gases in the air may increase the rate of corrosion.

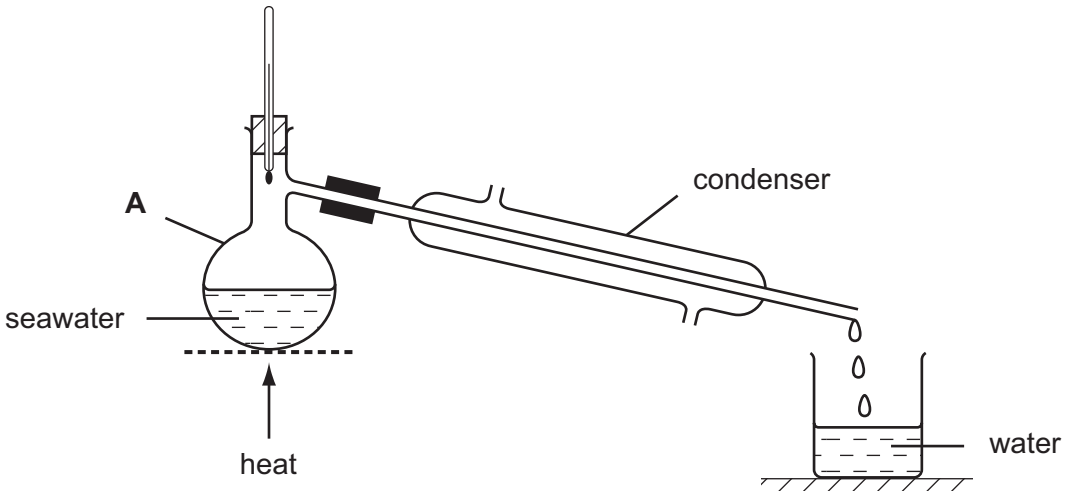
State the name and source of **one** acidic gas found in the air as a result of pollution.

name .....

source .....

[2]

6 A student took a sample of seawater and heated it using the apparatus shown below.



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

.....[1]

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

.....[1]

(c) Explain the function of the condenser.

.....

.....

.....[2]

(d) Pure water collects in the beaker.

(i) State the pH of pure water.

.....[1]

(ii) State the boiling point of pure water.

.....[1]

(e) The table shows the mass of various compounds obtained when 1 litre of seawater is evaporated.

compound	formula	mass of solid present / g
sodium chloride	NaCl	28.0
	$MgCl_2$	8.0
magnesium sulphate	$MgSO_4$	6.0
calcium sulphate	$CaSO_4$	2.0
potassium chloride	KCl	1.0
calcium carbonate	$CaCO_3$	
potassium bromide	KBr	
		total mass = 45.0

(i) How many grams of magnesium sulphate are present in 180 g of solid left by evaporation of seawater?

[1]

(ii) Which compound in the table reacts with acids to release carbon dioxide?

..... [1]

(iii) State the name of the compound which has the formula $MgCl_2$.

..... [1]

(iv) Calcium sulphate contains sulphate ions.

Describe a test for sulphate ions.

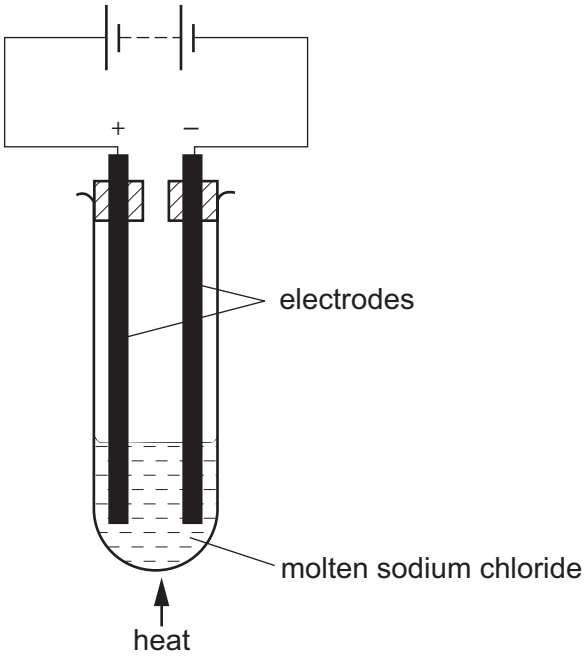
test .....

.....

result .....

..... [3]

(f) Pure sodium chloride can be electrolysed using the apparatus shown below.



(i) Why does the sodium chloride have to be molten for electrolysis to occur?

.....

..... [2]

(ii) State the name of the product formed during electrolysis at

the anode (positive electrode) .....

the cathode (negative electrode) ..... [2]

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

..... [1]

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.).