



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

0620/22

Paper 2

October/November 2011

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 20.

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.

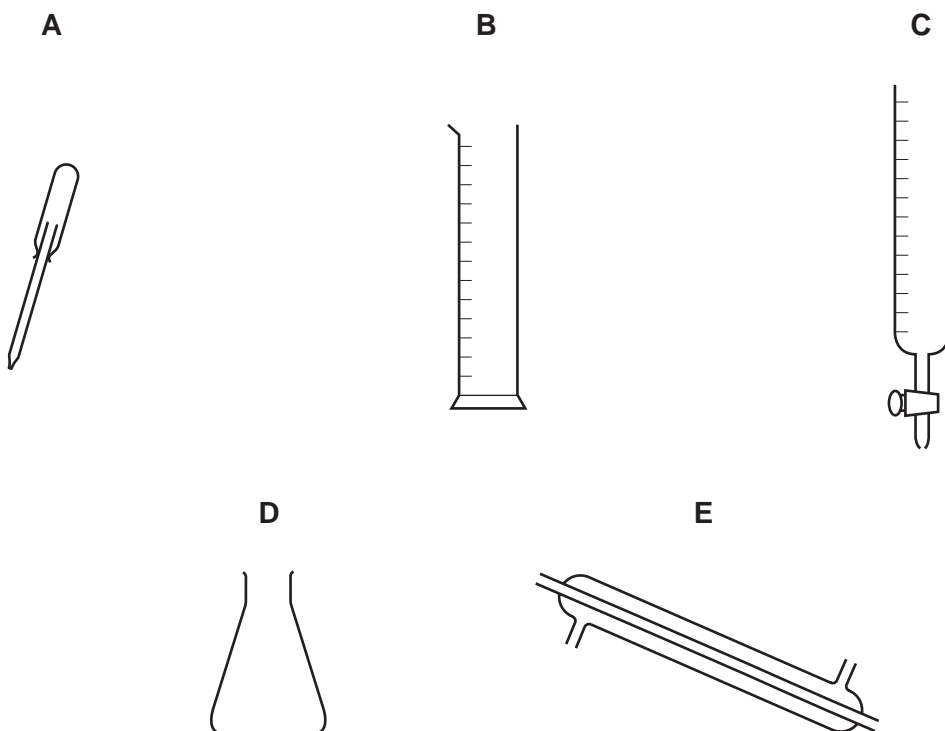
For Examiner's Use

1	
2	
3	
4	
5	
6	
7	
Total	

This document consists of **19** printed pages and **1** blank page.



1 The diagram shows five different pieces of laboratory glassware, **A**, **B**, **C**, **D** and **E**.



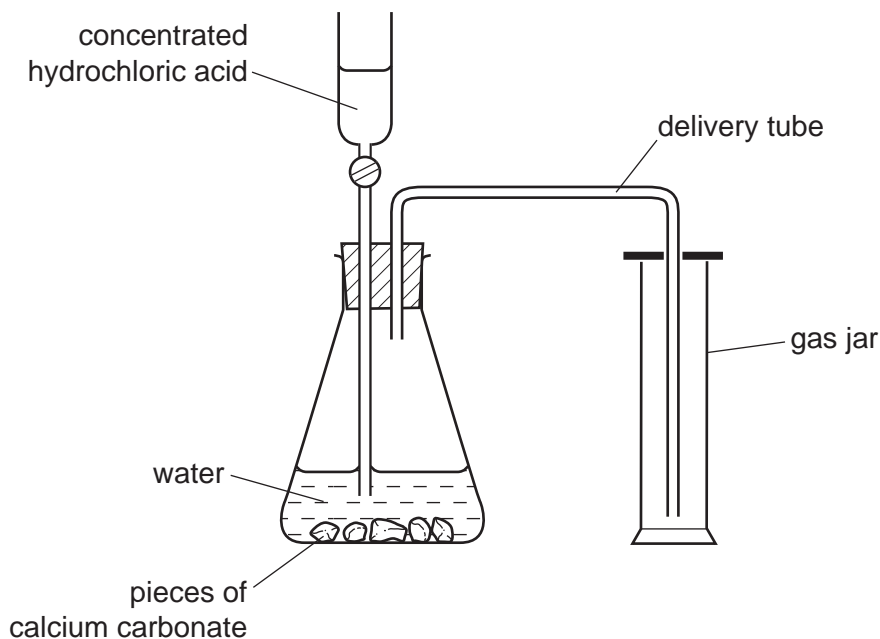
(a) Choose from **A**, **B**, **C**, **D** or **E** to answer the following questions. Each letter may be used once, more than once or not at all.

Which piece of glassware is best used to

- | | |
|--|--------------------------|
| (i) measure out a volume of liquid accurately, | <input type="checkbox"/> |
| (ii) place a spot of liquid on chromatography paper, | <input type="checkbox"/> |
| (iii) condense a liquid with a low boiling point, | <input type="checkbox"/> |
| (iv) shake two solutions together to mix them, | <input type="checkbox"/> |
| (v) deliver a variable volume of solution when performing a titration? | <input type="checkbox"/> |

[5]

(b) The diagram shows the apparatus used to prepare carbon dioxide in the laboratory.



(i) State the name of a rock which is made up largely of calcium carbonate.

..... [1]

(ii) Which one of these statements about carbon dioxide is correct?

Tick **one** box.

Carbon dioxide is lighter than air.

Carbon dioxide is a liquid at room temperature.

Carbon dioxide is heavier than air.

Carbon dioxide has the same density as air.

[1]

(iii) Complete the equation for the reaction of calcium carbonate with hydrochloric acid.



[Total: 9]

2 Many of the elements in the Periodic Table are metals.

(a) State **one** common use for each of the following metals.

(i) copper [1]

(ii) platinum [1]

(iii) aluminium [1]

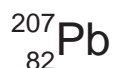
(b) Lead is a metal in Group IV of the Periodic Table.

(i) State **one** adverse effect of lead on health.

..... [1]

(ii) Lead has several isotopes.

One isotope of lead is



State the number of protons and neutrons in this isotope of lead.

number of protons [1]

number of neutrons [1]

(c) Sodium is a very reactive metal.

(i) A student added a few drops of litmus solution to a large beaker of water. She then dropped a small piece of sodium into the beaker. Describe what the student would observe during the reaction.

.....

 [3]

(ii) Complete the word equation for the reaction of sodium with water.

sodium + water → +
 [2]

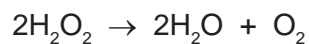
- (iii) Sodium chloride is formed when sodium burns in chlorine.
Sodium chloride is an ionic compound.
Complete the following sentences about this reaction using words from the list.

electron **gains** **ion** **loses**
molecule **negative** **positive** **proton**

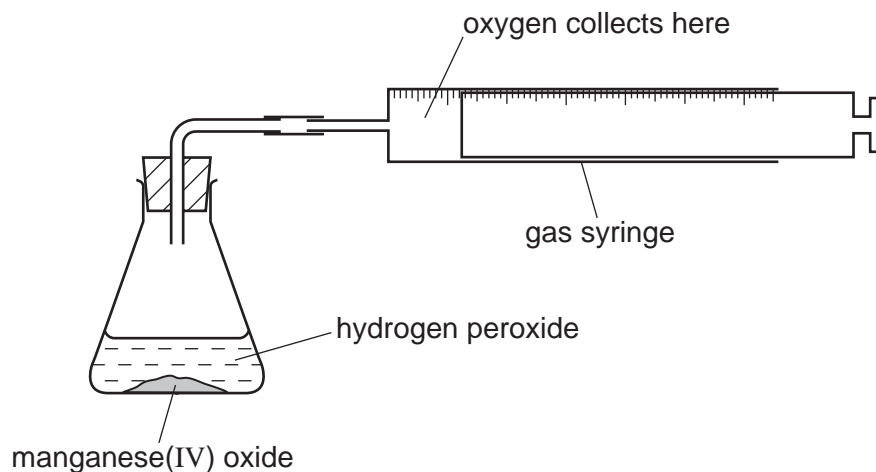
When sodium burns in chlorine, each sodium atom loses an and becomes a sodium Each chlorine atom an electron and becomes a ion. [4]

[Total: 15]

- 3 Hydrogen peroxide decomposes slowly at room temperature to form water and oxygen. The reaction is catalysed by manganese(IV) oxide.



A student used the apparatus shown below to study how changing the concentration of hydrogen peroxide affects the speed of this reaction.

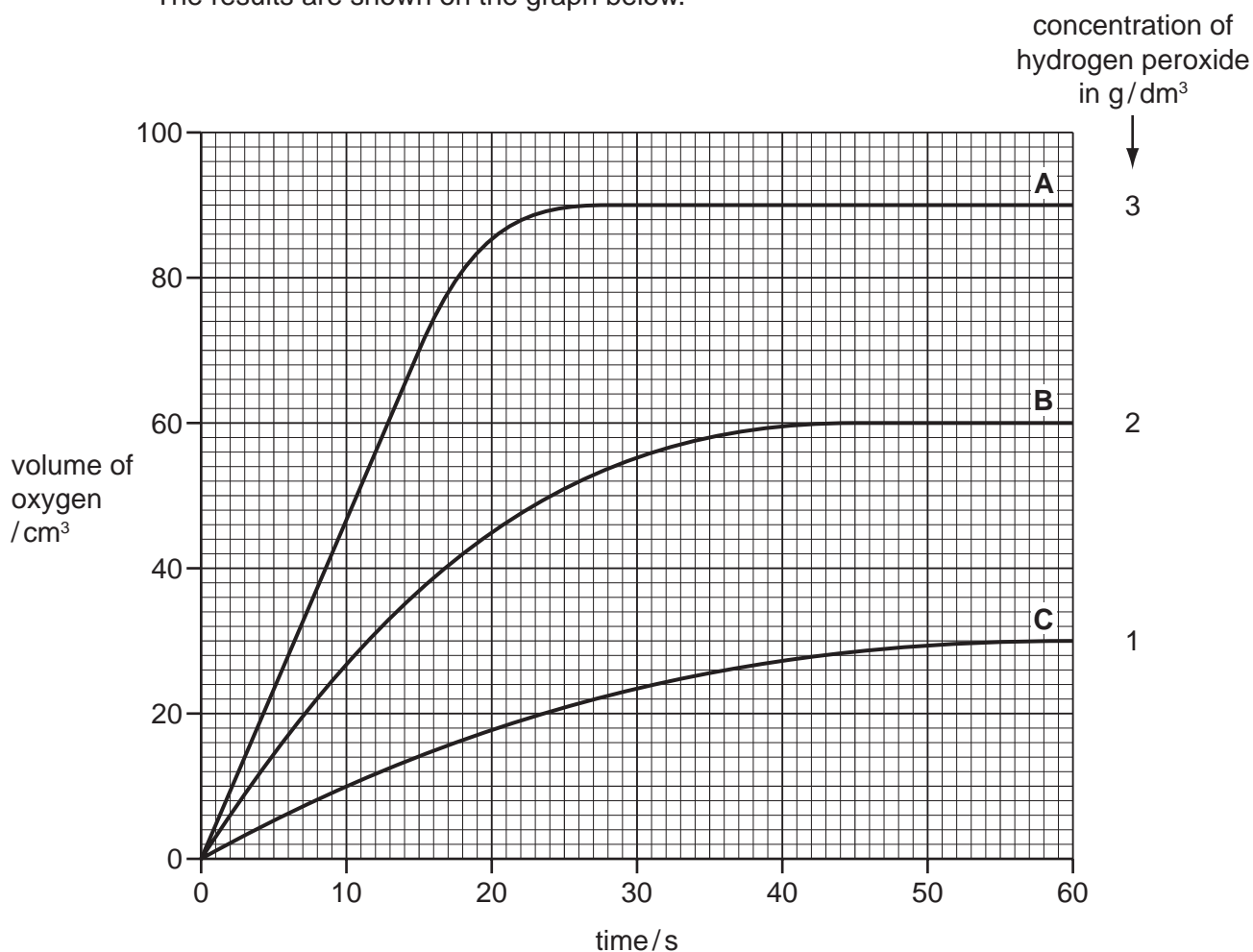


- (a) Apart from the volume of hydrogen peroxide, state two things that the student must keep the same in each experiment.

1.

2. [2]

- (b) The student measured the volume of oxygen produced using three different concentrations of hydrogen peroxide. The results are shown on the graph below.



- (i) Describe how the speed of the reaction varies with the concentration of hydrogen peroxide.
..... [1]
- (ii) Explain why the final volume of oxygen given off is less for graph **B** than for graph **A**.
.....
..... [1]
- (iii) From the graph, determine
- the time taken for the reaction to be completed when 3 g/dm³ hydrogen peroxide (line **A**) was used.
..... [1]
- the volume of oxygen produced by 2 g/dm³ hydrogen peroxide (line **B**) in the first 15 seconds.
..... [1]

- (c) The student then tested various compounds to see how well they catalysed the reaction. He used the same concentration of hydrogen peroxide in each experiment. The table shows the time taken to produce 20 cm³ of oxygen using each compound as a catalyst.

compound	time taken to produce 20 cm ³ of oxygen / s
copper(II) oxide	130
lead(IV) oxide	15
magnesium oxide	did not produce any oxygen
manganese(IV) oxide	18

Put these compounds in order of their effectiveness as catalysts.

worst catalyst \longrightarrow best catalyst

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[1]

[Total: 7]

4 Natural gas and the hydrocarbons obtained from the distillation of petroleum are important fuels.

(a) State the name of the main substance present in natural gas.

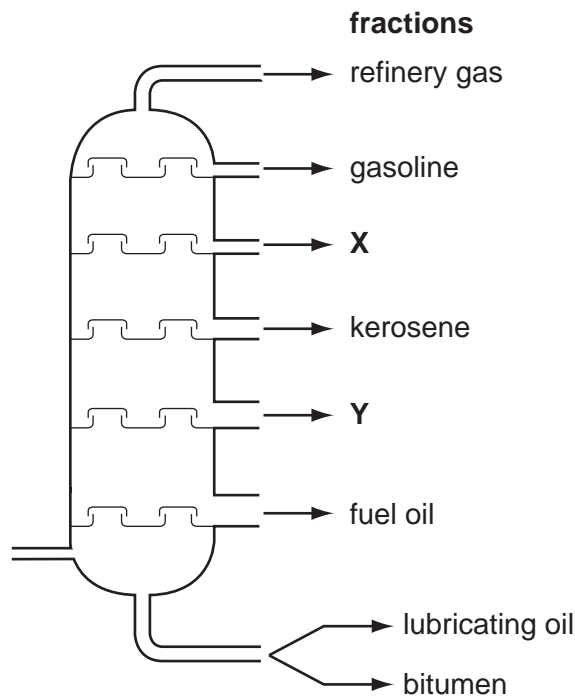
..... [1]

(b) Petroleum is a thick liquid.
Describe the liquid state in terms of

- how close the particles are to each other,
- the arrangement of the particles,
- the movement of the particles.

.....
.....
.....
..... [3]

(c) The diagram shows a distillation column used to separate petroleum into fractions.



(i) On the diagram, draw an arrow to show where the petroleum vapour enters the column. [1]

(ii) What do you understand by the term *fraction*?

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

- (iii) In the diagram on page 9, two fractions have not been named.
State the name of

fraction X

fraction Y [2]

- (iv) One of the refinery gases is ethane.
Draw the structure of ethane showing all atoms and bonds.

[1]

- (v) Which one of these phrases describes ethane correctly?
Tick **one** box.

Ethane is an unsaturated hydrocarbon.

Ethane is a saturated hydrocarbon.

Ethane polymerises to form poly(ethene).

Ethane is an alkene.

[1]

[Total: 11]

- 5 (a) Match the phrases on the left with the definitions on the right.
The first one has been done for you.

relative formula mass	an atom that has become charged
molecule	the smallest part of an element which can take part in a chemical change
atom	two or more atoms covalently bonded together
ion	the sum of the relative atomic masses in a compound

[3]

- (b) Sodium hydroxide, NaOH, is an ionic compound which dissolves in water to form a strongly alkaline solution.

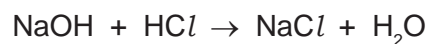
- (i) Which **one** of the following best describes the pH of a concentrated aqueous solution of sodium hydroxide?
Put a ring around the correct answer.

pH 2 pH 5 pH 7 pH 8 pH 13 [1]

- (ii) Calculate the relative formula mass of sodium hydroxide.

[1]

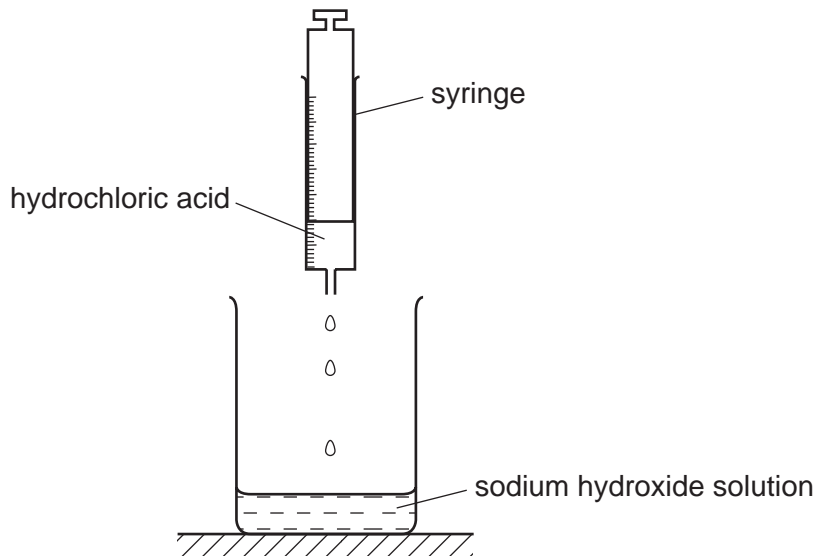
- (iii) The equation describes how sodium hydroxide reacts with hydrochloric acid.



What type of chemical reaction is this?

..... [1]

- (iv) A student used a syringe to add 1 cm^3 portions of hydrochloric acid to an aqueous solution of sodium hydroxide.



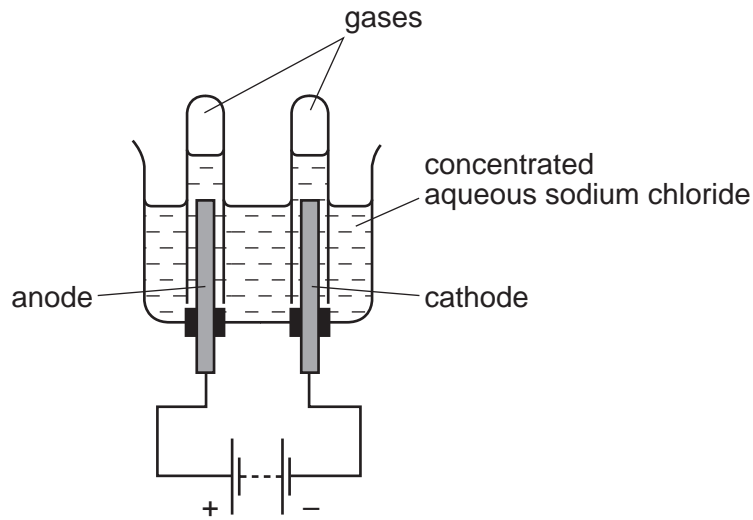
Describe how the pH of the solution in the beaker changes as the hydrochloric acid is added until the acid is in excess.

.....

.....

..... [2]

(c) The diagram shows the apparatus used to electrolyse concentrated aqueous sodium chloride.



Give a description of this electrolysis.
In your description include

- what substance the electrodes are made from and the reason for using this substance
- what you would observe during the electrolysis
- the names of the substances produced at each electrode.

.....

.....

.....

.....

.....

.....

.....

..... [6]

[Total: 14]

6 When coal is heated in the absence of air, coke is formed together with a gas called coal gas and a liquid which contains ammonia.

(a) Coke is largely carbon.
State **one** use of coke in industry.

..... [1]

(b) Two other forms of carbon are diamond and graphite.

(i) Use your knowledge of the structure of diamond and graphite to explain why graphite is a good lubricant.

..... [1]

why diamond is very hard.

..... [1]

(ii) Give **one** use of diamond that depends on its hardness.

..... [1]

(c) The liquid which contains ammonia can be reacted with sulfuric acid.

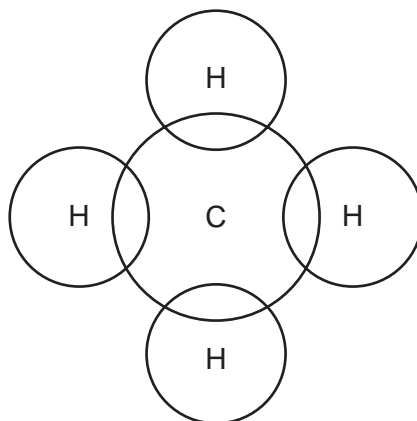
(i) Complete the word equation for this reaction

ammonia + sulfuric acid → [1]

(ii) Which **one** of the following elements do most fertilisers contain?
Put a ring around the correct answer.

chlorine **nitrogen** **sodium** **sulfur** [1]

(d) Coal gas contains methane.
Complete the diagram to show how the electrons are arranged in a molecule of methane.



[1]

- (e) When coal is burnt, sulfur dioxide is given off.
Which two of the following statements about sulfur dioxide are correct?
Tick **two** boxes.

Sulfur dioxide is an acidic oxide.

About 20% of the air is sulfur dioxide.

Most of the sulfur dioxide in the air comes from car exhausts.

Sulfur dioxide contributes to acid rain.

[2]

[Total: 9]

7 Ethanol, C_2H_5OH , is a member of the alcohol homologous series.

(a) (i) Give **two** characteristics of a homologous series.

1.

2. [2]

(ii) Draw the structure of ethanol showing all atoms and bonds.

[1]

(b) One use of ethanol is as a solvent.

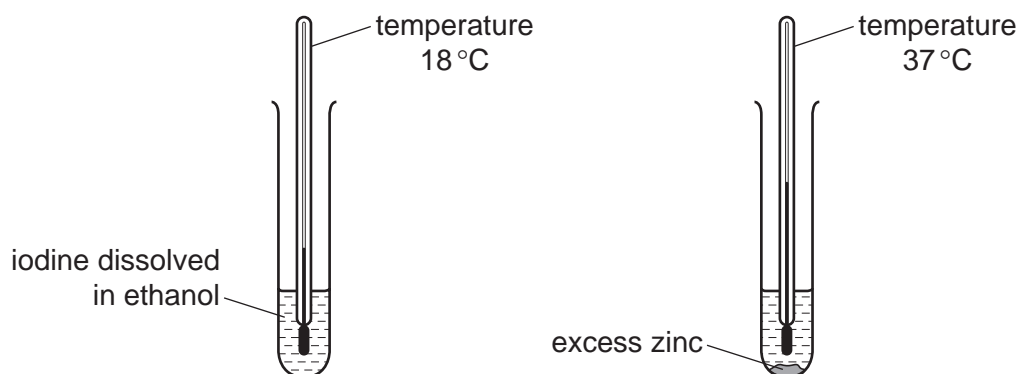
A pupil studied the reaction of iodine with zinc.

She first dissolved a few crystals of iodine in ethanol and recorded the temperature of the solution.

The temperature was $18^\circ C$.

She then added excess powdered zinc and recorded the temperature again.

The new temperature was $37^\circ C$.



(i) Is this reaction endothermic or exothermic?
Explain your answer.

.....

..... [1]

(ii) What colour is solid iodine?

..... [1]

(c) The equation for the reaction is



When the reaction is complete, the mixture contains zinc iodide dissolved in ethanol and unreacted zinc powder.

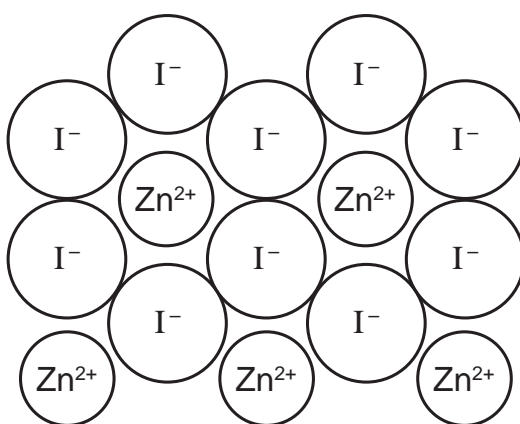
Suggest how you can get crystals of zinc iodide from the reaction mixture.

.....

.....

..... [2]

(d) The diagram shows the structure of zinc iodide.



(i) What is the simplest formula for zinc iodide?

..... [1]

(ii) The list below shows four different types of structure.
What type of structure is zinc iodide?
Put a ring around the correct answer.

giant covalent

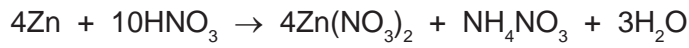
giant ionic

metallic

molecular

[1]

(e) The equation for the reaction of zinc with dilute nitric acid is



Write a word equation for this reaction.

..... [3]

(f) Describe a test for ammonium ions.

test

result

..... [3]

[Total: 15]

DATA SHEET
The Periodic Table of the Elements

		Group																																																																																																																																																																																																																																																																																																																																																																																																																																											
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7 Li Lithium 3	9 Be Beryllium 4	1 H Hydrogen 1	11 B Boron 5	12 C Carbon 6	13 Al Aluminium 13	14 N Nitrogen 7	15 O Oxygen 8	16 F Fluorine 9	17 Ne Neon 10	18 Ar Argon 18	19 K Potassium 19	20 Ca Calcium 20	21 Sc Scandium 21	22 Ti Titanium 22	23 V Vanadium 23	24 Cr Chromium 24	25 Mn Manganese 25	26 Fe Iron 26	27 Co Cobalt 27	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	37 Rb Rubidium 37	38 Sr Strontium 38	39 Y Yttrium 39	40 Zr Zirconium 40	41 Nb Niobium 41	42 Mo Molybdenum 42	43 Tc Technetium 43	44 Ru Ruthenium 44	45 Rh Rhodium 45	46 Pd Palladium 46	47 Ag Silver 47	48 Cd Cadmium 48	49 In Indium 49	50 Sn Tin 50	51 Sb Antimony 51	52 Te Tellurium 52	53 I Iodine 53	54 Xe Xenon 54	55 Cs Caesium 55	56 Ba Barium 56	57 La Lanthanum 57	72 Hf Hafnium 72	73 Ta Tantalum 73	74 W Tungsten 74	75 Re Rhenium 75	76 Os Osmium 76	77 Ir Iridium 77	78 Pt Platinum 78	79 Au Gold 79	80 Hg Mercury 80	81 Tl Thallium 81	82 Pb Lead 82	83 Bi Bismuth 83	84 Po Polonium 84	85 At Astatine 85	86 Rn Radon 86	87 Fr Francium 87	88 Ra Radium 88	89 Ac Actinium 89	†	90 Th Thorium 90	91 Pa Protactinium 91	92 U Uranium 92	93 Np Neptunium 93	94 Pu Plutonium 94	95 Am Americium 95	96 Cm Curium 96	97 Bk Berkelium 97	98 Cf Californium 98	99 Es Einsteinium 99	100 Fm Fermium 100	101 Md Mendelevium 101	102 No Nobelium 102	103 Lr Lawrencium 103	104 Rf Rutherfordium 104	105 Db Dubnium 105	106 Sg Seaborgium 106	107 Bh Bohrium 107	108 Hs Hassium 108	109 Mt Meitnerium 109	110 Ds Darmstadtium 110	111 Rg Roentgenium 111	112 Cn Copernicium 112	113 Nh Nihonium 113	114 Fl Flerovium 114	115 Mc Moscovium 115	116 Lv Livermorium 116	117 Ts Tennessine 117	118 Og Oganesson 118	119 Uu Ununennium 119	120 Uub Unbinilium 120	121 Uut Untrium 121	122 Uuq Unquadium 122	123 Uuq Unquadium 123	124 Uuq Unquadium 124	125 Uuq Unquadium 125	126 Uuq Unquadium 126	127 Uuq Unquadium 127	128 Uuq Unquadium 128	129 Uuq Unquadium 129	130 Uuq Unquadium 130	131 Uuq Unquadium 131	132 Uuq Unquadium 132	133 Uuq Unquadium 133	134 Uuq Unquadium 134	135 Uuq Unquadium 135	136 Uuq Unquadium 136	137 Uuq Unquadium 137	138 Uuq Unquadium 138	139 Uuq Unquadium 139	140 Uuq Unquadium 140	141 Uuq Unquadium 141	142 Uuq Unquadium 142	143 Uuq Unquadium 143	144 Uuq Unquadium 144	145 Uuq Unquadium 145	146 Uuq Unquadium 146	147 Uuq Unquadium 147	148 Uuq Unquadium 148	149 Uuq Unquadium 149	150 Uuq Unquadium 150	151 Uuq Unquadium 151	152 Uuq Unquadium 152	153 Uuq Unquadium 153	154 Uuq Unquadium 154	155 Uuq Unquadium 155	156 Uuq Unquadium 156	157 Uuq Unquadium 157	158 Uuq Unquadium 158	159 Uuq Unquadium 159	160 Uuq Unquadium 160	161 Uuq Unquadium 161	162 Uuq Unquadium 162	163 Uuq Unquadium 163	164 Uuq Unquadium 164	165 Uuq Unquadium 165	166 Uuq Unquadium 166	167 Uuq Unquadium 167	168 Uuq Unquadium 168	169 Uuq Unquadium 169	170 Uuq Unquadium 170	171 Uuq Unquadium 171	172 Uuq Unquadium 172	173 Uuq Unquadium 173	174 Uuq Unquadium 174	175 Uuq Unquadium 175	176 Uuq Unquadium 176	177 Uuq Unquadium 177	178 Uuq Unquadium 178	179 Uuq Unquadium 179	180 Uuq Unquadium 180	181 Uuq Unquadium 181	182 Uuq Unquadium 182	183 Uuq Unquadium 183	184 Uuq Unquadium 184	185 Uuq Unquadium 185	186 Uuq Unquadium 186	187 Uuq Unquadium 187	188 Uuq Unquadium 188	189 Uuq Unquadium 189	190 Uuq Unquadium 190	191 Uuq Unquadium 191	192 Uuq Unquadium 192	193 Uuq Unquadium 193	194 Uuq Unquadium 194	195 Uuq Unquadium 195	196 Uuq Unquadium 196	197 Uuq Unquadium 197	198 Uuq Unquadium 198	199 Uuq Unquadium 199	200 Uuq Unquadium 200	201 Uuq Unquadium 201	202 Uuq Unquadium 202	203 Uuq Unquadium 203	204 Uuq Unquadium 204	205 Uuq Unquadium 205	206 Uuq Unquadium 206	207 Uuq Unquadium 207	208 Uuq Unquadium 208	209 Uuq Unquadium 209	210 Uuq Unquadium 210	211 Uuq Unquadium 211	212 Uuq Unquadium 212	213 Uuq Unquadium 213	214 Uuq Unquadium 214	215 Uuq Unquadium 215	216 Uuq Unquadium 216	217 Uuq Unquadium 217	218 Uuq Unquadium 218	219 Uuq Unquadium 219	220 Uuq Unquadium 220	221 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Unquadium 266	267 Uuq Unquadium 267	268 Uuq Unquadium 268	269 Uuq Unquadium 269	270 Uuq Unquadium 270	271 Uuq Unquadium 271	272 Uuq Unquadium 272	273 Uuq Unquadium 273	274 Uuq Unquadium 274	275 Uuq Unquadium 275	276 Uuq Unquadium 276	277 Uuq Unquadium 277	278 Uuq Unquadium 278	279 Uuq Unquadium 279	280 Uuq Unquadium 280	281 Uuq Unquadium 281	282 Uuq Unquadium 282	283 Uuq Unquadium 283	284 Uuq Unquadium 284	285 Uuq Unquadium 285	286 Uuq Unquadium 286	287 Uuq Unquadium 287	288 Uuq Unquadium 288	289 Uuq Unquadium 289	290 Uuq Unquadium 290	291 Uuq Unquadium 291	292 Uuq Unquadium 292	293 Uuq Unquadium 293	294 Uuq Unquadium 294	295 Uuq Unquadium 295	296 Uuq Unquadium 296	297 Uuq Unquadium 297	298 Uuq Unquadium 298	299 Uuq Unquadium 299	300 Uuq Unquadium 300	301 Uuq Unquadium 301	302 Uuq Unquadium 302	303 Uuq Unquadium 303	304 Uuq Unquadium 304	305 Uuq Unquadium 305	306 Uuq Unquadium 306	307 Uuq Unquadium 307	308 Uuq Unquadium 308	309 Uuq Unquadium 309	310 Uuq Unquadium 310	311 Uuq Unquadium 311	312 Uuq Unquadium 312	313 Uuq Unquadium 313	314 Uuq Unquadium 314	315 Uuq Unquadium 315	316 Uuq Unquadium 316	317 Uuq Unquadium 317	318 Uuq Unquadium 318	319 Uuq Unquadium 319	320 Uuq Unquadium 320	321 Uuq Unquadium 321	322 Uuq Unquadium 322	323 Uuq Unquadium 323	324 Uuq Unquadium 324	325 Uuq Unquadium 325	326 Uuq Unquadium 326	327 Uuq Unquadium 327	328 Uuq Unquadium 328	329 Uuq Unquadium 329	330 Uuq Unquadium 330	331 Uuq Unquadium 331	332 Uuq Unquadium 332	333 Uuq Unquadium 333	334 Uuq Unquadium 334	335 Uuq Unquadium 335	336 Uuq Unquadium 336	337 Uuq Unquadium 337	338 Uuq Unquadium 338	339 Uuq Unquadium 339	340 Uuq Unquadium 340	341 Uuq Unquadium 341	342 Uuq Unquadium 342	343 Uuq Unquadium 343	344 Uuq Unquadium 344	345 Uuq Unquadium 345	346 Uuq Unquadium 346	347 Uuq Unquadium 347	348 Uuq Unquadium 348	349 Uuq Unquadium 349	350 Uuq Unquadium 350	351 Uuq Unquadium 351	352 Uuq Unquadium 352	353 Uuq Unquadium 353	354 Uuq Unquadium 354	355 Uuq Unquadium 355	356 Uuq Unquadium 356	357 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