



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

0620/23

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.

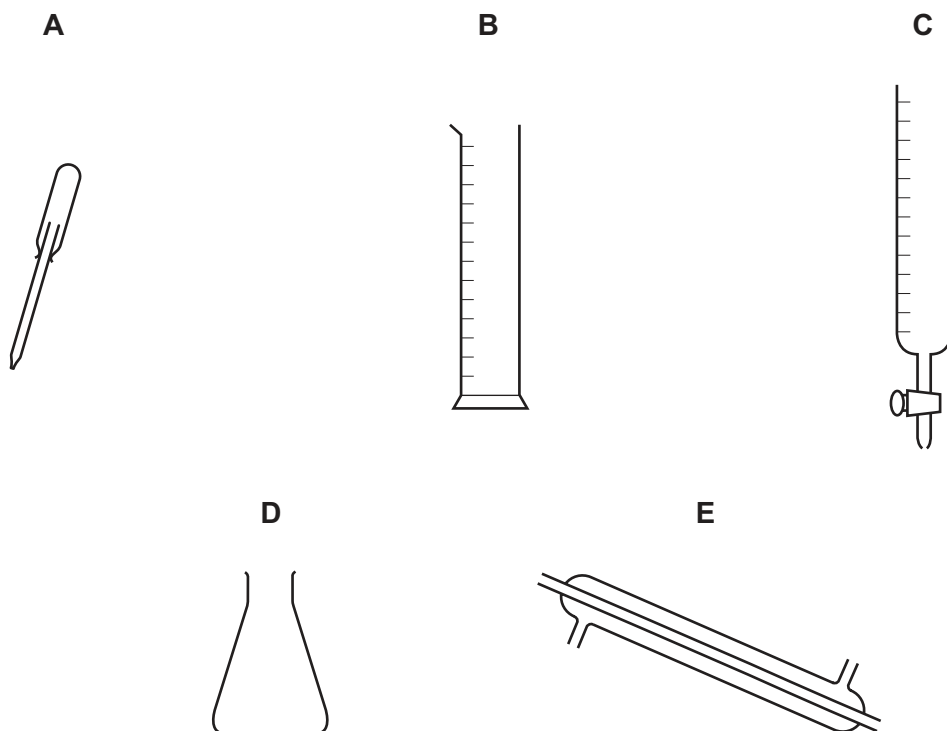
For Examiner's Use

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**.



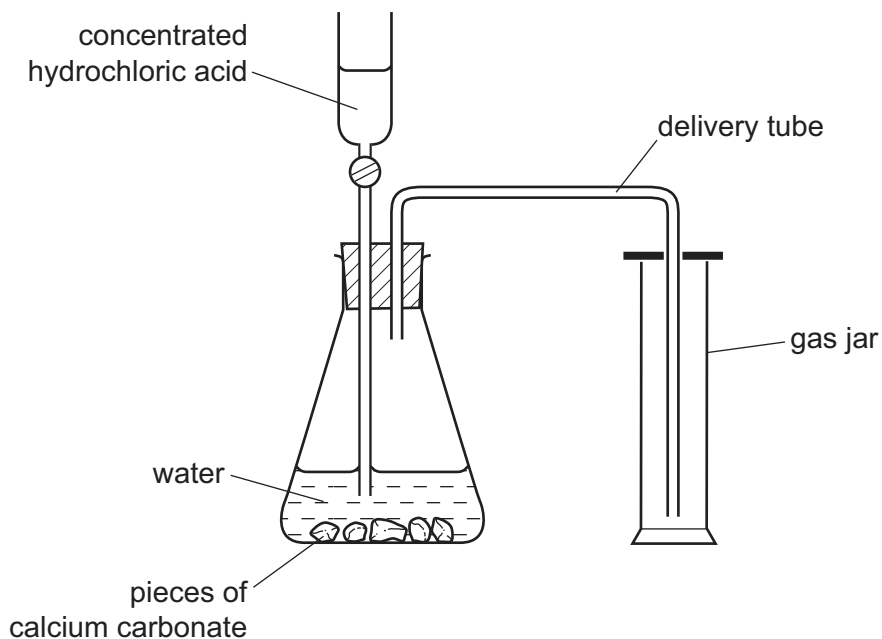
(a) Choose from **A**, **B**, **C**, **D** or **E** to answer the following questions. Each letter may be used once, more than once or not at all.

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]

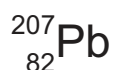
(iii) aluminium [1]

(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]

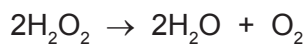
- (iii) Sodium chloride is formed when sodium burns in chlorine.
Sodium chloride is an ionic compound.
Complete the following sentences about this reaction using words from the list.

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

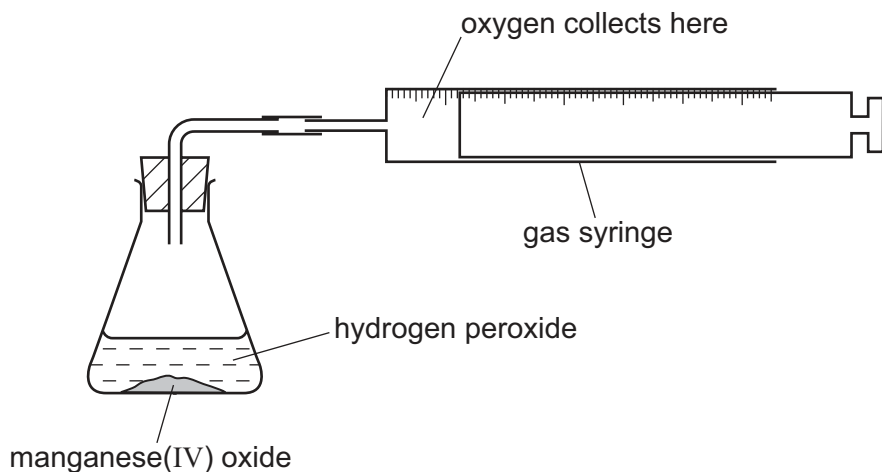
When sodium burns in chlorine, each sodium atom loses an and becomes a sodium Each chlorine atom an electron and becomes a ion. [4]

[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.

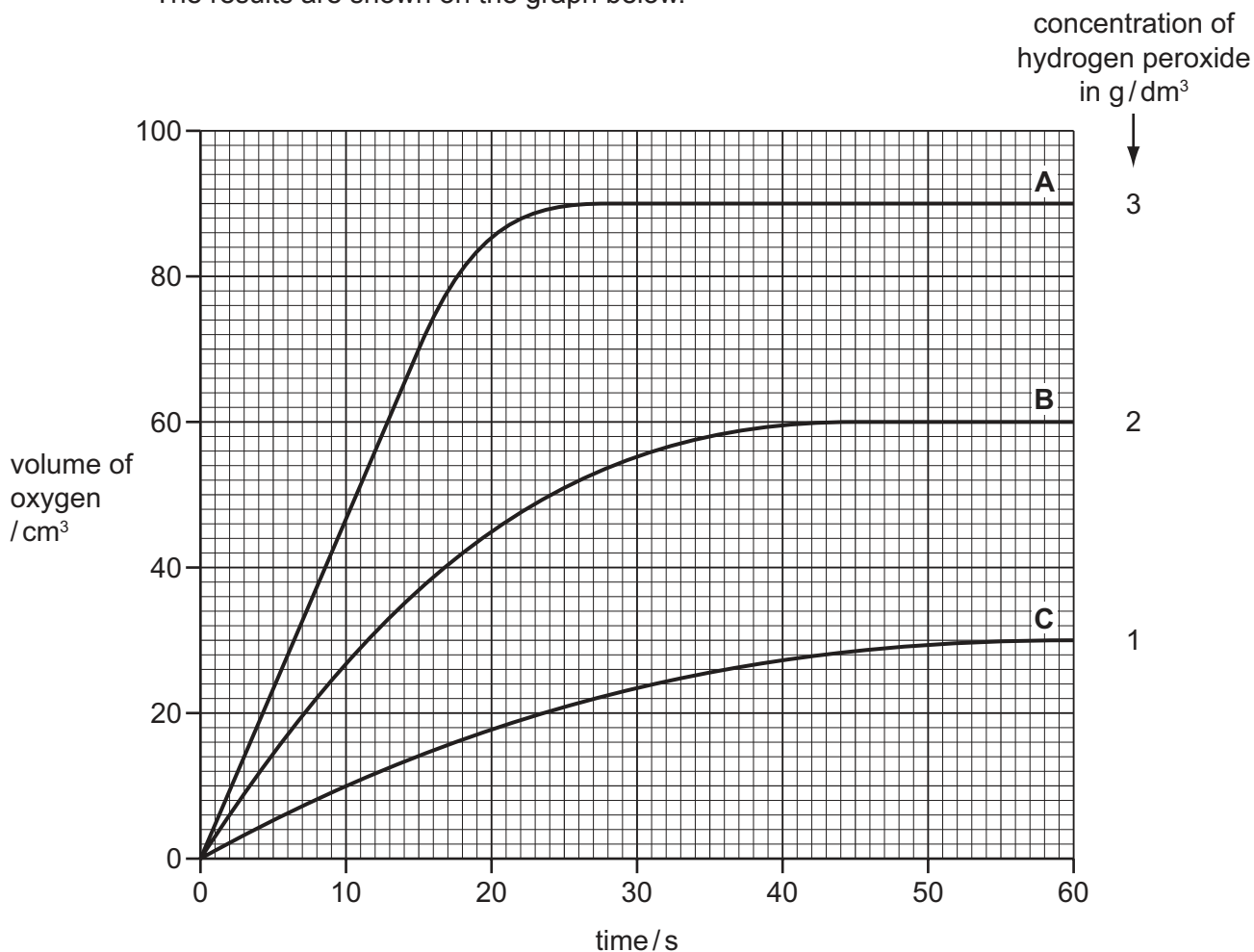


- (a) Apart from the volume of hydrogen peroxide, state two things that the student must keep the same in each experiment.

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

--	--	--	--

[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.

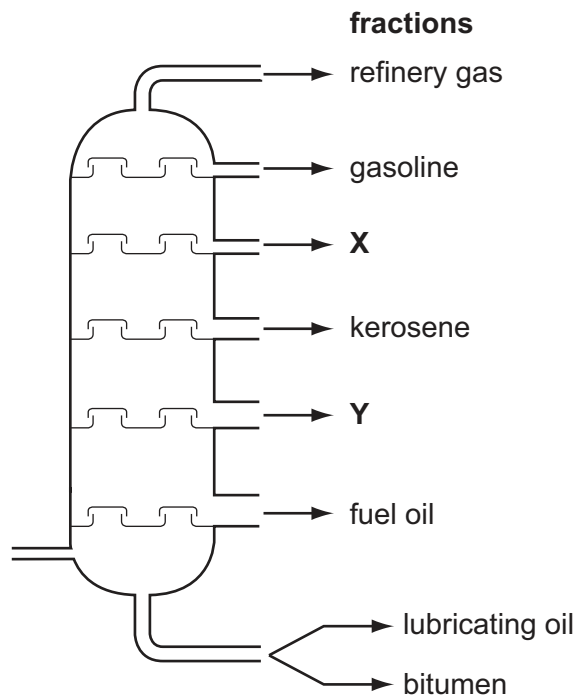
..... [1]

(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.

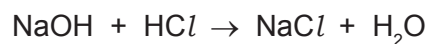
- (i) Which **one** of the following best describes the pH of a concentrated aqueous solution of sodium hydroxide?
Put a ring around the correct answer.

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

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

[1]

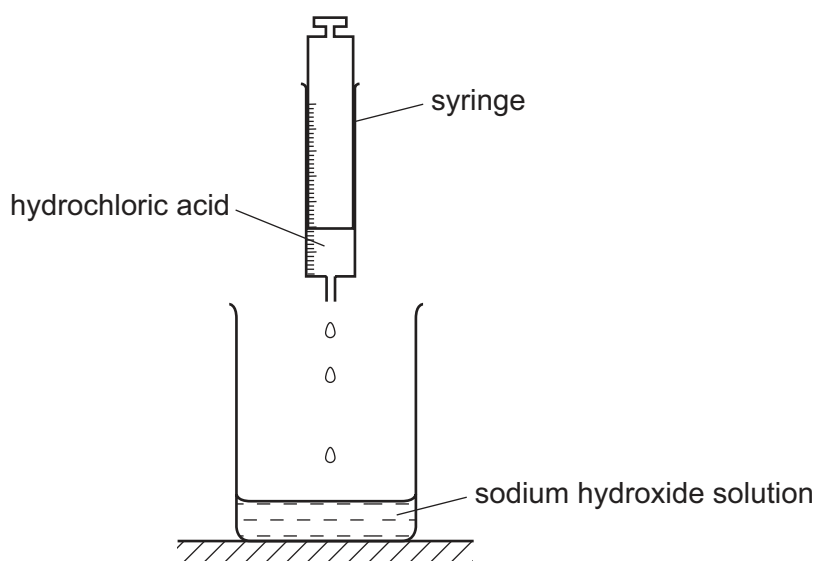
- (iii) The equation describes how sodium hydroxide reacts with hydrochloric acid.



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]

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

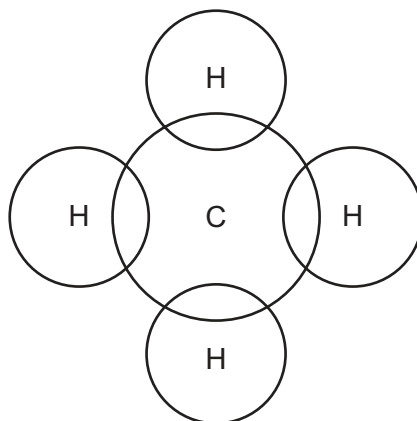
ammonia + sulfuric acid → [1]

(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.

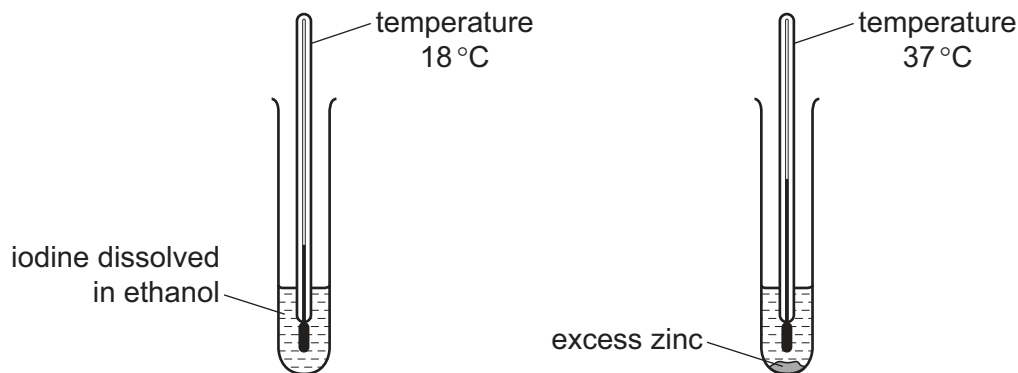
A pupil studied the reaction of iodine with zinc.

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.

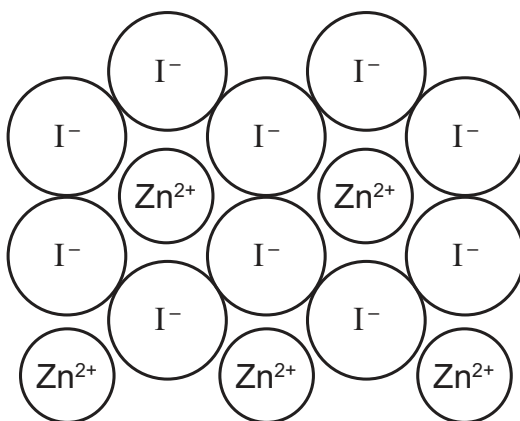
Suggest how you can get crystals of zinc iodide from the reaction mixture.

.....

.....

..... [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

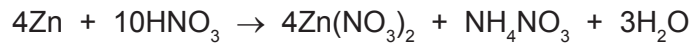
giant ionic

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																																																																																													
I	II	III	IV	V	VI	VII	0																																																																																								
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 Lv Livermorium 115	116 Ts Tennessine 116	117 Og Oganesson 117
		140 Ce Cerium 58	141 Pr Praseodymium 59	142 Nd Neodymium 60	143 Pm Promethium 61	144 Nd Neodymium 60	145 Sm Samarium 62	146 Eu Europium 63	147 Gd Gadolinium 64	148 Tb Terbium 65	149 Dy Dysprosium 66	150 Ho Holmium 67	151 Er Erbium 68	152 Tm Thulium 69	153 Yb Ytterbium 70	154 Lu Lutetium 71	155 Hf Hafnium 72	156 Ta Tantalum 73	157 W Tungsten 74	158 Re Rhenium 75	159 Os Osmium 76	160 Ir Iridium 77	161 Pt Platinum 78	162 Au Gold 79	163 Hg Mercury 80	164 Tl Thallium 81	165 Pb Lead 82	166 Bi Bismuth 83	167 Po Polonium 84	168 At Astatine 85	169 Rn Radon 86	170 Fr Francium 87	171 Ra Radium 88	172 Ac Actinium 89	173 Th Thorium 90	174 Pa Protactinium 91	175 U Uranium 92	176 Np Neptunium 93	177 Pu Plutonium 94	178 Am Americium 95	179 Cm Curium 96	180 Bk Berkelium 97	181 Cf Californium 98	182 Es Einsteinium 99	183 Fm Fermium 100	184 Md Mendelevium 101	185 No Nobelium 102	186 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 dm³ at room temperature and pressure (r.t.p.).

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