

Candidate Name \_\_\_\_\_

Centre Number

Candidate  
Number

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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.

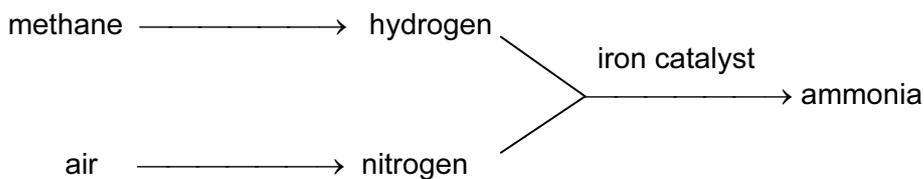
A copy of the Periodic Table is printed on page 16.

FOR EXAMINER'S USE	
1	
2	
3	
4	
5	
6	
<b>TOTAL</b>	

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**This question paper consists of 16 printed pages.**

1 Ammonia,  $\text{NH}_3$ , is synthesised by the following route.



(a) (i) To which group of organic compounds does methane,  $\text{CH}_4$ , 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.



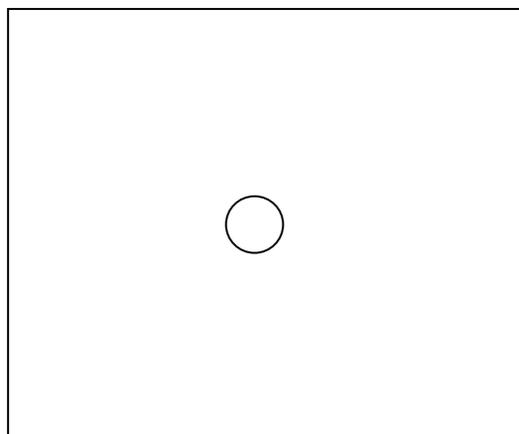
- (ii) What does the sign  $\rightleftharpoons$  mean?

..... [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	$\text{Ca}^{2+}$	10
chloride	$\text{Cl}^{-}$	8
hydrogencarbonate	$\text{HCO}_3^{-}$	64
sodium	$\text{Na}^{+}$	8
sulphate	$\text{SO}_4^{2-}$	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.



[1]

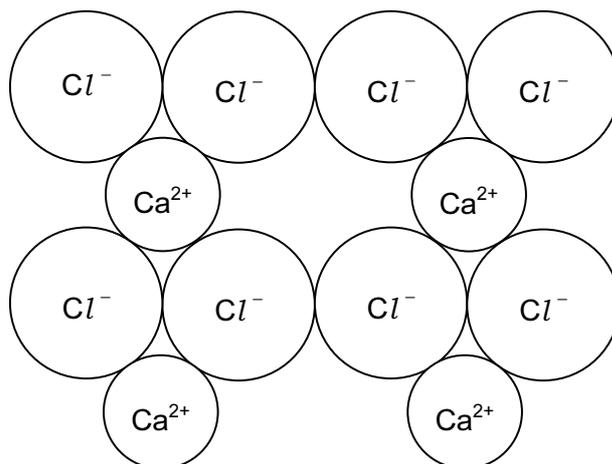
- (d) When this sample of mineral water is evaporated to dryness, various compounds are formed. One of these compounds is calcium chloride.

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]

7

For  
Examiner's  
Use

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

Hydrogen chloride gas,  $\text{H} - \text{Cl}$ , is given off during this reaction.

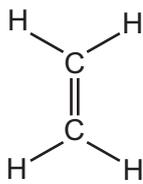
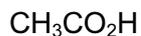
State the type of bonding in a hydrogen chloride molecule.

Put a ring around the correct answer.

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

[1]

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

**A****B****C****D****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]

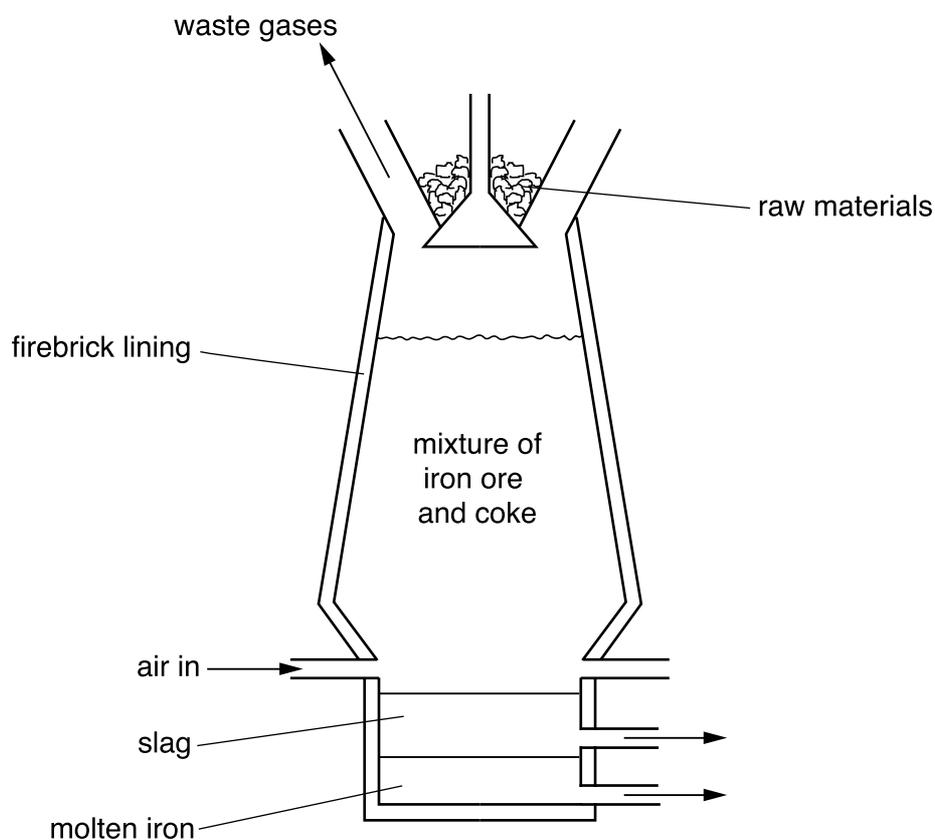
- (i) Many fruits contain a variety of different coloured compounds.

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.



(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.

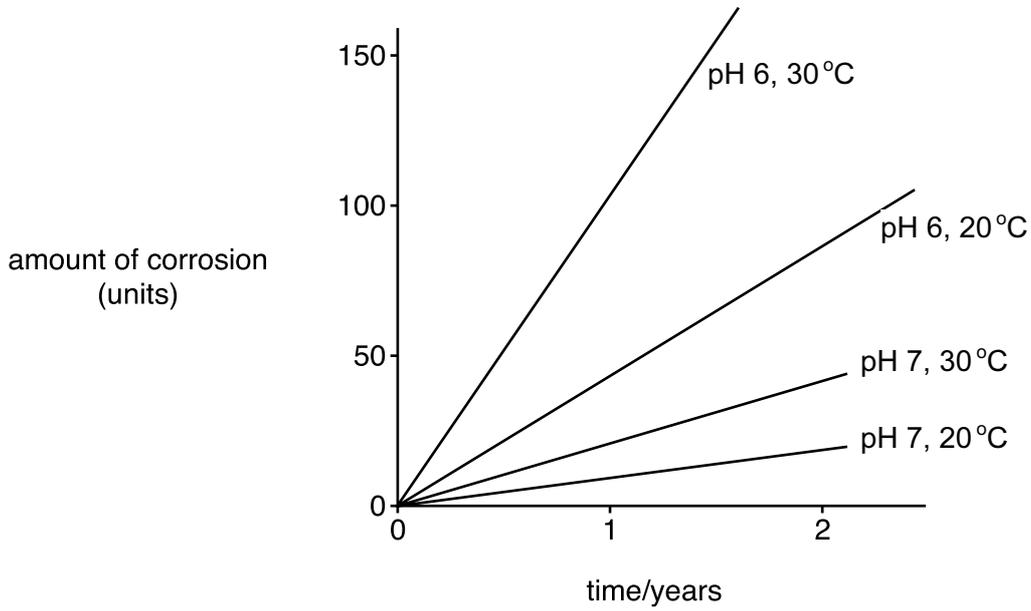
.....  
.....  
..... [2]

(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.

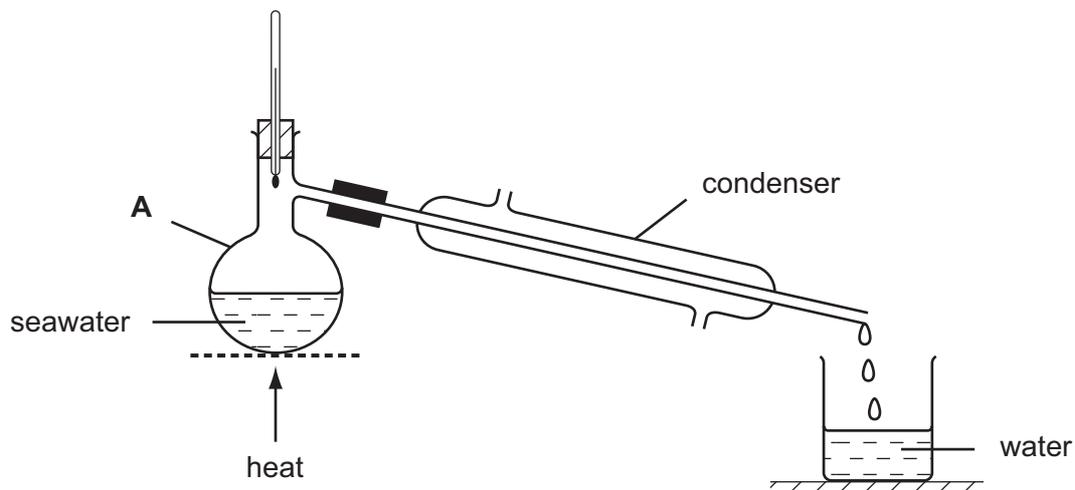
State the name and source of **one** acidic gas found in the air as a result of pollution.

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	$\text{NaCl}$	28.0
	$\text{MgCl}_2$	8.0
magnesium sulphate	$\text{MgSO}_4$	6.0
calcium sulphate	$\text{CaSO}_4$	2.0
potassium chloride	$\text{KCl}$	1.0
calcium carbonate	$\text{CaCO}_3$	
potassium bromide	$\text{KBr}$	
		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  $\text{MgCl}_2$ .

[1]

- (iv) Calcium sulphate contains sulphate ions.

Describe a test for sulphate ions.

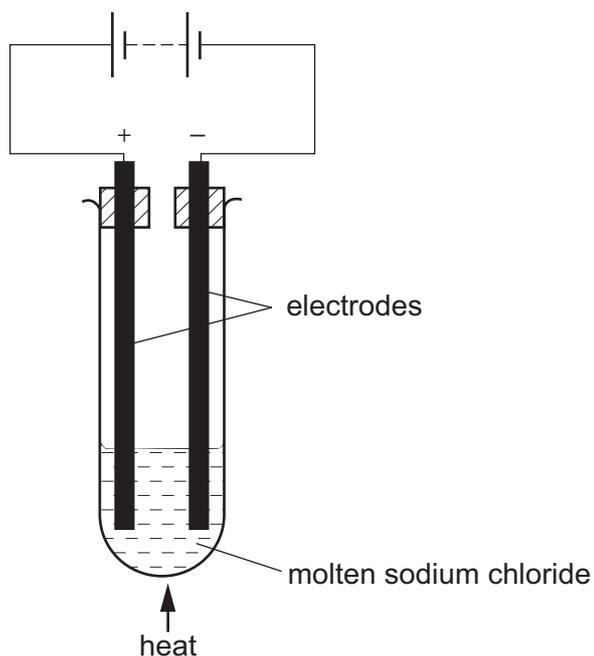
test .....

.....

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																																				
7 <b>Li</b> Lithium 3	9 <b>Be</b> Beryllium 4	<table border="1" style="margin: auto; border-collapse: collapse;"> <tr> <td style="text-align: center;">1 <b>H</b> Hydrogen 1</td> </tr> </table>																1 <b>H</b> Hydrogen 1	11 <b>B</b> Boron 5	12 <b>C</b> Carbon 6	14 <b>N</b> Nitrogen 7	16 <b>O</b> Oxygen 8	19 <b>F</b> Fluorine 9	20 <b>Ne</b> Neon 10																			
1 <b>H</b> Hydrogen 1																																											
23 <b>Na</b> Sodium 11	24 <b>Mg</b> Magnesium 12	27 <b>Al</b> Aluminium 13	28 <b>Si</b> Silicon 14	31 <b>P</b> Phosphorus 15	32 <b>S</b> Sulphur 16	35.5 <b>Cl</b> Chlorine 17	40 <b>Ar</b> Argon 18																																				
39 <b>K</b> Potassium 19	40 <b>Ca</b> Calcium 20	45 <b>Sc</b> Scandium 21	48 <b>Ti</b> Titanium 22	51 <b>V</b> Vanadium 23	52 <b>Cr</b> Chromium 24	55 <b>Mn</b> Manganese 25	56 <b>Fe</b> Iron 26	59 <b>Co</b> Cobalt 27	59 <b>Ni</b> Nickel 28	64 <b>Cu</b> Copper 29	65 <b>Zn</b> Zinc 30	70 <b>Ga</b> Gallium 31	73 <b>Ge</b> Germanium 32	75 <b>As</b> Arsenic 33	79 <b>Se</b> Selenium 34	80 <b>Br</b> Bromine 35	84 <b>Kr</b> Krypton 36																										
85 <b>Rb</b> Rubidium 37	88 <b>Sr</b> Strontium 38	89 <b>Y</b> Yttrium 39	91 <b>Zr</b> Zirconium 40	93 <b>Nb</b> Niobium 41	96 <b>Mo</b> Molybdenum 42	101 <b>Ru</b> Ruthenium 44	106 <b>Pd</b> Palladium 46	108 <b>Ag</b> Silver 47	112 <b>Cd</b> Cadmium 48	115 <b>In</b> Indium 49	119 <b>Sn</b> Tin 50	122 <b>Sb</b> Antimony 51	127 <b>I</b> Iodine 53	131 <b>Xe</b> Xenon 54																													
133 <b>Cs</b> Caesium 55	137 <b>Ba</b> Barium 56	139 <b>La</b> Lanthanum 57	178 <b>Hf</b> Hafnium 72	181 <b>Ta</b> Tantalum 73	184 <b>W</b> Tungsten 74	190 <b>Os</b> Osmium 76	195 <b>Pt</b> Platinum 78	197 <b>Au</b> Gold 79	201 <b>Hg</b> Mercury 80	204 <b>Tl</b> Thallium 81	207 <b>Pb</b> Lead 82	209 <b>Bi</b> Bismuth 83	210 <b>Po</b> Polonium 84	210 <b>Rn</b> Radon 86																													
87 <b>Fr</b> Francium	88 <b>Ra</b> Radium	227 <b>Ac</b> Actinium																																									
<p>*58-71 Lanthanoid series 90-103 Actinoid series</p>																																											
<table border="1" style="margin: auto; border-collapse: collapse;"> <tr> <td style="text-align: center;">a</td> <td style="text-align: center;"><b>X</b></td> <td style="text-align: center;">b</td> </tr> </table> <p>Key a = relative atomic mass X = atomic symbol b = proton (atomic) number</p>																		a	<b>X</b>	b																							
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<table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <tr> <td>140 <b>Ce</b> Cerium 58</td> <td>141 <b>Pr</b> Praseodymium 59</td> <td>144 <b>Nd</b> Neodymium 60</td> <td>150 <b>Sm</b> Samarium 62</td> <td>152 <b>Eu</b> Europium 63</td> <td>157 <b>Gd</b> Gadolinium 64</td> <td>162 <b>Dy</b> Dysprosium 66</td> <td>165 <b>Ho</b> Holmium 67</td> <td>167 <b>Er</b> Erbium 68</td> <td>169 <b>Tm</b> Thulium 69</td> <td>173 <b>Yb</b> Ytterbium 70</td> <td>175 <b>Lu</b> Lutetium 71</td> <td>181 <b>Th</b> Thorium 90</td> <td>232 <b>Th</b> Thorium 90</td> <td>238 <b>U</b> Uranium 92</td> <td>92 <b>Pa</b> Protactinium 91</td> <td>94 <b>Pu</b> Plutonium 94</td> <td>95 <b>Am</b> Americium 95</td> <td>96 <b>Cm</b> Curium 96</td> <td>97 <b>Bk</b> Berkelium 97</td> <td>98 <b>Cf</b> Californium 98</td> <td>99 <b>Es</b> Einsteinium 99</td> <td>100 <b>Fm</b> Fermium 100</td> <td>101 <b>Md</b> Mendelevium 101</td> <td>102 <b>No</b> Nobelium 102</td> <td>103 <b>Lr</b> Lawrencium 103</td> </tr> </table>																		140 <b>Ce</b> Cerium 58	141 <b>Pr</b> Praseodymium 59	144 <b>Nd</b> Neodymium 60	150 <b>Sm</b> Samarium 62	152 <b>Eu</b> Europium 63	157 <b>Gd</b> Gadolinium 64	162 <b>Dy</b> Dysprosium 66	165 <b>Ho</b> Holmium 67	167 <b>Er</b> Erbium 68	169 <b>Tm</b> Thulium 69	173 <b>Yb</b> Ytterbium 70	175 <b>Lu</b> Lutetium 71	181 <b>Th</b> Thorium 90	232 <b>Th</b> Thorium 90	238 <b>U</b> Uranium 92	92 <b>Pa</b> Protactinium 91	94 <b>Pu</b> Plutonium 94	95 <b>Am</b> Americium 95	96 <b>Cm</b> Curium 96	97 <b>Bk</b> Berkelium 97	98 <b>Cf</b> Californium 98	99 <b>Es</b> Einsteinium 99	100 <b>Fm</b> Fermium 100	101 <b>Md</b> Mendelevium 101	102 <b>No</b> Nobelium 102	103 <b>Lr</b> Lawrencium 103
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The volume of one mole of any gas is 24 dm<sup>3</sup> at room temperature and pressure (r.t.p.).