

Centre Number	Candidate Number	Name
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UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS  
International General Certificate of Secondary Education

**CHEMISTRY**

**0620/02**

Paper 2 (Core)

May/June 2005

**1 hour 15 minutes**

Candidates answer on the Question Paper.  
No Additional Materials required.

**READ THESE INSTRUCTIONS FIRST**

Write your Centre number, candidate number and name on all the work you hand in.  
Write in dark blue or black pen in the spaces provided on the Question Paper.  
You may use a pencil for any diagrams, graphs or rough working.  
Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer **all** questions.  
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 16.

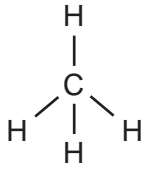
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If you have been given a label, look at the details. If any details are incorrect or missing, please fill in your correct details in the space given at the top of this page.

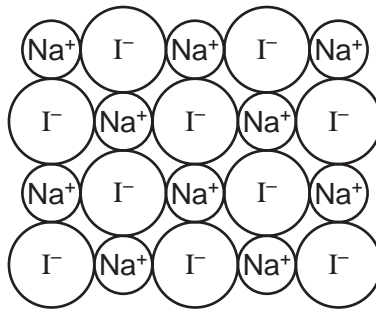
Stick your personal label here, if provided.

This document consists of **16** printed pages.

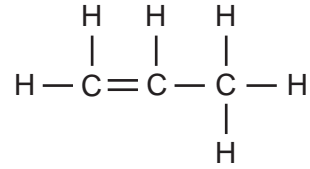
1 The structures of some substances are shown below.



A



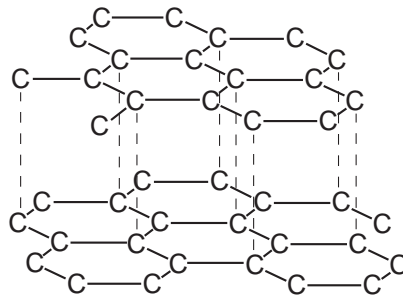
B



C



D



E

(a) Answer these questions using the letters **A**, **B**, **C**, **D** or **E**.

- (i) Which structure is methane? ..... [1]
- (ii) Which two structures are giant structures? ..... and ..... [1]
- (iii) Which two structures are hydrocarbons? ..... and ..... [1]
- (iv) Which structure contains ions? ..... [1]
- (v) Which two structures have very high melting points?  
..... and ..... [1]

(b) Structure **E** is a form of carbon.

(i) What is the name of this structure?  
Put a ring around the correct answer.

carbide                  graphite                  lead                  poly(hexene)                  [1]

(ii) Name another form of carbon.

..... [1]

(c) Write the simplest formula for substance **B**.

..... [1]

(d) Is substance **D** an element or a compound?  
Explain your answer.

.....  
..... [1]

- 2 A student collected some water from a polluted river. The water contained soluble solids and insoluble clay and had a pH of 5.

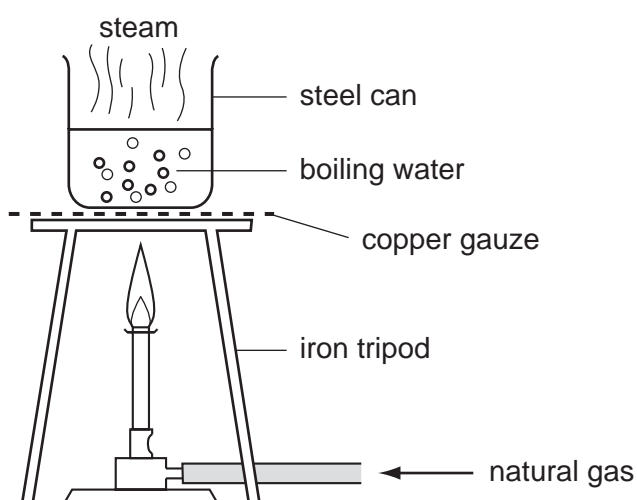
(a) How can the student separate the clay from the rest of the river water?

..... [1]

(b) The student uses litmus paper to show that the river water is acidic. What will be the result of this test?

..... [1]

(c) The student then boiled the river water to obtain the soluble solids. The diagram shows how she heated the water.



Which of the substances named in the diagram is

- (i) an alloy, ..... [1]  
 (ii) a compound which is liquid at room temperature, ..... [1]  
 (iii) an element, ..... [1]  
 (iv) a fuel? ..... [1]

(d) Name the main substance in natural gas.

..... [1]

(e) What is the normal temperature of boiling water?

..... [1]

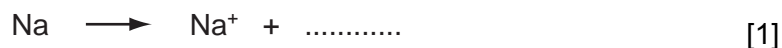
- (f) After the student boiled off the water, she analysed the white powder on the inside of the steel can.  
The table shows her results.

name of ion	formula of ion	mass of ion present /milligrams
calcium	$\text{Ca}^{2+}$	16
carbonate	$\text{CO}_3^{2-}$	35
chloride	$\text{Cl}^-$	8
nitrate	$\text{NO}_3^-$	4
sodium	$\text{Na}^+$	8
sulphate	$\text{SO}_4^{2-}$	6

- (i) Which positive ion had the greatest concentration in the sample of river water?

..... [1]

- (ii) Complete the following equation to show how a sodium ion is formed from a sodium atom.



- (g) Instead of using natural gas, the student could have used butane to heat the water.  
The formula of butane is  $\text{C}_4\text{H}_{10}$ .

- (i) What products are formed when butane burns in excess air?

..... [1]

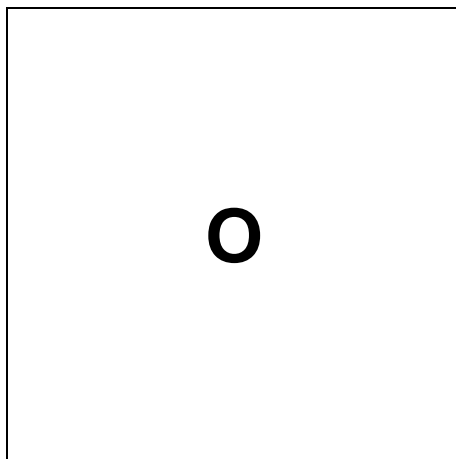
- (ii) Name the poisonous gas formed when butane undergoes incomplete combustion.

..... [1]

3 Ammonia is a gas which forms an alkaline solution when dissolved in water.

(a) Complete the diagram below to show the arrangement of the molecules in ammonia gas.

**O** represents a single molecule of ammonia.



[2]

(b) Which one of the following values is most likely to represent the pH of a dilute solution of ammonia?

Put a ring around the correct answer.

pH2

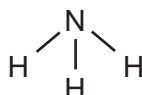
pH6

pH7

pH9

[1]

(c) The structure of the ammonia molecule is shown below.



(i) Write the simplest formula for ammonia.

[1]

(ii) Describe the type of bonding in a molecule of ammonia.

..... [1]

(iii) Ammonia is a gas at room temperature.  
Suggest why ammonia has a low boiling point.

..... [1]

(d) Many fertilisers contain ammonium sulphate.

- (i) Which acid must be added to ammonia solution to make ammonium sulphate?  
Put a ring around the correct answer.

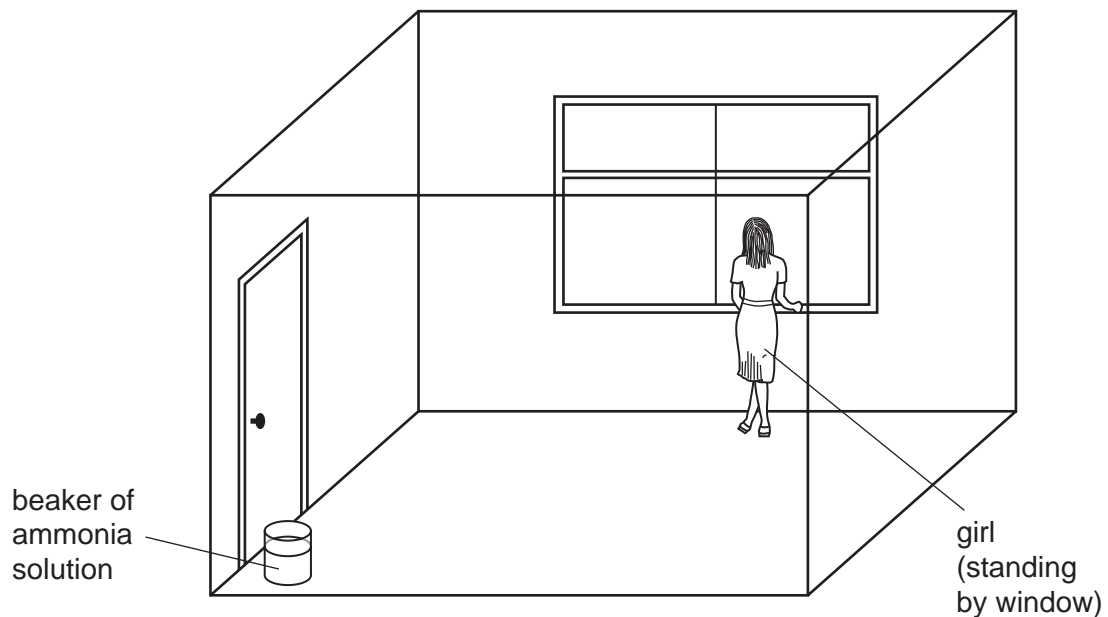
HCl                      HNO<sub>3</sub>                      H<sub>3</sub>PO<sub>4</sub>                      H<sub>2</sub>SO<sub>4</sub>                      [1]

- (ii) Fill in the missing words in the following sentence using two of the words from the list.

air                      hydrogen                      nitrogen                      soil                      sodium                      water

Fertilisers are needed in agriculture to replace the .....,  
phosphorus and other elements which are removed from the .....  
when crops are grown. [2]

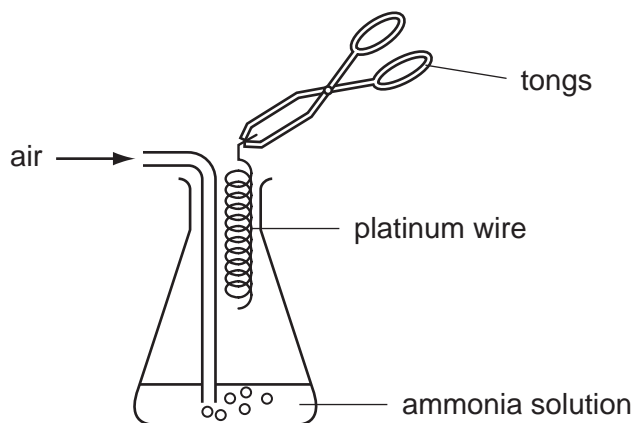
- (e) A solution of ammonia has a strong smell.  
A beaker of ammonia solution is put in the corner of a room which is free of draughts.



At first, the girl by the closed window cannot smell the ammonia.  
After 30 seconds she smells the ammonia.  
Use the kinetic particle theory to explain these facts.

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

- (f) The diagram shows the apparatus used for oxidising ammonia in the laboratory.

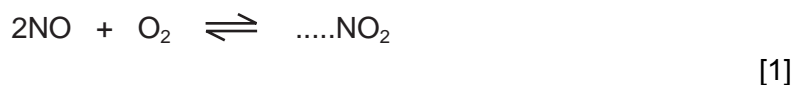


First, nitrogen(II) oxide, NO, is produced. This then reacts with oxygen to form nitrogen(IV) oxide, NO<sub>2</sub>.

- (i) Where does the oxygen come from in this reaction?

..... [1]

- (ii) Balance the equation for the reaction of nitrogen(II) oxide with oxygen.



- (iii) What is the meaning of the symbol  $\rightleftharpoons$  ?

..... [1]

- (iv) The platinum wire acts as a catalyst in the reaction. As the reaction takes place, the wire begins to glow red hot. What does this show about the reaction?

..... [1]

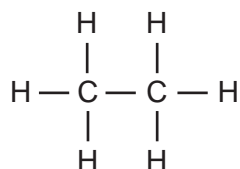


4 Poly(ethene) is a plastic which is made by polymerizing ethene,  $C_2H_4$ .

(a) Which one of the following best describes the ethene molecules in this reaction?  
Put a ring around the correct answer.

alcohols      alkanes      monomers      polymers      products      [1]

(b) The structure of ethane is shown below.



Explain, by referring to its bonding, why ethane cannot be polymerized.

..... [1]

(c) Draw the structure of ethene, showing all atoms and bonds.

[1]

(d) Ethene is obtained by cracking alkanes.

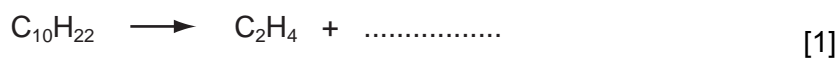
(i) Explain the meaning of the term *cracking*.

.....  
..... [1]

(ii) What condition is needed to crack alkanes?

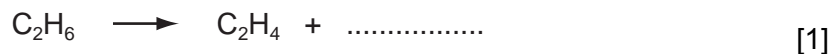
..... [1]

(iii) Complete the equation for cracking decane,  $C_{10}H_{22}$ .



(e) Some oil companies 'crack' the ethane produced when petroleum is distilled.

(i) Complete the equation for this reaction.



(ii) Describe the process of fractional distillation which is used to separate the different fractions in petroleum.

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

(iii) State a use for the following petroleum fractions.

petrol fraction .....

lubricating fraction ..... [2]

5 The halogens are a group of diatomic non-metals showing a trend in colour, state and reactivity.

(a) In this description, what is the meaning of

(i) diatomic, ..... [1]

(ii) state? ..... [1]

(b) The table gives some information about some of the halogens.

element	melting point /°C	boiling point /°C	colour	state at room temperature
chlorine	-101	-35	green	
bromine	-7	+59		
iodine	+114		grey-black	

(i) Complete the last column in the table to show the state of each of the halogens at room temperature. [2]

(ii) State the colour of bromine.

..... [1]

(iii) Suggest a value for the boiling point of iodine.

..... [1]

(c) Complete the word equation for the reaction of chlorine with potassium iodide.

chlorine + potassium iodide → ..... + .....  
..... [2]

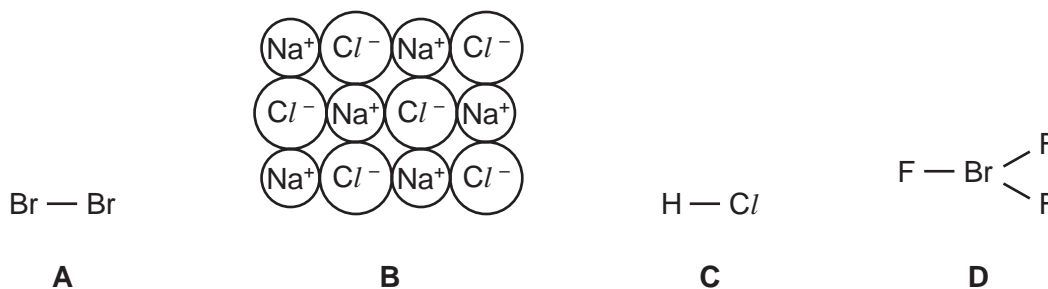
- (d) (i) Draw a diagram to show the electronic structure of a chlorine molecule.  
Show only the outer electrons.

[2]

- (ii) State a use of chlorine.

[1]

- (e) The structures of some substances containing halogens are shown below.



- (i) Which one of these structures, **A**, **B**, **C** or **D**, shows an element?

[1]

- (ii) Which one of these structures forms hydrochloric acid when dissolved in water?

[1]

- (iii) Complete the following sentence.

Structure **B** conducts electricity when it is molten because .....

[2]

(f) Astatine, At, is below iodine in Group VII of the Periodic Table.

(i) In which Period of the Periodic Table is astatine?

..... [1]

(ii) How many protons does astatine have in its nucleus?

..... [1]

(iii) Astatine has many isotopes.  
What do you understand by the term *isotopes*?

.....  
..... [1]

(iv) The most common isotope of astatine has a nucleon number (mass number) of 210.  
Calculate the number of neutrons in this isotope of astatine.

..... [1]

- 6 The electroplating of iron with chromium involves four stages.
1. The iron object is cleaned with sulphuric acid, then washed with water.
  2. The iron is plated with copper.
  3. It is then plated with nickel to prevent corrosion.
  4. It is then plated with chromium.

(a) The equation for stage 1 is



(i) Write a word equation for this reaction.

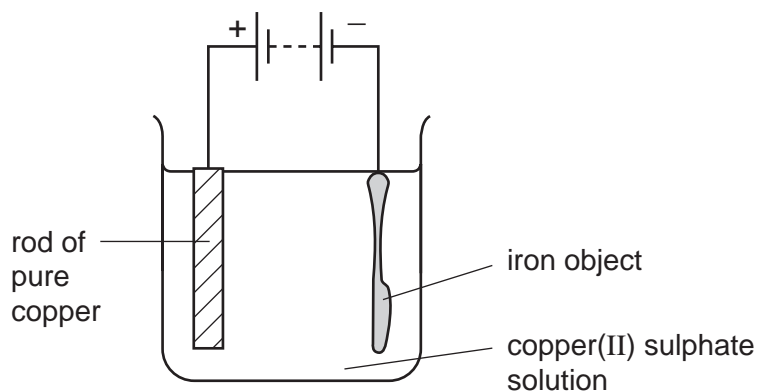
[2]

(ii) Describe a test for the gas given off in this reaction.

test .....

result ..... [2]

(b) The diagram shows how iron is electroplated with copper.



(i) Choose a word from the list below which describes the iron object.  
Put a ring around the correct answer.

anion                  anode                  cathode                  cation                  [1]

(ii) What is the purpose of the copper(II) sulphate solution?

..... [1]

(iii) Describe what happens during the electroplating to  
the iron object, .....

the rod of pure copper. .... [2]

(iv) Describe a test for copper(II) ions.

test .....

result .....

..... [3]

(c) Suggest why chromium is used to electroplate articles.

..... [1]

(d) The information below shows the reactivity of chromium, copper and iron with warm hydrochloric acid.

chromium – few bubbles of gas produced every second

copper – no bubbles of gas produced

iron – many bubbles of gas produced every second

Put these three metals in order of their reactivity with hydrochloric acid.

Most reactive →


Least reactive →

[1]

**DATA SHEET**  
**The Periodic Table of the Elements**

		Group																															
I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII																						
1 <b>H</b> Hydrogen																																	
3 <b>Li</b> Lithium	4 <b>Be</b> Beryllium																																
7 <b>Li</b> Lithium	9 <b>Be</b> Beryllium	11 <b>Na</b> Sodium	12 <b>Mg</b> Magnesium									19 <b>K</b> Potassium	20 <b>Ca</b> Calcium	21 <b>Sc</b> Scandium	22 <b>Ti</b> Titanium	23 <b>V</b> Vanadium	24 <b>Cr</b> Chromium	25 <b>Mn</b> Manganese	26 <b>Fe</b> Iron	27 <b>Co</b> Cobalt	28 <b>Ni</b> Nickel	29 <b>Cu</b> Copper	30 <b>Zn</b> Zinc	31 <b>Ga</b> Gallium	32 <b>Ge</b> Germanium	33 <b>As</b> Arsenic	34 <b>Se</b> Selenium	35 <b>Br</b> Bromine	36 <b>Kr</b> Krypton				
11 <b>Na</b> Sodium	12 <b>Mg</b> Magnesium	13 <b>Al</b> Aluminium	14 <b>Si</b> Silicon	15 <b>P</b> Phosphorus	16 <b>S</b> Sulphur	17 <b>Cl</b> Chlorine	18 <b>Ar</b> Argon					37 <b>Rb</b> Rubidium	38 <b>Sr</b> Strontium	39 <b>Y</b> Yttrium	40 <b>Zr</b> Zirconium	41 <b>Nb</b> Niobium	42 <b>Mo</b> Molybdenum	43 <b>Tc</b> Technetium	44 <b>Ru</b> Ruthenium	45 <b>Rh</b> Rhodium	46 <b>Pd</b> Palladium	47 <b>Ag</b> Silver	48 <b>Cd</b> Cadmium	49 <b>In</b> Indium	50 <b>Sn</b> Tin	51 <b>Sb</b> Antimony	52 <b>Te</b> Tellurium	53 <b>I</b> Iodine	54 <b>Xe</b> Xenon				
19 <b>K</b> Potassium	20 <b>Ca</b> Calcium	23 <b>V</b> Vanadium	24 <b>Cr</b> Chromium	25 <b>Mn</b> Manganese	26 <b>Fe</b> Iron	27 <b>Co</b> Cobalt	28 <b>Ni</b> Nickel	29 <b>Cu</b> Copper	30 <b>Zn</b> Zinc	31 <b>Ga</b> Gallium	32 <b>Ge</b> Germanium	33 <b>As</b> Arsenic	34 <b>Se</b> Selenium	35 <b>Br</b> Bromine	36 <b>Kr</b> Krypton	37 <b>Rb</b> Rubidium	38 <b>Sr</b> Strontium	39 <b>Y</b> Yttrium	40 <b>Zr</b> Zirconium	41 <b>Nb</b> Niobium	42 <b>Mo</b> Molybdenum	43 <b>Tc</b> Technetium	44 <b>Ru</b> Ruthenium	45 <b>Rh</b> Rhodium	46 <b>Pd</b> Palladium	47 <b>Ag</b> Silver	48 <b>Cd</b> Cadmium	49 <b>In</b> Indium	50 <b>Sn</b> Tin	51 <b>Sb</b> Antimony	52 <b>Te</b> Tellurium	53 <b>I</b> Iodine	54 <b>Xe</b> Xenon
37 <b>Rb</b> Rubidium	38 <b>Sr</b> Strontium	41 <b>Nb</b> Niobium	42 <b>Mo</b> Molybdenum	43 <b>Tc</b> Technetium	44 <b>Ru</b> Ruthenium	45 <b>Rh</b> Rhodium	46 <b>Pd</b> Palladium	47 <b>Ag</b> Silver	48 <b>Cd</b> Cadmium	49 <b>In</b> Indium	50 <b>Sn</b> Tin	51 <b>Sb</b> Antimony	52 <b>Te</b> Tellurium	53 <b>I</b> Iodine	54 <b>Xe</b> Xenon	55 <b>Cs</b> Caesium	56 <b>Ba</b> Barium	57 <b>La</b> Lanthanum	58 <b>Ce</b> Cerium	59 <b>Pr</b> Praseodymium	60 <b>Nd</b> Neodymium	61 <b>Pm</b> Promethium	62 <b>Sm</b> Samarium	63 <b>Eu</b> Europium	64 <b>Gd</b> Gadolinium	65 <b>Tb</b> Terbium	66 <b>Dy</b> Dysprosium	67 <b>Ho</b> Holmium	68 <b>Er</b> Erbium	69 <b>Tm</b> Thulium	70 <b>Yb</b> Ytterbium	71 <b>Lu</b> Lutetium	
55 <b>Cs</b> Caesium	56 <b>Ba</b> Barium	73 <b>Ta</b> Tantalum	74 <b>W</b> Tungsten	75 <b>Re</b> Rhenium	76 <b>Os</b> Osmium	77 <b>Ir</b> Iridium	78 <b>Pt</b> Platinum	79 <b>Au</b> Gold	80 <b>Hg</b> Mercury	81 <b>Tl</b> Thallium	82 <b>Pb</b> Lead	83 <b>Bi</b> Bismuth	84 <b>Po</b> Polonium	85 <b>At</b> Astatine	86 <b>Rn</b> Radon	87 <b>Fr</b> Francium	88 <b>Ra</b> Radium	89 <b>Ac</b> Actinium	90 <b>Th</b> Thorium	91 <b>Pa</b> Protactinium	92 <b>U</b> Uranium	93 <b>Np</b> Neptunium	94 <b>Pu</b> Plutonium	95 <b>Am</b> Americium	96 <b>Cm</b> Curium	97 <b>Bk</b> Berkelium	98 <b>Cf</b> Californium	99 <b>Es</b> Einsteinium	100 <b>Fm</b> Fermium	101 <b>Md</b> Mendelevium	102 <b>No</b> Nobelium	103 <b>Lr</b> Lawrencium	
87 <b>Fr</b> Francium	88 <b>Ra</b> Radium	90 <b>Th</b> Thorium	91 <b>Pa</b> Protactinium	92 <b>U</b> Uranium	93 <b>Np</b> Neptunium	94 <b>Pu</b> Plutonium	95 <b>Am</b> Americium	96 <b>Cm</b> Curium	97 <b>Bk</b> Berkelium	98 <b>Cf</b> Californium	99 <b>Es</b> Einsteinium	100 <b>Fm</b> Fermium	101 <b>Md</b> Mendelevium	102 <b>No</b> Nobelium	103 <b>Lr</b> Lawrencium																		

\*58-71 Lanthanoid series  
90-103 Actinoid series

**Key**

a	<b>X</b>
a = relative atomic mass	
X = atomic symbol	
b = proton (atomic) number	

The volume of one mole of any gas is 24 dm<sup>3</sup> at room temperature and pressure (r.t.p.).