Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

2794815785

PHYSICAL SCIENCE **0652/31**

Paper 3 (Extended) **October/November 2015**

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 on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams, graphs, tables or rough working.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.

A copy of the Periodic Table is printed on page 24.
Electronic calculators may be used.

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.

This document consists of **20** printed pages and **4** blank pages.

CAMBRIDGE International Examinations

1 Fig. 1.1 shows an Atlas space rocket as it takes off from its launch pad.

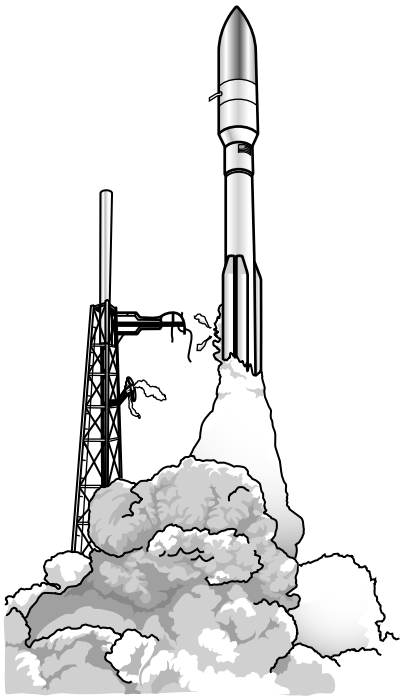

Fig. 1.1

(a) The initial mass of the rocket and fuel is 160 000 kg.

Calculate the weight of the rocket and fuel. Use $g = 10\,m/s^2$.

weight = ... N [1]

(b) The initial thrust from the rocket motors is 2 000 000 N.

(i) Calculate the resultant upward force on the rocket.

force = ... N [1]

(ii) Calculate the initial acceleration of the rocket and state the unit.

acceleration = ... unit ..... [3]

(c) The thrust from the motors is constant. However, the acceleration of the rocket increases. Suggest a reason for this increase.

.....

.....

..... [1]

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2 Acids react with bases to form salts.

Table 2.1 shows some reactions of acids and bases and the salts formed.

Table 2.1

acid	base	salt formed
sulfuric acid	sodium hydroxide	sodium sulfate
hydrochloric acid	sodium carbonate	
	zinc oxide	zinc nitrate
sulfuric acid		magnesium sulfate

(a) Complete Table 2.1 by filling in the empty boxes. [3]

(b) Write a balanced equation for the reaction between hydrochloric acid and sodium carbonate.

..... [2]

(c) Zinc oxide will react with alkalis as well as acids.

State the name given to this sort of oxide.

..... [1]

(d) **(i)** When an acid is added to an alkali, a salt and water only are formed.

This is a neutralisation reaction.

Write an equation, using ions, to represent the neutralisation in such a reaction.

..... [1]

(ii) Dilute sulfuric acid is added to an aqueous solution of sodium hydroxide.

Use ideas of proton transfer to explain why sodium hydroxide is the base in this reaction.

.....

..... [1]

3 **(a)** Fig. 3.1 shows a piece of apparatus, viewed from above. Four different metal strips are fixed to a wooden ring.

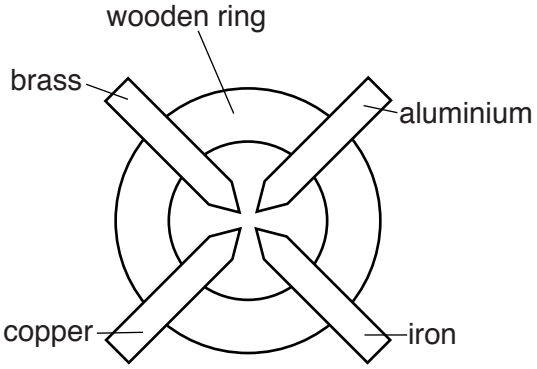


Fig. 3.1

Fig. 3.2 shows an experiment using the apparatus.

A match head is placed on the end of each metal strip. The strips are then heated at the centre.

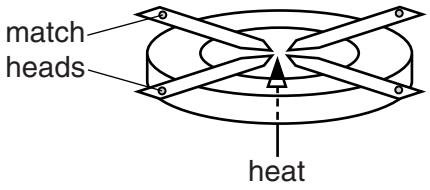


Fig. 3.2

Each of the match heads ignites after a different length of time. This is shown in Table 3.1.

Table 3.1

metal strip	time for match head to ignite / minutes
aluminium	4
brass	3
copper	1
iron	8

List the metals in order of their thermal conductivity.

most conductive .....

.....

.....

least conductive ..... [2]

(b) Fig. 3.3 shows an experiment to investigate the energy absorbed by different surfaces.

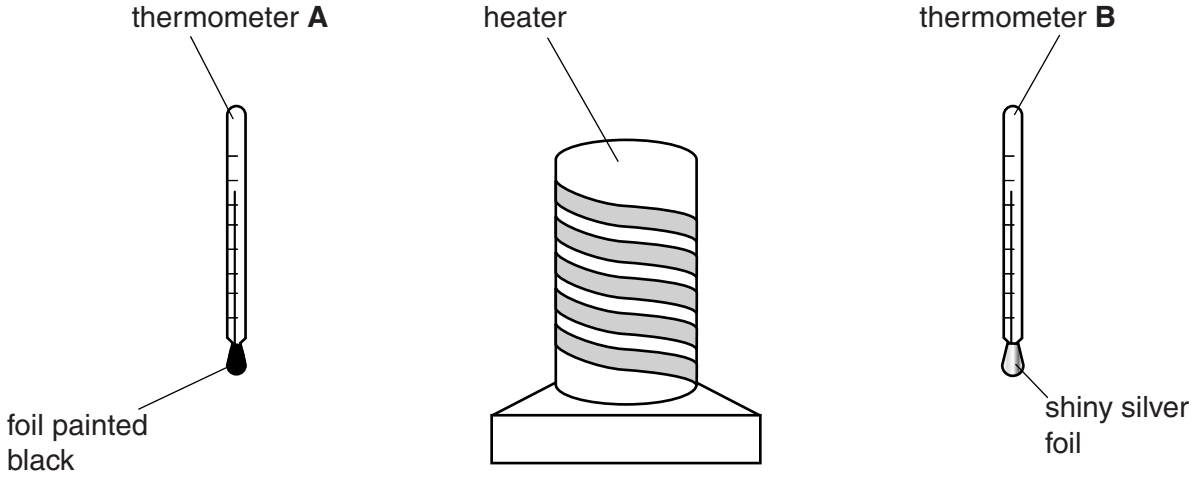


Fig. 3.3

The two thermometers are equal distances from the heater. Both of their bulbs are wrapped in aluminium foil. The foil on thermometer **A** is painted black and the foil on thermometer **B** is left shiny silver.

At the beginning of the experiment the two thermometers both show a temperature of 18 °C.

The heater is switched on.

(i) State the main method of thermal energy transfer that takes energy from the heater to the thermometers.

..... [1]

The heater is left on for ten minutes. Thermometer **A** now shows a reading of 32 °C.

(ii) Predict the temperature reading shown by thermometer **B**.

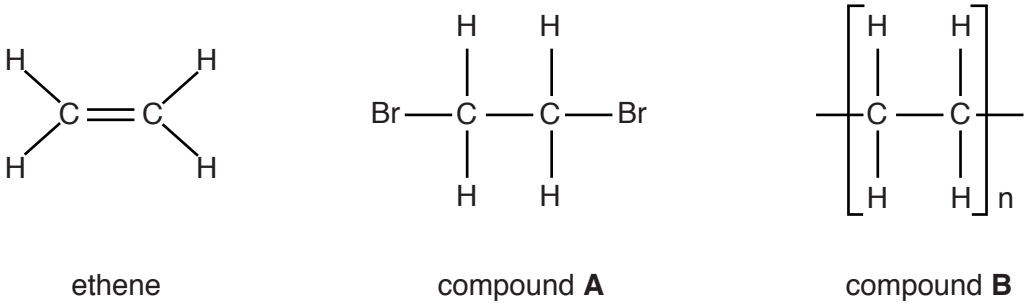
temperature = ... °C [1]

(iii) Explain why there is a difference in the two thermometer readings.

.....

..... [1]

4 Fig. 4.1 shows the structural formulae of ethene and two compounds, **A** and **B**, that can be made from ethene.



ethene compound **A** compound **B**

Fig. 4.1

(a) Ethene can be made from the large chain alkanes found in crude oil.

Name this process and state the conditions necessary for it to occur.

.....

..... [2]

(b) Compound **A** is formed in a test to distinguish between ethane and ethene.

Describe this test and the results you would expect for each.

test .....

.....

.....

result with ethane .....

.....

result with ethene .....

..... [2]

(c) State the type of reaction used to make compound **B** from ethene.

..... [2]

(d) Ethanol can be made by the reaction of ethene with steam.

$$C_2H_4 + H_2O \rightarrow C_2H_5OH$$

Calculate the mass of ethanol that can be made from 1.0 kg of ethene.

[Relative atomic masses: A_r: C, 12; H, 1; O, 16.]

Show your working in the box.

mass of ethanol = ... kg [3]

5 Fig. 5.1 shows a ray of light entering a lens. The insert shows an enlarged view.

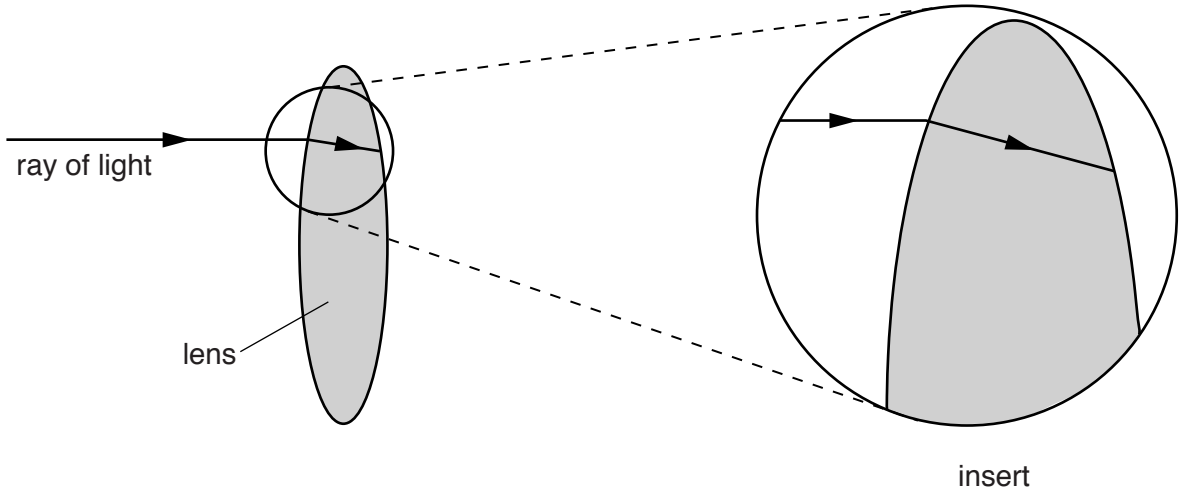


Fig. 5.1

(a) On the enlarged insert, identify and label, with the letter *r*, the angle of refraction the ray of light makes with the lens. [1]

(b) The ray of light has an angle of incidence of 16.0° at the lens and the angle of refraction is 11.0°.

Calculate the refractive index of the lens. Give your answer to 3 significant figures.

refractive index = ... [2]

(c) Fig. 5.2 shows the lens being used as a magnifying glass to study a beetle.

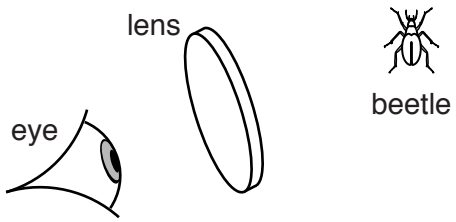


Fig. 5.2

(i) Mark, with an **X**, on Fig. 5.2 a possible position of the principal focus of the lens. [1]

(ii) State three words that describe the image seen when a lens is used as a magnifying glass.

1. .....

2. .....

3. ..... [3]

6 Table 6.1 shows properties of some metals.

Table 6.1

metal	density g/cm^3	melting point /°C	relative measurements		
			strength	hardness	electrical conductivity
aluminium	2.7	660	21	48	62
copper	8.9	1085	78	52	100
iron	7.9	1538	50	65	17
titanium	4.5	1668	100	100	3

(a) Use information from Table 6.1 to explain why

(i) copper is used in electrical wiring in houses,

..... [1]

(ii) aluminium is the main metal in the alloy used to make aeroplane bodies.

..... [1]

(b) An alloy of aluminium, containing small quantities of copper, manganese and magnesium, is used to make aeroplane bodies.

(i) Suggest how the properties of this alloy make it more suitable for use in aeroplane bodies than pure aluminium.

.....

..... [1]

(ii) Use ideas about metallic bonding to explain this difference in properties.

You may draw a diagram to help your answer.

.....

.....

.....

.....

..... [4]

(c) (i) When exposed to humid air, iron rusts until none of the metal remains.

Aluminium does not react in a similar way.

Explain this difference.

.....

..... [1]

(ii) Iron can be galvanised to prevent rusting.

The iron is covered with a layer of zinc. This stops the iron rusting even if the layer of zinc is scratched to expose iron.

Explain why this layer of zinc prevents the exposed iron from rusting.

..... [1]

7 A student constructs the circuit shown in Fig. 7.1 using a cell of e.m.f. 6.0 V, a resistor of resistance 20 Ω and a resistance wire of length 25 cm.

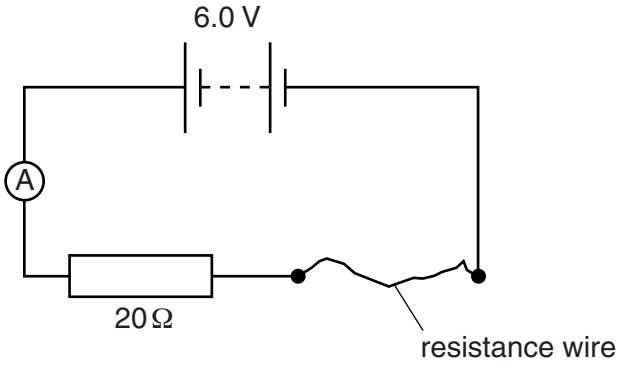


Fig. 7.1

(a) Explain what is meant by the term *e.m.f.* (*electromotive force*).

.....

.....

..... [2]

(b) The ammeter reading is 0.24 A and the potential difference across the resistor is 4.8 V.

(i) Calculate the charge passing through the resistor in 5 minutes. Give the unit.

charge = ... unit ..... [3]

(ii) Calculate the energy dissipated in the resistor in this time.

energy = ...J [2]

(iii) Calculate the potential difference across the resistance wire.

potential difference = ... V [1]

(iv) Use your result from **(iii)** to calculate the resistance of this wire.

resistance = ...Ω [2]

(c) The student replaces the resistance wire with one made from the same material but of length 50 cm and half the diameter.

(i) Calculate the resistance of the replacement wire.

resistance = ... Ω [2]

(ii) State how the potential difference across the resistor changes and explain your answer.

.....

.....

..... [2]

8 Table 8.1 shows how the concentration of nitrogen oxides and carbon dioxide in the air increased during the twentieth century.

Table 8.1

year	concentration in parts per million	
	nitrogen oxides	carbon dioxide
1900	18	300
1920	18	305
1940	20	310
1960	25	320
1980	30	340
2000	35	370

(a) Describe and compare the trends shown in Table 8.1.

.....

.....

.....

..... [2]

(b) It is suggested that these trends may have been due to an increased use of cars.

Since 2000, the number of cars fitted with catalytic converters has increased.

This equation shows the reaction taking place in a catalytic converter.

$$2NO + 2CO \rightarrow N_2 + 2CO_2$$

Suggest and explain what effect the increased use of catalytic converters may have on the concentration of nitrogen oxides in the air.

.....

.....

.....

..... [2]

(c) Cars release pollutants other than those shown in Table 8.1 into the air.

Name two of these other pollutants.

1. .....

2. .....
[2]

(d) One of the hydrocarbons in petrol is octane, C_8H_{18}.

This equation shows the complete combustion of octane.

$$2C_8H_{18} + 25O_2 \rightarrow 16CO_2 + 18H_2O$$

Calculate the volume of carbon dioxide, measured at room temperature and pressure, produced when 1.0 kg of octane burns completely.

[Relative atomic masses: A_r: C, 12; H, 1; O, 16]

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure.

Show your working in the box.

volume of carbon dioxide = ... dm^3 [4]

9 Fig. 9.1 shows an experiment where a magnet is placed near a coil of wire. The voltmeter is shown at the beginning of the experiment.

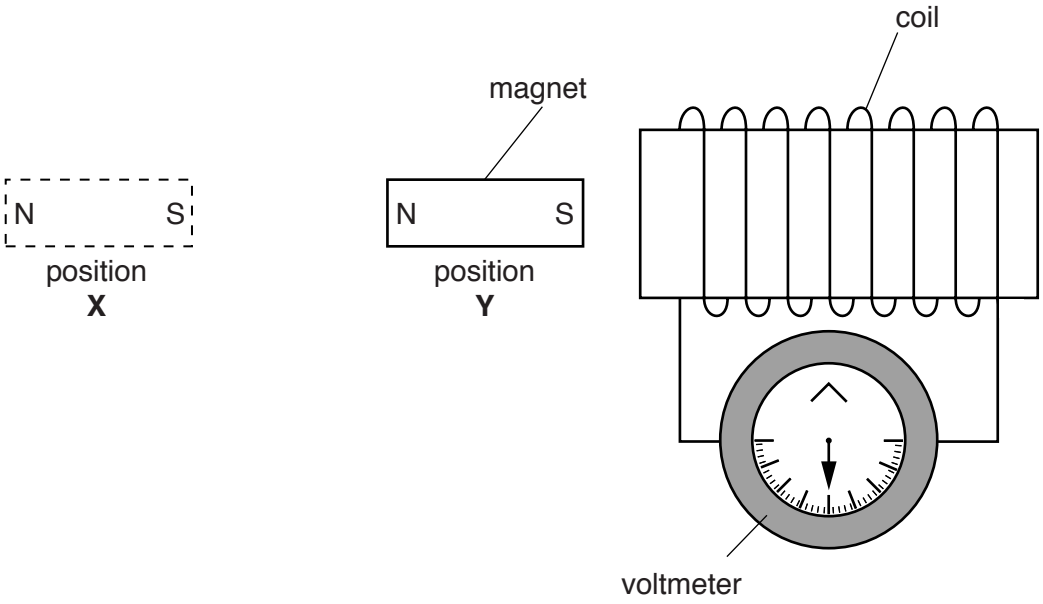


Fig. 9.1

(a) State what is observed when

(i) the magnet is moved from position **Y** to position **X**,

.....

.....

(ii) the magnet is moved from position **X** to position **Y**,

.....

.....

(iii) the magnet is moved from position **X** to position **Y** at a greater speed,

.....

.....

(iv) the coil is moved towards the magnet.

.....

.....

[5]

(b) The magnet is replaced by a current carrying coil of wire as shown in Fig. 9.2.

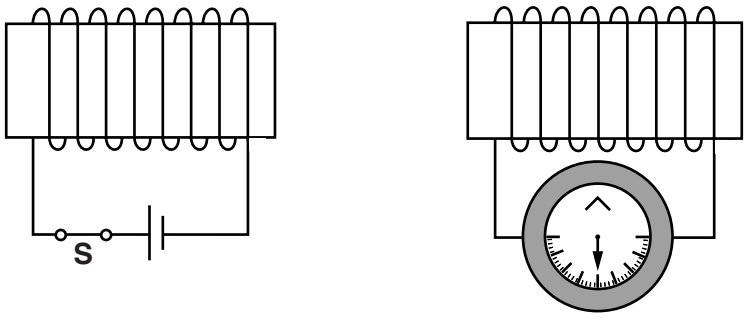


Fig. 9.2

Switch **S** is initially closed and there is a current in the coil of wire. Switch **S** is then opened and the current falls to zero.

State and explain, by referring to magnetic fields, what is observed.

.....

.....

.....

..... [3]

10 Table 10.1 gives information about some of the elements in Group VII.

Table 10.1

element	atomic number	melting point/°C	colour
chlorine	17	–101	light green
bromine	35	–7	red
iodine	53	114	dark grey

(a) Describe two trends shown in Table 10.1 that occur with increasing atomic number of the element.

1. .....

.....

2. .....

.....

[2]

(b) The halogens decrease in reactivity with increasing atomic number.

Bromine is added to a solution of potassium iodide.

Iodine is displaced, forming a brown coloured solution.

The equation for this reaction is shown below.

$$Br_2 + 2KI \longrightarrow 2KBr + I_2$$

Predict and explain what you would **see** if chlorine is added to a solution of potassium iodide.

prediction .....

explanation .....

.....

..... [2]

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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** Sulfur 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	209 **Po** Polonium 84	210 **At** Astatine 85	222 **Rn** Radon 86
223 **Fr** Francium 87	226 **Ra** Radium 88	227 **Ac** Actinium 89 †															

140 **Ce** Cerium 58	141 **Pr** Praseodymium 59	144 **Nd** Neodymium 60	147 **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	231 **Pa** Protactinium 91	238 **U** Uranium 92	237 **Np** Neptunium 93	244 **Pu** Plutonium 94	243 **Am** Americium 95	247 **Cm** Curium 96	247 **Bk** Berkelium 97	251 **Cf** Californium 98	252 **Es** Einsteinium 99	257 **Fm** Fermium 100	258 **Md** Mendelevium 101	259 **No** Nobelium 102	260 **Lr** Lawrencium 103

* 58–71 Lanthanoid series
† 90–103 Actinoid series

Key

a **X** b

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

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