UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

ADDITIONAL COMBINED SCIENCE **5130/02**

Paper 2 **October/November 2007**

2 hours 15 minutes

Additional Materials: Answer Booklet/Paper.

READ THESE INSTRUCTIONS FIRST

If you have been given an Answer Booklet, follow the instructions on the front cover of the Booklet.
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 a soft pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.
DO **NOT** WRITE ON ANY BARCODES.

Section A
Answer **all** questions.
Write your answers in the spaces provided on the question paper.

Section B
Answer **one** part of each of the three questions.
Write your answers on the separate answer paper provided.

A copy of the Periodic Table is printed on page 24.

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	
Section A	
10	
11	
12	
Total	

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

Section A

Answer **all** the questions.

Write your answers in the spaces provided on the question paper.

1 Fig. 1.1 shows the response of an eye to bright light.

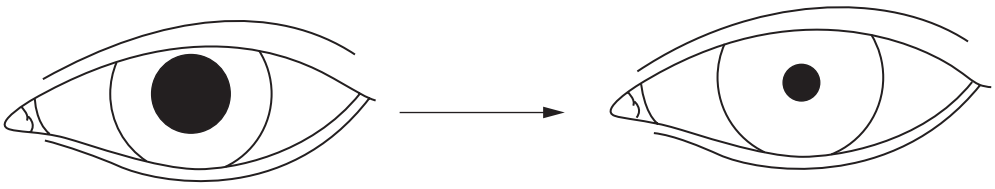

Fig. 1.1

(a) (i) Which part of the eye has changed to make this response?

.....[1]

(ii) Why is this response important for the function of the eye?

.....

.....

.....

.....[2]

(b) The response is a reflex action. It involves the following parts of the nervous system.

muscle **motor neurones** **relay neurones** **sensory neurones**

Describe how each of these parts is involved in the response.

.....

.....

.....

.....

.....[4]

2 Petroleum (crude oil) is a mixture containing many compounds.

It is separated into its different parts as shown in Fig. 2.1.

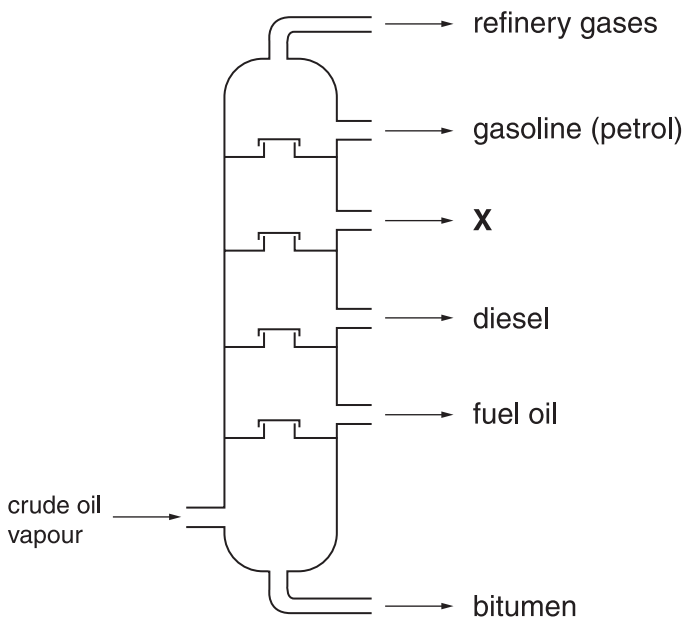

Fig. 2.1

(a) (i) The compounds in petroleum are mainly of one type.

What is the name of this type of compound?

.....[1]

(ii) The apparatus in Fig. 2.1 separates the mixture into fractions.

What is the name of this process?

.....[1]

(iii) Explain how this apparatus separates petroleum into fractions.

.....

.....

.....

.....[3]

(b) (i) What is the name of the fraction produced at position **X** on Fig. 2.1?

.....[1]

(ii) State a use for this fraction.

.....[1]

[Turn over

3 Fig. 3.1 shows a car on the track of a roller-coaster. An electric motor lifts the car to the top of the slope, which is 75 m high. The car then runs down the other side and back to the start.

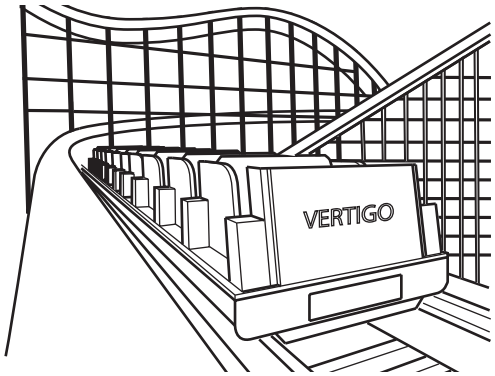

Fig. 3.1

(a) The car full of passengers has a mass of 15 000 kg.

It takes 15 seconds for the motor to lift this car from the start to the top of the slope.

(i) Calculate the work done by the motor to lift the car to the top of the slope.

Show your working and give the unit for your answer.

(The weight of 1 kg mass is 10 N)

work done = ……. unit ……. [3]

(ii) Calculate the power produced by the motor.

Show your working and give the unit for your answer.

power = ……. unit …… [3]

(b) The electrical energy used by the motor is more than the energy gained by the car.

Suggest why.

.....

.....

.....[2]

(c) What is the main energy change that takes place as the car runs down the other side of the slope and back to the start?

……..…….. energy to ……..…….. energy [1]

4 Majid and his daughter Zahra have fingers that are bent.

This is a genetic disorder caused by a dominant allele.

Part of their family tree is shown in Fig. 4.1.

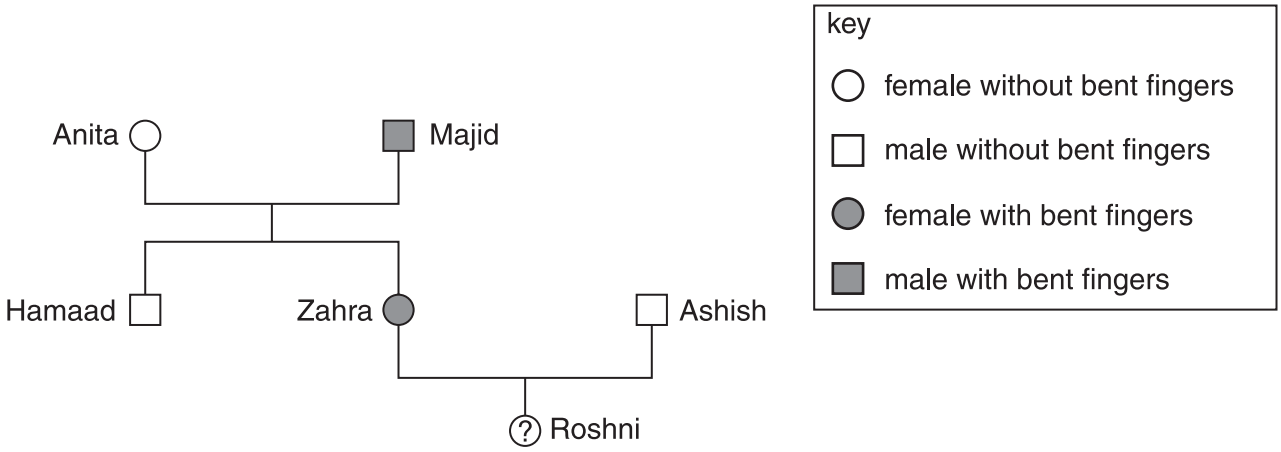

Fig. 4.1

(a) Zahra has bent fingers but her brother Hamaad does not have them.

Explain why.

.....

.....[2]

(b) Hamaad says he thinks that Zahra's bent fingers are caused by a mutation of her genes.

(i) What is a *mutation*?

.....

.....[1]

(ii) State **one** factor that may increase the chance of mutation.

.....[1]

(iii) How does Fig. 4.1 show that Hamaad is wrong?

.....

.....[1]

(c) Zahra marries Ashish, and they have a daughter, Roshni.

Ashish is not a carrier of this disorder.

What is the chance that Roshni will have bent fingers?

Use a diagram to show how you work out your answer.

Use **B** to represent the dominant allele and **b** to represent the recessive allele.

.....[3]

5 Fig. 5.1 shows the arrangement of electrons in atoms of the elements carbon, chlorine and magnesium.

element	electron arrangement
carbon	2,6
chlorine	2,8,7
magnesium	2,8,2

Fig. 5.1

(a) (i) Complete Fig. 5.2 to show the bonding in the compound magnesium chloride.

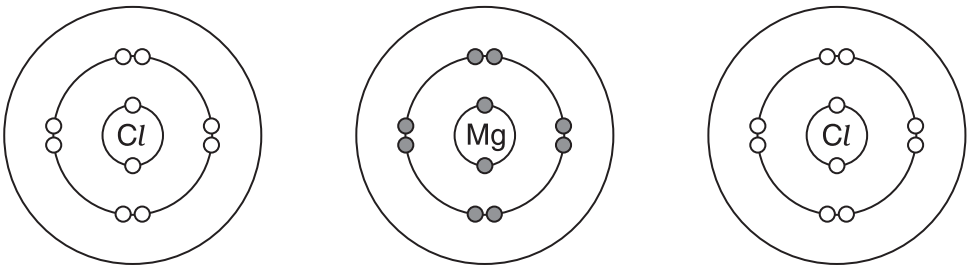

Fig. 5.2

[3]

(ii) What type of bonding is present in magnesium chloride?

.....[1]

(b) Magnesium and chlorine react according to this equation.

$$Mg + Cl_2 \rightarrow MgCl_2$$

What mass of magnesium chloride is made when 3.8 g of magnesium reacts with chlorine?

Show how you work out your answer.

[A_r: Mg, 24; Cl, 35.5.]

mass of magnesium chloride = ……. g [3]

(c) Carbon also forms a compound with chlorine, tetrachloromethane.

(i) What type of bonding is present in tetrachloromethane?

.....[1]

(ii) Describe three differences between the physical properties of magnesium chloride and tetrachloromethane.

1. .....

.....

2. .....

.....

3. .....

.....[3]

6 Fig. 6.1 shows the electromagnetic spectrum, but two parts are missing.

← increasing frequency						
gamma rays	……..……	ultraviolet	visible	……..……	microwaves	radio waves

Fig. 6.1

(a) Complete the spectrum by writing in the two missing parts. [2]

(b) Fig. 6.2 shows a water wave.

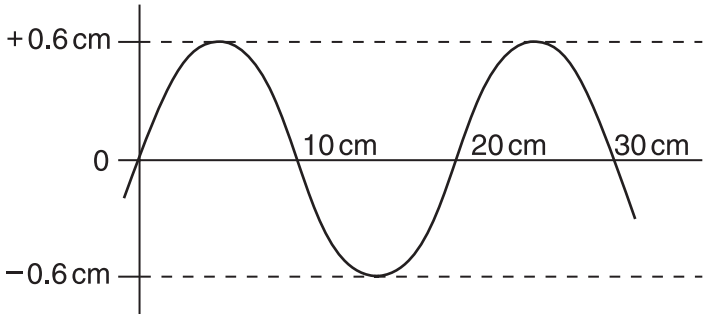

Fig. 6.2

(i) What is the amplitude of this wave?

.....[1]

(ii) What is the wavelength of this wave?

.....[1]

(iii) The wave is travelling at a speed of 50 cm/s.
Calculate the frequency of this wave.

frequency = …… Hz [2]

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Turn to page 12 for Question 7.

7 Plants lose water through openings named stomata, which mainly occur on the underside of leaves. Fig. 7.1 shows one stoma.

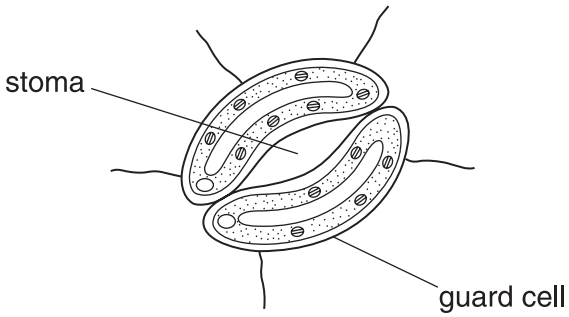


Fig. 7.1

(a) What name is given to this process of water loss in plants?

.....[1]

(b) Fig. 7.2 shows the relationship between the appearance of a stoma and the concentration of glucose in the guard cells.

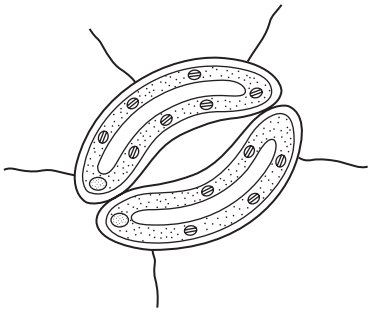
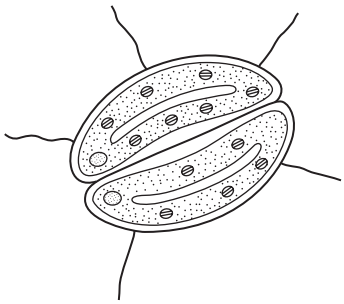
concentration of glucose in guard cells	appearance of stoma
high	
low	

Fig. 7.2

The process of osmosis is involved in the opening and closing of stomata.

(i) Define *osmosis*.

.....

.....

.....[3]

(ii) Suggest how osmosis is involved in the opening and closing of stomata.

Use Fig. 7.2 to help your answer.

.....

.....

.....

.....

.....[4]

8 A student studies the reaction of zinc with hydrochloric acid.

He investigates the effects of changing the temperature and concentration of acid on the rate of reaction.

His results are shown in Fig. 8.1.

temperature in °C	concentration of hydrochloric acid in mol/dm^3	rate of reaction (in arbitrary units)
20	0.3	4.5
	0.6	9.1
	1.2	17.9
30	0.3	9.0
	0.6	18.1
	1.2	35.9
40	0.3	18.0
	0.6	36.1
	1.2	71.9

Fig. 8.1

(a) (i) Describe how, at a fixed temperature, a rise in concentration of acid affects the rate of this reaction.

.....

.....[1]

(ii) Describe how, at a fixed concentration of acid, a rise in temperature affects the rate of this reaction.

.....

.....[1]

(b) Describe the measurements that the student must make to determine whether the reaction is exothermic or endothermic.

.....

.....[1]

(c) Zinc and hydrochloric acid react according to this equation.

$$Zn + 2HCl \rightarrow ZnCl_2 + H_2$$

This is a redox reaction.

(i) Complete this ionic equation for the reaction of zinc.

$$Zn \rightarrow \text{…….....} + \text{…....……}$$ [2]

(ii) What is the meaning of the term *redox*?

.....

.....[1]

9 Fig. 9.1 shows part of a nuclear reactor used for the generation of electricity.

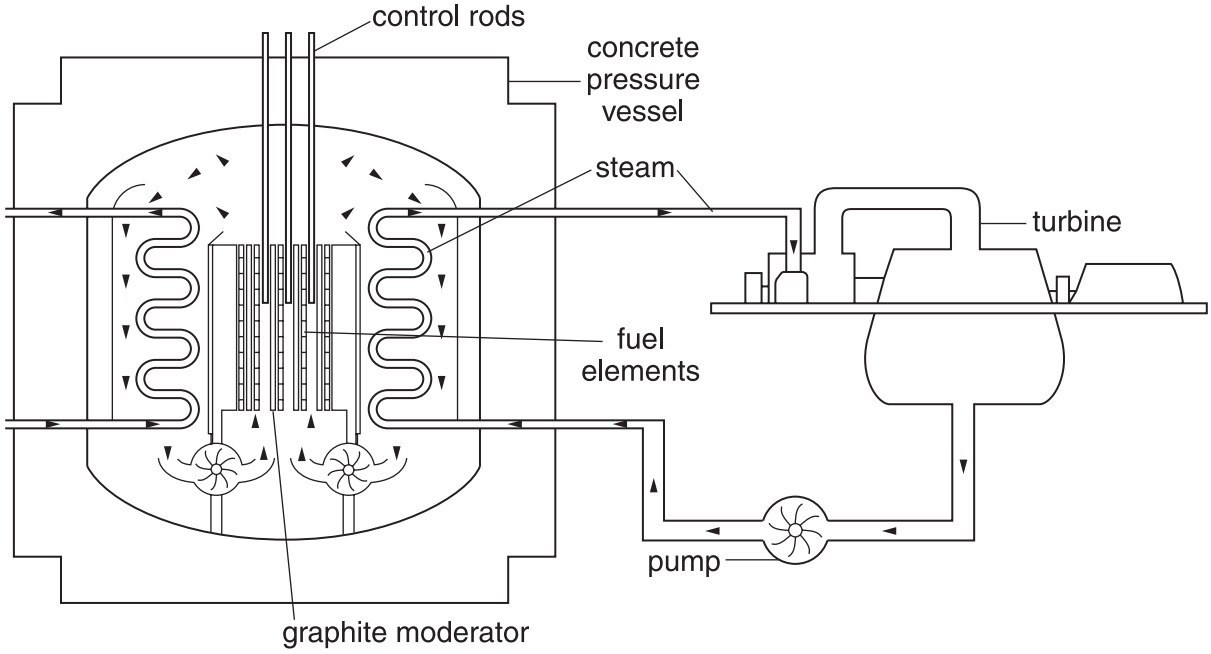
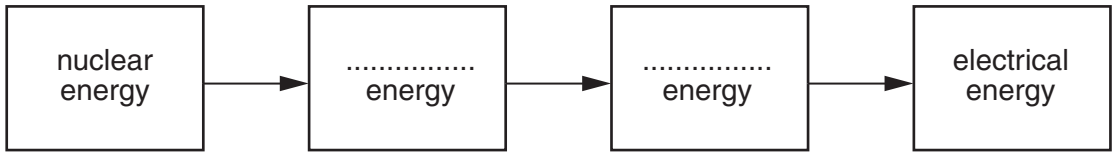


Fig. 9.1

(a) Complete the diagram to show the energy changes that take place in the production of electrical energy from nuclear energy.



[2]

(b) The fuel elements contain uranium-235.

(i) When the nucleus of an atom of uranium-235 is hit by a neutron it undergoes fission.

Complete this equation for the nuclear fission of uranium-235.

$$^{235}_{92}U + {}^{1}_{0}n \rightarrow {}^{141}_{.....}Ba + {}^{.....}_{36}Kr + 3{}^{1}_{0}n$$

[2]

(ii) The reaction releases three more neutrons.

Explain how this creates a chain reaction in the uranium-235.

.....

.....

.....[2]

(c) During the fission of one atom of uranium-235, 0.304×10^{-26} kg of mass is lost.

Calculate the energy released in this fission.

Show how you work out your answer.

[The speed of light, $c = 3.00 \times 10^8$ m/s.]

energy released = ……..…….. J [2]

Section B

Answer **one** part, **(a)** or **(b)**, of each of the three questions.

Write your answers on the separate answer paper provided.

10 Either

(a) The apparatus shown in Fig. 10.1 can be used to investigate the effect of changing the temperature on the rate of photosynthesis.

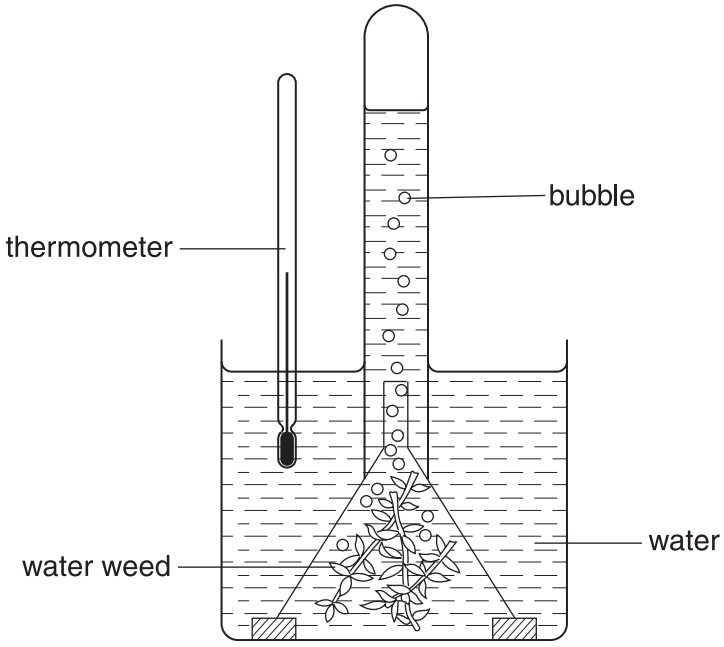


Fig. 10.1

(i) Describe how you would carry out this investigation.
Indicate the range of temperatures you would use in your experiment. [5]

(ii) Sketch a graph of the results you would expect.
Explain the shape of your graph. [5]

Or

(b) (i) Define *homeostasis*.
Describe the maintenance of a constant body temperature in Man. [5]

(ii) Explain the difference between the terms *excretion* and *egestion*.
Use examples to illustrate your answer. [5]

11 Either

(a) Ammonia is manufactured in the Haber Process.

(i) Write an equation for the reaction by which ammonia is produced and describe the essential conditions used in this process. [6]

(ii) Explain how the Haber Process is of benefit to farmers. [4]

Or

(b) (i) Describe trends in the colour and physical state of the elements chlorine, bromine and iodine in Group VII of the Periodic Table (the halogens).
Fluorine is the element at the top of this Group. Predict the colour and state of fluorine. [3]

(ii) A halogen may react with the sodium salts of other halogens (halides).
Explain how the reactions of the elements chlorine, bromine and iodine with the sodium halides show a trend in their reactivity. [7]

12 Either

(a) Fig. 12.1 shows a freefall skydiver.

The skydiver steps out of an aeroplane and falls for 3 minutes. He then opens his parachute and falls to Earth.

Sketch a velocity-time graph of the skydiver's vertical motion as he falls until he is almost at the Earth's surface.

Describe and explain the shape of the graph in terms of the motion of the skydiver. [10]

Or

(b) Nichrome is an alloy used in making resistance wires for heaters.

Describe how you would carry out an experiment to determine the relationship between the diameter of nichrome wire and its resistance. Nichrome wire of three different diameters is available.

Include in your answer a diagram of the electrical circuit you would use and details of the results you would expect. [10]

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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 Sulphur 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	Po Polonium 84	At Astatine 85	Rn Radon 86
Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89 †															

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

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

Key

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

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