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UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME	

CENTRE NUMBER		CANDIDATE NUMBER	

4362952058

CO-ORDINATED SCIENCES **0654/32**

Paper 3 (Extended) **October/November 2011**

2 hours

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 a soft pencil for any diagrams, graphs, tables 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 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	
1	
2	
3	
4	
5	
6	
7	
8	
9	
Total	

This document consists of **22** printed pages and **2** blank pages.

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For Examiner's Use

1 Houseflies are common insect pests. Fig. 1.1 shows a housefly.

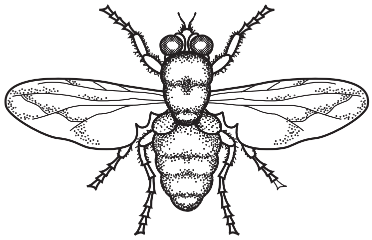

Fig. 1.1

(a) On Fig. 1.1, label and name **two** features that are characteristic of insects. [2]

(b) Houseflies feed by spitting saliva onto food, such as meat. Enzymes in the saliva turn insoluble substances into soluble ones. The flies can then suck up the liquid into their digestive system.

(i) Suggest **one** enzyme in a housefly's saliva that could digest a substance in meat.

.... [1]

(ii) State the soluble product or products that this enzyme would produce.

.... [1]

(c) Houseflies spread diseases such as typhoid fever. They leave harmful microorganisms on food that will later be eaten by a person.

Describe **two** ways in which white blood cells can destroy microorganisms that have entered a person's body.

1 ....

....

2 ....

.... [2]

(d) When a housefly flies, its wings produce a buzzing sound.

(i) Suggest how a movement such as that of a fly's wings produces sound.

....

....

.... [2]

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(ii) A housefly beats its wings about 200 times per second. A midge (a small insect) beats its wings about 1000 times per second.

State and explain how the sound produced by a flying midge will differ from the sound produced by a flying housefly.

....

....

.... [2]

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2 Nordic gold is an alloy of four metals used to make coins.

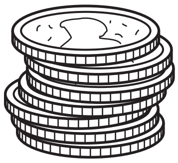

Table 2.1 shows information about the metals contained in Nordic gold.

Table 2.1

metal	% by mass in Nordic gold	compound from which the metal is extracted
aluminium	5	Al_2O_3
copper	89	$CuFeS_2$
tin	1	SnO_2
zinc	5	ZnS

(a) Nordic gold has properties which make it suitable for making coins.

Suggest **one** property Nordic gold is likely to have, other than its appearance, that makes it suitable for making coins.

Explain briefly why this property is important.

property ....

importance ....

.... [2]

(b) The method used to extract a metal from its compounds depends on the reactivity of the metal.

(i) Tin may be extracted from tin oxide, SnO_2, by heating a mixture of tin oxide and carbon. The other product of this reaction is carbon monoxide, CO.

Construct a balanced, symbolic equation for this reaction.

.... [2]

For Examiner's Use

(ii) When aluminium oxide is heated with carbon, no reaction occurs.

Explain why it is possible to extract tin but **not** aluminium by heating their oxides with carbon.

....

....

.... [2]

(iii) Aluminium is extracted from the insoluble compound aluminium oxide by electrolysis.

Outline the stages by which aluminium oxide, containing aluminium ions, is converted into metallic aluminium, containing aluminium atoms, using electrolysis.

....

....

....

....

....

.... [3]

(c) A coin made of Nordic gold has a mass of 7.80 g.

Calculate the number of moles of copper in the coin.

Show your working.

.... [2]

3 Yaks are animals that live in the cold mountainous region of the Himalayas.

Fig. 3.1 shows a yak.

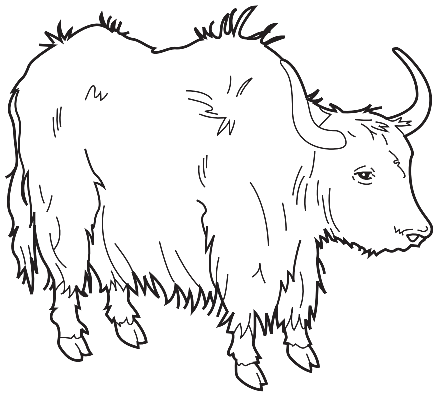

Fig. 3.1

(a) Explain how the long hair of the yak keeps it warm during the cold weather.

....

....

.... [2]

(b) Yaks are used as 'beasts of burden'. They can be ridden or used to carry or pull heavy objects.

A yak of mass 1000 kg is carrying a load of 80 kg.

(i) The yak carries its load up a mountain slope and finishes 100 m higher up the mountain.

Calculate the work done gaining this height.

The Earth's gravitational field strength is 10 N / kg.

State the formula that you use and show your working.

formula used

working

.... [3]

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(ii) While the yak is carrying the load, it travels at a speed of 0.2 m / s.

Calculate the kinetic energy of the yak and its load at this time.

State the formula that you use and show your working.

formula used

working

.... [2]

(c) A yak has a mass of 1000 kg. It has four feet, each of area 300 cm^2.

Calculate the average pressure that the yak exerts on the ground.

State the formula that you use and show your working.

formula used

working

.... [3]

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4 Hydrocarbons are compounds which contain only the elements hydrogen and carbon.

For Examiner's Use

(a) The simplest hydrocarbon is methane, CH_4, which is an important fuel.

(i) State **two** natural sources of methane.

1 ....

2 .... [2]

(ii) A free (unbonded) carbon atom has four electrons in its outer shell.

State the number, and describe the arrangement, of the electrons in the outer shell of a carbon atom in a methane molecule.

You may wish to draw a diagram to help you answer this question.

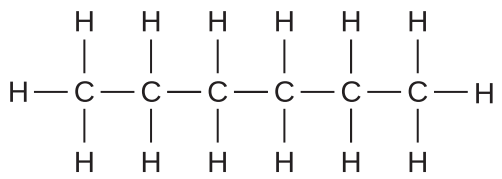
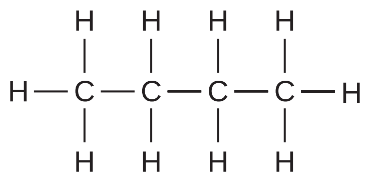
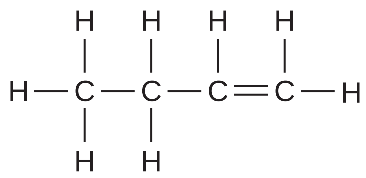
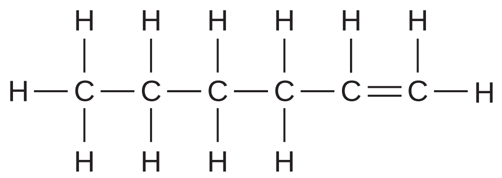
....

.... [2]

For Examiner's Use

(b) Table 4.1 shows the displayed formulae and boiling points of four hydrocarbons, **A**, **B**, **C** and **D**.

Table 4.1

	displayed formula	boiling point / °C
A		69
B		−0.5
C		−6.3
D		63

(i) Name the **two** homologous series to which the hydrocarbons in Table 4.1 belong.

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

(ii) Use the information in Table 4.1 to suggest **one** way in which the boiling point of a hydrocarbon is affected by its molecular structure.

....

....

.... [2]

(iii) A bottle contains a colourless liquid which is thought to be either hydrocarbon **A** or **D**.

Describe a **chemical** test, and its result, which could be used to identify which hydrocarbon is in the bottle.

Explain your choice of test.

....

....

....

.... [3]

For Examiner's Use

5 Fig. 5.1 shows two plants that are grown as crops.

For Examiner's Use

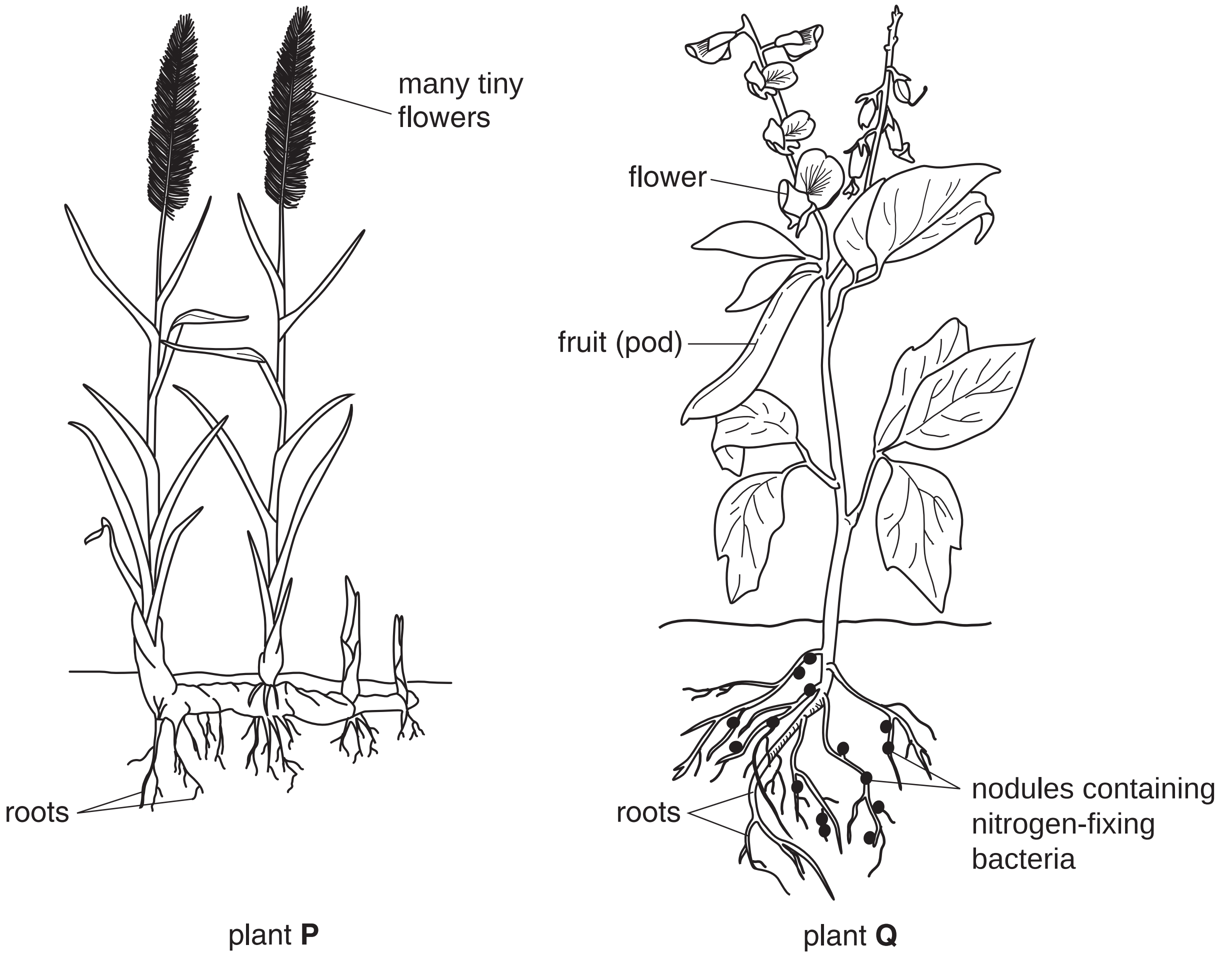


Fig. 5.1

(a) Describe what would happen in a flower of plant **Q** after pollination, in order to form a fruit.

....

....

....

....

....

.... [4]

For Examiner's Use

(b) Farmers often add fertilisers containing nitrates to the soil where they grow crops.

(i) Explain why this is done.

....

....

.... [2]

(ii) Explain why fields in which plant **Q** is growing would require less nitrate fertiliser than fields in which plant **P** is growing.

....

....

.... [2]

(iii) Explain why using large amounts of nitrate fertiliser near a river could cause harm to the environment.

....

....

....

....

.... [3]

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For Examiner's Use

6 Fig. 6.1 shows the inside of a refrigerator. The temperature inside the freezing compartment is -20 °C and the temperature in the rest of the refrigerator is +5 °C.

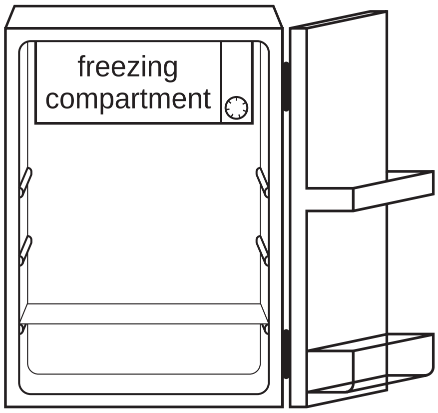


Fig. 6.1

(a) (i) Draw arrows on Fig. 6.1 to show what happens to the air cooled by the freezing compartment. [1]

(ii) Explain, with reference to air particles, why this happens.

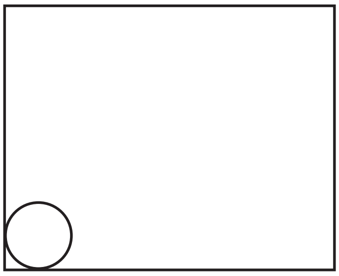
....

....

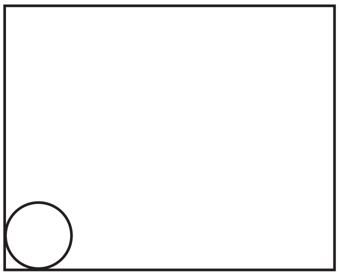
.... [2]

(b) Ice is formed in the freezer when water freezes.

Draw diagrams to show the arrangement of water molecules in solid ice and in liquid water. One molecule has been drawn for you in each box.



solid ice



liquid water

[2]

For Examiner's Use

(c) A steel spoon of mass 0.05 kg is moved from the freezing compartment to the inside of the fridge. The specific heating capacity of steel is 450 J / kg °C.

Calculate how much heat energy is needed to warm the spoon from -20 °C to +5 °C.

State the formula that you use and show your working.

formula used

working

.... [3]

(d) The refrigerator has two identical lamps. The supply voltage is 250 V and the current passing through each lamp when lit is 0.05 A.

(i) Show that the resistance of one lamp when lit is 5000 Ω.

State the formula that you use and show your working.

formula used

working

.... [1]

(ii) The lamps are connected together in parallel.

Calculate the combined resistance of the two lamps.

State the formula that you use and show your working.

formula used

working

.... [3]

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7 Coral reefs are made of living individuals (coral polyps) on top of the skeletons of dead corals. When a coral polyp dies, its skeleton remains and a new polyp takes its place.

(a) The coral polyp takes in calcium ions and carbonate ions from the surrounding seawater to produce calcium carbonate, $CaCO_3$, which it uses to build its skeleton.

(i) Some of the calcium ions present in seawater were once part of limestone rocks on the Earth's surface.

Describe **one** sequence of natural, **physical** processes which is involved in moving calcium ions from limestone to the sea.

....

....

....

....

....

.... [3]

(ii) Some of the carbonate ions present in seawater are formed when carbon dioxide from the air dissolves and reacts.

State **two** processes that add carbon dioxide to the atmosphere.

1 ....

2 .... [2]

(iii) Some ships have been seriously damaged when they have collided with coral reefs.

Use your knowledge of the structure and properties of ionic compounds such as calcium carbonate to explain why ships are seriously damaged if they hit a coral reef.

....

....

....

....

....

.... [3]

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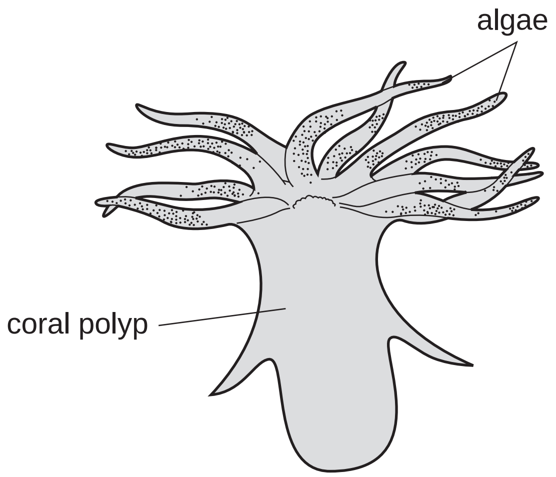
(b) Coral polyps and certain algae (microscopic plants) live closely together and these organisms help each other to survive.

The algae in the coral polyps produce oxygen in the presence of sunlight. The coral polyps produce carbon dioxide as a waste product.



(i) Name the process, occurring in the algae, that produces oxygen.

.... [1]

(ii) Underline **one** of the formulae below which represents a compound also formed by the process in **(i)**.

C_2H_6 $C_2H_5O_2N$ $C_6H_{12}O_6$ CO

Name the compound you have underlined. .... [2]

(iii) Explain briefly why it is beneficial for the coral polyps and the algae to live closely together.

....

....

.... [2]

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(c) In recent years, the amount of carbon dioxide in the atmosphere has increased. This has contributed to a decrease in the average pH of seawater.

During this period, the growth rate of many coral reefs has significantly decreased, and many others are no longer part of a successful ecosystem.

(i) Explain why increased levels of carbon dioxide in the atmosphere cause the average pH of seawater to decrease.

....

....

.... [2]

(ii) Suggest a possible reason why a decrease in the average pH of seawater could damage coral reefs.

....

.... [1]

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Please turn over for Question 8.

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For Examiner's Use

8 Most cells obtain energy from carbohydrates and other nutrients by aerobic respiration.

(a) Describe how a cell in a human muscle obtains the oxygen that it needs for respiration.

....

....

.... [2]

(b) When a person runs, muscles generate heat energy which increases the body temperature. Body temperature can be lowered by sweating. Sweat contains potassium ions, sodium ions and chloride ions dissolved in water.

The core temperature of an athlete was measured as she ran steadily for 120 minutes, drinking no fluids while running. She repeated the run the next day but this time drank fluids throughout the run. The environmental temperature and humidity were the same on both days.

The results are shown in Fig. 8.1.

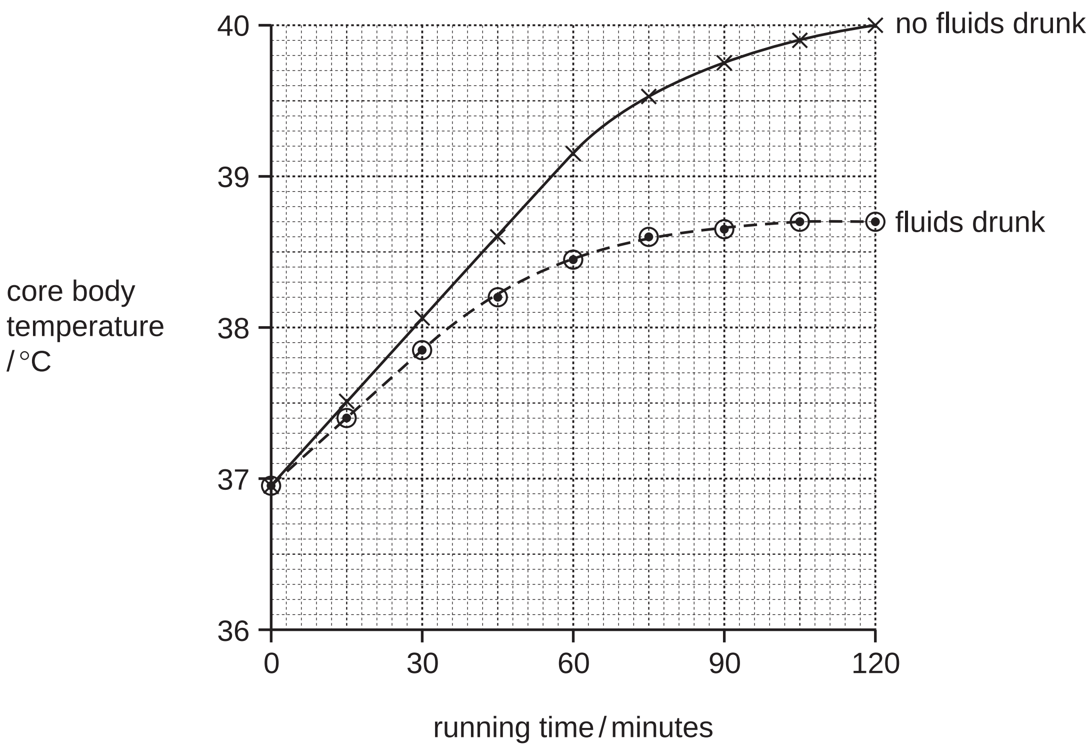

Fig. 8.1

(i) Explain how sweating can reduce body temperature.

....

....

....

.... [2]

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(ii) Compare the body temperature of the athlete when she ran without drinking fluids to her body temperature when she ran while drinking fluids.

....

....

....

.... [2]

(iii) Suggest an explanation for the differences you have described in **(ii)**.

....

....

....

.... [2]

(iv) During a long run, athletes prefer to drink fluids containing glucose, potassium ions, sodium ions and chloride ions rather than pure water.

Suggest how this can help them to perform better.

....

....

....

.... [2]

For Examiner's Use

For Examiner's Use

9 **(a)** An aircraft has a mass of 400 000 kg. It has four engines each capable of producing a maximum force of 300 000 N.

Calculate the maximum acceleration of the aircraft.

State the formula that you use and show your working.

formula used

working

.... [3]

(b) People who fly frequently have greater exposure to ionising radiation than those who do not fly.

Explain why exposure to ionising radiation can be harmful.

....

....

.... [2]

(c) Potato snacks are packed in airtight packets and filled with nitrogen gas at atmospheric pressure.

(i) Suggest why nitrogen gas is used, rather than air.

....

....

.... [2]

For Examiner's Use

(ii) A passenger has a packet of potato snacks in his hand luggage on the aircraft. During the flight, the aircraft cabin is at a pressure less than normal atmospheric pressure.

The passenger notices that the packet has expanded.

Explain, in terms of particles, why this happens.

....

....

....

....

.... [3]

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	**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 above, **X** in the centre, b at the bottom left of each element box

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

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

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