Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER | | | | | |

CANDIDATE NUMBER | | | | |

0689172130

CO-ORDINATED SCIENCES **0654/32**

Paper 3 (Extended) **May/June 2014**

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 an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.
Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.
A copy of the Periodic Table is printed on page 32.

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 **30** printed pages and **2** blank pages.

1 **(a)** Select elements from the list below to complete the left hand column in Table 1.1.

Each element may be used once, more than once or not at all.

aluminium	**chlorine**	**copper**	**gold**
helium	**potassium**	**sulfur**	**zinc**

Table 1.1

element	use of element
	filling weather balloons
	galvanising steel
	making food containers
	sterilising drinking water

[2]

(b) Table 1.2 shows properties of four elements **A**, **B**, **C** and **D**.

Table 1.2

element	melting point / °C	electrical conductivity	reaction with water
A	1455	high	none
B	–220	very low	reacts quickly
C	–112	very low	none
D	181	high	reacts quickly

Use the information in Table 1.2 to suggest which element could be found in Group I of the Periodic Table.

Explain your answer.

element .....

explanation .....

.....

..... [2]

(c) Fig. 1.1 shows what happens when a student dips a nail made of zinc into a solution of copper sulfate for one minute.

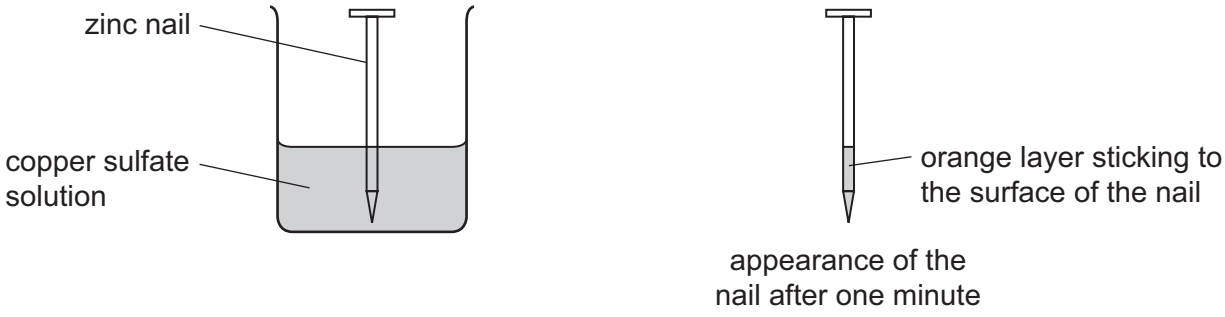


Fig. 1.1

(i) Suggest the **word** equation for the reaction that occurs between zinc and copper sulfate solution.

.....[1]

(ii) Explain the change in appearance of the nail in terms of the reactivity series of metals.

.....

.....

.....[2]

(d) The student then carries out another experiment involving copper sulfate solution, using the apparatus shown in Fig. 1.2.

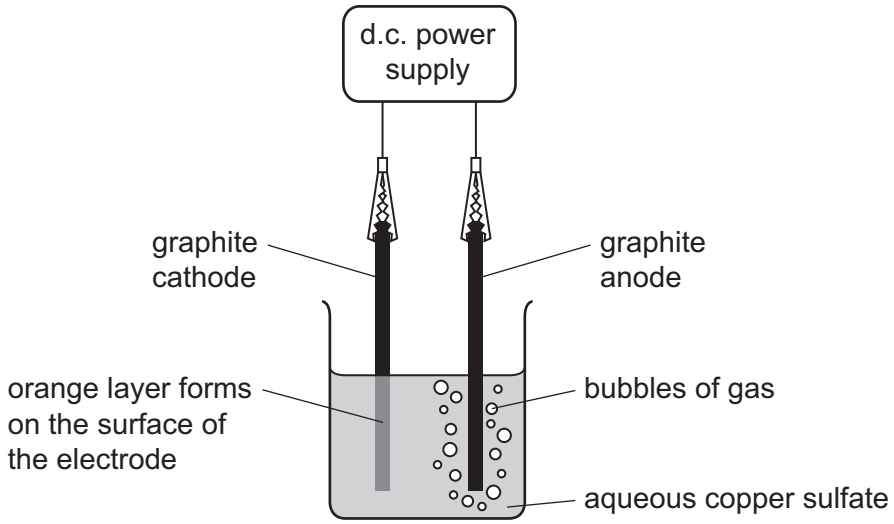


Fig. 1.2

(i) Name the gaseous **element** present in the gas bubbles produced at the anode.

.....[1]

(ii) Describe, in terms of copper ions, Cu^{2+}, what happens to cause the formation of the orange layer on the surface of the cathode.

.....

.....

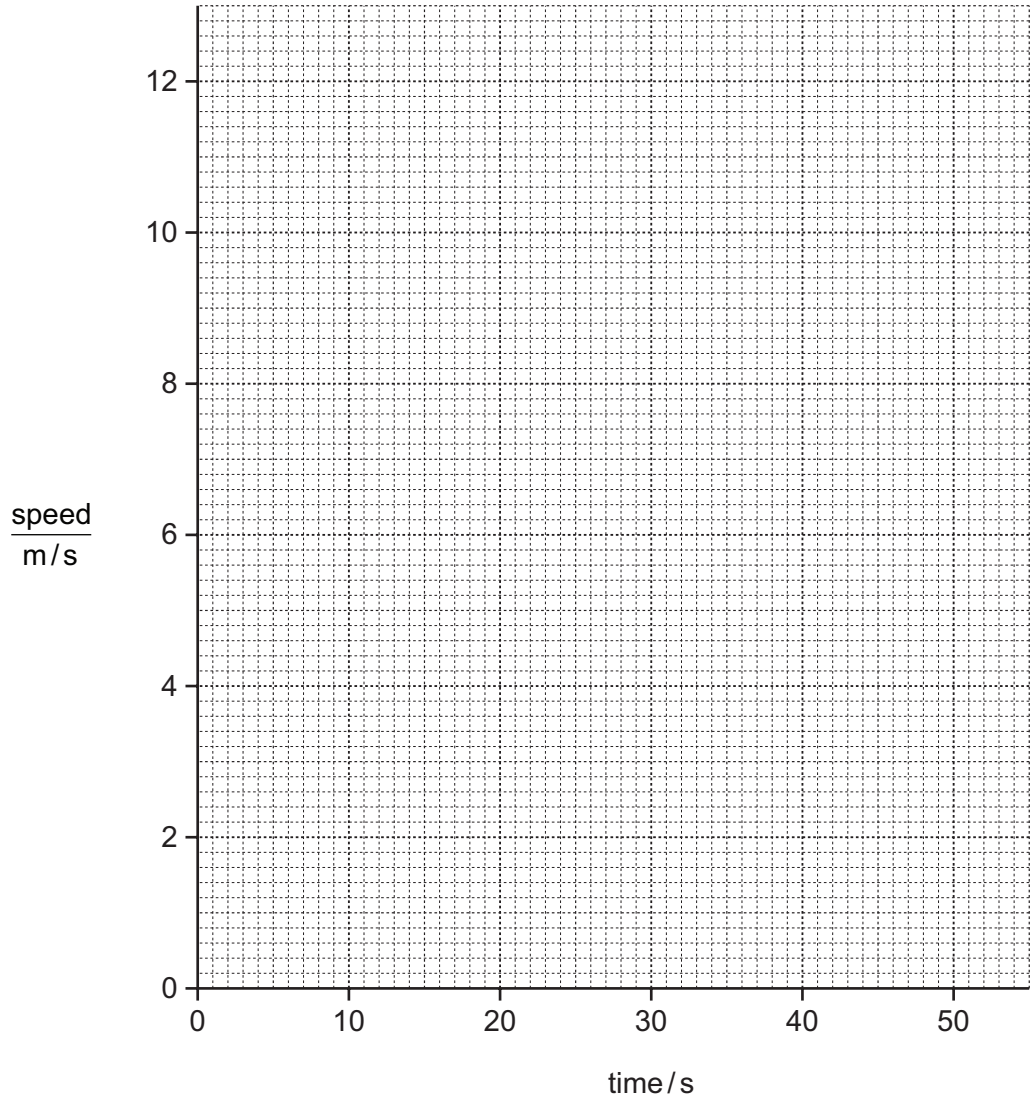
.....

..... [3]

2 **(a)** A skier takes part in a downhill race.

He accelerates from rest. After 30 seconds he reaches a maximum speed of 12 m / s. He continues at this speed for another 10 seconds. The race is then completed and he slows down and stops after a total time of 50 seconds.

On the grid, draw a speed / time graph of the motion of the skier.



[2]

(b) The speed / time graph for another skier is shown in Fig. 2.1.

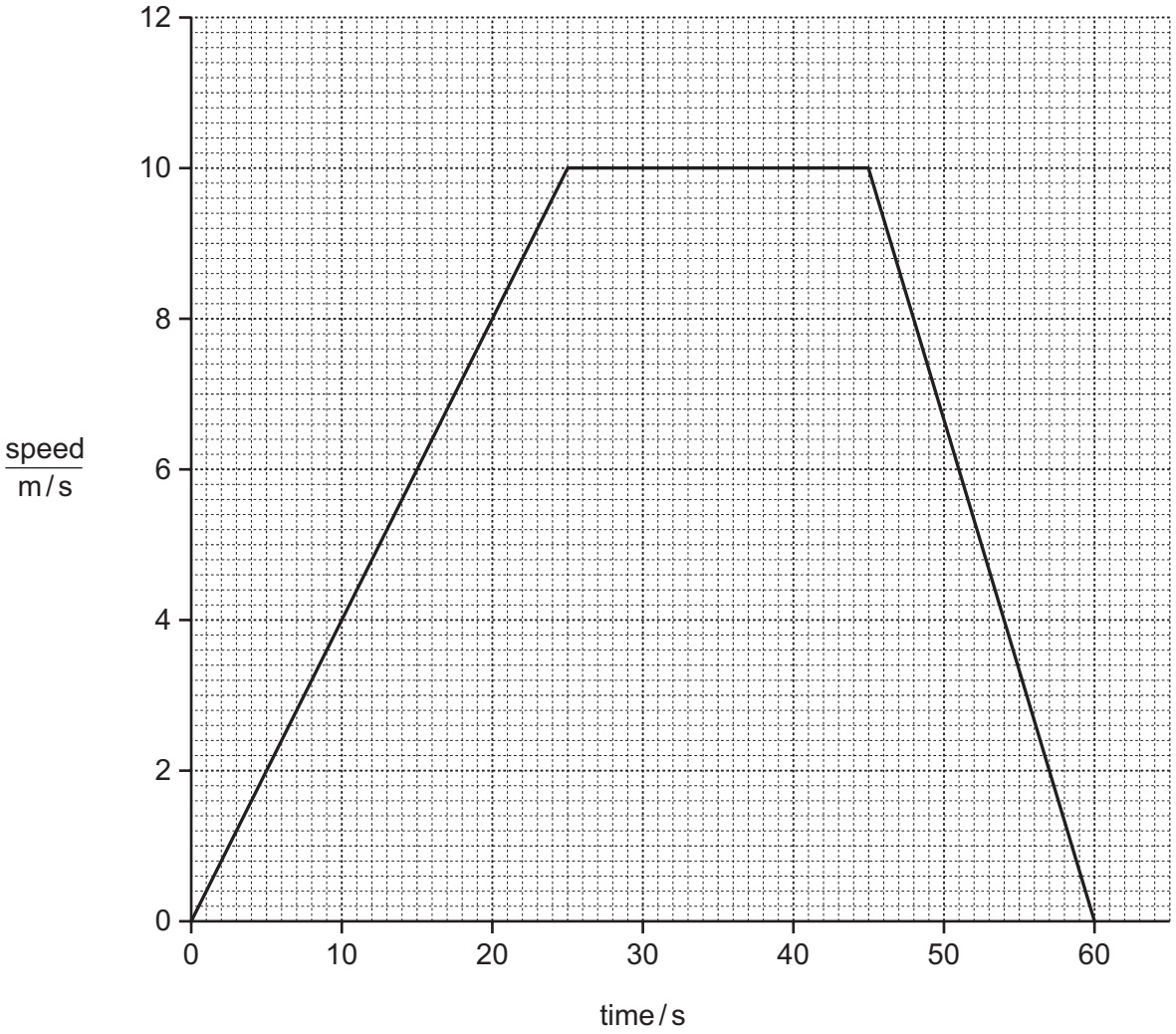


Fig. 2.1

(i) Describe how to use the graph in Fig. 2.1 to determine the total distance travelled in 60 s by the skier.

.....

..... [1]

(ii) Calculate the total distance travelled by the skier from 0 to 60 s.

Show your working.

distance = ... m [2]

(c) Fig. 2.2 shows the skier as he is pulled up a mountain by a cable (lift).

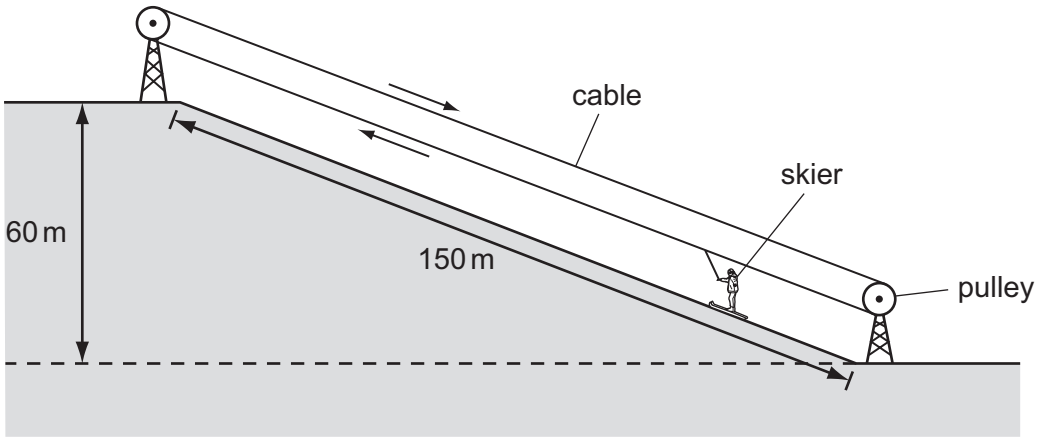


Fig. 2.2

The skier has a mass of 80 kg. The cable pulls him 150 m up the slope. He rises through a total vertical distance of 60 m.

Calculate the work done lifting the skier from the bottom to the top of the slope. You should ignore the work done against friction.
(Use gravitational field strength g = 10 N / kg).

State the formula used, show your working and state the unit of your answer.

formula

working

work done = ... unit ..... [3]

3 **(a)** Explain what is meant by *negative feedback* in homeostasis.

.....

.....

..... [2]

(b) In the homeostatic control of blood glucose concentration, name

(i) the hormone that causes blood glucose concentration to fall,

..... [1]

(ii) the gland that secretes this hormone.

..... [1]

(c) Fig. 3.1 shows some blood vessels in skin.

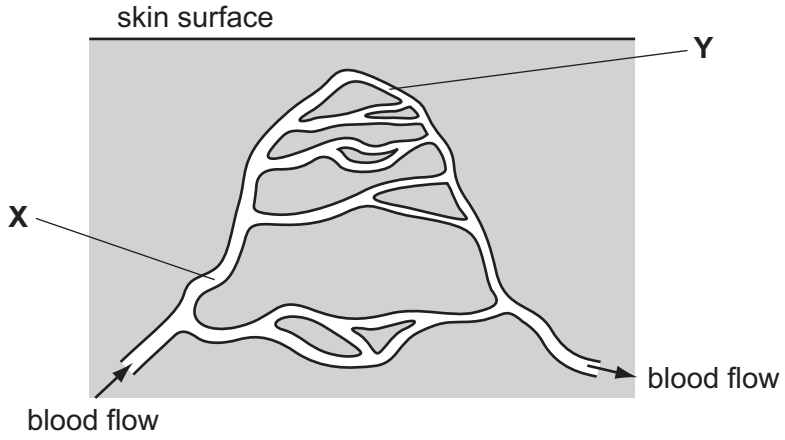


Fig. 3.1

Describe the changes that take place at **X** and **Y** when a person is feeling too hot, and explain how these changes help to keep the person cool.

description .....

.....

explanation .....

..... [3]

(d) Some people suffer from a disease called Raynaud's syndrome, in which the blood supply to the fingers may be severely reduced for a period of time varying from just a few minutes up to several hours.

(i) Suggest what changes in the body to cause the blood supply to the fingers to be reduced.

.....

..... [1]

(ii) People with Raynaud's syndrome are told to take special care to keep their hands warm in cold weather.

Suggest the reason for this advice.

.....

..... [1]

(iii) Explain what might be the effect on the fingers if the blood supply to them is severely reduced for several hours.

.....

.....

..... [2]

4 (a) (i) Hydrogen and carbon are elements.

The gaseous hydrocarbon, propane, is a compound.

Use these examples to explain the difference between elements and compounds.

.....

.....

.....

..... [2]

(ii) State **one** raw material from which hydrocarbons like propane can be obtained.

..... [1]

(iii) State the name of a process that can be used to separate propane gas from the raw material you have named in **(ii)**.

..... [1]

(iv) State **one** use of propane.

..... [1]

(b) Fig. 4.1 shows a simplified diagram of the catalytic cracking of propane, a saturated hydrocarbon.

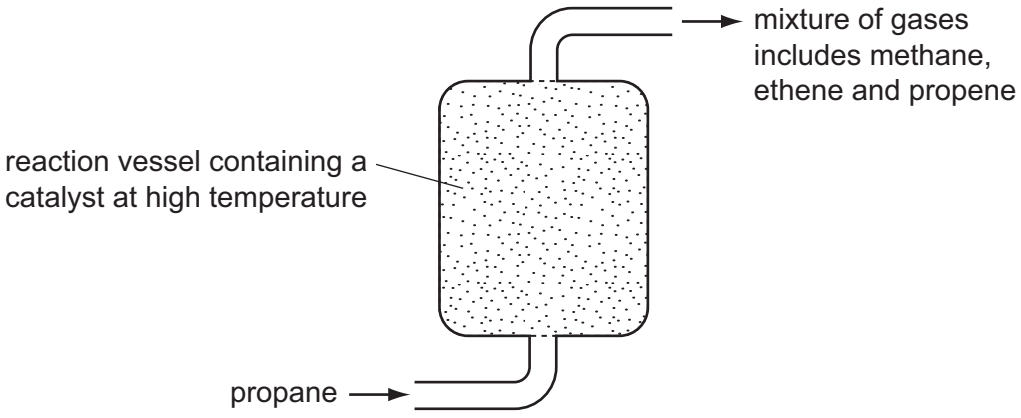


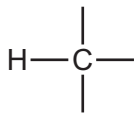
Fig. 4.1

(i) State what is meant by the word *saturated* when it is used to describe hydrocarbon molecules.

.....

..... [1]

(ii) Complete the diagram below to show the structure of one molecule of **propene**.



[2]

(iii) A teacher says that 'When propane is passed into the apparatus in Fig. 4.1, chemical bonds between the carbon atoms in some of the propane molecules are broken.'

State and explain which information in Fig. 4.1 supports this statement.

.....

.....

..... [2]

5 **(a)** A bar magnet is brought close to a piece of iron as shown in Fig. 5.1. The piece of iron moves towards the bar magnet but does not touch it.

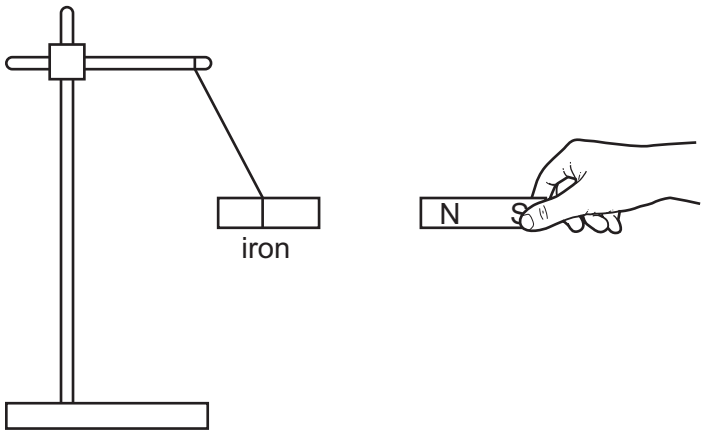


Fig. 5.1

Explain why the piece of iron is attracted to the bar magnet by referring to the magnetic properties of iron.

.....

.....

.....

..... [2]

(b) Relays are often used as switches in circuits that use large currents for operating machinery.

(i) Explain why relays are used in this way.

.....

.....

..... [2]

(ii) Describe how a relay switches electrical machinery on and off. You may draw a diagram if it helps your answer.

.....

.....

..... [2]

(c) Fig. 5.2 shows a circuit containing three identical lamps. The circuit is switched on.

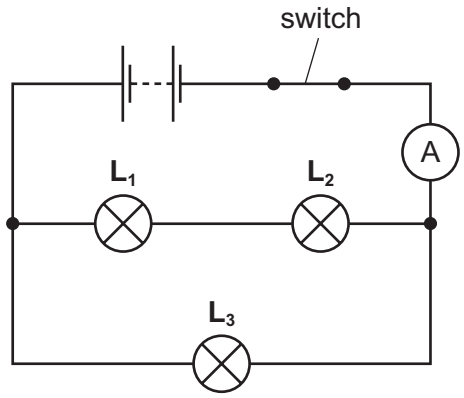


Fig. 5.2

(i) The current flowing through lamps L_1 **and** L_2 is 0.15 A. The current flowing through lamp L_3 is 0.3 A.

State the reading on the ammeter.

..... A [1]

(ii) The voltage across lamp L_3 is 3.0 V.

State the voltage across the battery.

voltage = ... V [1]

(iii) Calculate the resistance of lamp L_3.

State the formula that you use and show your working.

formula

working

resistance = ... Ω [2]

(iv) Write down the combined resistance of lamps L_1 and L_2.

resistance = ... Ω [1]

(v) Using your answers to parts **(iii)** and **(iv)** calculate the combined resistance of the three lamps in the circuit.

State the formula that you use and show your working.

formula

working

resistance = ... Ω [3]

Please turn over for Question 6.

6 The picture shows an animal called a mongoose. The mongoose is a mammal that feeds on insects and small vertebrates such as lizards.

Table 6.1 shows what happens to the energy in a mongoose's food. The figures are per 100 kJ of energy in the food eaten.

Table 6.1

type of energy transfer	energy transferred (kJ per 100 kJ in food eaten)
lost in faeces	20
absorbed into the body	80
used in production of new tissue	24
used in respiration	56

(a) Using Table 6.1,

(i) state the percentage of the animal's food energy that is absorbed into the body.

..... [1]

(ii) calculate the percentage of the food energy absorbed into the body that is used in the production of new tissue.

Show your working.

..... % [2]

(b) All of the energy in the mongoose's food will eventually be transferred into the same form of energy.

State this form of energy.

..... [1]

(c) Suggest **one** way in which the mongoose would use energy released from respiration.

..... [1]

(d) Suggest and explain how the values in Table 6.1 would be different for

(i) a mammal in a colder climate,

.....

.....

..... [2]

(ii) an animal that eats mainly grass.

.....

.....

..... [2]

7 The isotope technetium-99 is used in medical tests as a radioactive tracer. It emits γ-(gamma) radiation that medical equipment can detect in the human body.

(a) Fig. 7.1 shows the results of an experiment to measure how the radioactivity of technetium-99 changes with time.

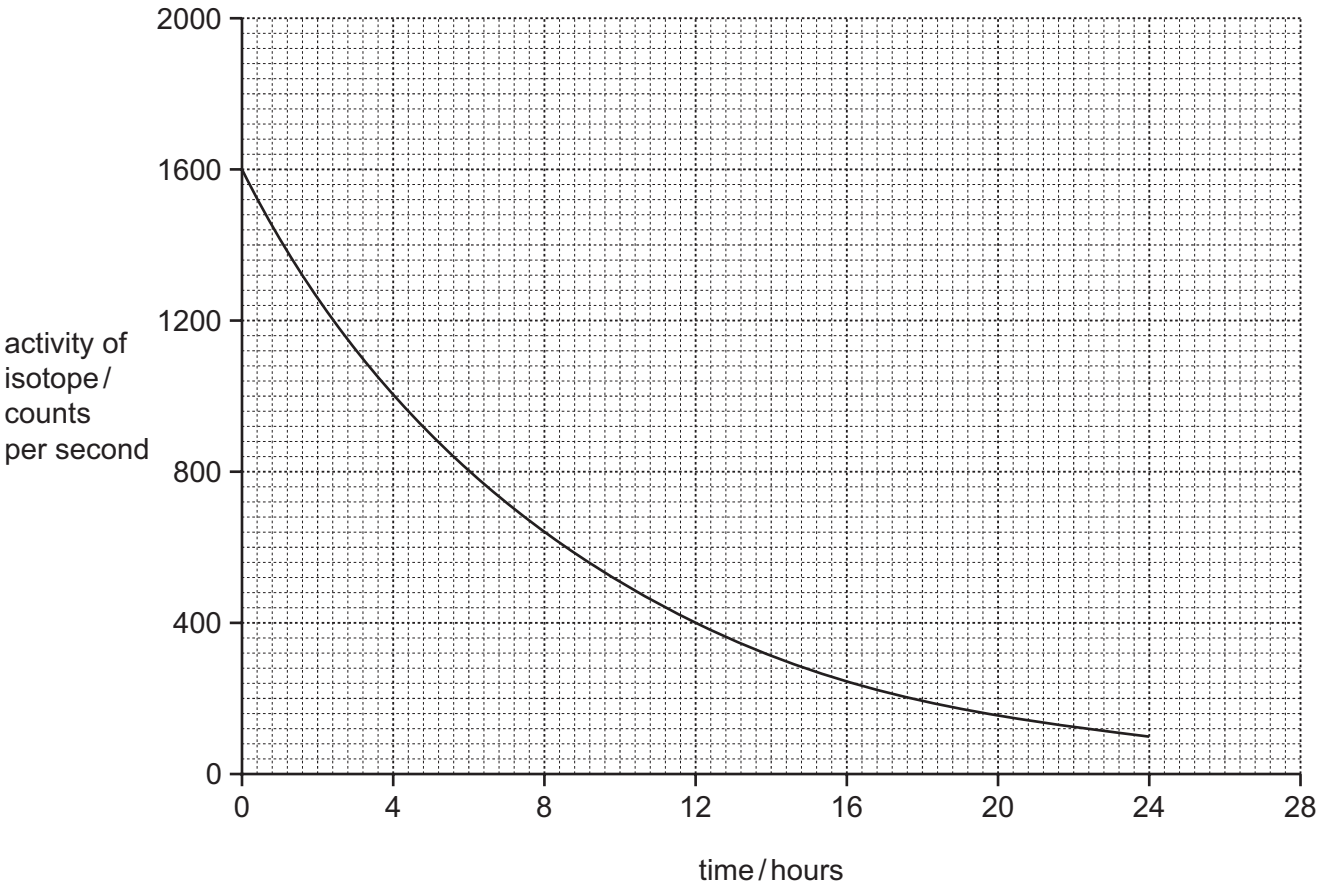


Fig. 7.1

(i) The results plotted in Fig. 7.1 have already been corrected for a background radiation of 50 counts per second.

Sketch on Fig. 7.1, the graph for the results before the correction for background radiation. [2]

(ii) Use Fig. 7.1 to find the half-life of the isotope in hours.

Show your working.

half-life = ... hours [2]

(iii) Suggest why the half-life you calculated in **(ii)** makes the isotope suitable for its use as a radioactive tracer in the human body.

.....

..... [2]

(b) The isotope releases γ-radiation but not α-radiation or β-radiation.

Suggest why this makes technetium-99 suitable for its use as a radioactive tracer in the human body.

.....

..... [2]

(c) γ-rays are one part of the electromagnetic spectrum.

Fig. 7.2 shows an incomplete electromagnetic spectrum.

gamma-rays	X-rays		visible light	infra-red	microwaves	

Fig. 7.2

(i) Use words from the list to complete the spectrum in Fig. 7.2.

infra-sound radio waves seismic waves ultrasound ultraviolet water waves

[1]

(ii) State the part of the electromagnetic spectrum which has the shortest wavelength.

..... [1]

(iii) Explain what is meant by the term *wavelength*.

You may draw a diagram if it helps your answer.

.....

..... [1]

(d) β-particles are electrons. Electrons are involved in the production of electrostatic charges.

Describe in terms of electrons how a rubber balloon becomes charged when rubbed against a piece of cloth.

.....

.....

.....

..... [2]

8 **(a)** Define the term *chromosome*.

.....

.....

..... [2]

(b) Fig. 8.1 shows all the chromosomes in a human skin cell, arranged in pairs.

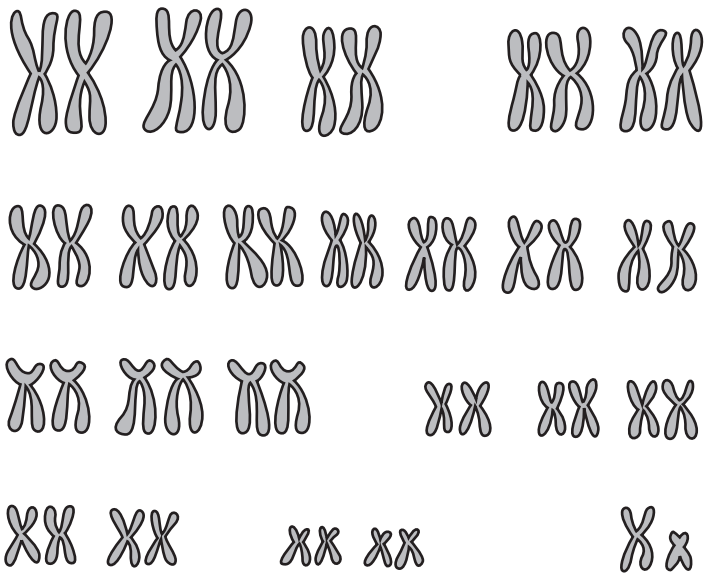


Fig. 8.1

(i) A student examines the chromosomes in Fig. 8.1. He describes the skin cell as 'haploid'.

Explain why the student's description was wrong. State the description that should have been used.

.....

.....

..... [2]

(ii) State **two** ways in which the chromosomes in an egg cell would be different from those in Fig. 8.1.

1 .....

2 ..... [2]

(c) Fig. 8.2 shows the number of chromosomes in each cell in some of the stages of the life-cycle of a peach aphid (a small insect). The young aphids are called nymphs.

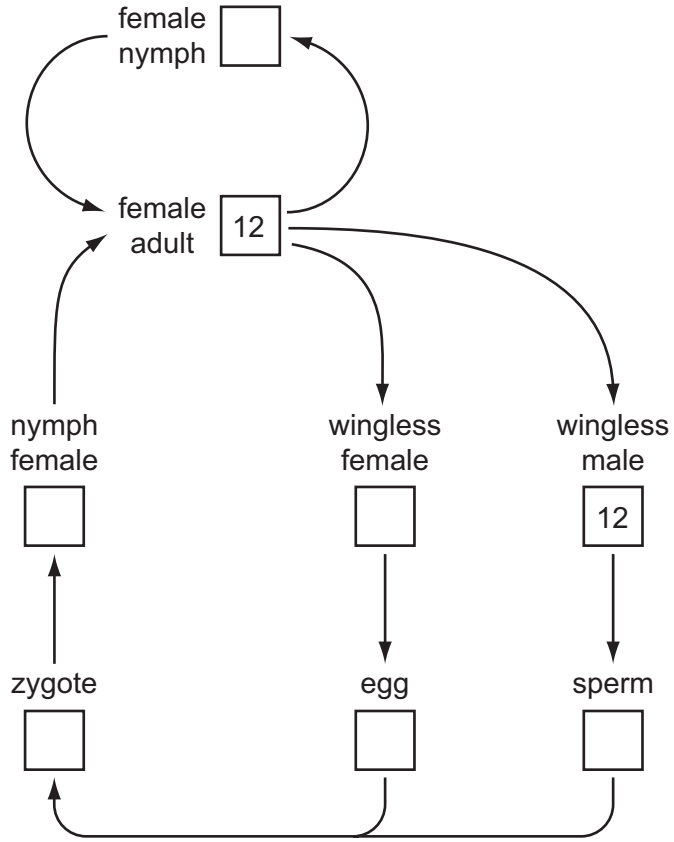


Fig. 8.2

On Fig. 8.2,

(i) mark with the letter **M** a point at which meiosis occurs, [1]

(ii) fill in the empty squares to show the number of chromosomes per cell in the remaining stages of the life-cycle. [2]

(d) Insects such as the peach aphid show both sexual and asexual reproduction.

Suggest an advantage to the peach aphid of

(i) sexual reproduction,

.....

..... [1]

(ii) asexual reproduction.

.....

..... [1]

9 **(a)** Fig. 9.1 shows the nucleus of an atom of the element sulfur, proton number 16.

Fig. 9.1

Complete Fig. 9.1 to show how **all** of the electrons are arranged in an atom of sulfur. [2]

(b) **(i)** Fig. 9.2 shows a diagram of the structure of one molecule of sulfur dioxide, SO_2. In this molecule, the atoms of oxygen and sulfur are held together by double covalent bonds.

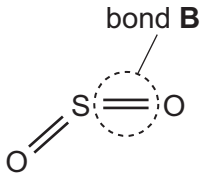


Fig. 9.2

Deduce the number of shared electrons in bond **B**.

..... [1]

(ii) Explain why the presence of sulfur dioxide in the atmosphere causes the water in some lakes to become acidic.

.....

.....

.....

..... [2]

(c) Fig. 9.3 shows apparatus used to measure the rate of reaction between magnesium and dilute sulfuric acid.

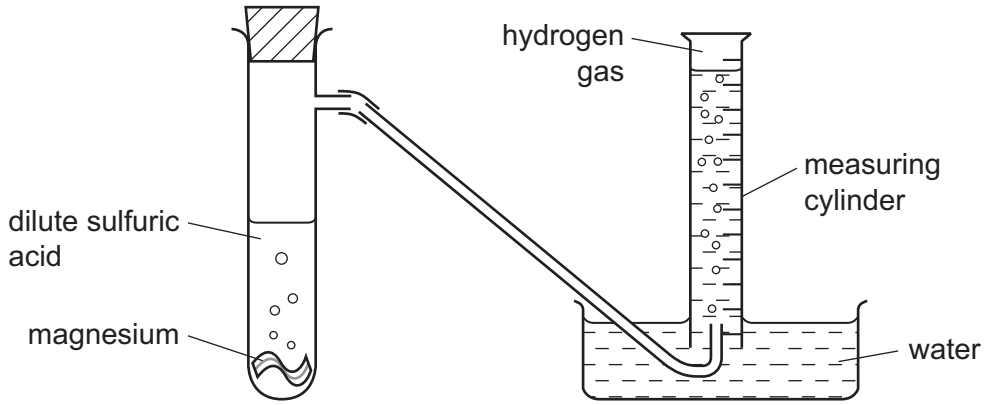


Fig. 9.3

(i) State the effect of changing the temperature of the acid on the time taken for the measuring cylinder to fill with hydrogen gas.

.....

..... [1]

(ii) Explain your answer to **(i)** in terms of collisions between particles.

.....

.....

..... [2]

(d) The balanced symbolic equation for the reaction between magnesium and excess dilute sulfuric acid is

$$Mg(s) + H_2SO_4(aq) \longrightarrow MgSO_4(aq) + H_2(g)$$

A student was asked to use the apparatus in Fig. 9.3 to collect 120 cm^3 of hydrogen gas.

(i) Calculate the number of moles of hydrogen gas in 120 cm^3. The volume of one mole of hydrogen gas under the conditions in the laboratory is 24.0 dm^3.

Show your working.

number of moles = ... [1]

(ii) Calculate the minimum mass of magnesium that the student should use to make sure that she has enough to produce 120 cm^3 of hydrogen gas.

Show your working.

mass of magnesium = ... g [2]

10 (a) Define the term *nutrition*.

.....

.....

..... [2]

(b) Fig. 10.1 shows some stages in the production of yoghurt from milk.

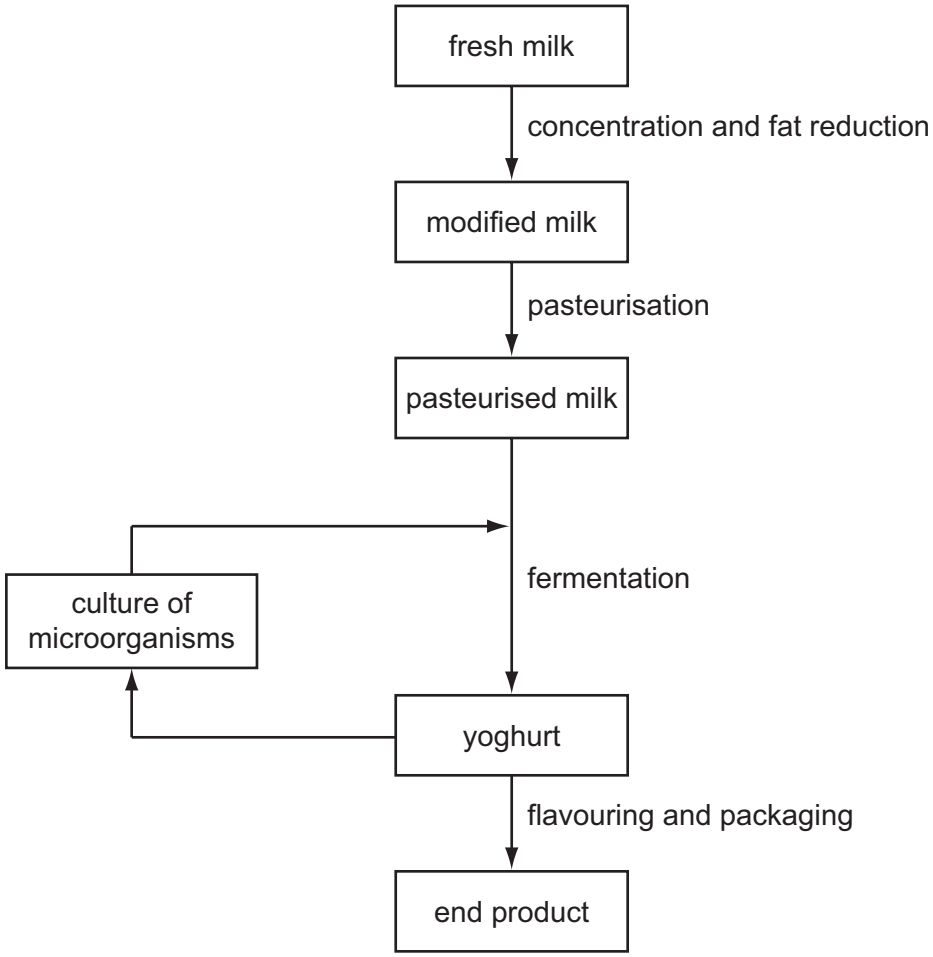


Fig. 10.1

(i) Name the type of microorganisms used in producing yoghurt from milk.

..... [1]

(ii) During the fermentation stage, air is kept out of the fermentation vessel.

Explain why this is important.

.....

.....

..... [1]

(iii) Before fermentation, the milk is heat treated during the process of pasteurisation.

Suggest **two** reasons why this is important.

1 .....

.....

2 .....

..... [2]

(iv) In this production process, fat is removed from the milk before the milk is converted to yoghurt.

Explain why, as a result of this, the yoghurt might be healthier to eat than yoghurt from full-fat milk.

.....

.....

..... [2]

(v) During the fermentation stage, the pH of the mixture falls.

Explain why this happens.

.....

..... [1]

11 Fig. 11.1 shows a ray diagram of a lens producing an image.

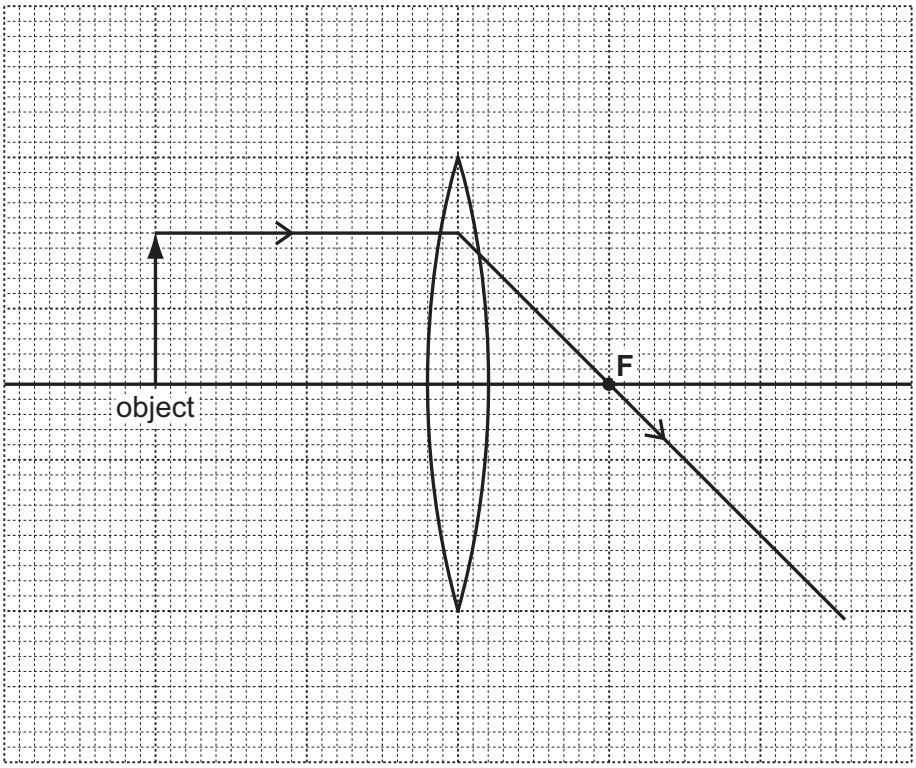


Fig. 11.1

(a) (i) On Fig. 11.1 draw another ray of light from the top of the object, that passes through the centre of the lens and crosses the first ray on the right hand side of the lens. [1]

(ii) On Fig. 11.1 draw the image of the object and label it 'image'. [1]

(iii) State the name given to point **F** on Fig. 11.1.

..... [1]

(b) The image produced in Fig. 11.1 is a real image.

(i) State **two** other characteristics of the image formed in Fig. 11.1.

1 .....

2 ..... [1]

(ii) State the difference between a real image and a virtual image.

.....

..... [1]

12 Compounds containing ammonium ions are added to soil as fertilisers.

Ammonia gas manufactured by the Haber process is used to produce ammonium nitrate and ammonium sulfate.

(a) Ammonium nitrate is made in a neutralisation reaction between the base, ammonia, and an acid.

(i) Name the acid that reacts with ammonia to produce ammonium nitrate.

..... [1]

(ii) Ammonium sulfate has the chemical formula $(NH_4)_2SO_4$. The formula of the sulfate ion is SO_4^{2-}.

Deduce the formula of the ammonium ion.

Show your working.

ammonium ion = ... [2]

(b) Fig. 12.1 shows a simplified diagram of part of the Haber process.

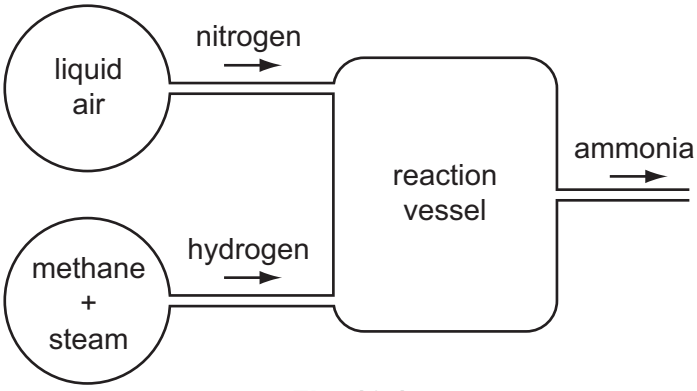


Fig. 12.1

(i) Hydrogen gas is made in a reaction between methane and steam. In this reaction methane reacts with steam, $H_2O(g)$, to produce carbon monoxide, CO, and hydrogen gas.

Deduce the balanced symbolic equation for this reaction.

..... [3]

(ii) State the **three** important reaction conditions inside the reaction vessel in Fig. 12.1.

1 .....

2 .....

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

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

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

Key: a **X** b

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.).