Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

COMBINED SCIENCE **0653/32**

Paper 3 (Extended) **October/November 2016**

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 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 20.

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.

CAMBRIDGE International Examinations

[Turn over

1 Fig. 1.1 shows a wireless doorbell to alert people inside a building that someone has come to visit.

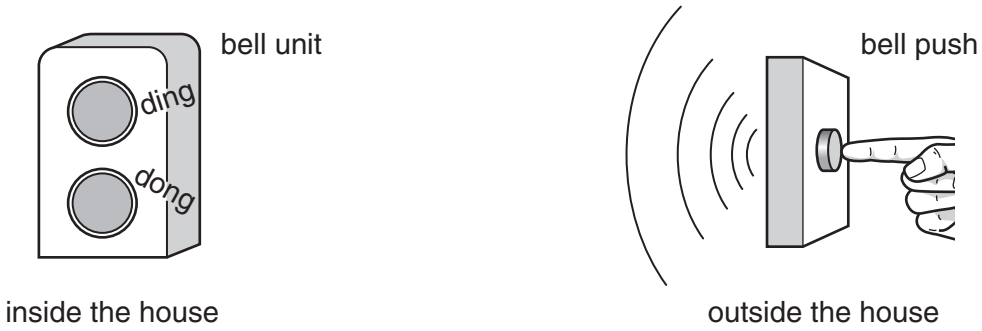


Fig. 1.1

When the button in the bell push is pressed, a radio signal is sent to the bell unit, and the bell sounds.

(a) Table 1.1 shows part of the electromagnetic spectrum.

Table 1.1

	X-rays	ultraviolet		infra-red		

highest frequency ⟷ lowest frequency

(i) Three forms of electromagnetic radiation are shown in Table 1.1.

State which of these forms of electromagnetic radiation has the shortest wavelength.

Give a reason for your answer.

Electromagnetic radiation having the shortest wavelength is .....

Reason .....

.....[1]

(ii) In Table 1.1, write the name of the electromagnetic waves used for radio signals in the correct position in the electromagnetic spectrum. [1]

(b) The radio signal travels at a speed of 3×10^8 m/s.

(i) Suggest the speed of visible light. Give a reason for your answer.

.....

.....[1]

(ii) The radio signal has a frequency of 200 MHz (200×10^6 Hz).

Calculate the wavelength of the radio signal.

State the formula that you use and show your working.

formula

working

wavelength = ...m [2]

(c) The bell unit also contains an electrical circuit.

Fig. 1.2 shows two different bells, **A** and **B**, inside the bell unit. When the wireless signal is received, an arm moves and hits the two bells.

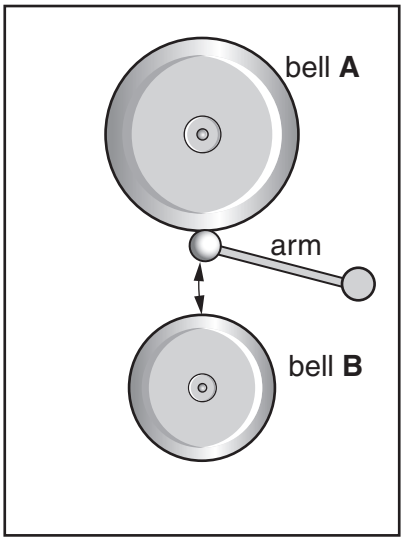


Fig. 1.2

(i) Complete the sequence of useful energy transfers when someone hears the bells.

from ...electrical..... energy

to ..... energy

to ..... energy. [2]

(ii) Bell **A** emits a loud sound of frequency 500 Hz.

Bell **B** emits a quieter sound of frequency 250 Hz.

State which bell, **A** or **B**, produces the sound with the

1. higher pitch, ...

2. larger amplitude. .....

[1]

(d) The sound of the bell is transmitted through the air as a succession of compressions and rarefactions.

Describe how the arrangement of molecules in the air in a compression is different from the arrangement in a rarefaction.

.....

.....[1]

2 The Periodic Table lists all of the elements in order.

(a) State, in terms of atomic structure, which number determines the order of the elements in the Periodic Table.

.....[1]

(b) Part of the Periodic Table is shown in Fig. 2.1. The letters in this table are **not** the symbols of the elements.

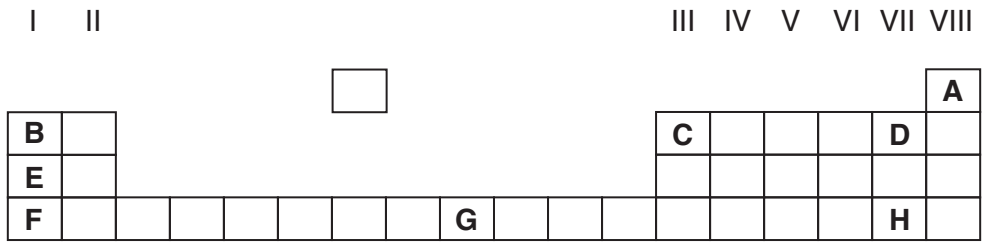


Fig. 2.1

(i) Choose from letters **A** to **H** to complete the sentences below.

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

The most reactive element in Group I is ..... .

The least reactive element in Group VII is ..... .

The **three** elements with the same number of outer shell electrons are

..... , ... and ..... . [3]

(ii) Suggest **two** properties of the element labelled **G**.

1. .....

2. .....

[2]

(c) Aluminium, A*l*, is in Group III. Oxygen, O, is in Group VI.

Deduce the charges on the aluminium ion and on the oxygen ion.

aluminium ion charge .....

oxygen ion charge .....

[2]

(d) Magnesium ions have the formula Mg^{2+}.

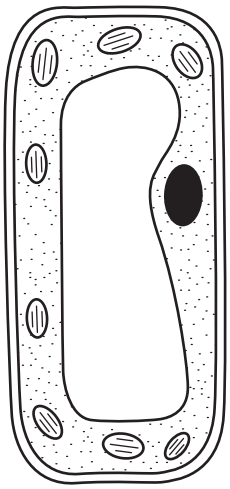
Nitride ions have the formula N^{3-}.

Deduce the formula of magnesium nitride.

.....[1]

3 **(a)** Fig. 3.1 shows a plant cell as seen under the microscope.

Draw lines to label the parts of the plant cell that carry out the functions shown.



controlling centre of the cell

controls what enters and leaves the cell

where respiration takes place

Fig. 3.1 [3]

(b) **(i)** With reference to Fig. 3.1 describe how the contents of the cell enable it to carry out photosynthesis.

.....

.....

.....

.....

.....[2]

(ii) Write the balanced symbol equation for photosynthesis.

.....[2]

4 Fig. 4.1 shows an electric iron for smoothing clothes. An electric heater inside the iron is connected to the mains electricity supply.

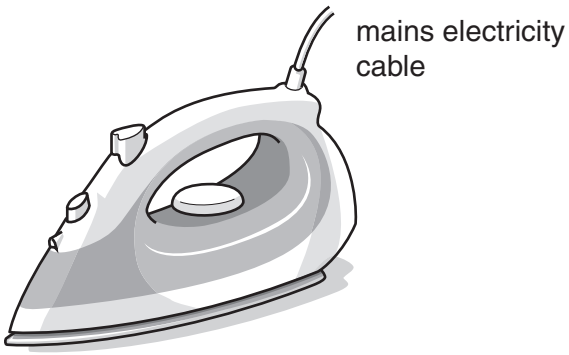


Fig. 4.1

(a) The heating element inside the electric iron is made of two long thin wires that have equal resistance.

The two wires

- are made of the same material,
- are equal in diameter.

(i) State another property that must be the same for the wires to have equal resistance.

.....[1]

(ii) The wires are connected in parallel with each other, and connected to the mains a.c. power supply through a fuse and a switch.

Draw a circuit diagram for this arrangement.

Use the resistor symbol to represent each of the wires.

[4]

(b) In an electric steam iron, the element heats water inside the iron. When the water boils, the steam comes out through holes in the bottom of the iron.

Explain, in terms of the distances between water molecules, why the steam is forced out from the holes in the bottom of the iron.

.....

.....

.....

.....[2]

(c) Fig. 4.2a and Fig. 4.2b show another switch included inside the iron to control the temperature.

This type of switch uses a bimetallic strip, made of two different metals, brass and steel, joined together.

Fig. 4.2a shows the switch when the iron is cold.

Fig. 4.2b shows the switch when the iron has reached the correct temperature for ironing.

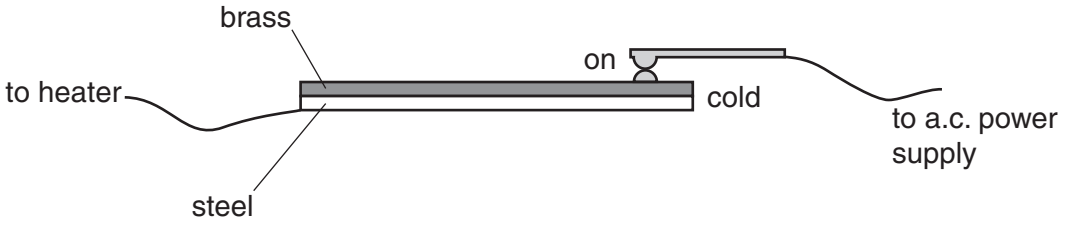


Fig. 4.2a

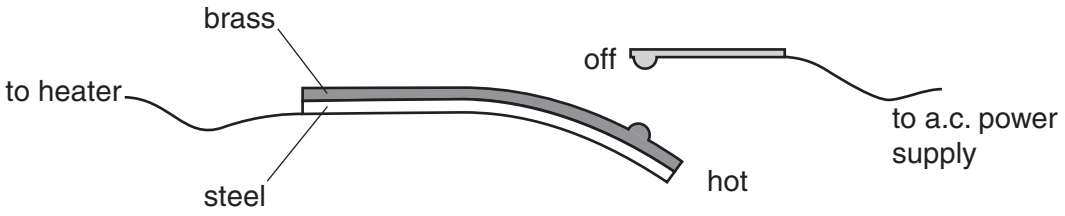


Fig. 4.2b

Explain why this bimetallic strip switches off the heating element when the temperature increases.

.....

.....

.....

.....[2]

5 A student investigates the speed of the reaction between excess dilute hydrochloric acid and powdered calcium carbonate.

The equation for the reaction is shown below.

$$2HCl(aq) + CaCO_3(s) \rightarrow CaCl_2(aq) + H_2O(l) + CO_2(g)$$

Fig. 5.1 shows some of the apparatus she uses.

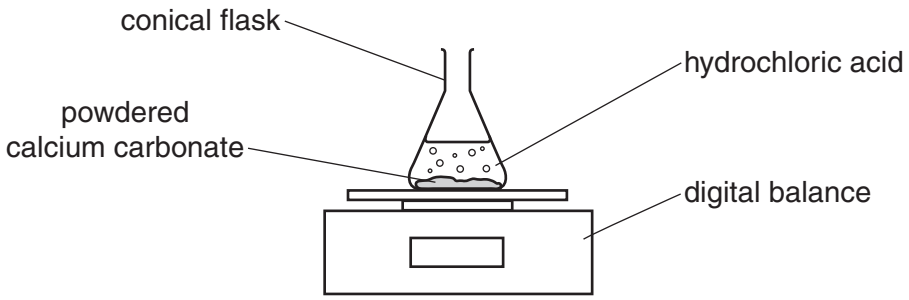


Fig. 5.1

(a) Name one other piece of apparatus that is needed to investigate the speed of this reaction.

.....[1]

(b) The student plots the mass of the conical flask and its contents, as shown in Fig. 5.2.

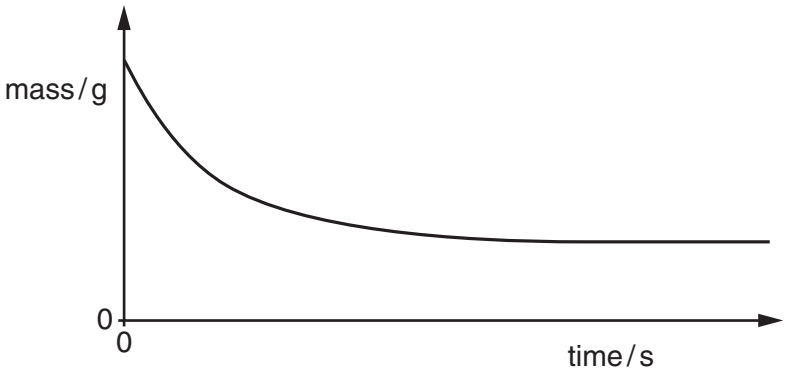


Fig. 5.2

(i) Explain why

the mass decreases,

.....

.....

the mass becomes constant.

.....

.....
[2]

(ii) On Fig. 5.2, draw a line to show the results obtained when the experiment is repeated at a higher temperature. [2]

(iii) State and explain, in terms of particle collisions, the effect of increasing the concentration of the acid on the speed of the reaction.

effect .....

explanation .....

.....

.....[2]

(c) The student repeats the experiment using **excess** powdered calcium carbonate.

Suggest **two** further processes that are used to obtain calcium chloride crystals from the mixture formed in this reaction.

first process .....

second process .....
[2]

(d) Pure calcium chloride is an ionic substance that can be melted and electrolysed.

Predict the substances that form at the electrodes during this electrolysis.

at the anode .....

at the cathode .....
[2]

6 **(a)** Fig. 6.1 is a diagram of an alveolus in the lungs.

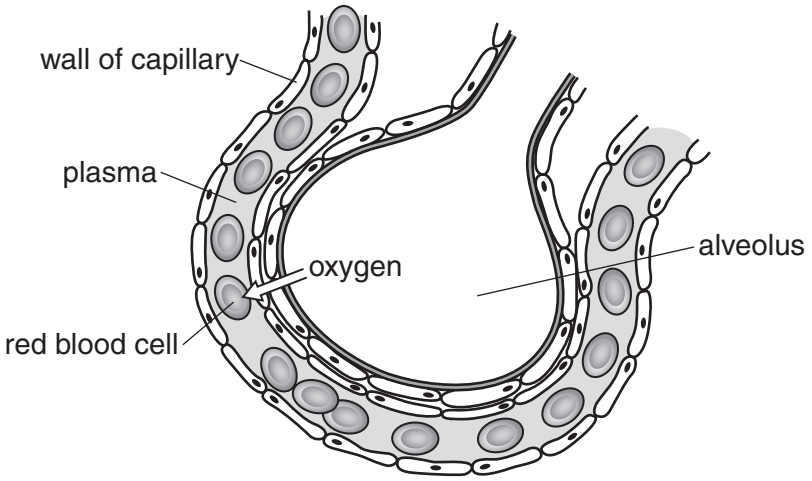


Fig. 6.1

(i) An arrow in Fig. 6.1 shows the diffusion of oxygen.

Draw another arrow to show the diffusion of carbon dioxide. [1]

(ii) Describe **two** ways in which the structure of the alveolus is adapted for efficient gas exchange.

1. .....

.....

2. .....

.....

[2]

(b) A student uses a machine to measure the volume of air breathed in and out of his lungs. The machine produces a graph showing the results.

Fig. 6.2 shows how the volume of his lungs changes as he breathes in and out while resting.

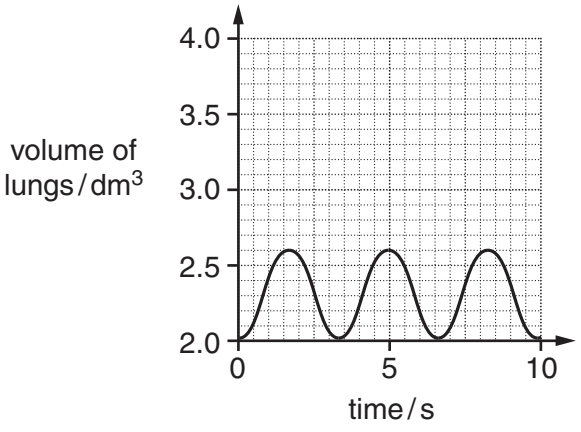


Fig. 6.2

(i) State the volume of air he breathes in with each breath.

volume = ... dm^3 [1]

(ii) Calculate the total volume that he breathes in during ten seconds.
Show your working.

total volume = ... dm^3 [1]

(c) The student then does a running exercise. His breathing pattern changes.

Fig. 6.3 shows the graph of his breathing while exercising.

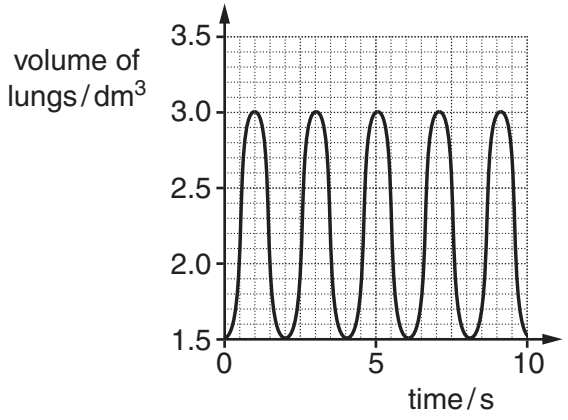


Fig. 6.3

(i) Describe **two** ways in which the student's breathing changes when he starts to exercise.

1. .....

2. .....

[2]

(ii) Explain in detail why the student's breathing needs to change during exercise.

.....

.....

.....

.....

.....

.....[3]

7 A boy uses a catapult to launch a ball vertically upwards, as shown in Fig. 7.1.

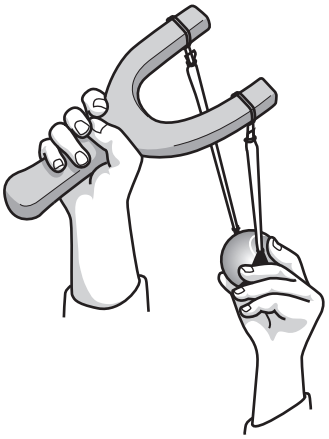


Fig. 7.1

The boy places a ball of mass 0.055 kg in the catapult.

He applies a force to stretch the elastic cords before the ball is launched. This is shown in Fig. 7.2.

When the elastic cords are fully stretched, the boy holds the ball at rest in the catapult.

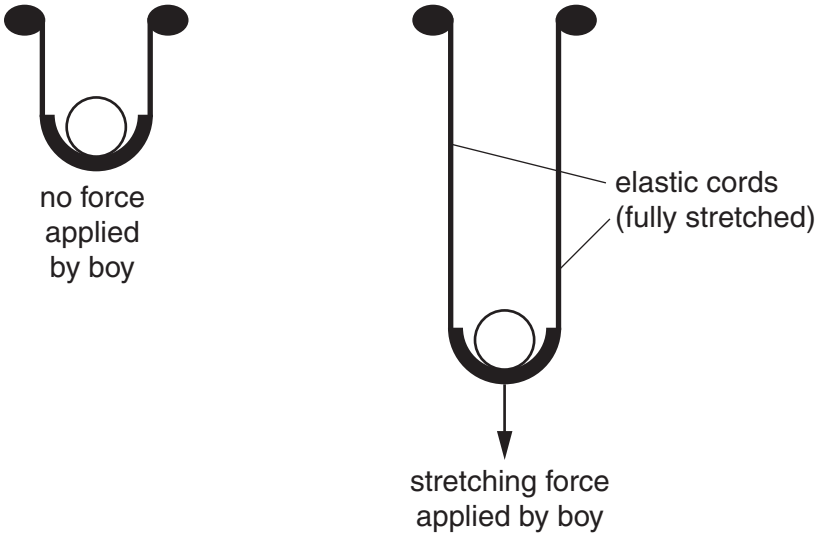


Fig. 7.2

(a) Explain why, before the boy stretches the catapult, there is a small force stretching the elastic cords.

.....

.....

.....[2]

(b) (i) Describe how the forces in the elastic cords change as the cords stretch.

.....

.....[1]

(ii) When the cords are fully stretched by a total force of 100 N, the boy holds the ball without moving the catapult.

State the total upward force when the elastic cords are fully stretched.
Give a reason for your answer.

total upward force = ... N

reason .....

.....[2]

(c) The boy releases the stretched catapult and launches the ball.

The ball, mass 0.055 kg, moves vertically upwards at a speed of 20 m / s.

(i) Calculate the kinetic energy of the ball as it leaves the catapult.

State the formula that you use and show your working.

formula

working

kinetic energy = ... J [2]

(ii) Use your answer to **(c)(i)** to calculate the maximum height above the catapult reached by the ball. Assume there is no loss of energy to the air as the ball rises.

State any formula that you use and show your working.

(gravitational field strength g = 10 N / kg)

formula

working

height = ...m [2]

8 **(a)** Some fuels are listed below.

coal **natural gas** **petroleum** **wood**

State which of these four fuels is **not** a fossil fuel.

.....[1]

(b) Petroleum is a mixture of hydrocarbons. It is separated by fractional distillation, as shown in Fig. 8.1. Another process, **X**, is also shown.

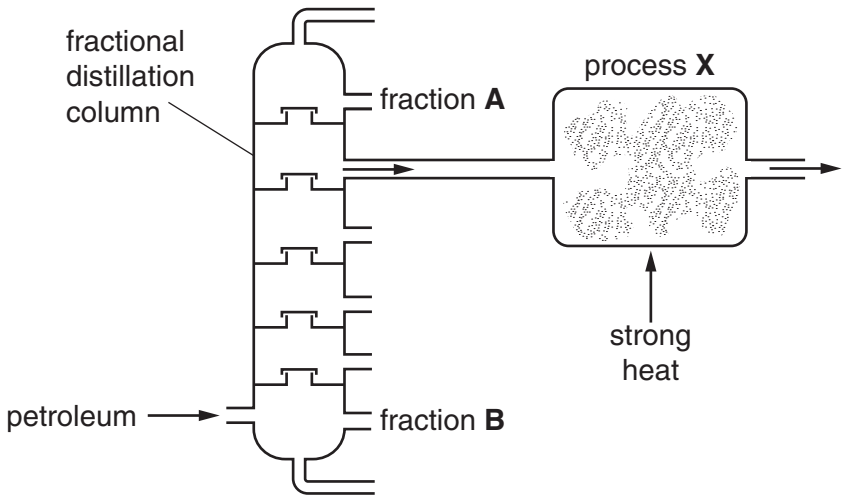


Fig. 8.1

(i) A hydrocarbon in fraction **A** has a different boiling point from a hydrocarbon in fraction **B**.

Explain why these hydrocarbons have different boiling points.

Use ideas about molecules in your answer.

.....

.....

.....

.....

.....[2]

(ii) One of the fractions obtained contains octane. Fig. 8.2 shows a molecule of octane.

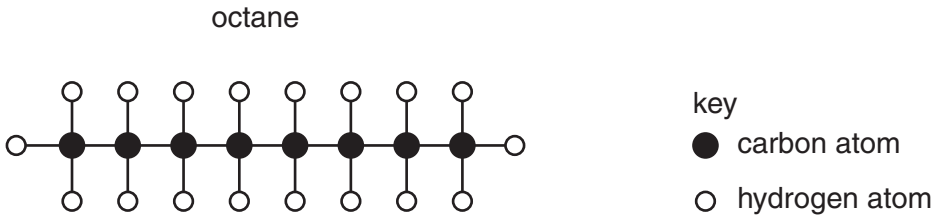


Fig. 8.2

State the formula of octane.

..... [1]

(iii) Process **X** converts large hydrocarbon molecules into many shorter molecules.

Name process **X**.

.....[1]

(iv) The structure of propene is shown in Fig. 8.3.

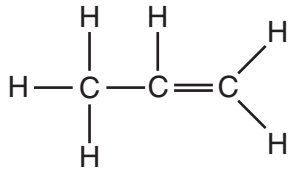


Fig. 8.3

Describe a chemical test that distinguishes propene from octane.

Give the results for both compounds.

test .....

propene result .....

octane result .....
[2]

9 Fig. 9.1 shows a food web in a lake.

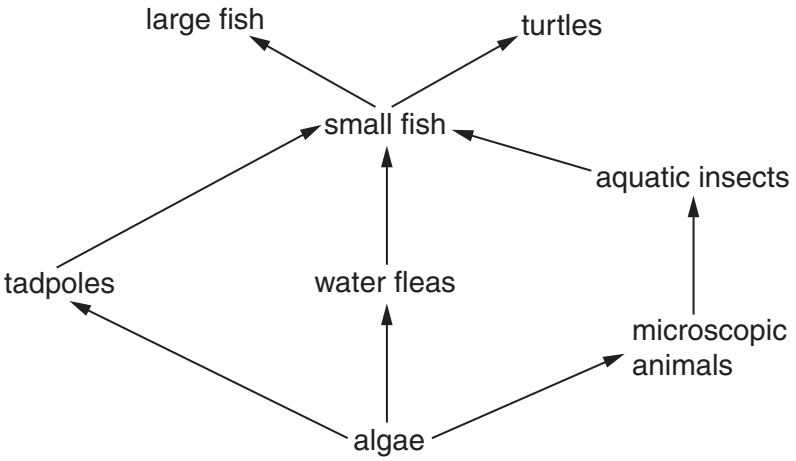


Fig. 9.1

(a) Use the words or phrases in the list below to complete the following sentences.

Each word or phrase can be used once, more than once, or not at all.

algae **consumer** **decomposers** **environment** **food chain**

nests **Sun** **turtle** **water flea**

The source of energy for this food web is the ..... .

The lake is the ecosystem because it contains all the organisms interacting with their ..... . In this food web one example of a herbivore is a ..... and one example of a carnivore is a ..... . [4]

(b) A food web is a network of interconnected food chains.

Use this idea to explain why the small fish in the food web in Fig. 9.1 cannot be placed in just one trophic level.

Include **two** different food chains from Fig. 9.1 in your answer.

.....

.....

.....

.....[3]

(c) The actions of humans can affect the environment.

A farmer uses fertiliser near to the lake.

Explain what could happen if some of the fertiliser gets washed into the lake.

.....

.....

.....

.....

.....[2]

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	VIII
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium –	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57–71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89–103 actinoids	104 Rf rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

Key

atomic number
atomic symbol
name
relative atomic mass

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

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