UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER | | | | | |

CANDIDATE NUMBER | | | | |

6597812837

CO-ORDINATED SCIENCES **0654/22**

Paper 2 (Core) **May/June 2013**

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 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 28.

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 **27** printed pages and **1** blank page.

For Examiner's Use

1 **(a)** Fig. 1.1 shows some of the elements in Group 1 of the Periodic Table.

Li
Na
K

Fig. 1.1

(i) Name the alkali that is produced when potassium reacts with water.

..... [1]

(ii) Describe how the rate of reaction between water and the metals in Fig. 1.1 changes as you go down the group.

.....

..... [1]

(b) Fig. 1.2 shows some of the elements in Group 7 of the Periodic Table.

C*l*
Br
I

Fig. 1.2

(i) Describe how the melting point of the elements in Fig. 1.2 changes as you go down the group.

.....

..... [1]

(ii) A solution of potassium bromide is colourless and a solution of chlorine is almost colourless.

Describe and explain briefly what would be seen when these solutions are mixed.

what would be seen .....

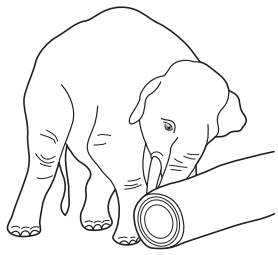
explanation .....

.....

..... [3]

For Examiner's Use

2 **(a)** An elephant of mass 5000 kg exerts a constant force to push a tree trunk along at a steady speed of 1.5 m / s.



State the **two** quantities that would need to be measured to calculate the work done by the elephant.

..... and ..... [2]

(b) The volume of the elephant is 5 m^3. Its mass is 5000 kg.

Calculate the density of the elephant.

State the formula that you use and show your working.

formula

working

..... kg / m^3 [2]

(c) An elephant can communicate with other elephants using infrasound. This is a very low frequency vibration which it is usually impossible for a human to hear.

(i) Suggest a possible frequency for this vibration and explain why you chose your answer.

frequency ..... Hz

explanation .....

.....

..... [2]

(ii) State the meaning of the term *frequency*.

.....

..... [1]

3 Fig. 3.1 shows an animal cell, just before it divides.

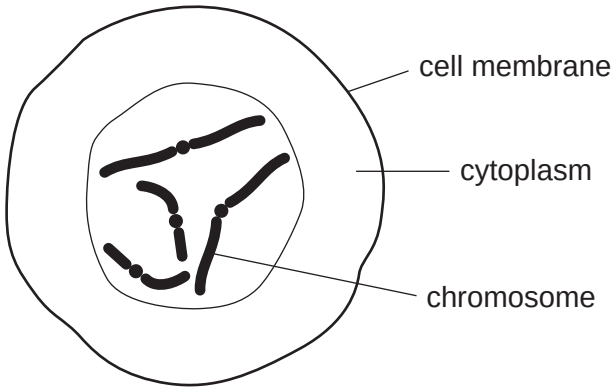


Fig. 3.1

(a) Define the term *chromosome*.

.....

.....

..... [2]

(b) Some cattle have horns, but other cattle do not. This is determined by a gene. The allele of the gene that produces horns, **h**, is recessive.

(i) Complete Table 3.1 to show the phenotypes of cattle with each of the possible genotypes for this gene.

Table 3.1

genotype	phenotype
HH	no horns
Hh	
hh	

[1]

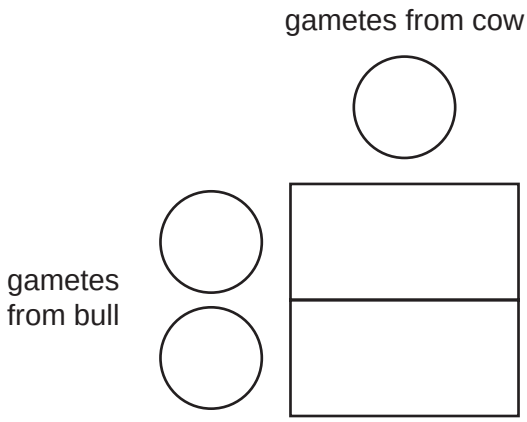
For Examiner's Use

(ii) A farmer has a bull with no horns. He wants to make sure that the bull does not have the recessive allele, **h**, for horns.

He breeds the bull with a cow that has horns.

Complete the genetic diagram to show the possible offspring if the bull does have the allele for horns.

parents	bull with no horns	cow with horns
genotype of parents	**Hh**	**hh**
gametes	○ and ○	○



[3]

(iii) Explain how the results of the cross can help the farmer to decide whether the bull has the allele **h** or not.

.....

.....

..... [2]

(iv) Cows usually give birth to one or two calves each time.

Explain why the farmer needs to cross the bull with the cow several times before he can be sure whether the bull has the allele **h** or not.

.....

.....

.....

..... [2]

For Examiner's Use

4 Fig. 4.1 shows a microwave oven.

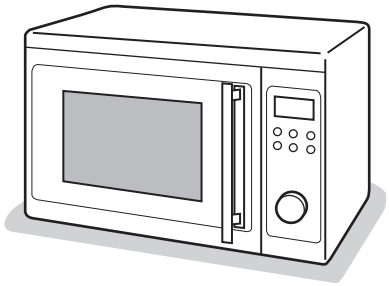


Fig. 4.1

(a) Microwaves cook food by transferring energy to the food.

Choose words from the list to complete the sentences below. You may use each word once, more than once or not at all.

chemical	**conduction**	**convection**
potential	**radiation**	**thermal**

Microwaves are absorbed by the outer layers of food.

The microwave energy is transferred to water and fat molecules in these layers,

increasing the ..... energy of these layers.

..... energy is mostly transferred to the centre of

solid food by ..... . [2]

(b) A student heated some water in a microwave oven for five minutes. Fig. 4.2 shows how the temperature of the water changed.

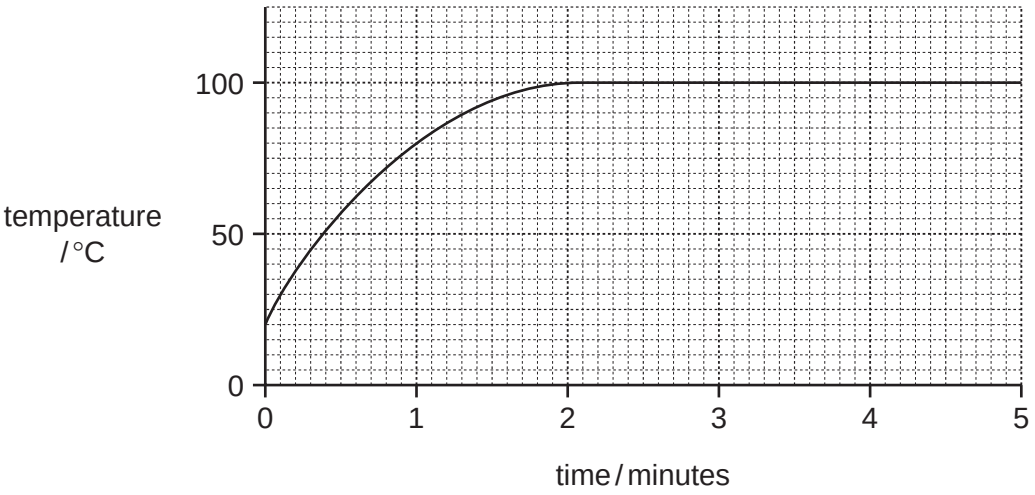


Fig. 4.2

The temperature of the water stops increasing after two minutes.

Explain what happened to the water molecules during the five minutes.

.....

.....

.....

.....

.....

.....

..... [3]

(c) The microwave oven is made of solids. The water is a liquid.

Complete Fig. 4.3 to show the arrangement of particles in a liquid. The diagram for a solid has been done for you.

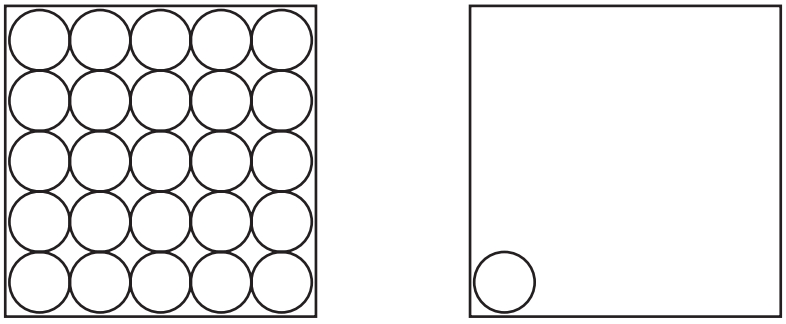


Fig. 4.3 [2]

For Examiner's Use

5 **(a)** Sodium is a reactive metal that forms compounds with non-metals.

(i) Name the compounds which are formed when sodium reacts with

chlorine, ...

oxygen. ..... [1]

(ii) Fig. 5.1 shows diagrams of a sodium atom and a chlorine atom.

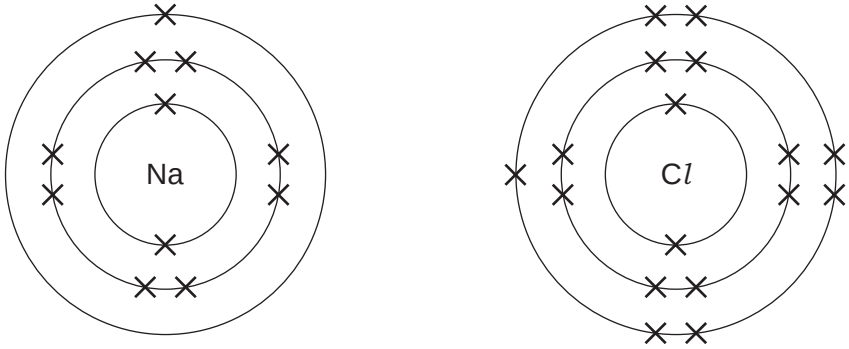


Fig. 5.1

When sodium reacts with chlorine, the atoms shown in Fig. 5.1 first change into electrically charged atoms known as ions.

Describe what happens when sodium and chlorine atoms change into ions.

.....

.....

..... [2]

(iii) State why the ions formed by sodium and chlorine attract each other.

.....

..... [1]

(iv) Describe **two** differences between the properties of a typical ionic compound and a typical covalent compound.

1 .....

.....

2 .....

.....

[2]

(b) Fig. 5.2 shows apparatus a student used to investigate the electrolysis of dilute sulfuric acid.

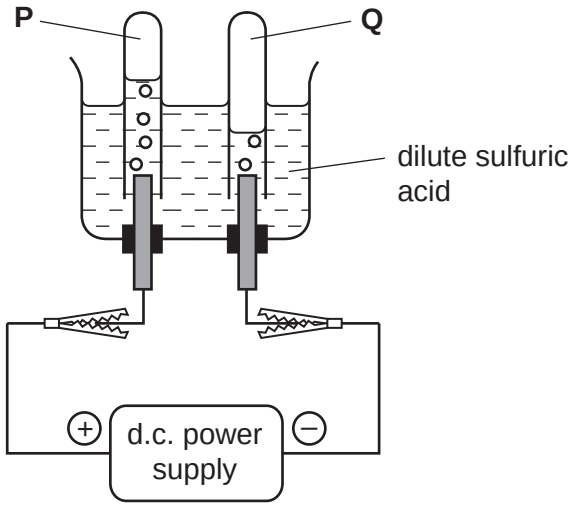


Fig. 5.2

(i) On Fig. 5.2, label the anode. [1]

(ii) Name the gases **P** and **Q**.

P .....

Q ..... [2]

(iii) Choose **one** of the gases in **(ii)** and describe a test for this gas.

gas .....

description of test .....

.....

..... [2]

For Examiner's Use

6 Fig. 6.1 shows a section through a blood capillary.

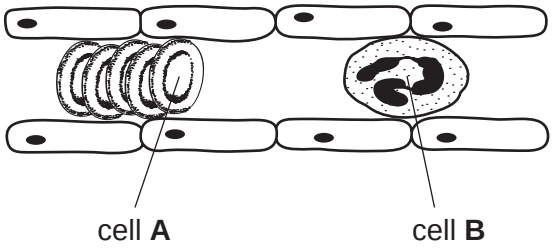


Fig. 6.1

(a) Describe how cell **A** transports oxygen.

.....

.....

.....

..... [2]

(b) Describe the function of cell **B**.

.....

.....

.....

..... [2]

(c) Outline the functions of a blood capillary.

.....

.....

.....

..... [2]

For Examiner's Use

7 **(a)** A resistor of 1200 Ω is connected in series with another resistor of 2400 Ω.

Calculate the combined resistance of these two resistors.

State the formula that you use and show your working.

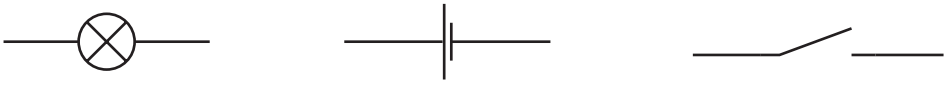
formula

working

..... Ω [2]

(b) **(i)** The diagrams below show the circuit symbols for three components of an electric torch (flashlight).

On the line below each diagram state the name of the component.



.... [2]

(ii) Using only these symbols draw a circuit diagram for a torch.

[1]

(c) Complete the sentences to describe the energy transfers which take place when the torch (flashlight) is used.

Choose from the words below. You may use each word once, more than once or not at all.

chemical	**electrical**	**kinetic**	**light**
nuclear	**potential**	**sound**	**thermal**

..... energy is stored in the cells.

This is transferred into ..... energy which passes to the lamp.

The useful energy output from the lamp is ..... energy, but

much energy is wasted as ..... energy. [2]

(d) A ray of light from the torch is reflected by a mirror. This is shown in Fig. 7.1.

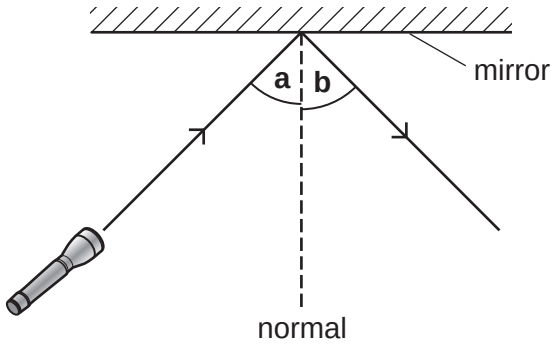


Fig. 7.1

Angle **a** has a value of 45°.

Name angle **b** and write down its value.

name .....

value ..... ° [2]

For Examiner's Use

8 **(a)** The ovary of a flower contains one or more ovules. The ovules contain female gametes. After fertilisation, an ovule becomes a seed containing an embryo plant.

Fig. 8.1 shows a pea seed developing inside a pod.

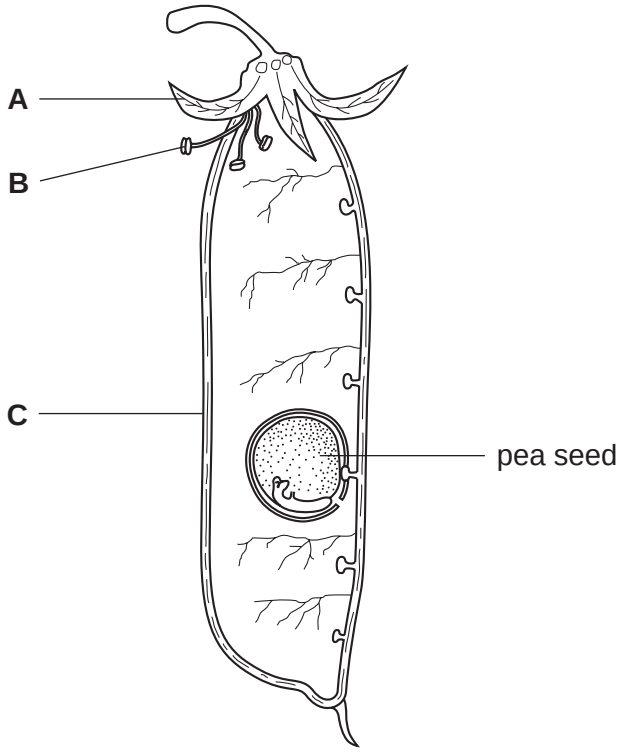


Fig.8.1

(i) Explain the meaning of each of the following terms.

gamete .....

fertilisation .....

[2]

(ii) Parts **A** and **B** in Fig. 8.1 remain from the flower.

State the name of part **A** and function of part **B** of these parts **in the flower**.

name of part **A** .....

function of part **B** .....

[2]

(iii) Suggest the part of the flower from which structure **C** developed.

..... [1]

(b) Four sets of pea seeds were placed in Petri dishes containing either damp soil or damp filter paper. They were left in different conditions, shown in Table 8.1.

Table 8.1

set	conditions		
A	damp soil	cold	dark
B	damp filter paper	warm	light
C	damp filter paper	warm	dark
D	damp soil	cold	light

Predict which sets of seeds will germinate.

Explain your answer.

prediction .....

explanation .....

.....

..... [3]

(c) A pea seed was planted in a pot. When the seed had grown into a young plant, the pot was placed on its side, in a room where light was coming from all sides.

Fig. 8.2 shows the young pea plant three days after the pot had been placed on its side.

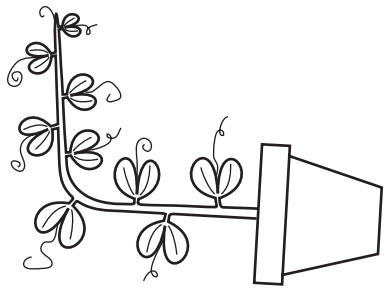


Fig. 8.2

(i) Name the response shown by the pea plant in Fig. 8.2.

..... [2]

(ii) Suggest how this response will help the plant to reproduce sexually.

For Examiner's Use

.....

.....

.....

.....

.....

..... [3]

For Examiner's Use

9 **(a)** **(i)** Explain why hydrogen and carbon are described as elements, but hydrocarbons such as methane and ethane are described as compounds.

.....

.....

.....

..... [2]

(ii) Complete the diagram below to show one molecule of methane.

H—C

[2]

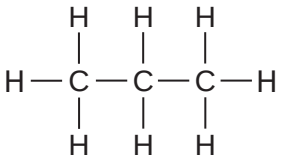
(iii) Name the material found in the Earth that is the main source of methane.

..... [1]

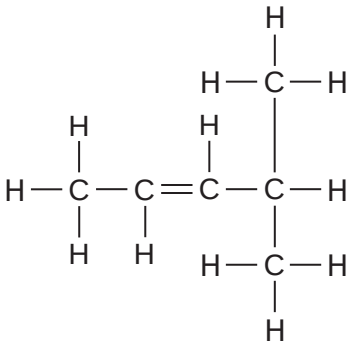
(b) Ethene is a colourless gas made of hydrocarbon molecules.

Fig. 9.2 shows diagrams of four hydrocarbon molecules, **W**, **X**, **Y** and **Z**.

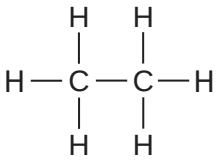
W



X



Y



Z

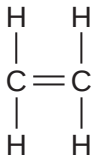


Fig. 9.2

(i) State which diagram, **W**, **X, Y** or **Z**, represents one molecule of ethene.

..... [1]

For Examiner's Use

(ii) State and explain which of the diagrams, **W**, **X**, **Y** or **Z**, represent molecules that are **unsaturated**.

diagrams .....

explanation .....

..... [2]

(c) When gaseous ethene is heated and pressurised, a white solid known as poly(ethene) is produced.

(i) Describe briefly what occurs when ethene molecules react to form poly(ethene). You may wish to draw a simple diagram of a poly(ethene) molecule, using the symbol (E) to represent ethene.

.....

.....

..... [2]

(ii) State the full name of the type of chemical reaction that occurs to form poly(ethene).

..... [2]

For Examiner's Use

10 (a) Draw a straight line from each radiation to its correct use.

radiation	used for
	killing cancer cells
γ (gamma) rays	
	night vision glasses
X-rays	
	photographing bones

[2]

(b) X-rays and γ-rays are both examples of ionising radiation.

Explain what is meant by the term *ionising radiation*.

.....

..... [1]

(c) Some countries use nuclear fission in electricity power stations.

What is meant by the term *nuclear fission*?

.....

..... [2]

For Examiner's Use

(d) The stages that take place in a nuclear power station generating electricity are shown in Table 10.1 below.

Put the stages in the correct sequence by adding numbers 1, 3, 5 and 7 to the right hand column.

Table 10.1

stage	sequence
A chain reaction happens in the core.	
A generator is turned.	
A turbine turns.	**6**
Electrical energy is generated.	**8**
Steam is produced.	
Thermal energy is produced.	**2**
Thermal energy is removed from core.	
Water is heated.	**4**

[3]

(e) Which of these statements about the generation of electricity from nuclear fuel are correct?

Tick (✓) the **two** correct statements.

no carbon dioxide is produced ☐

no dangerous waste is produced ☐

no fossil fuels are used ☐

no problems with the radioactive waste ☐

no thermal energy is wasted ☐ [2]

(f) A teacher demonstrated how the count rate detected by a Geiger-Müller tube depends on the distance between the front of the tube and a radioactive α (alpha) source.

Fig. 10.1 shows how the equipment was set up.

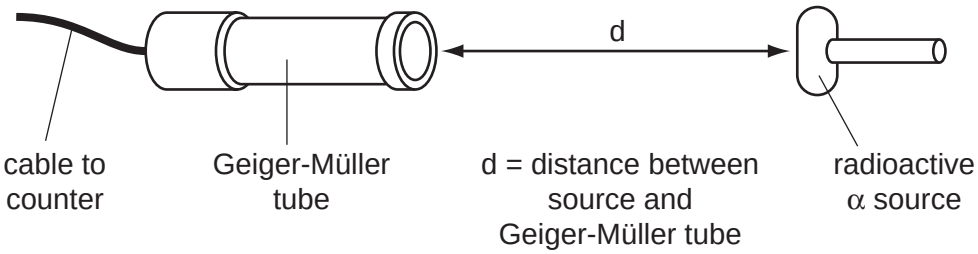


Fig. 10.1

Fig. 10.2 shows a graph of the results of the experiment.

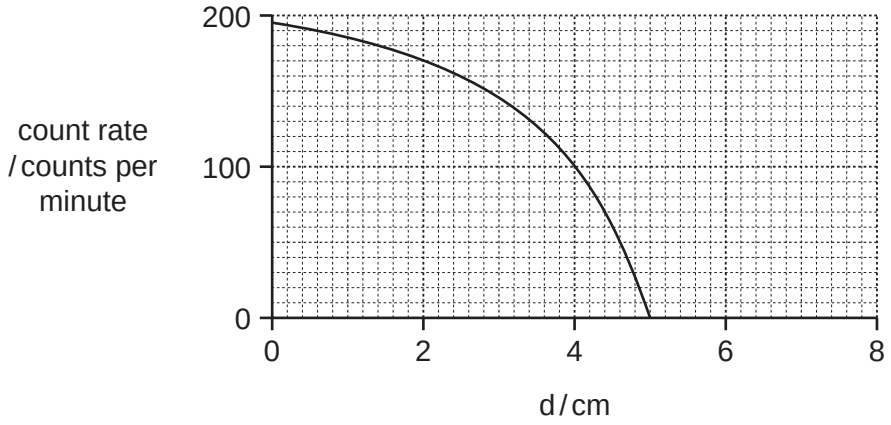


Fig. 10.2

(i) State the range of the alpha particles. ..... cm [1]

(ii) Describe how you would use the apparatus to obtain these results.

.....

.....

.....

..... [3]

For Examiner's Use

(iii) Before carrying out the experiment the teacher discussed how to reduce her exposure to radiation.

Which idea below would **not** help reduce the radiation exposure of the teacher during the experiment? Explain your answer.

idea 1 Hold the source with long tongs and wear gloves.

idea 2 Place a lead shield between the source and the teacher.

idea 3 Wear a photographic badge that detects radiation.

idea ..... because .....

.....

..... [2]

11 Fig. 11.1 shows a food chain. The arrows show how energy flows from one organism to another, along the chain.

For Examiner's Use

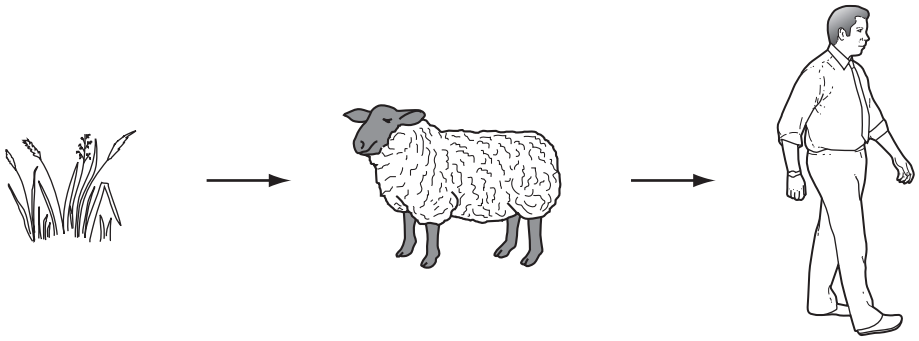


Fig. 11.1

(a) Energy enters the food chain as sunlight. Plant leaves use this energy to make food.

(i) Name the substance in the leaves of a plant that absorbs this energy.

..... [1]

(ii) Name the **two** raw materials that the plant uses to make food.

1 ..... 2 ..... [2]

(iii) Name the gas released from plant leaves during this process.

..... [1]

(b) A sheep is a herbivore.

Define the term *herbivore*.

.....

..... [2]

(c) Meat from the sheep contains protein.

Describe the importance of protein in the diet.

.....

.....

..... [2]

(d) In the cells of the plant, sheep and man, useful energy is released from the food by respiration. Some of the energy is released as heat.

For Examiner's Use

Explain why the following changes occur when the man's body temperature rises too high.

The arterioles near the surface of his skin dilate.

.....

.....

.....

.....

.....

His sweat glands produce more sweat.

.....

.....

.....

.....

.....

[4]

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For Examiner's Use

12 (a) A student added a solution of the same dilute acid to each of the test-tubes **P** to **T** shown in Fig. 12.1.

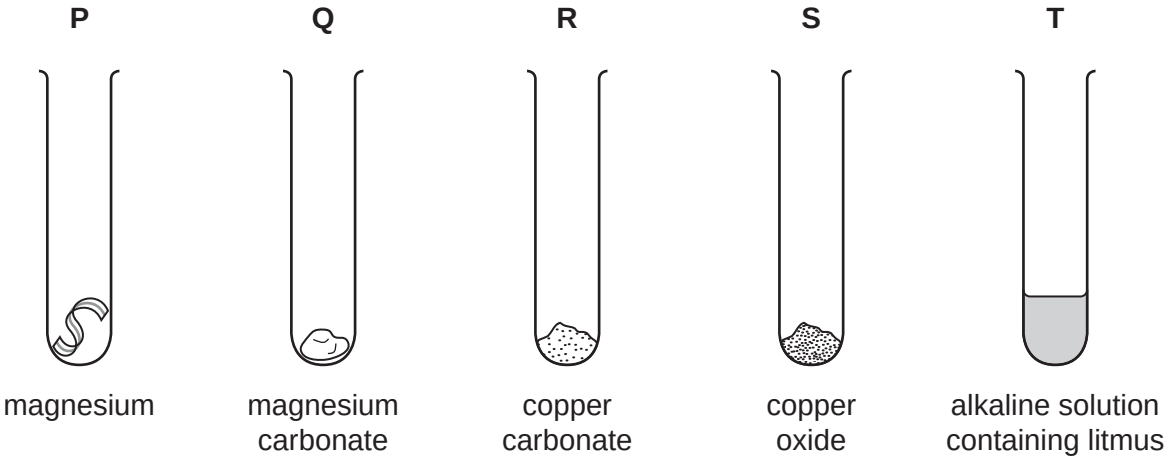

Fig. 12.1

Complete Table 12.1 by matching the test-tubes, **P**, **Q**, **R**, **S** and **T**, with the observations which are made when the dilute acid reacts with the contents.

Some of the observations could apply to more than one of the test-tubes. You may use each letter once, more than once or not at tall.

Table 12.1

observations	test-tube(s)
The mixture turns red when excess acid has been added.	
A colourless gas is given off.	
A blue solution is formed.	
A colourless gas which pops when ignited is given off.	

[4]

For Examiner's Use

(b) The student used the apparatus shown in Fig. 12.2 to investigate neutralisation reactions involving three acids, **A**, **B** and **C**.

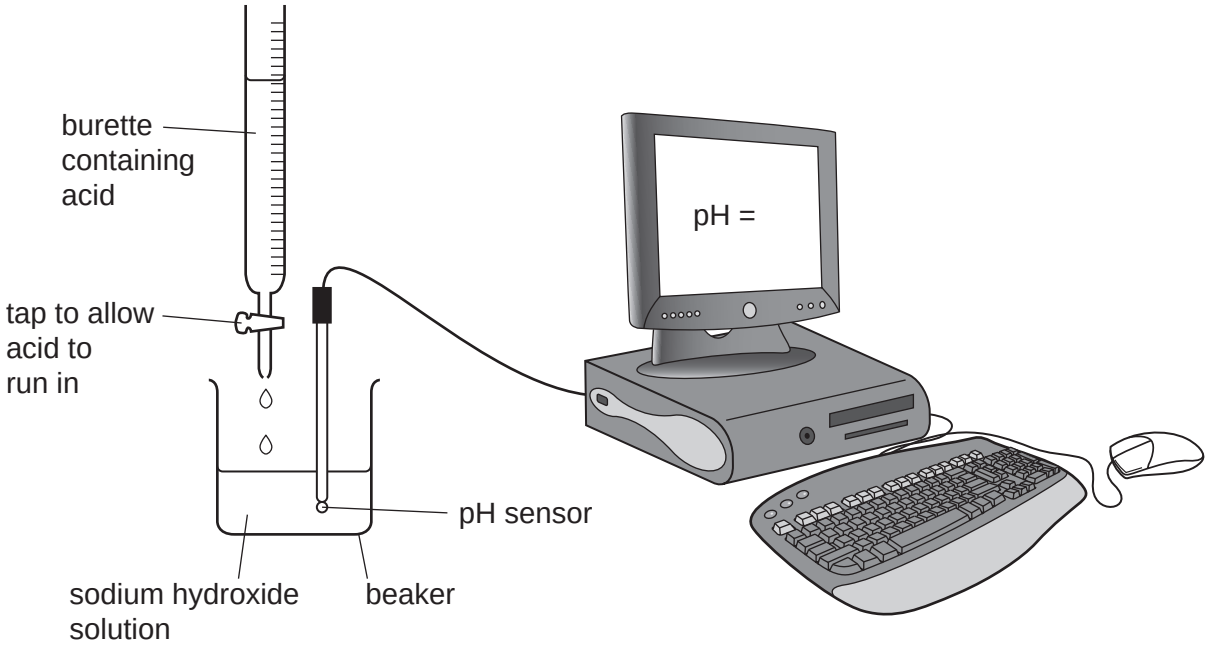

Fig. 12.2

In each experiment, 25.0 cm^3 of the same solution of sodium hydroxide were placed into a beaker. The tap on the burette was opened and acid was added slowly.

The measurements made by the pH sensor were displayed on the computer screen.

Some of the measurements from the three experiments are shown in Table 12.2.

Table 12.2

acid	source of acid	volume required to produce a neutral mixture / cm^3
A	sample taken from an acidic lake	42.0
B	sample taken from a car battery	15.0
C	acid from a chemical laboratory	60.0

(i) Suggest a possible pH value of the alkali before any acid was added.

..... [1]

(ii) State, with a reason, which acid **A**, **B** or **C**, had the highest concentration.

acid .....

reason .....

..... [1]

For Examiner's Use

(iii) The student noticed that in all three experiments, the temperature of the mixture increased as the acid was added.

Suggest why the temperature increased.

.....

..... [1]

(iv) Complete the general word equation for the reaction which occurs between an acid and an alkali.

acid	+	alkali	→		+	

[2]

(v) Sample **A** was taken from an acidic lake. Much of the acidity of the acidic lake is caused by sulfur dioxide gas dissolving and reacting with lake water.

State **two** possible sources of the sulfur dioxide, one natural and one the result of human activity.

natural .....

human activity .....

..... [2]

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: box with a (top), **X** (centre), b (bottom left)

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.).