Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER			

CO-ORDINATED SCIENCES **0654/21**

Paper 2 (Core) **May/June 2016**

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 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 **28** printed pages.

CAMBRIDGE International Examinations

1 Fig. 1.1 shows a house.

Fig. 1.1

(a) In the garden of the house there is a wind turbine. The turbine generates electricity.

State the main energy transformation in the wind turbine.

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

(b) There are solar panels on the roof of the house. Infra-red radiation from the Sun heats up water in the panels.

Suggest what colour the panels should be painted.

Explain your answer.

colour .....

explanation .....

.....

[2]

(c) The heated water is stored in a copper tank. During the night, the water cools as thermal energy passes from the water, through the copper, to the air surrounding the tank.

State the name of this energy transfer process.

.....[1]

(d) Wind energy and energy from the Sun are both examples of renewable energy resources.

State **two** other renewable energy resources.

1 .....

2 .....
[2]

(e) State **one** disadvantage of using solar energy to heat water.

.....[1]

(f) Infra-red radiation is part of the electromagnetic spectrum.

Place infra-red in the correct position in the incomplete electromagnetic spectrum below.

	X-rays		visible light		microwaves	

[1]

(g) There is a lake near the house.

The wind blowing across the lake creates waves on the surface of the water.

One of these waves is represented in Fig. 1.2.

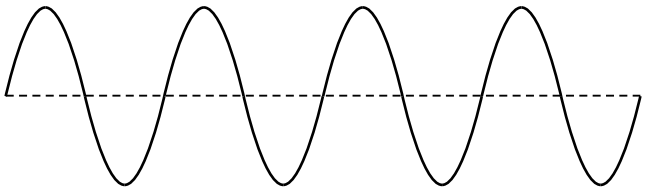


Fig. 1.2

On Fig. 1.2, draw a double headed arrow (◄►) to indicate

(i) the amplitude, labelled **A**, [1]

(ii) one wavelength, labelled **W**. [1]

(h) The wind turbine is noisy. The owner of the house fits double-glazing to the windows.

Fig. 1.3 shows the sound waves from the wind turbine measured outside and inside the house.

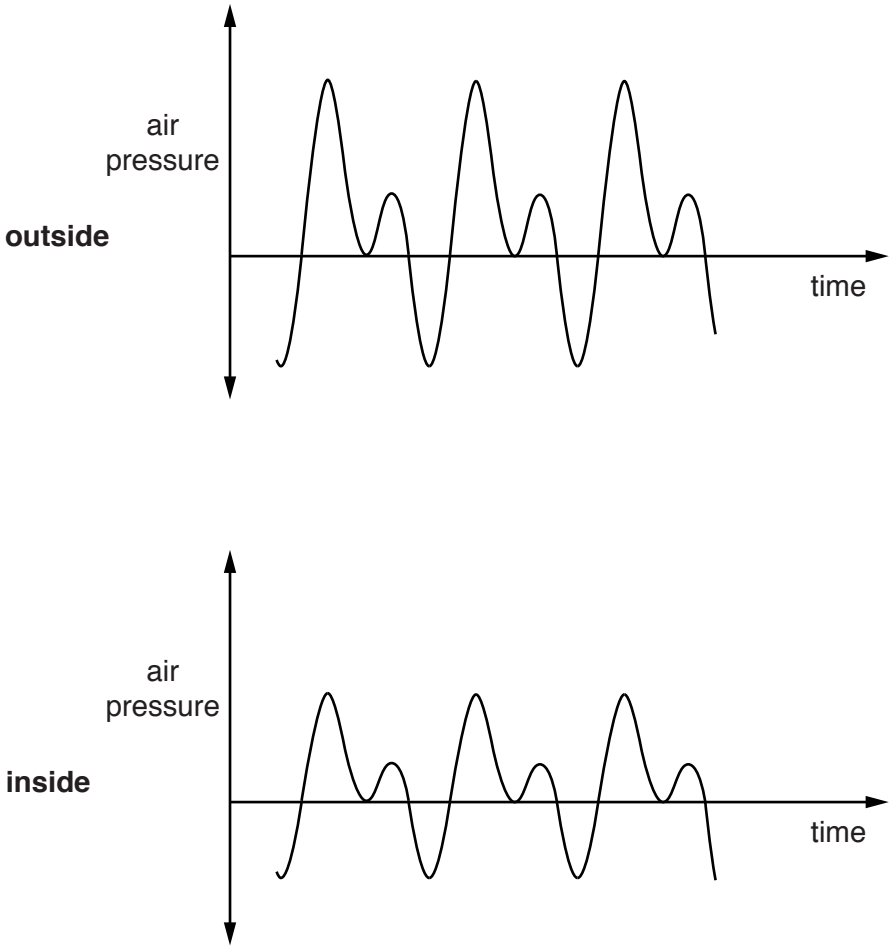


Fig. 1.3

Circle **two** phrases that describe the sound waves from the turbine inside the house compared with those outside the house.

higher volume	**lower volume**	**same volume**	
higher pitch	**lower pitch**	**same pitch**	[2]

2 **(a)** Fig. 2.1 shows a flower as seen from the side and the same flower in a horizontal section taken along the line X–X.

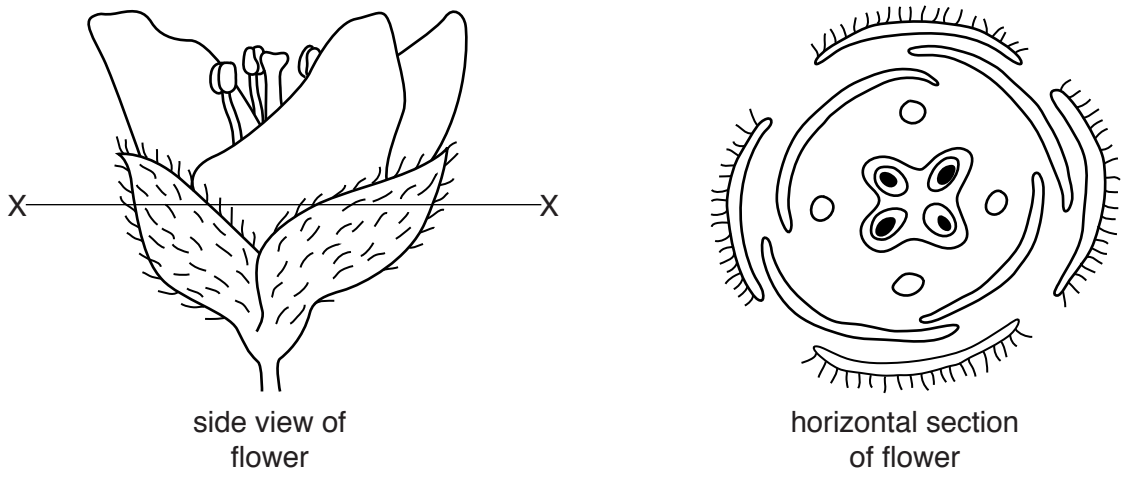


Fig. 2.1

(i) On the **horizontal** section, label a sepal **and** a stamen. [2]

(ii) State how it will affect the plant if all the stamens are removed from the flower.

.....

.....[1]

(iii) Name the part of the flower that will develop into a seed.

.....[1]

(b) In an experiment, a student incubates seeds at different temperatures on dishes containing cotton wool.

After one week, the student records the percentage of seeds that germinate. Fig. 2.2 shows the results.

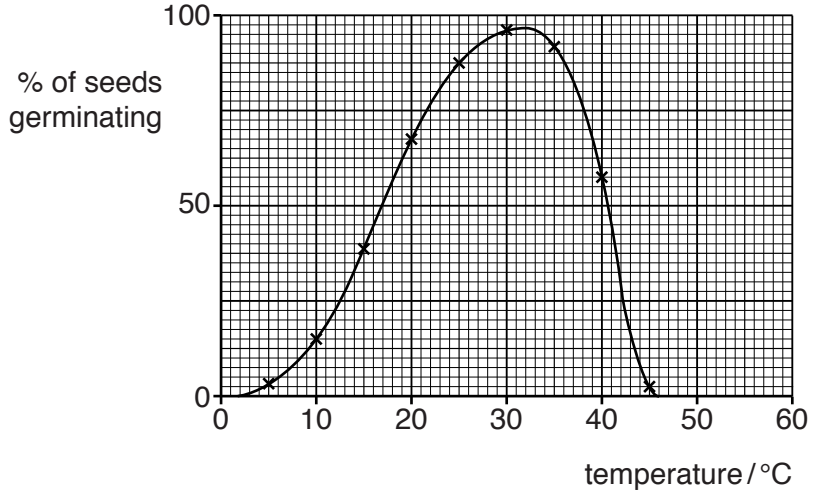


Fig. 2.2

(i) State the optimum temperature for the germination of these seeds.

..... °C [1]

(ii) State **two** conditions that the student would need to provide to ensure that the seeds could germinate when the temperature is right.

1 .....

2 .....
[2]

(iii) Suggest why very few seeds germinate

at 5 °C, ...

.....

at 45 °C. .....

.....
[2]

(iv) Even in perfect environmental conditions for germination, some seeds will not germinate. Suggest a possible reason why.

.....

.....[1]

Please turn over for Question 3.

3 **(a)** In many countries, water for drinking is taken from rivers and lakes.

The water contains insoluble material and microorganisms. It is treated, before being sent to homes.

(i) Name the process that is used to remove insoluble materials.

.....[1]

(ii) Microorganisms are destroyed by treating the water with chlorine.

Suggest the risk to humans if microorganisms are **not** destroyed before water is sent into homes.

.....

.....[1]

(b) Fig. 3.1 shows apparatus used to produce chlorine gas.

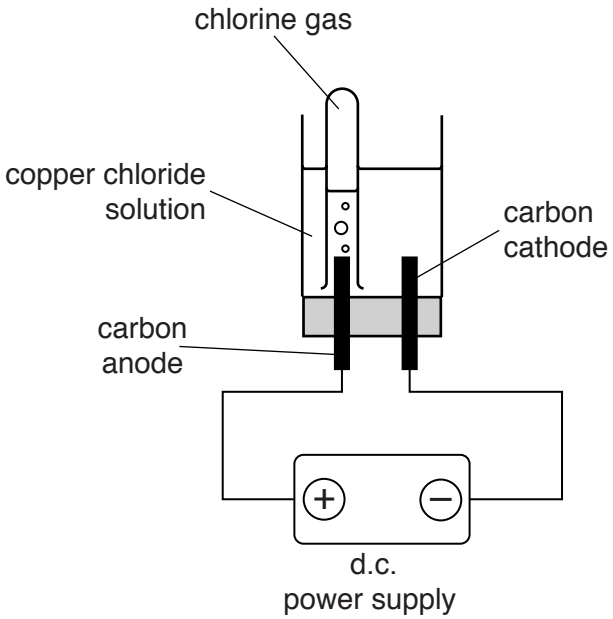


Fig. 3.1

Chlorine gas is produced when an electric current passes through a solution of copper chloride.

(i) Name the process shown in Fig. 3.1.

.....[1]

(ii) Describe a safe chemical test for chlorine and give the positive result.

test .....

result .....

.....
[2]

(iii) Describe how the colour of the cathode changes during the process shown in Fig. 3.1.

.....

.....[1]

(iv) State why there is a change in the appearance of the cathode in Fig. 3.1.

.....[1]

(c) Fig. 3.2 shows chlorine gas being bubbled through a colourless solution of sodium bromide.

The solution in the test-tube becomes orange.

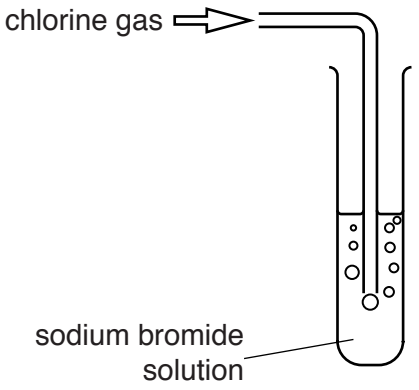


Fig. 3.2

(i) Name the orange substance that is produced.

.....[1]

(ii) Explain why chlorine produces the orange substance when it reacts with sodium bromide.

.....

.....[1]

4 **(a)** Fig. 4.1 shows a graph of the motion of a truck over 40 seconds.

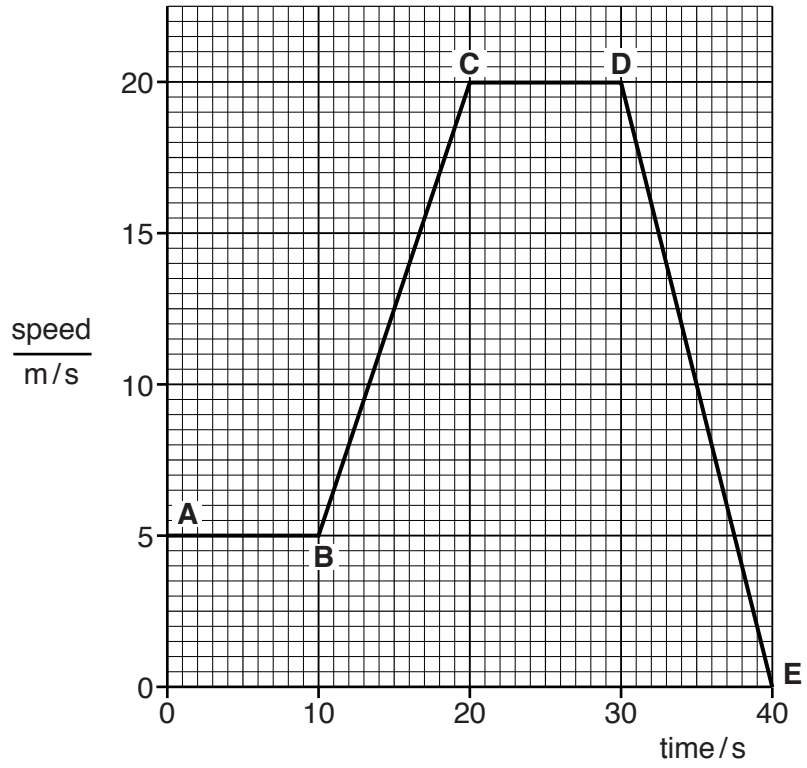


Fig. 4.1

(i) Describe the motion of the truck between **A** and **B**.

.....[1]

(ii) Describe the motion of the truck between **D** and **E**.

.....[1]

(iii) State the speed of the truck at 25 seconds.

..... m/s [1]

(iv) At what point on the graph does the truck stop moving?

..... [1]

(v) Calculate the distance travelled by the truck between **C** and **D**.

Show your working.

distance = ... m [2]

(b) The truck enters a town. The truck brakes to slow down.

(i) On Fig. 4.2, draw one arrow to show the direction of a force acting to slow down the truck. Label the arrow to describe the force acting. [2]

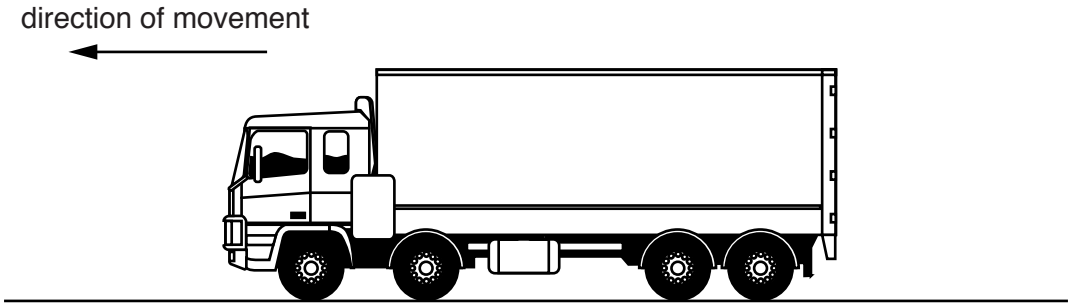


Fig. 4.2

(ii) When the truck slows down it loses kinetic energy.

Suggest what happens to most of this kinetic energy.

.....[1]

5 Fig. 5.1 shows part of the carbon cycle.

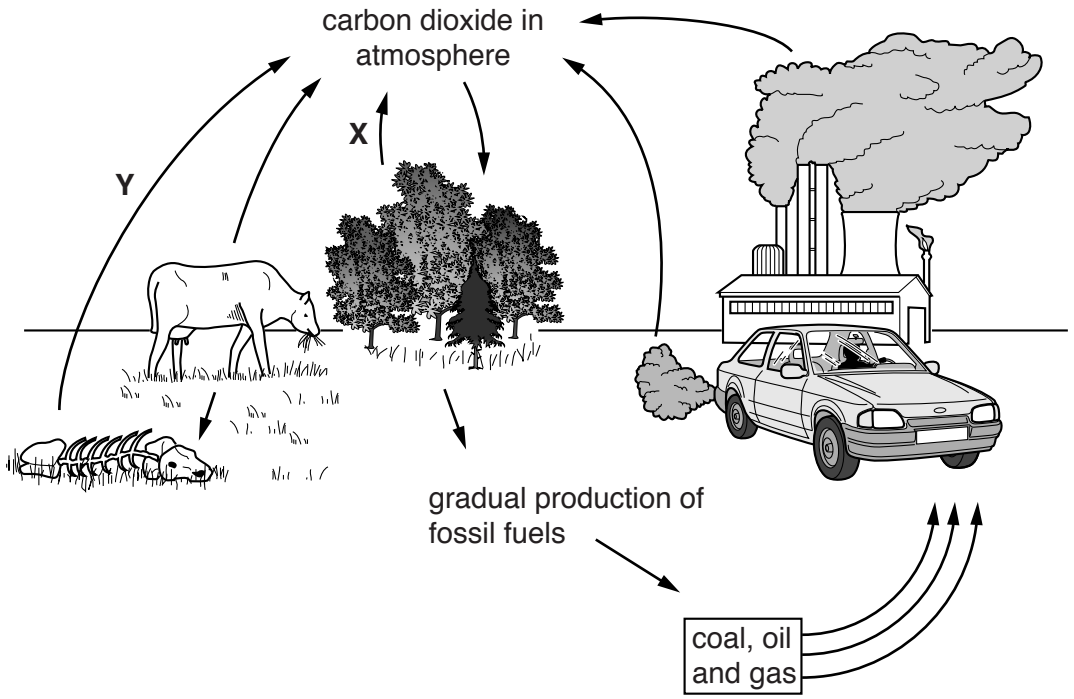


Fig. 5.1

(a) Name the processes labelled **X** and **Y**.

X .....

Y .....
[2]

(b) Describe and explain the effect on the carbon cycle of

(i) deforestation,

.....

.....

.....

.....[3]

(ii) using coal in power stations.

.....

.....[1]

(c) (i) State how energy is **gained** by the ecosystem.

.....

.....[1]

(ii) State how energy is **lost** from the ecosystem.

.....

.....[1]

6 **(a)** **(i)** The elements in the Periodic Table are placed in order of increasing proton number.

Name the part of an atom that contains protons.

.....[1]

(ii) State **two** ways in which an electron differs from a proton.

1 .....

.....

2 .....

.....
[2]

(b) Chlorine, C*l*, is in Group VII of the Periodic Table.

Potassium combines with chlorine in an exothermic reaction to form crystals of potassium chloride.

(i) State the meaning of the word *exothermic*.

.....

.....[1]

(ii) Potassium, K, is in Group I of the Periodic Table.

Describe what happens when a potassium atom changes into a potassium ion. Include the electrical charge of the potassium ion in your answer.

.....

.....

.....

.....[3]

(c) The graph in Fig. 6.1 shows the maximum mass of potassium chloride that dissolves in 100 cm^3 of water at different temperatures.

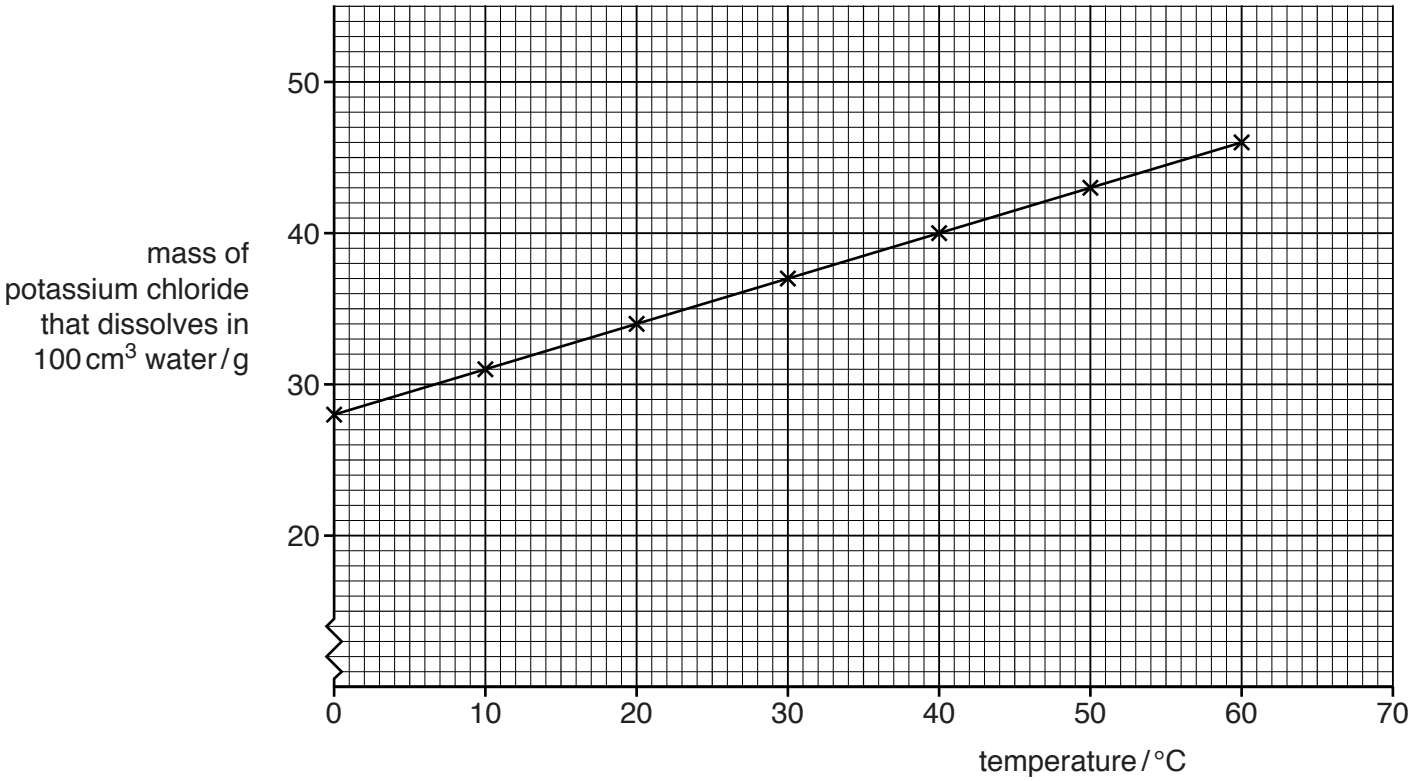


Fig. 6.1

(i) Describe the trend shown in Fig. 6.1.

.....

.....[1]

(ii) Use the graph to estimate the mass of potassium chloride that dissolves in 100 cm^3 of water at 70 °C.

mass = ... g [1]

(iii) Potassium chloride is used to provide potassium (K) in NPK fertilisers.

Name the other **two** important elements that NPK fertiliser provides.

1 .....

2 .....

[1]

(iv) Explain why it is important to crops that potassium chloride is soluble in water.

.....

.....[1]

7 **(a)** Below is a list of materials.

aluminium **copper** **glass** **iron** **plastic**

From the list choose **one** material to match each description below.

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

- It can be charged by rubbing with a cloth. .....
- It can be used to make a magnet. .....
- It can be used to make a lens. .....
- It is used as the conductor in electric cables. .....
- It is a good conductor of heat. .....
- It is used as an electrical insulator around electric cables. .....

[3]

(b) One nuclide of iron is represented in nuclide notation as $^{54}_{26}Fe$.

For one neutral atom of $^{54}_{26}Fe$, state

(i) its nucleon number, ... [1]

(ii) the number of neutrons, ... [1]

(iii) the number of electrons. ..... [1]

(c) Iron has a melting point of 1538 °C.

State the meaning of the term *melting point*.

.....

.....[1]

(d) Iron is an example of a solid at room temperature.

The three diagrams **A**, **B** and **C**, in Fig. 7.1, show the different arrangements of particles in the three states of matter.

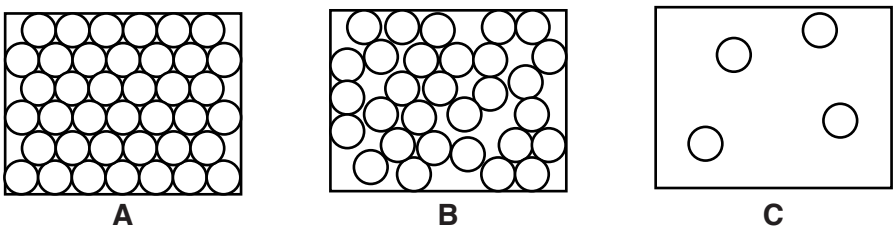


Fig. 7.1

Use the correct letter **A**, **B** or **C** from Fig. 7.1 to fill in the blank and complete the statement to explain your choice.

Diagram ..... shows solid iron because the particles .....

.....[1]

(e) A piece of iron has a mass of 39 g and a volume of 4.9 cm^3.

Calculate the density of the piece of iron.

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

formula

working

density = ... unit = ... [3]

8 A balanced diet should contain some fat.

(a) (i) State **one** function of fat in the body.

.....[1]

(ii) List the **six** other components of a balanced diet.

1 .....

2 .....

3 .....

4 .....

5 .....

6 ..... [6]

(b) Fig. 8.1 shows the structure of the human alimentary canal and associated organs.

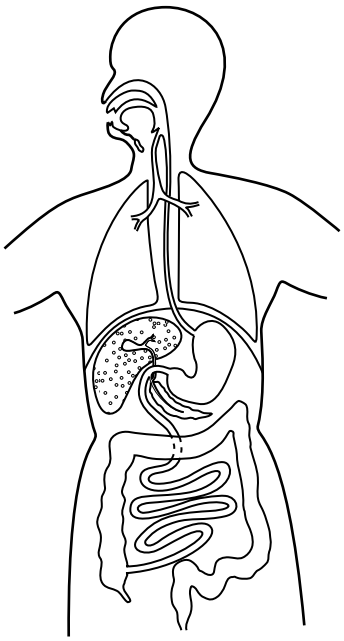


Fig. 8.1

(i) On Fig. 8.1 label, with a line and the letter **G**, a gland that secretes an enzyme for fat digestion. [1]

(ii) Name this enzyme.

.....[1]

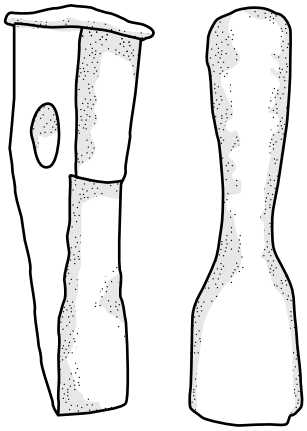
(iii) Name the part of the alimentary canal in which most of the products of fat digestion are absorbed.

.....[1]

9 Ancient civilisations made use of iron which had fallen to Earth in meteorites.

These meteorites contained a mixture of iron and nickel.

meteorite made of a mixture of iron and nickel



ancient metal tools

(a) (i) State the general term for a mixture of metals.

.....[1]

(ii) Suggest **one** advantage of the metal from the meteorite for tool-making compared to pure iron.

.....

.....[1]

(iii) Name the collection of metals in the Periodic Table that contain both iron and nickel.

.....[1]

(iv) State **two** properties that are typical of the collection of metals in **(a)(iii)** that are **not** shared by sodium.

1 .....

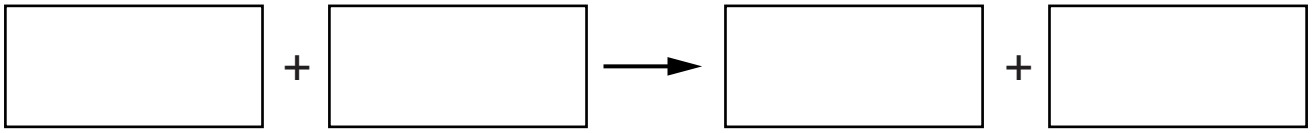
2 .....

[2]

(b) In industry, iron is produced when iron oxide reacts with carbon monoxide.

In this reaction, the carbon monoxide is converted into carbon dioxide.

(i) Construct the word equation for this reaction.



[2]

(ii) State and explain which of the substances in this reaction is **reduced**.

substance reduced .....

explanation .....

.....[1]

(c) Mild steel contains mainly iron and easily rusts.

Fig. 9.1 shows an experiment to investigate the rusting of nails made of mild steel.

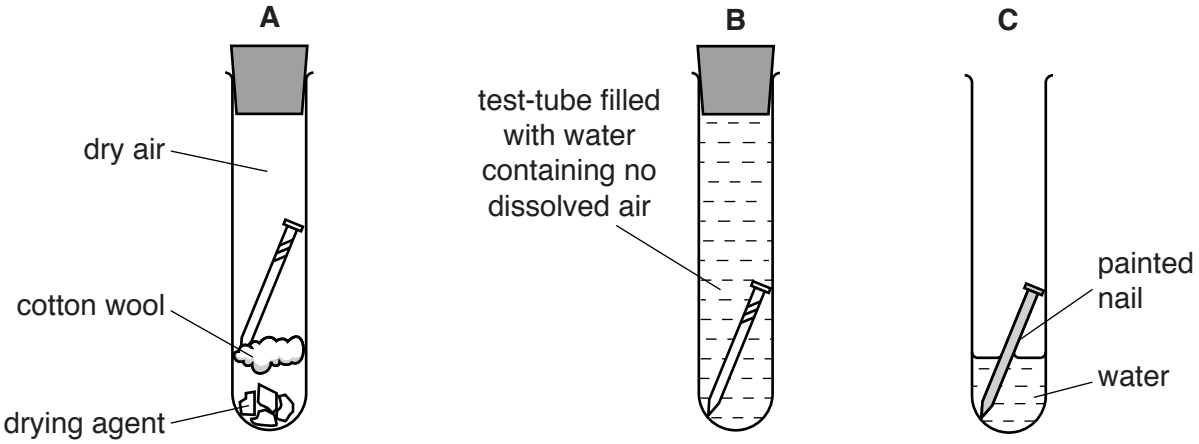


Fig. 9.1

State and explain whether or not each nail in tubes **A**, **B** and **C** rusts.

tube **A** .....

explanation .....

.....

tube **B** .....

explanation .....

.....

tube **C** .....

explanation .....

.....

[3]

10 (a) A school has a corner in a corridor where the students are likely to collide.

To avoid collisions, a plane mirror is placed across the corner. This is shown in Fig. 10.1.

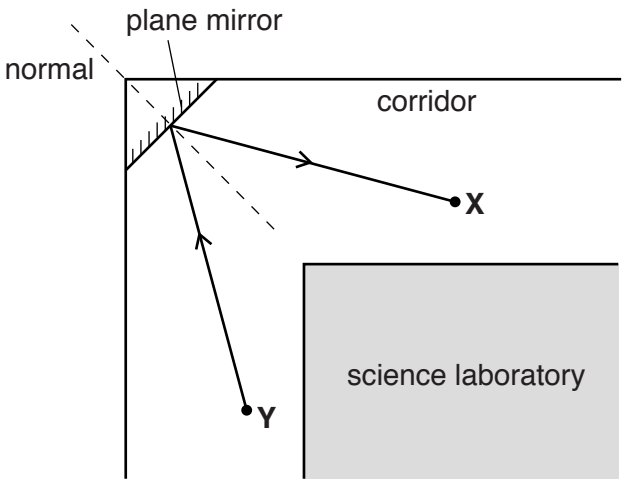


Fig. 10.1

Student **X** is able to see student **Y** around the corner by using the mirror.

(i) On Fig. 10.1, label the angle of incidence of the ray of light with an ***i***. [1]

(ii) The angle of incidence is 30°. State the value of the angle of reflection.

..... ° [1]

(iii) At the corner, student **X** sees her own image in the mirror.

Select **two** words or phrases from the list below that describe her image correctly.

larger than object **real** **same size as object**

smaller than object **upright** **upside down** **virtual**

1 .....

2 .....

[1]

(b) In the school science laboratory, a student builds an electric circuit.

Fig. 10.2 shows a circuit diagram for the circuit.

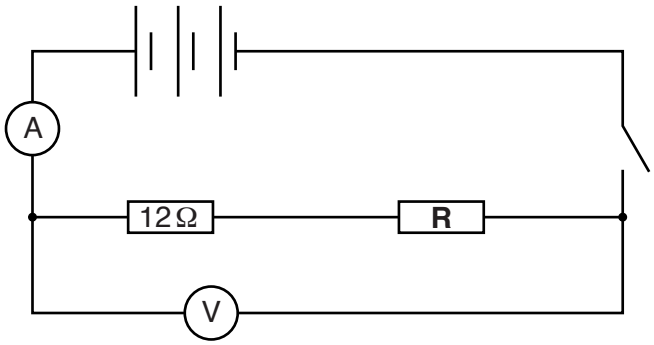
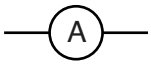


Fig. 10.2

(i) Name the instrument represented by the symbol:



.....[1]

(ii) The reading on instrument  is 0.30 A and on instrument  is 6 V.

Calculate the value of resistance **R**.

State any formula you use and show your working.

formula

working

resistance = ... Ω [3]

(iii) One of the resistors is replaced by a variable resistor.

Draw the symbol for a variable resistor.

[1]

11 Mice usually have brown fur, but some mice have white fur due to the presence of recessive alleles for white.

(a) Using **F** for the dominant alleles and **f** for the recessive alleles, state **all** the possible genotypes of

(i) a brown mouse, ...[1]

(ii) a white mouse. .....[1]

(b) The length of the fur in mice is also genetically determined. Short fur is dominant to long fur.

(i) Complete the genetic diagram to show the result of crossing two heterozygous mice with short fur. Include **both** genotypes **and** phenotypes for the offspring and state the ratio of the phenotypes.

parents

phenotypes	short fur	short fur
genotypes	**Hh**	**Hh**
gametes	....	....

offspring

		male gametes	
		.....	.....
female gametes	.....	....	....
	.....	....	....

ratio of phenotypes ..... : ..... [4]

(ii) Explain why the offspring of two mice with long fur will always have long fur.

.....

.....

.....[2]

12 Alkanes and alkenes are two families of compounds that contain carbon.

(a) Both alkanes and alkenes produce carbon dioxide when they burn in air.

(i) Name **one** other substance that may be produced when alkanes and alkenes burn.

.....[1]

(ii) Name a liquid mixture, containing mainly alkanes, that is used as fuel for cars.

.....[1]

(iii) Name the process that is used in the chemical industry to convert alkanes into alkenes.

.....[1]

(b) Fig. 12.1 shows diagrams to represent the molecules of the different gaseous carbon compounds contained in three gas cylinders **J**, **K** and **L**.

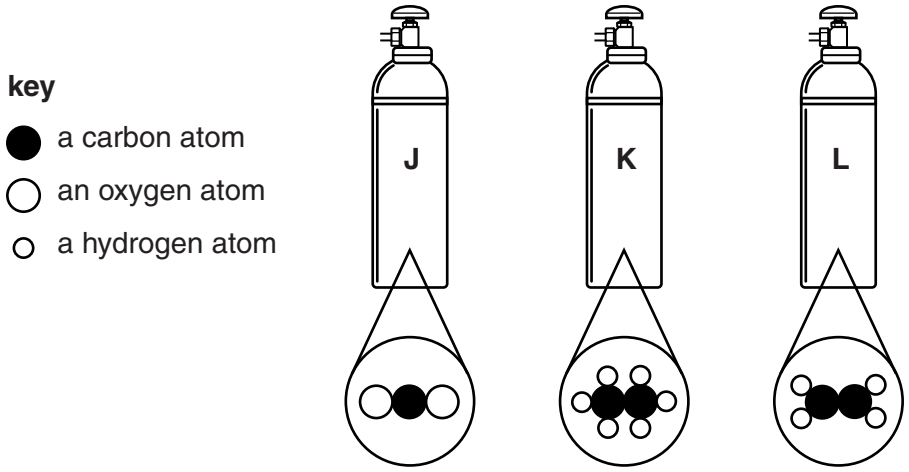


Fig. 12.1

(i) State and explain which cylinder contains a gas that reacts with limewater to form a white precipitate.

container .....

explanation .....

.....[1]

(ii) State and explain which cylinder contains molecules of ethane.

container .....

explanation .....

.....[1]

(c) Ethene molecules can be made to react with each other when heated at high pressure. When they react under these conditions they form a polymer.

(i) Describe what happens to the ethene molecules when they form a polymer.

.....

.....[1]

(ii) Name the substance that is produced when ethene forms a polymer.

.....[1]

(d) Sodium reacts with substances in the air.

A piece of sodium is protected by placing it in a liquid.

State and explain in which bottle, **M** or **N**, shown in Fig. 12.2, the sodium is placed.

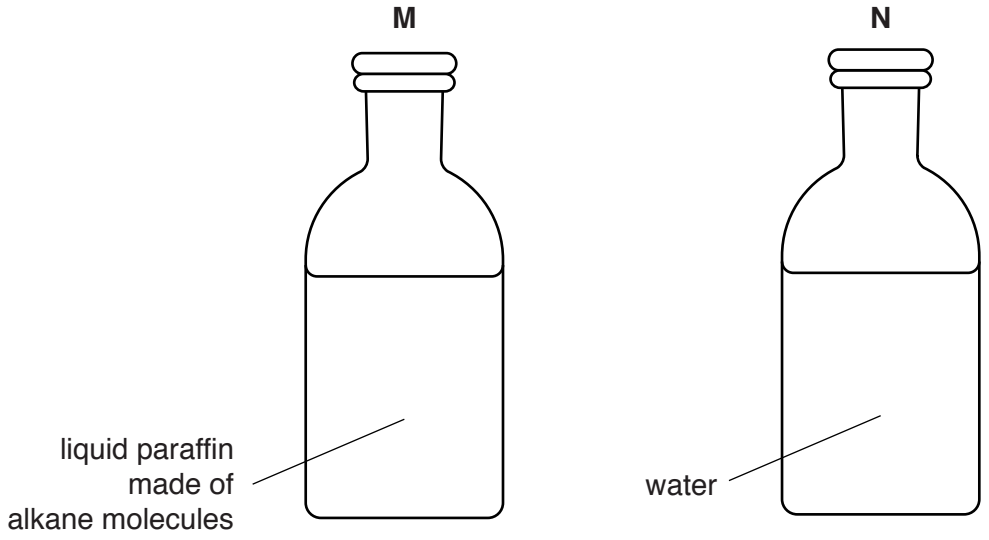


Fig. 12.2

bottle .....

explanation .....

.....

[2]

13 Fig. 13.1 shows part of a transverse section of a leaf, as seen through a microscope.

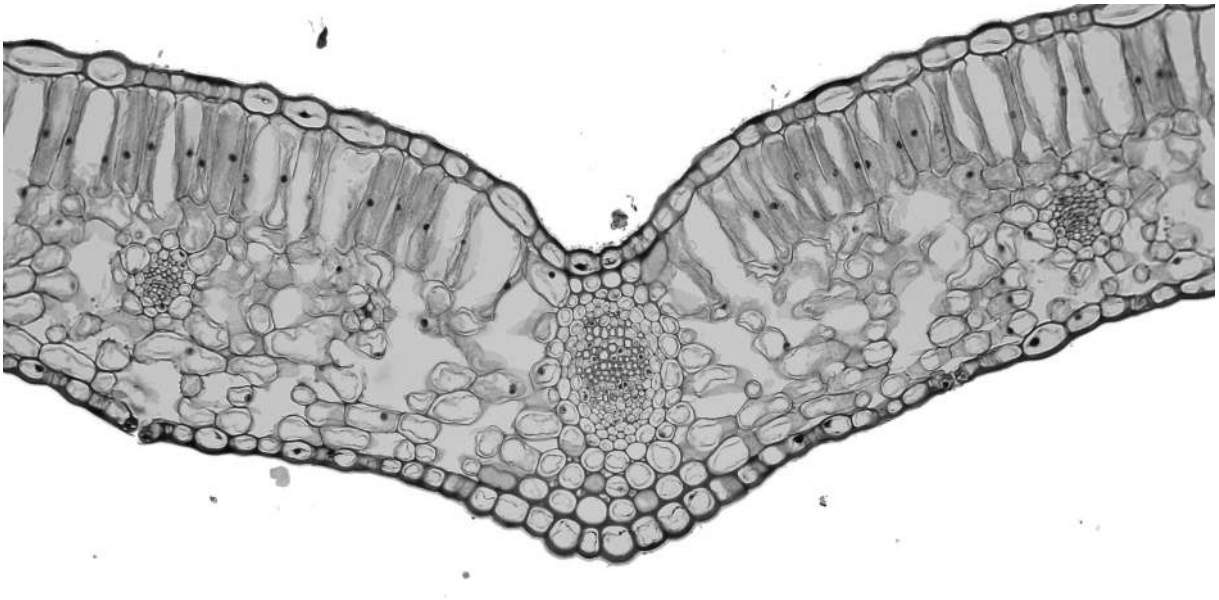


Fig. 13.1

In this leaf, name

(a) a tissue where photosynthesis occurs,

.....[1]

(b) **two** tissues specialised for transport,

1 .....

2 .....
[2]

(c) a place where water loss occurs from the leaf.

.....[1]

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		**Key** atomic number atomic symbol name relative atomic mass									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 117	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 Cr copernicium –		114 Fl flerovium –		116 Lv livermorium –		

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.)