Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

2241060655

CO-ORDINATED SCIENCES **0654/31**

Paper 3 (Extended) **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 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.

CAMBRIDGE International Examinations

[Turn over

1 Fig. 1.1 shows a house.

Fig. 1.1

In the garden of the house there is a wind turbine.

(a) The house is painted white. Suggest why houses are often painted white in hot countries.

.....

.....[1]

(b) The wind turbine generates electricity.

State the main energy transformation in the wind turbine.

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

(c) There are solar panels on the roof of the house. Energy from the Sun heats 4 kg of water in the panels.

The energy falling on the solar panels is 400 000 J.

(i) The efficiency of the solar panels is 15%.

Calculate the thermal energy gained by the water.

thermal energy gained = ... J [2]

(ii) Calculate the temperature rise in the 4 kg of water heated in the solar panels.

The specific heat capacity of water is 4200 J/kg °C.

State the formula you use and show your working.

formula

working

increase in temperature = ... °C [2]

(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) Visible light from the Sun is part of the electromagnetic spectrum.

(i) Place visible light in the correct position in the incomplete electromagnetic spectrum below.

	X-rays			infra-red		radio waves

[1]

(ii) State the speed at which all electromagnetic waves travel.

speed = ... m/s [1]

(f) The household circuits use alternating current.

Fig. 1.2 shows the graph of current against time.

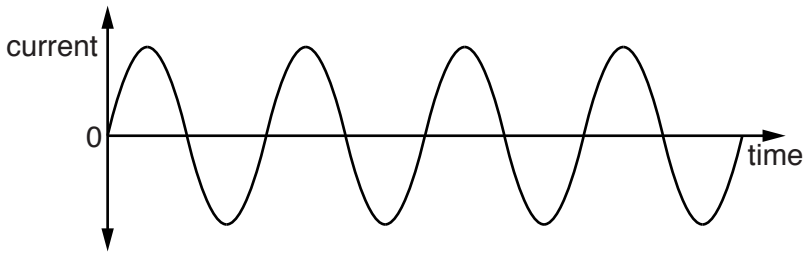


Fig. 1.2

On Fig. 1.2, use a double headed arrow (◄►) to indicate the amplitude. [1]

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.

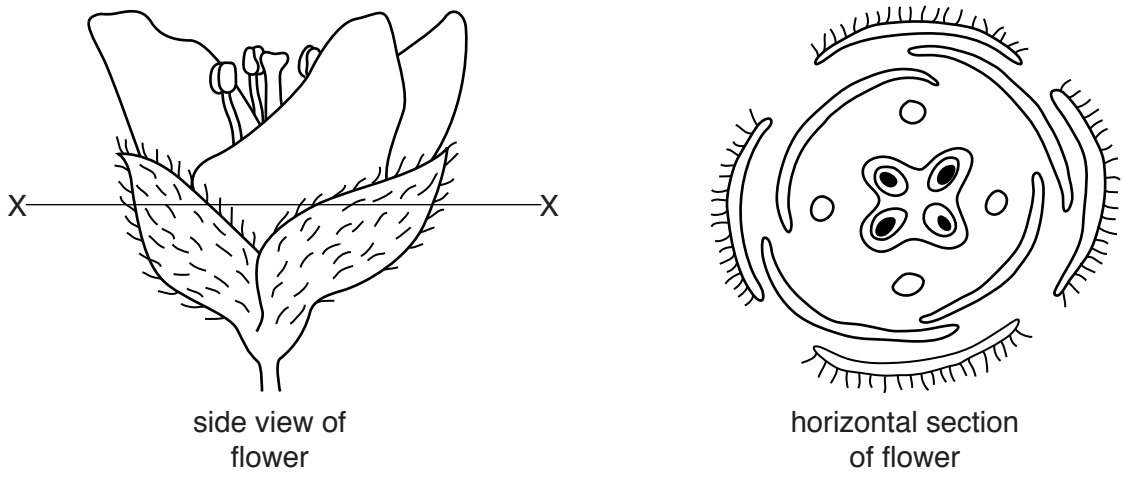


Fig. 2.1

(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) This flower is pollinated by insects.

State **two** features, visible in Fig. 2.1, that show it is an insect-pollinated flower.

1 .....

2 .....
[2]

(b) Fig. 2.2 shows a fruit from a maple tree.

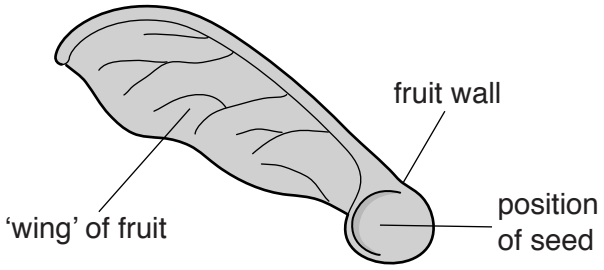


Fig. 2.2

A student observed the fruits that fell from a maple tree. He measured the horizontal distance from the tree to the place where each fruit landed.

Fig. 2.3 shows the student's results.

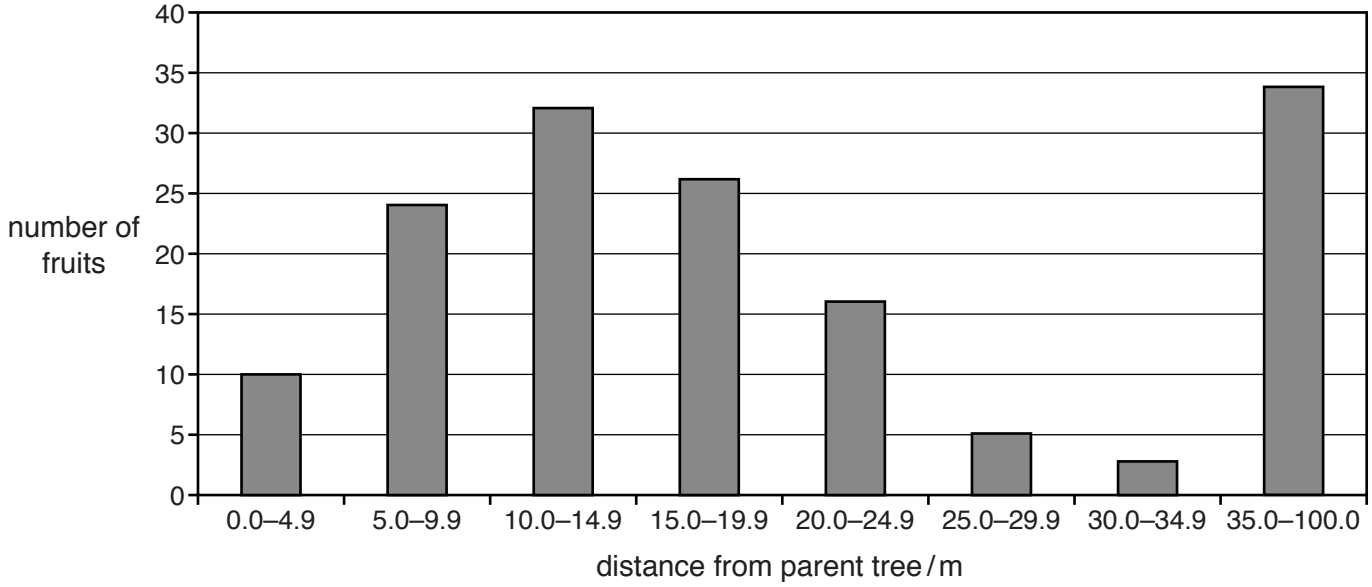


Fig. 2.3

(i) State the number of fruits that landed less than 10 m from the parent tree.

.....[1]

(ii) Fig. 2.3 shows the eight different distance ranges chosen by the student. State the distance range within which the most fruits landed.

.....[1]

(iii) Suggest why so many fruits landed within this distance range.

.....

.....[1]

(iv) State **two** advantages for the maple tree of the seeds inside its fruits being dispersed away from the parent tree.

1 .....

.....

2 .....

.....
[2]

(v) Maple fruits are dispersed by the wind.

State **one** other way in which the fruits or seeds of trees may be dispersed.

.....[1]

(vi) State and explain how you would expect the student's results to have been different if

the tree had been taller,

.....

.....

the weather had been windier.

.....

.....
[2]

(c) Fig. 2.4 shows the outline of the testa of a seed, such as a bean seed.

Inside this outline, draw a plant embryo as it would appear in longitudinal section (with the seed cut lengthways).

On your drawing, label the radicle, plumule and cotyledon.

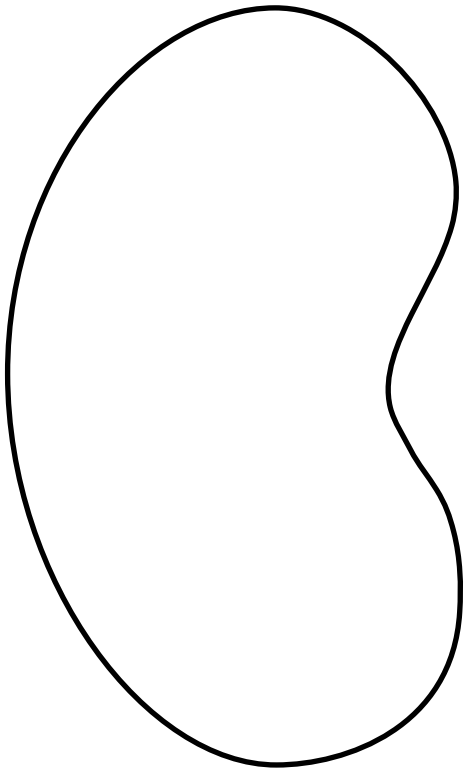


Fig. 2.4

[4]

Please turn over for Question 3.

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

The water contains insoluble materials and microorganisms.

(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.

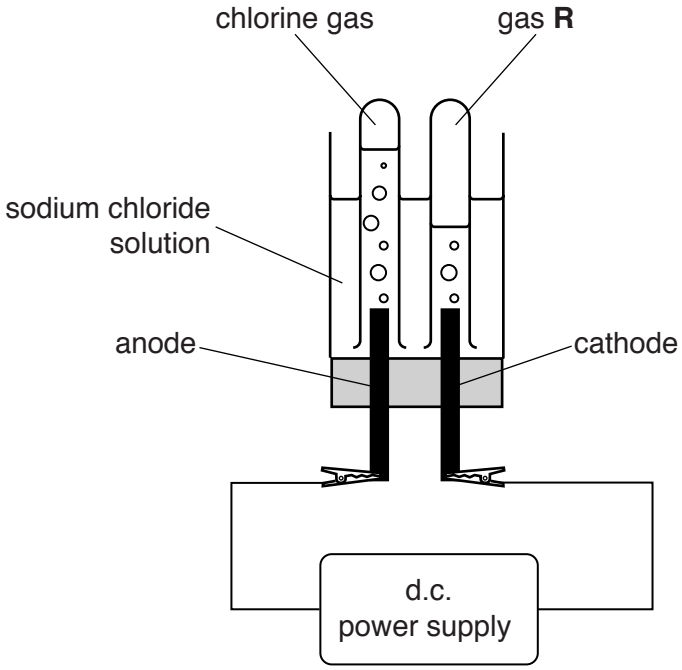


Fig. 3.1

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

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

.....[1]

(ii) Name gas **R**.

.....[1]

(iii) Describe a safe chemical test for chlorine and give the positive result:

.....

.....

.....[2]

(iv) Before it is used to produce chlorine, the solution of sodium chloride in Fig. 3.1 is neutral.

Predict and explain the change in the pH value of the solution during the process.

pH changes from ..... to .....

explanation .....

.....

.....
[2]

(v) Draw a bonding diagram that shows the arrangement of the **outer** electrons in a chlorine molecule.

[2]

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

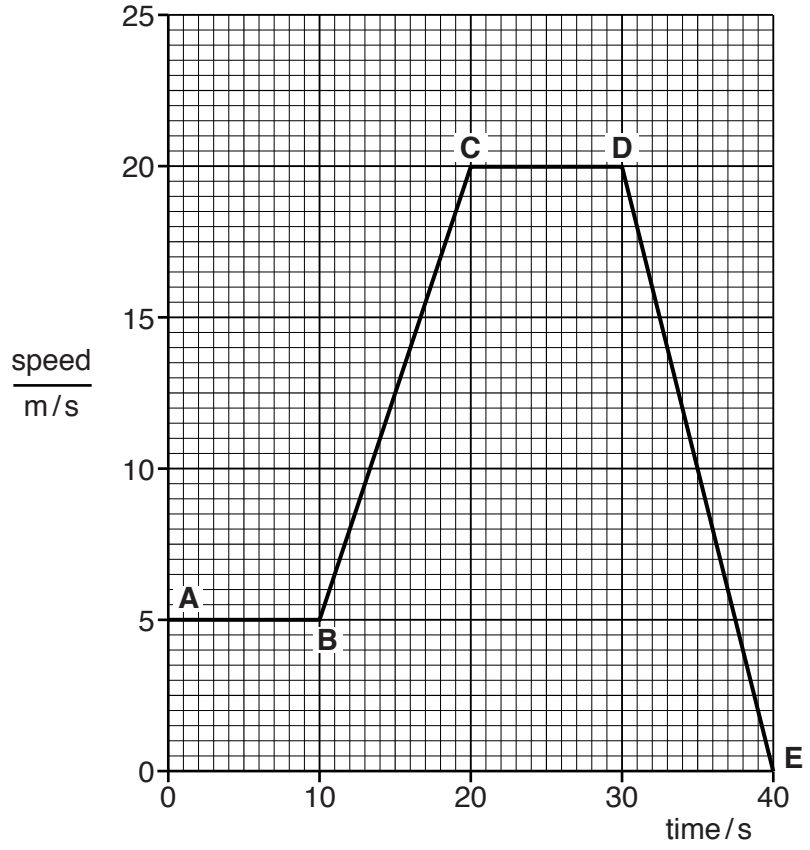


Fig. 4.1

(i) Calculate the acceleration of the truck between **B** and **C**.

Show your working.

acceleration = ... m/s^2 [2]

(ii) The mass of the truck is 2000 kg. Calculate the size of the force needed for the acceleration between **B** and **C**.

State the formula you use and show your working. State the units.

formula

working

force = ... unit = ... [3]

(iii) Calculate the distance travelled by the truck in the time that the speed is decreasing.

Show your working.

distance = ... m [2]

(b) The driver stops the truck. He receives an electric shock when he gets out of the truck.

(i) Suggest why the driver receives an electric shock.

.....

.....

.....

.....[2]

(ii) The shock is caused by a current of 0.004 A passing for 0.1 ms.

Calculate the charge which passes.

State the formula you use and show your working.

formula

working

charge = ... C [2]

5 Fig. 5.1 shows part of the carbon cycle.

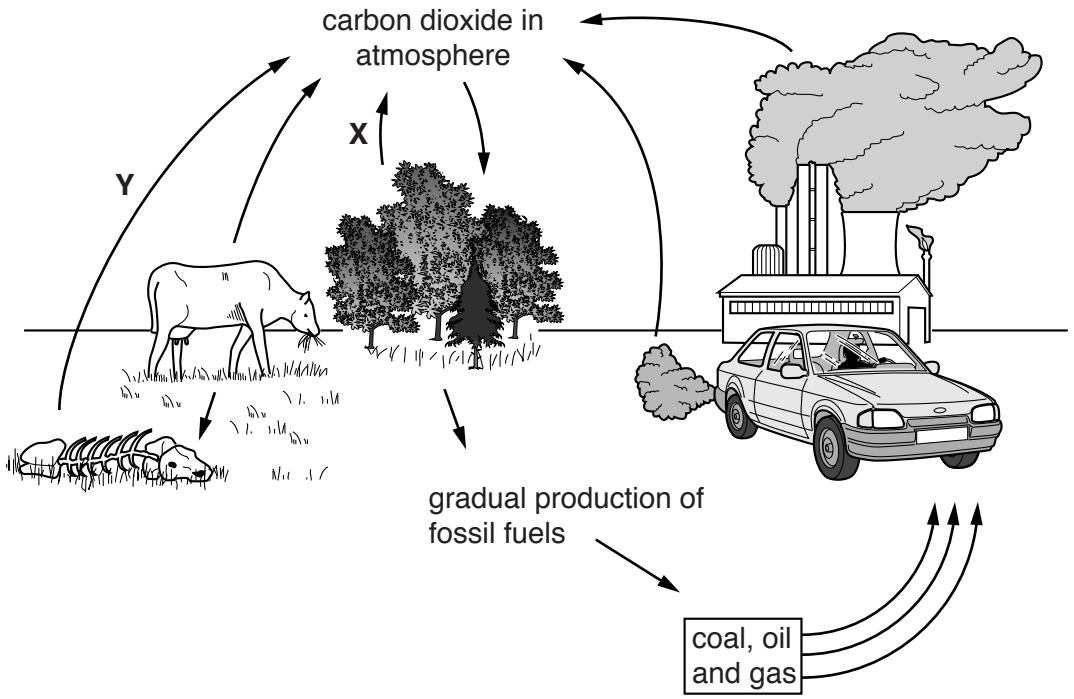


Fig. 5.1

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

X .....

Y .....
[2]

(b) Explain how the following human activities increase the amount of carbon dioxide in the air.

(i) deforestation

.....

.....

.....

.....

.....[3]

(ii) using fuels in power stations

.....

.....[1]

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

Define the term *proton number*.

.....

.....[1]

(ii) State **two** differences between the properties of a proton and an electron.

1 .....

.....

2 .....

.....
[2]

(b) Caesium, Cs, is an element in Group I of the Periodic Table.

Iodine, I, is a halogen in Group VII.

Caesium combines with iodine to form the compound caesium iodide.

(i) State the number of electrons in the outer shells (valence shells) of atoms of these elements.

number of outer shell electrons in caesium .....

number of outer shell electrons in iodine ..... [1]

(ii) Predict the chemical formula for caesium iodide and name the type of bonding involved.

chemical formula .....

type of bonding .....[2]

(iii) Describe how the arrangements of the electrons in the atoms of caesium and iodine change when they combine.

.....

.....

.....[2]

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

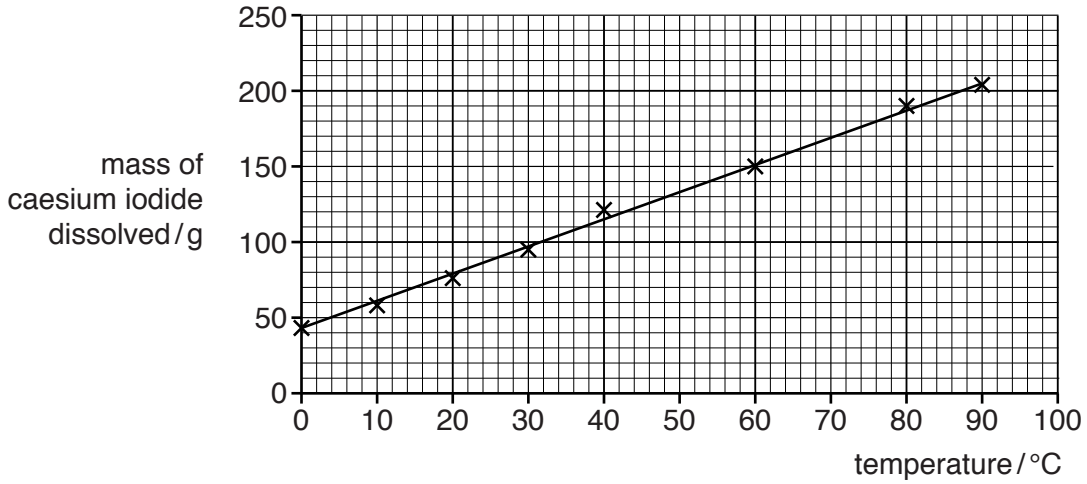


Fig. 6.1

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

.....

.....[1]

(ii) State the mass of caesium iodide that dissolves in 100 cm^3 of water at 48 °C.

mass = ... g [1]

(iii) Calculate the concentration, in mol / dm^3, of the caesium iodide solution at 48 °C.

Show your working.

concentration = ... mol / dm^3 [3]

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 as the core in a transformer. .....
- It can be used to make a lens. .....
- It is used as the conductor in the windings of a transformer. .....

[2]

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

(i) For one neutral atom of $^{54}_{26}Fe$, state its nucleon number.

..... [1]

(ii) Another isotope of iron has two more neutrons in the nucleus.

Use similar notation to that used in **(b)(i)** to represent this nuclide.

..... [1]

(iii) An isotope of iron is radioactive. It has a half-life of 2.73 years.

State what is meant by the term *half-life*.

.....

.....

.....[1]

(c) The boiling point of iron is 2862 °C. Some iron evaporates at a temperature below this.

Describe **one** difference between evaporation and boiling.

.....

.....[1]

(d) Fig. 7.1 shows an iron bar suspended by a string.

A magnet is brought close to the iron bar. The iron bar is attracted to the magnet.

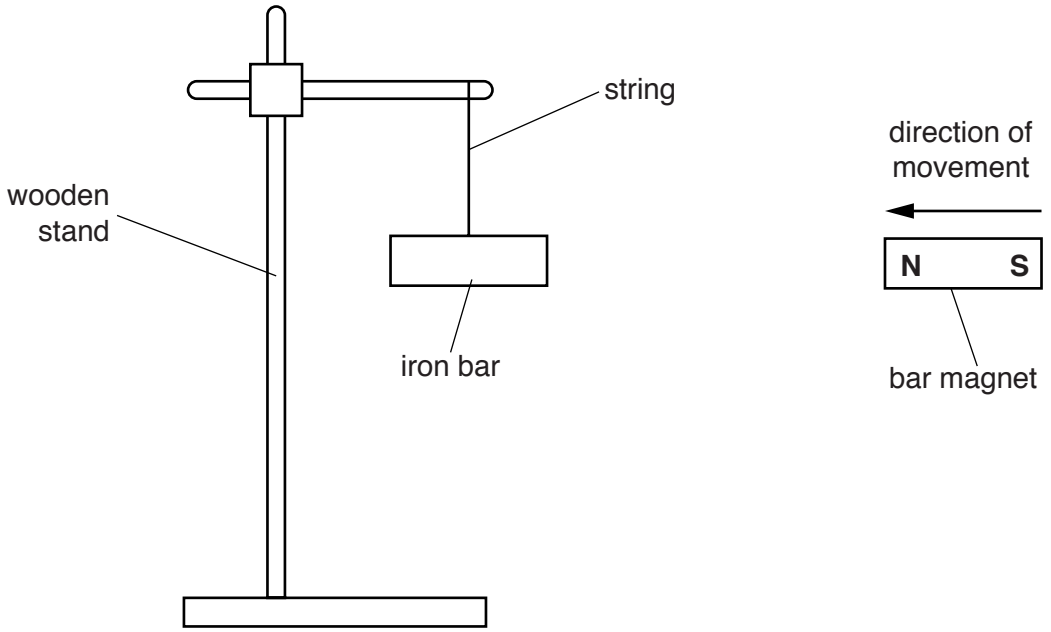


Fig. 7.1

Explain why the iron bar is attracted to the magnet.

.....

.....[1]

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

The three diagrams **A**, **B** and **C** in Fig. 7.2 show the different arrangements of particles in the three states of matter.

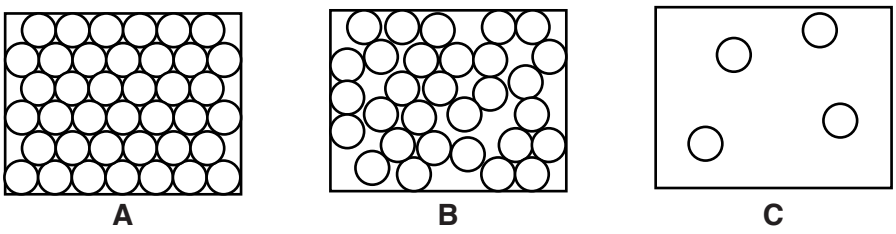


Fig. 7.2

Use the correct letter **A**, **B** or **C** from Fig. 7.2 to fill in the blank and complete the statement to explain your choice.

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

..... [1]

(f) A student is trying to calculate the density of an irregular piece of iron.

To do this he must measure the mass and the volume of the piece of iron.

Describe how the student could measure the **volume** of the piece of iron using a measuring cylinder.

.....

.....

.....

.....

.....[2]

8 **(a)** Too much fat in the diet is a form of malnutrition.

Describe the harmful effects of too much fat in the diet.

.....

.....

.....

.....[3]

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

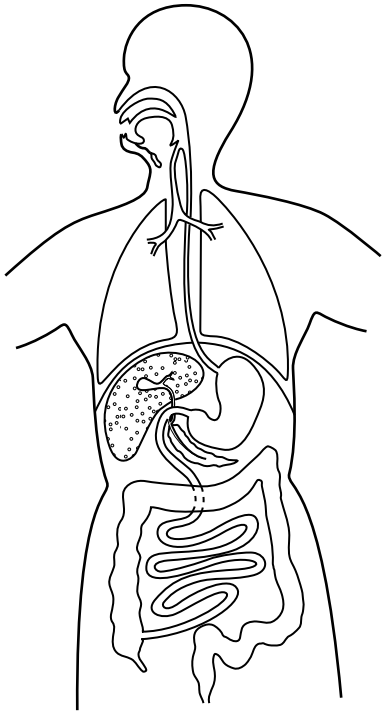


Fig. 8.1

(i) On Fig. 8.1, label a gland that secretes bile. [1]

(ii) Describe the role of bile in fat digestion.

.....

.....

.....[2]

(iii) Describe how the structure of the villi in the small intestine helps in the efficient absorption of fats.

.....

.....

.....[2]

[Turn over

9 Fig. 9.1 shows a meteorite.

Meteorites contain a mixture of iron and nickel.

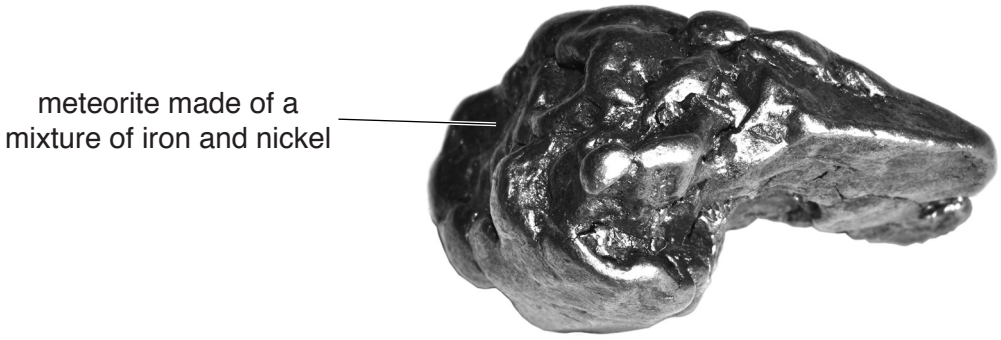


Fig. 9.1

(a) (i) Name the collection of metals in the Periodic Table that contains both iron and nickel.

.....[1]

(ii) State **two** properties that are typical of the collection of metals in **(a)(i)** that are **not** shared by all metals.

1 .....

2 .....
[2]

(iii) Iron will rust in the presence of air and water.

State and explain, in terms of a change in the number of electrons, which particles are **oxidised** when iron rusts.

.....

.....

.....[2]

(iv) Meteorites do not form rust in the presence of air and water.

Suggest a reason for this.

.....

.....[1]

(b) Iron is extracted from iron compounds found in the Earth's crust.

Fig. 9.2 shows a diagram of the industrial extraction of iron.

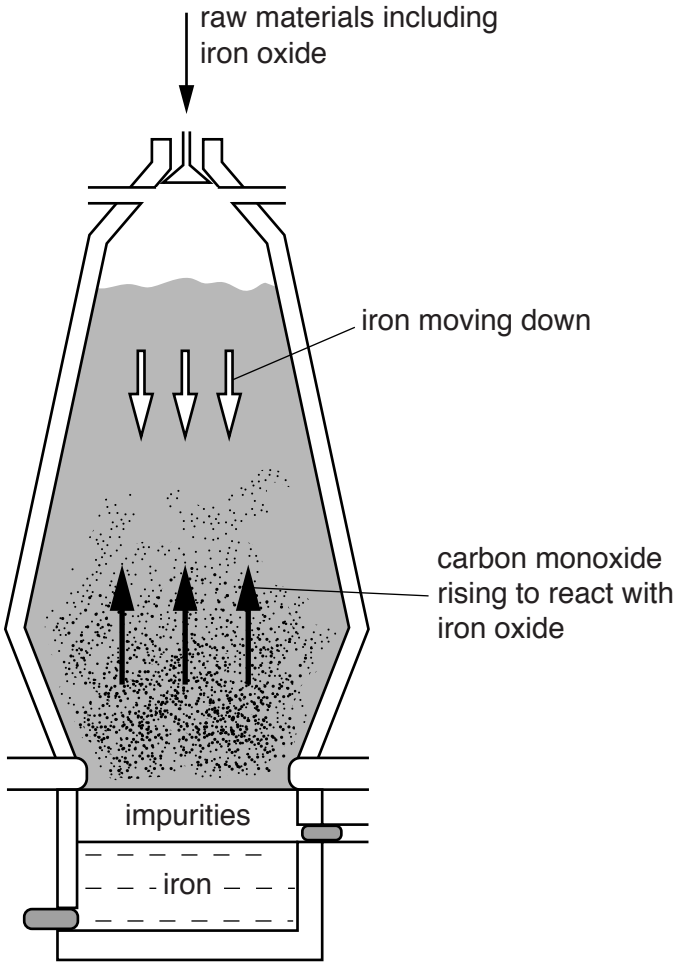


Fig. 9.2

(i) Name the industrial apparatus shown in Fig. 9.2.

.....[1]

(ii) Inside the apparatus, iron oxide, Fe_2O_3, is reduced by carbon monoxide, CO.

Write the balanced equation for this reaction.

.....[2]

[Turn over

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.

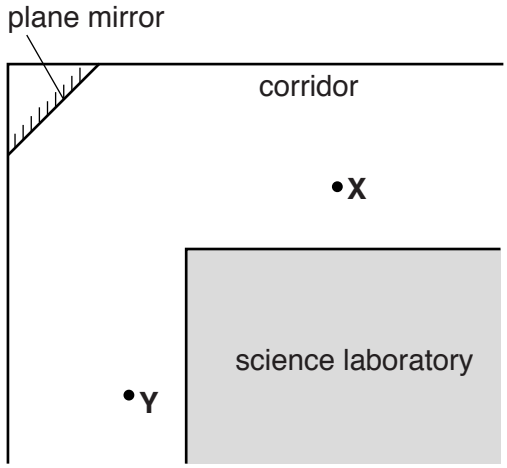


Fig. 10.1

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

(i) On Fig. 10.1, draw a ray of light from student **Y** so that it reflects off the mirror and is seen by student **X**. [1]

(ii) Draw and label the normal. [1]

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

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

Select **three** 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 .....

3 .....
[1]

(b) The corridor is very noisy. Sound waves travel through the air by a series of compressions and rarefactions.

Describe the difference between a compression and a rarefaction.

.....

.....[1]

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

Fig. 10.2 shows a circuit diagram for the circuit.

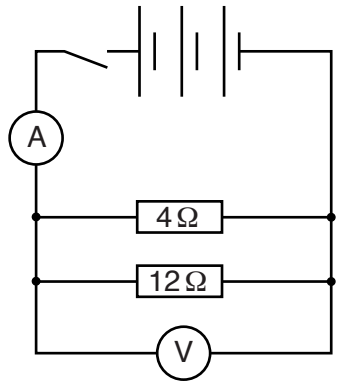
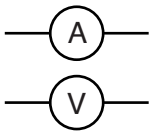


Fig. 10.2

(i) Name the instruments represented by each symbol.



..... A

..... V

[1]

(ii) Calculate the combined resistance of the two resistors.

State the formula you use and show your working.

formula

working

resistance = ... Ω [2]

11 Mice usually have brown fur due to the presence of dominant alleles for brown.

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

.....[1]

(ii) Suggest why some mice have white fur even though the alleles for white are recessive.

.....

.....[1]

(b) It is an advantage for mice to have brown fur rather than white fur.

(i) Suggest why having brown fur would be an advantage.

.....

.....[1]

(ii) Explain why a white mouse is less likely than a brown mouse to pass on its alleles to the next generation.

.....

.....

.....[2]

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

Complete the genetic diagram to show the result of crossing two 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]

12 (a) Fig. 12.1 shows diagrams of the arrangement of atoms in two forms of carbon, **L** and **M**.

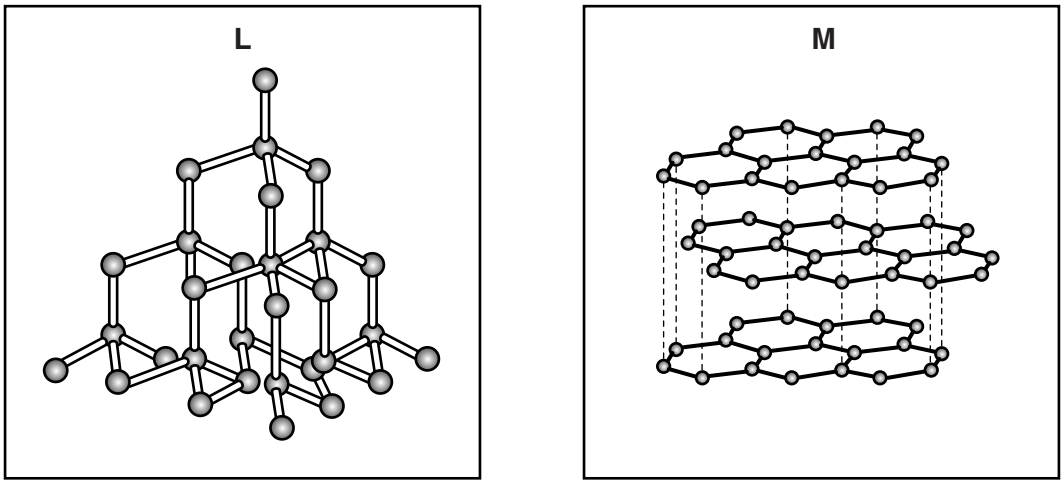


Fig. 12.1

(i) Name the structures of carbon shown in Fig. 12.1.

L .....

M .....
[1]

(ii) Explain, in terms of its atoms, why carbon is an example of an element and **not** a compound.

.....

.....[1]

(iii) Fig. 12.2 shows a pencil line being drawn on paper.

The form of carbon used in pencils has one of the structures shown in Fig. 12.1.

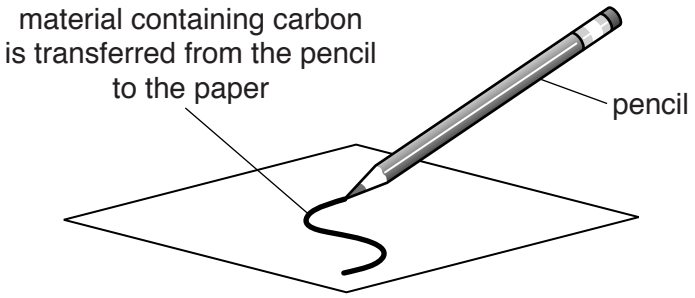


Fig. 12.2

Suggest which form of carbon, **L** or **M** in Fig. 12.1, is used in pencils. .....

Explain how the structure of this substance makes it possible for a pencil to draw a line on paper.

.....

.....

.....

.....

[2]

(b) Charcoal is a solid fuel that contains carbon.

(i) The word equation for the complete combustion of carbon is shown.

$$\underset{\text{(reactants)}}{\text{carbon + oxygen}} \longrightarrow \underset{\text{(product)}}{\text{carbon dioxide}}$$

Suggest and explain whether the reactants or the product possess the larger amount of chemical potential energy.

.....

.....

.....[2]

(ii) Explain, in terms of collisions involving molecules, why powdered charcoal burns more quickly than large pieces of charcoal.

.....

.....

.....

.....[2]

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The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	VIII
				Key			1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9			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.)