Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

4349173261

CO-ORDINATED SCIENCES **0654/42**

Paper 4 (Extended) **May/June 2017**

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 represents a diagram of the human circulatory system.

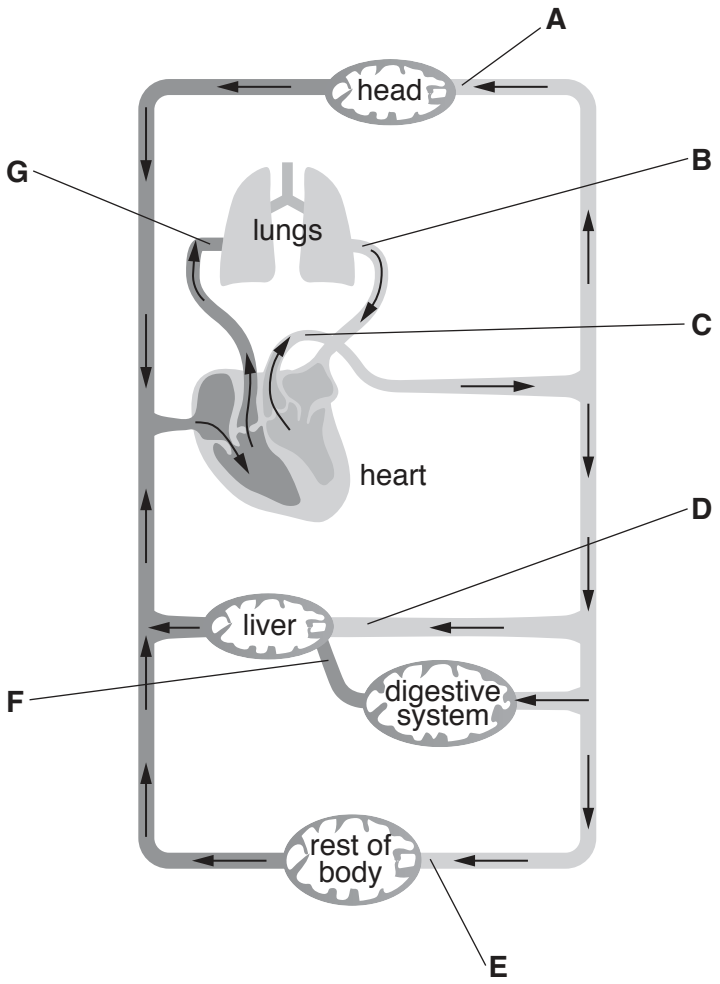


Fig. 1.1 Not drawn to scale

(a) The human circulatory system can be described as a double circulatory system.

Describe what is meant by *double circulation*.

.....

.....

.....[2]

(b) State the letter in Fig. 1.1 which identifies the blood vessel where

oxygen concentration of the blood is highest, ...

carbon dioxide concentration of the blood is highest, ...

blood pressure is highest, ...

glucose concentration is highest. .....

[4]

(c) (i) Name the blood vessels which become blocked when suffering from coronary heart disease.

.....[1]

(ii) A person has a family history of coronary heart disease.

State **two** lifestyle recommendations to reduce the chances of the person developing coronary heart disease.

1 .....

2 .....
[2]

2 Fig. 2.1 shows the electronic structures of atoms of four elements, **A**, **B**, **C** and **D**. These letters are not the chemical symbols of the elements.

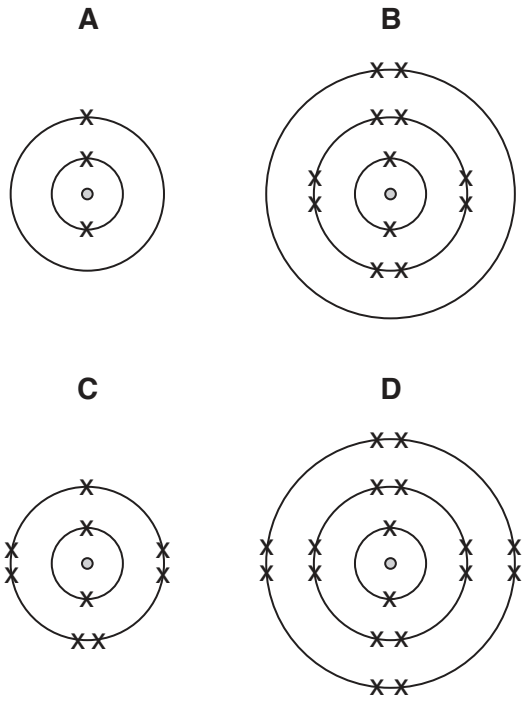


Fig. 2.1

(a) (i) State the letters of the elements that are good conductors of electricity.

Use the information in Fig. 2.1 to explain your answer.

elements .....

explanation .....

.....

[3]

(ii) State the letter of the least reactive element.

Use the information in Fig. 2.1 to explain your answer.

element .....

explanation .....

.....

[2]

(iii) Elements **B** and **C** in Fig. 2.1 react together to form a compound.

State the type of chemical bonding in this compound.

Explain your answer in terms of the type of elements involved.

type of bonding .....

explanation .....

.....

[2]

(b) Bronze is an alloy of copper and tin.

Bronze is harder (less malleable) than either of these two pure metals.

Fig. 2.2 shows the arrangement of atoms in bronze.

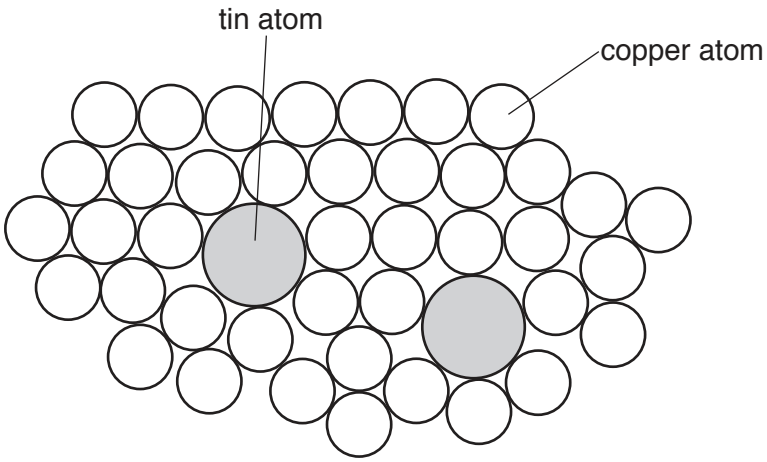


Fig. 2.2

Explain the difference in hardness between bronze and copper.

.....

.....

.....

.....

.....[2]

3 **(a)** A list of metals is shown below.

aluminium copper iron lead uranium

From the list of metals choose **one** to match each description.

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

(i) It may be easily magnetised. .....[1]

(ii) It is used as a fuel in nuclear power stations. .....[1]

(iii) It is used in the core of a transformer. .....[1]

(b) Copper has a boiling point of 2562 °C.

(i) State the meaning of the term *boiling point*.

.....

.....[1]

(ii) When a liquid boils, energy is required but the temperature remains the same.

Explain what is happening in terms of molecules.

Use the term *latent heat* in your answer.

.....

.....

.....

.....[2]

(c) An isotope of copper has a nuclide notation $^{64}_{29}Cu$ and decays by the emission of β-particles to produce an isotope of zinc.

Use the correct nuclide notation to write a symbol equation for this decay process.

$^{64}_{29}Cu \rightarrow$ ..... + ...

[3]

(d) A block of copper has a mass of 44.8 g and a volume of 5.0 cm^3.

(i) Calculate the density of the block of copper.

State the formula you use and show your working.

formula

working

density = ... g/cm^3 [2]

(ii) State the weight of the block of copper.

(g = 10 N/kg)

..... N [1]

(iii) The block of copper is resting on a desk. The area of the block in contact with the desk is 0.01 m^2.

Calculate the pressure exerted by the block on the desk.

State the formula you use and show your working.

formula

working

pressure = ... N/m^2 [2]

4 **(a)** The shell colour in crabs has two alleles as shown.

B - the allele for brown colour

b - the allele for red colour

A heterozygous brown crab and a homozygous red crab mated. Complete the genetic diagram to show the ratio of expected phenotypes of the offspring.

parental phenotypes	brown crab	x	red crab
parental genotypes	**Bb**	x	**bb**
parental gametes	....		....

offspring genotypes

....

offspring phenotypes

....

phenotypic ratio ..... brown : ..... red

[4]

(b) A mutation caused some of the red crabs to have a spotted appearance.

(i) Define the term *mutation.*

.....

.....[1]

(ii) The spotted red crabs were able to blend into the rocks on the sea bed more effectively than the other crabs.

Suggest and explain why over time the number of red spotted crabs in the population increased.

.....

.....

.....

.....[2]

5 A student carries out an investigation of the growth of a plant shoot by auxins. Light is shone onto only one side of the shoot for three days. Fig. 5.1 shows the results.

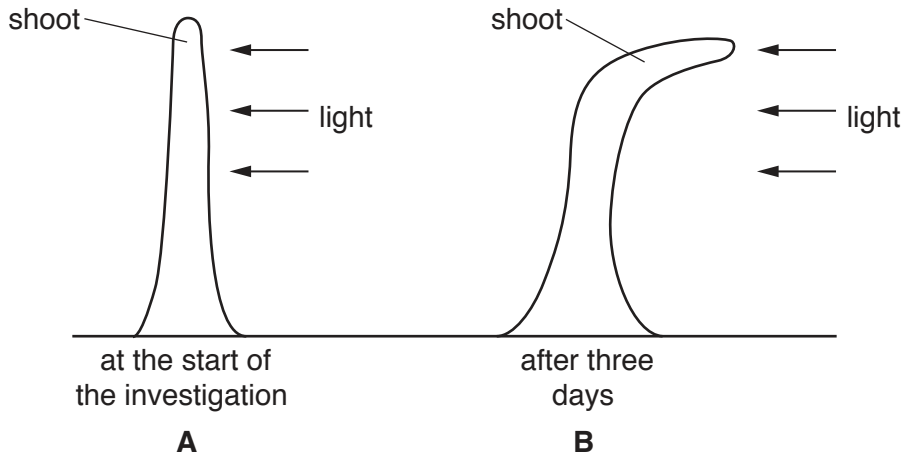


Fig. 5.1

(a) (i) On diagram **B** in Fig. 5.1, shade the area of the shoot that would contain the greatest concentration of auxins. [1]

(ii) State the name of the response shown by the shoot in diagram **B** in Fig. 5.1.

.....[1]

(b) Describe how auxins cause the shoot to bend.

.....

.....

.....[2]

(c) Plants use glucose made during photosynthesis for the growth of the shoots.

Write the balanced **symbol** equation for photosynthesis.

.....[2]

(d) Define the term *growth*.

.....

.....

.....[2]

(e) Describe how glucose is transported from the leaves to the growing shoots.

.....

.....

.....[2]

6 **(a)** Alkanes and alkenes are two homologous series (families) of hydrocarbons.

Alkanes are obtained from petroleum.

Alkenes are produced from alkanes.

(i) Name the processes used to

separate petroleum into alkanes, ...

produce alkenes from alkanes. .....

[2]

(ii) State **two** conditions needed inside the reaction vessel when alkenes are produced from alkanes.

1 .....

2 .....

[2]

(iii) Fig. 6.1 shows the structure of one molecule of ethene.

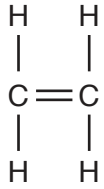
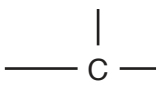


Fig. 6.1

Ethene reacts to form poly(ethene), a solid made of polymer molecules.

Complete the structure of part of a molecule of poly(ethene).

Your diagram should contain four carbon atoms.



[3]

(b) Polymers are used to make paint.

Steel parts of car bodies are painted to prevent rusting.

Fig. 6.2 shows a small area of rust on a car.

Fig. 6.2

(i) Suggest how the small area of rust formed on the car in Fig. 6.2.

Explain your answer in terms of a chemical reaction.

.....

.....

.....[2]

(ii) State the advantage of galvanising rather than painting as a method of preventing rusting.

.....

.....[1]

7 **(a)** A school orchestra is practising.

Table 7.1 shows the highest and lowest sound frequencies of some of the musical instruments in the orchestra.

Table 7.1

instrument	highest frequency / Hz	lowest frequency / Hz
cymbals	900	300
flute	2600	260
guitar	1400	80
piano	4200	30
violin	3500	200

(i) State which instrument can produce the sound with the highest pitch.

Explain your answer.

instrument .....

explanation .....

.....

[2]

(ii) State which instrument can produce the sound with the longest wavelength.

Explain your answer.

instrument .....

explanation .....

.....

[2]

(b) A student is playing an electric guitar. The guitar is connected to an amplifier and two loudspeakers as shown in Fig. 7.1.

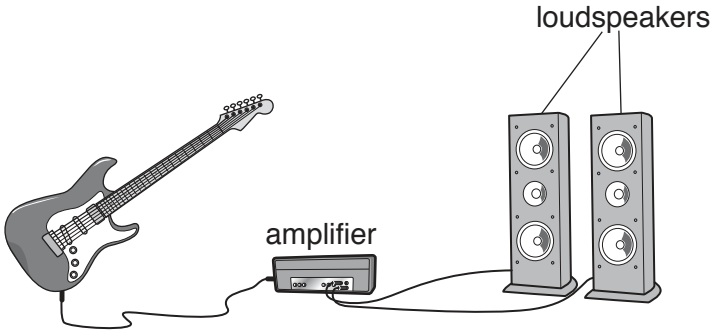


Fig. 7.1

(i) Each loudspeaker has a resistance of 15 Ω.

Calculate the combined resistance of the two loudspeakers when connected in parallel, as shown in Fig. 7.1.

Show your working.

resistance = ... Ω [2]

(ii) The amplifier is fitted with a heat sink. This allows unwanted thermal energy to be transferred away from the amplifier.

A heat sink is shown in Fig. 7.2.

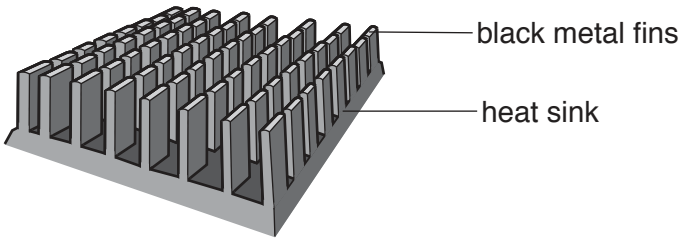


Fig. 7.2

State and explain **two** features of the heat sink that allow thermal energy to be transferred away from the amplifier.

feature 1 .....

explanation .....

.....

feature 2 .....

explanation .....

.....

[2]

8 **(a)** Fig. 8.1 shows a diagram of a grass flower. Grass is an example of a wind-pollinated plant.

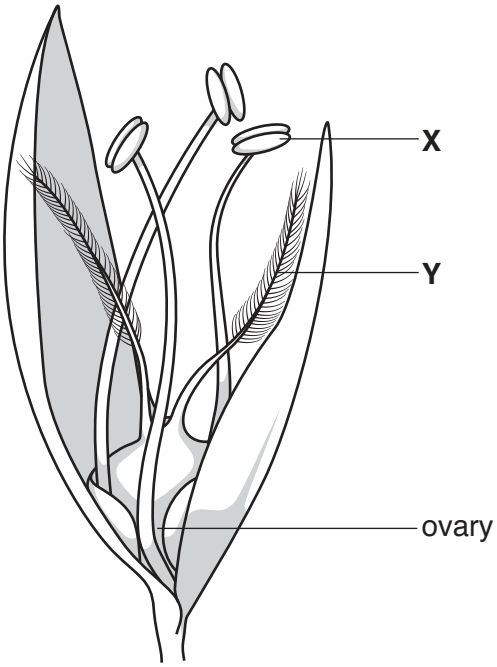


Fig. 8.1

(i) Name the parts of the flower labelled **X** and **Y**.

X .....

Y .....
[2]

(ii) Describe how the following parts of the flower would be different in an insect-pollinated plant.

petals .....

pollen .....
[2]

(b) Pollen is the male sex gamete in plants.

Name the process which produces gametes.

.....[1]

(c) In insect-pollinated plants, pollen is transferred by insects to other plants, which may result in fertilisation. This is an example of sexual reproduction.

State **one** advantage and **one** disadvantage of sexual reproduction.

advantage .....

.....

disadvantage .....

.....

[2]

(d) After sexual reproduction, seeds are produced. Seeds are dispersed so that plants can colonise new areas.

Describe **two** ways in which seeds can be dispersed by animals.

.....

.....

.....[2]

9 Four elements are shown in order of reactivity.

Mg (most reactive)

C

H

Cu (least reactive)

(a) Fig. 9.1 shows two sets of apparatus, **P** and **Q**, that a teacher uses to compare the reactivities of copper and magnesium.

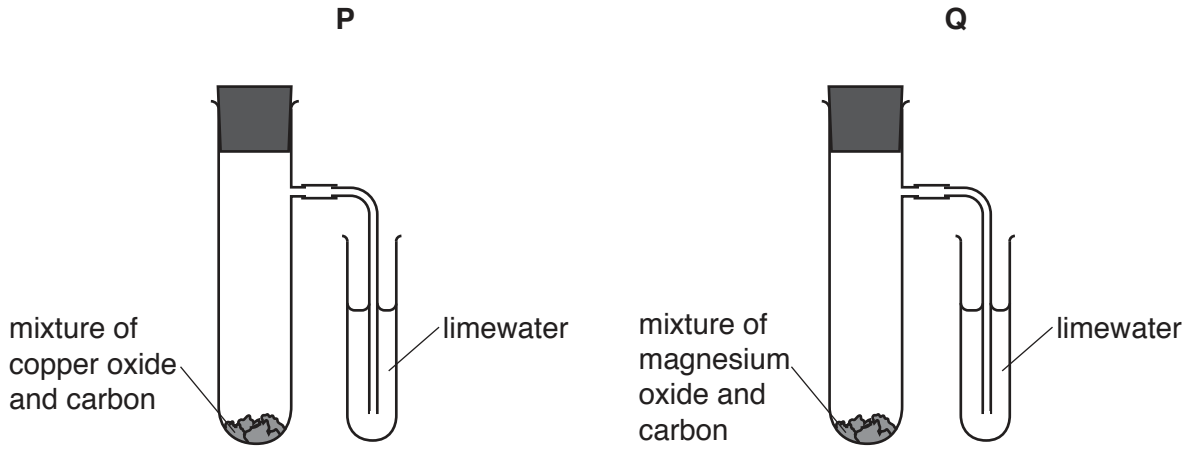


Fig. 9.1

Predict and explain in which apparatus, **P** or **Q**, the limewater becomes milky when each mixture is heated.

apparatus .....

explanation .....

.....

.....

.....

[3]

(b) A student investigates what happens when three solids, magnesium, magnesium carbonate and magnesium oxide, are added separately to dilute hydrochloric acid.

(i) The student records her observations in Table 9.1.

Complete Table 9.1 by writing

- a tick (✓) if you predict that the observation does occur,
- a cross (✗) if you predict the observation does **not** occur.

Table 9.1

solid	observations	
	solid reacts and dissolves	gas given off
magnesium		
magnesium carbonate		
magnesium oxide		

[3]

(ii) Complete the **word** equation for the reaction between dilute hydrochloric acid and copper carbonate.

hydrochloric acid + copper carbonate → ☐ + ☐ + ☐

[2]

(c) Iron combines with chlorine to form only iron chloride.

In a reaction to produce iron chloride, 5.60 g of iron combines with 10.65 g of chlorine.

(i) State the mass of iron chloride that forms.

..... g [1]

(ii) Calculate the numbers of moles of iron atoms and chlorine atoms that combine. Show your working. [A_r : Fe, 56; C*l*, 35.5]

iron

number of moles of iron atoms .....

chlorine

number of moles of chlorine atoms .....

[2]

(iii) Use your answers to **(c)(ii)** to deduce the chemical formula of this iron chloride.

.....[1]

Question 10 starts on page 20.

10 Electrolysis occurs when an electric current passes through an electrolyte.

(a) Explain why an aqueous solution of copper chloride is an electrolyte but copper chloride crystals are **not**.

.....

.....

.....[2]

(b) Table 10.1 shows details of three electrolytes and some of the electrode products that are observed during electrolysis.

Complete Table 10.1 to show the four missing electrode products.

Table 10.1

electrolyte	product at the anode	product at the cathode
aqueous sodium chloride	chlorine	
molten sodium chloride	chlorine	
dilute sulfuric acid		

[3]

(c) Fig. 10.1 shows the electronic structures of two types of chlorine particle, **L** and **M**.

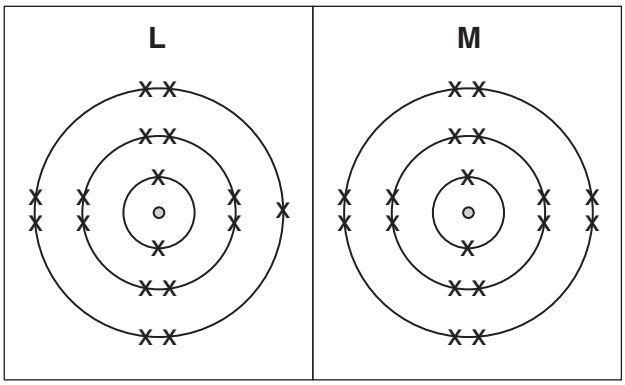


Fig. 10.1

(i) Explain why particles **L** and **M** in Fig. 10.1 have almost the same mass.

.....

.....[1]

(ii) The atomic number of chlorine is 17.

Explain, in terms of charges, why particle **M** is attracted to the anode during electrolysis.

.....

.....

.....[2]

(iii) Draw a dot-and-cross diagram of a chlorine **molecule**.

You should only show the outer shell electrons.

[1]

[Turn over

11 Fig. 11.1 shows an aircraft landing with constant deceleration along an airport runway.

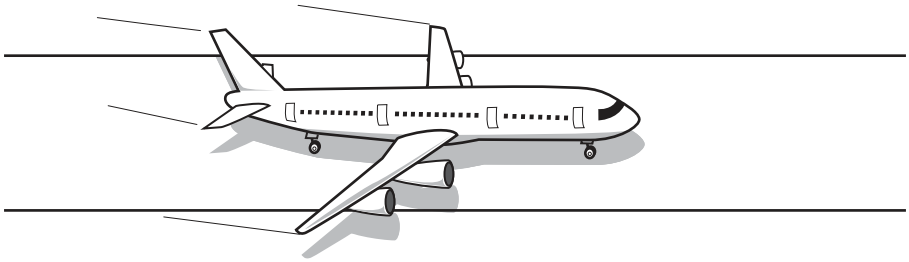
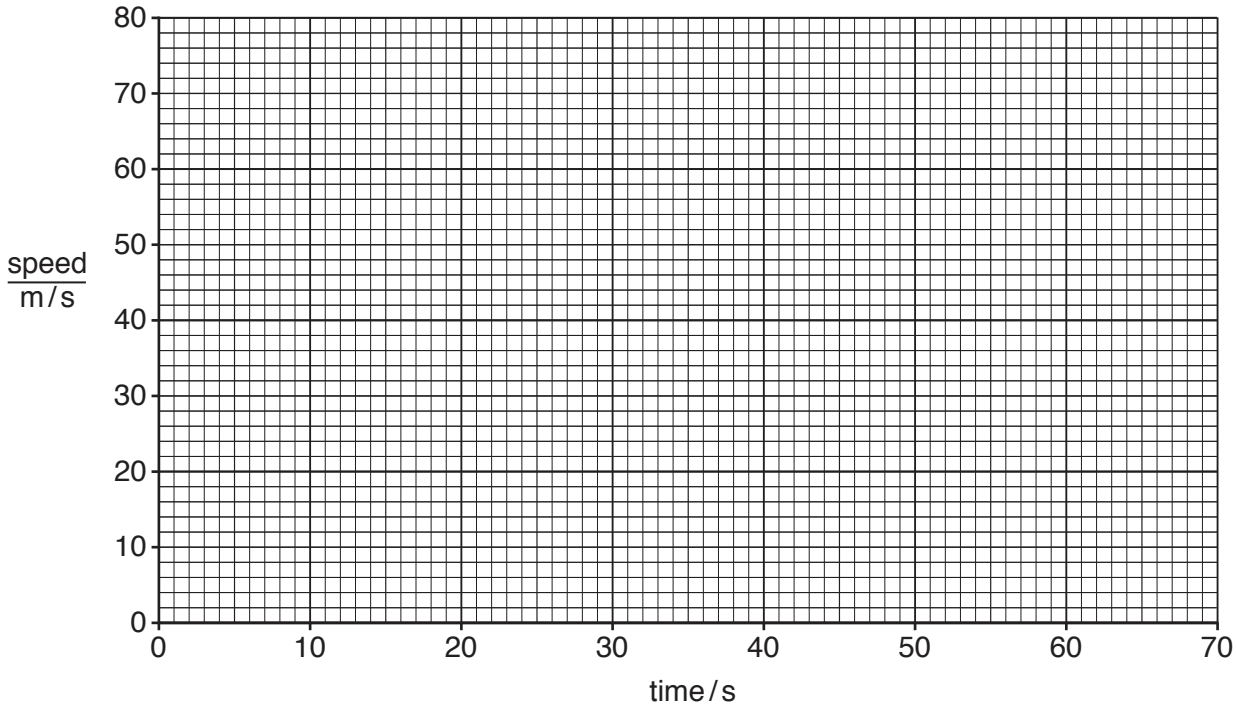


Fig. 11.1

The plane lands at 70 m / s and comes to a halt after 60 seconds.

(a) (i) On the grid provided, draw a speed-time graph to show the motion of the plane during this 60 second period.



[2]

(ii) Calculate the deceleration of the aircraft.

Show your working.

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

(iii) The aircraft has a mass of 350 000 kg.

Calculate the kinetic energy of the aircraft as it lands.

State the formula you use and show your working.

formula

working

kinetic energy = ... J [2]

(b) Microwaves travel at 3×10^8 m/s.

Radar uses microwaves with a frequency of 10 000 MHz to detect the aircraft when it is in flight.

A short pulse is sent from a transmitter, reflected by the aircraft and picked up by a receiver next to the transmitter.

The time it takes for the wave to make the journey to the aircraft and back is 3.3×10^{-5} seconds.

Calculate the distance from the radar transmitter to the aircraft.

State the formula you use and show your working.

formula

working

distance = ... m [3]

12 A student investigates anaerobic respiration in yeast.

He sets up the apparatus as shown in Fig. 12.1. The student measures the volume of carbon dioxide produced by the yeast and sugar mixture.

The investigation is repeated with the yeast and sugar mixture at different temperatures.

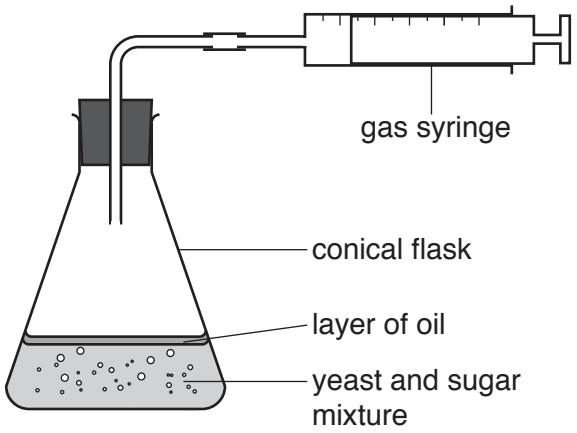


Fig. 12.1

Fig. 12.2 is a graph of the results.

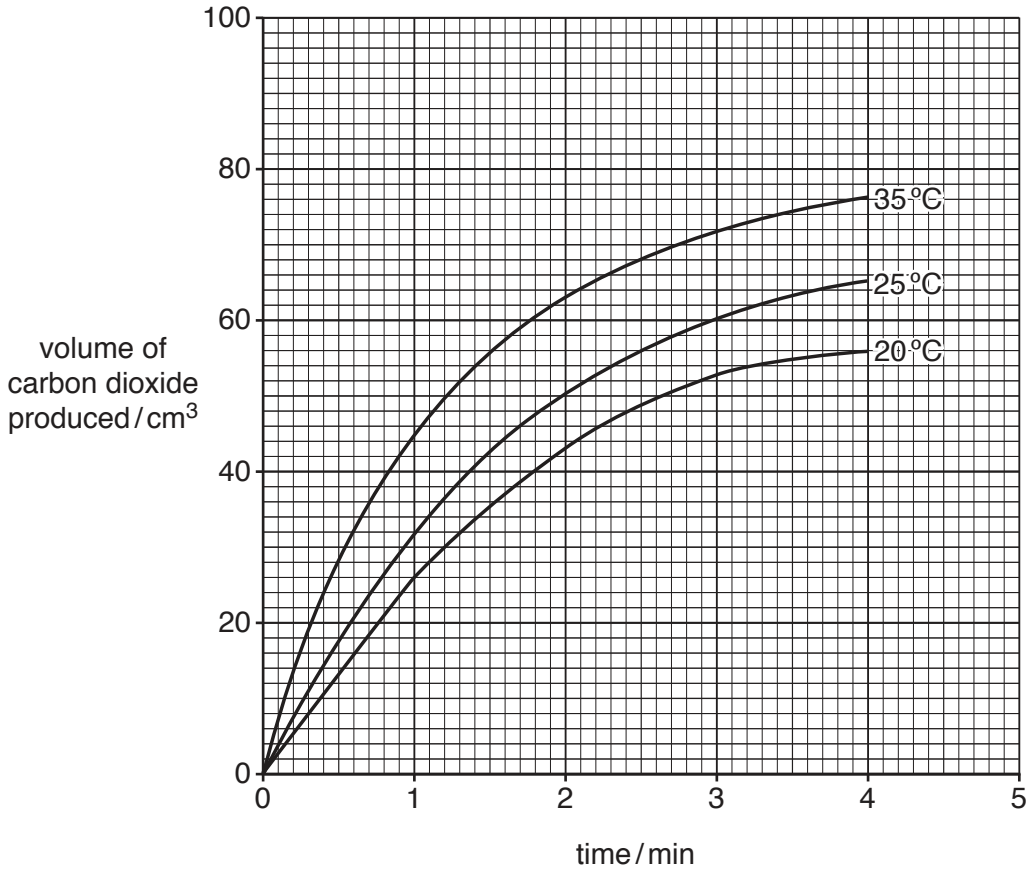


Fig. 12.2

(a) **(i)** Use Fig. 12.2 to predict the volume of carbon dioxide produced in 3 minutes at 30 °C.

..... cm^3 [1]

(ii) No carbon dioxide was produced when the temperature was increased to 60 °C.

Suggest why.

.....

.....[1]

(iii) State **one** modification, apart from changing the temperature, the student could make to his investigation to increase the volume of carbon dioxide produced by the yeast in the first 2 minutes.

.....

.....[1]

(b) Carbon dioxide is produced by the anaerobic respiration of yeast but not by the anaerobic respiration of animals.

State **one** other difference between the anaerobic respiration of yeast and the anaerobic respiration of animals.

.....

.....[1]

(c) Anaerobic respiration in yeast is used commercially in bread making.

Name **one** other commercial use of the anaerobic respiration in yeast.

.....[1]

[Turn over

13 (a) Fig. 13.1 shows information which is on the label attached to a washing machine.

voltage 240 V
frequency 50 Hz
power 2.5 kW

Fig. 13.1

(i) Show that the current in the washing machine when in use is 10.4 A.

State the formula you use and show your working.

formula

working

[2]

(ii) The fuse in the electrical supply to the washing machine has to be replaced.

The current through the washing machine when in use is 10.4 A.

Three fuses with different current ratings are available and shown in the list below.

10 A **13 A** **30 A**

Explain why only the 13 A fuse should be used.

.....

.....

.....[2]

(b) Some washing machines have relays in their circuits.

Fig. 13.2 shows a simple relay.

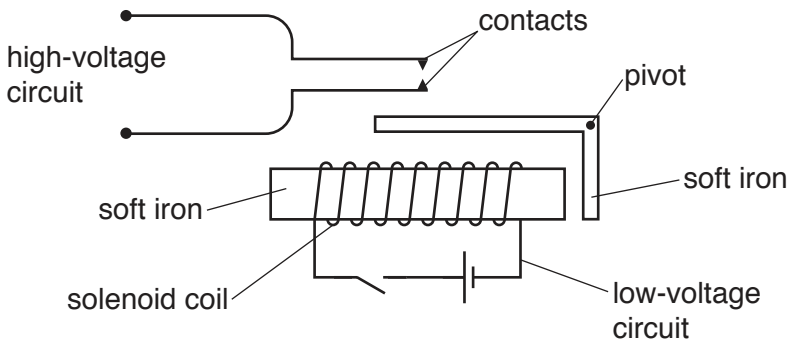


Fig. 13.2

Suggest why the contacts close when a current passes through the solenoid coil.

.....

.....

.....[2]

(c) Fig. 13.3 represents a sound wave travelling through the air from the washing machine.

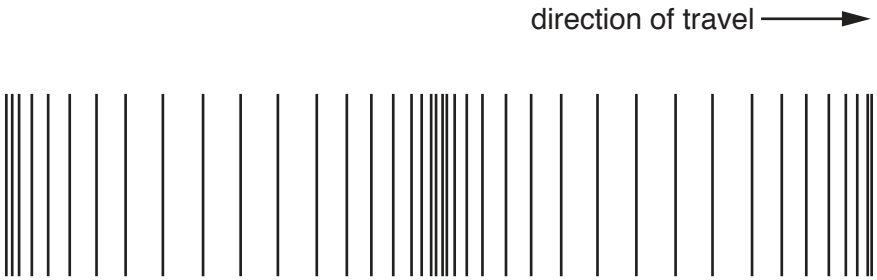


Fig. 13.3

(i) On Fig. 13.3, label a compression with the letter **C** and a rarefaction with the letter **R**. [2]

(ii) On Fig. 13.3, mark **one** wavelength with a double headed arrow (↔). [1]

The Periodic Table of Elements

Key

atomic number
atomic symbol
name
relative atomic mass

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 –		

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.)