

Location Entry Codes

As part of CIE's continual commitment to maintaining best practice in assessment, CIE uses different variants of some question papers for our most popular assessments with large and widespread candidature. The question papers are closely related and the relationships between them have been thoroughly established using our assessment expertise. All versions of the paper give assessment of equal standard.

The content assessed by the examination papers and the type of questions is unchanged.

This change means that for this component there are now two variant Question Papers, Mark Schemes and Principal Examiner's Reports where previously there was only one. For any individual country, it is intended that only one variant is used. This document contains both variants which will give all Centres access to even more past examination material than is usually the case.

The diagram shows the relationship between the Question Papers, Mark Schemes and Principal Examiners' Reports that are available.

Question Paper	Mark Scheme	Principal Examiner's Report
Introduction	Introduction	Introduction
First variant Question Paper	First variant Mark Scheme	First variant Principal Examiner's Report
Second variant Question Paper	Second variant Mark Scheme	Second variant Principal Examiner's Report

Who can I contact for further information on these changes?

Please direct any questions about this to CIE's Customer Services team at:

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The titles for the variant items should correspond with the table above, so that at the top of the first page of the relevant part of the document and on the header, it has the words:

- First variant Question Paper / Mark Scheme / Principal Examiner's Report

or

- Second variant Question Paper / Mark Scheme / Principal Examiner's Report

as appropriate.



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE
NAME

CENTRE
NUMBER

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CANDIDATE
NUMBER

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CO-ORDINATED SCIENCES

0654/31

Paper 3 (Extended)

May/June 2009

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 soft pencil for any diagrams, graphs, tables or rough working.

Do not use staples, paper clips, highlighters, glue or correction fluid.

DO NOT WRITE IN ANY BARCODES.

Answer **all** questions.

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.

For Examiner's Use	
1	
2	
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4	
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7	
8	
9	
Total	

This document consists of **25** printed pages and **3** blank pages.



- 1 (a) A student investigated how a change in potential difference across a lamp affected the current flowing through it.

She used wires to connect the components shown in Fig. 1.1 to make a circuit.

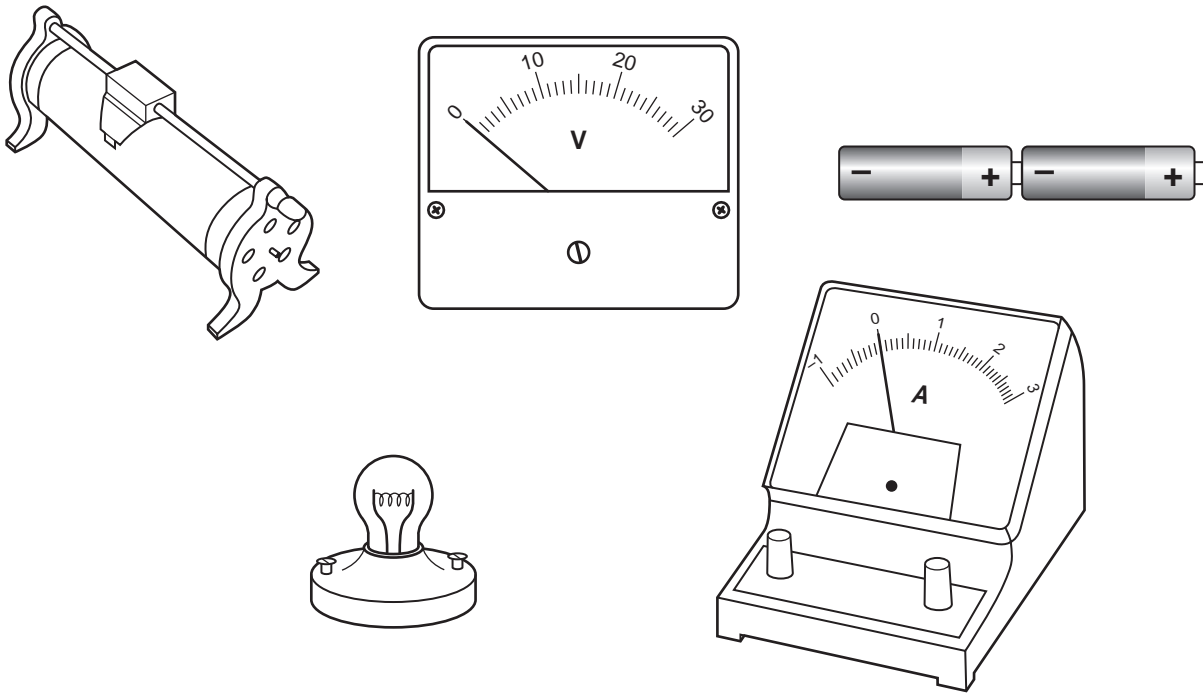


Fig. 1.1

- (i) Using the correct symbols, draw a diagram to show the circuit she used.

[2]

- (ii) Explain why the variable resistor is included in the circuit.

.....
 [1]

- (iii) Her results are shown in Table 1.1.

Table 1.1

potential difference across lamp/V	current through lamp/A	resistance of lamp filament/ Ω
4	1.2	3.3
8	1.5	
12	1.7	7.1

Complete the table by calculating the missing resistance and writing your answer in the empty box.

State the formula that you use and show your working.

formula

working

[2]

- (iv) The student concluded that the relationship between potential difference and current did not correspond to Ohm's law.

Explain why the relationship between potential difference and current for the lamp did not correspond to Ohm's law.

.....

 [2]

For
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Use

- (b) Fig. 1.2 shows a wire moving upwards between the poles of two magnets. The ends of the wire are connected to a sensitive ammeter. The ammeter shows the induced current.

For
Examiner's
Use

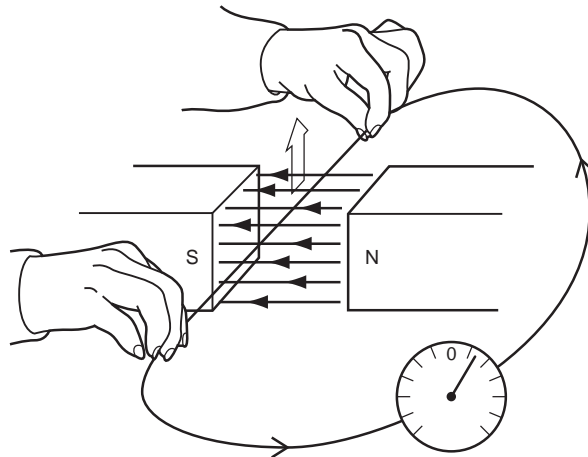


Fig. 1.2

- (i) Draw on the ammeter in Fig. 1.3 the reading obtained if the wire was moved twice as quickly in the same direction.

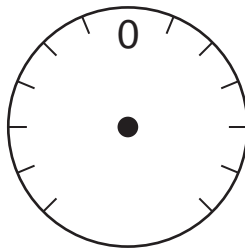


Fig. 1.3

[1]

- (ii) Draw on the ammeter in Fig. 1.4 the reading obtained if the wire was moved in the opposite direction.

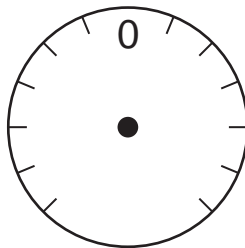


Fig. 1.4

[1]

- (iii) Suggest why the ammeter must be a sensitive ammeter.

.....
 [1]

- (iv) Name a device which uses this principle of inducing an electric current when a wire moves in a magnetic field.

..... [1]

2 Fig. 2.1 shows a vertical section through human skin.

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Examiner's
Use

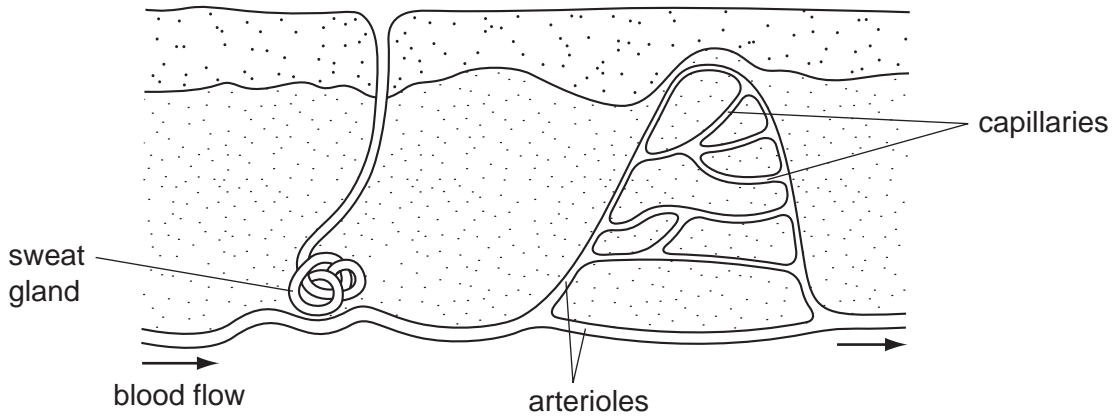


Fig. 2.1

(a) Describe how each of the following structures helps to lower the temperature of the body when it becomes too hot.

(i) sweat gland

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

(ii) arterioles

.....
.....
.....
..... [3]

(b) A man ran steadily on a running track for 60 minutes. The air temperature was 14°C.

Fig. 2.2 shows his core temperature (the temperature inside his body) before, during and after the run.

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Examiner's
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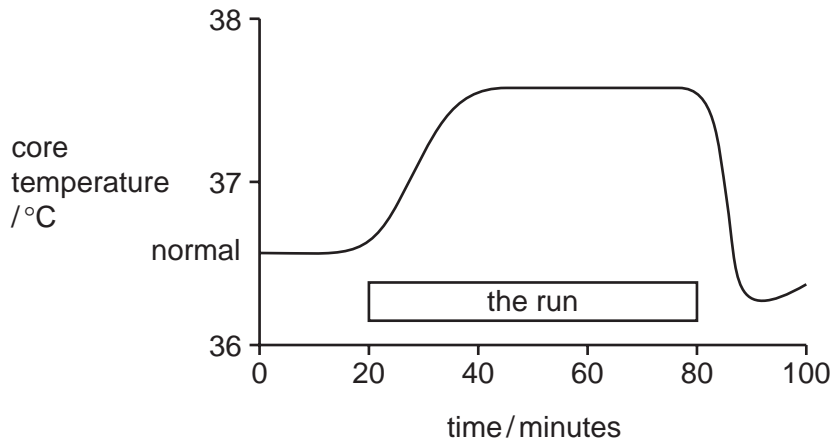


Fig. 2.2

(i) Explain why the man's core temperature increased while he was running.

.....

 [2]

(ii) Suggest why his core temperature dropped below normal when he stopped running.

.....

 [2]

(iii) When a runner has finished a marathon, a shiny silver-coloured blanket is often draped over his body. This helps to prevent his body temperature from dropping below normal.

Explain why this type of blanket is used, rather than a non-shiny dark-coloured one.

.....

 [1]

(c) The skin has an important role in making vitamin D, which it does when sunlight falls onto it.

Explain the importance of vitamin D in the body.

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

*For
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3 Food colourings are natural or synthetic dyes added to make food look more attractive.

(a) Describe the difference between natural and synthetic dyes.

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

(b) Fig. 3.1 shows a piece of cloth which is stained with food colouring.

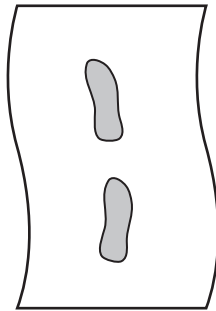


Fig. 3.1

The cloth is washed in water containing soap solution.

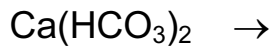
Describe how soap molecules help to remove stains from the cloth. You may wish to draw some simple diagrams to help you answer this question.

.....
.....
.....
..... [3]

(c) Some water supplied to houses contains calcium hydrogencarbonate, $\text{Ca}(\text{HCO}_3)_2$. When heated, calcium hydrogencarbonate undergoes thermal decomposition.

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Use

- (i) Complete the symbolic equation below which describes the thermal decomposition of calcium hydrogencarbonate.



[2]

- (ii) The ionic charge of a calcium ion is $2+$. Deduce the ionic charge of a hydrogencarbonate ion.

Show how you obtained your answer.

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

- 4 (a) Many people have survived accidents where they have been exposed to ionising radiation from radioactive materials. Such exposure can have serious effects on their health.

The table and graph show how the dose (amount) of radiation received is linked to a type of cancer called leukaemia. The radiation dose is measured in units called grays.

Table 4.1

radiation dose/grays	incidences of leukaemia/cases per 10 000 people per year
1.0	1.0
2.5	2.3
5.0	
10.0	10.1
15.0	15.2

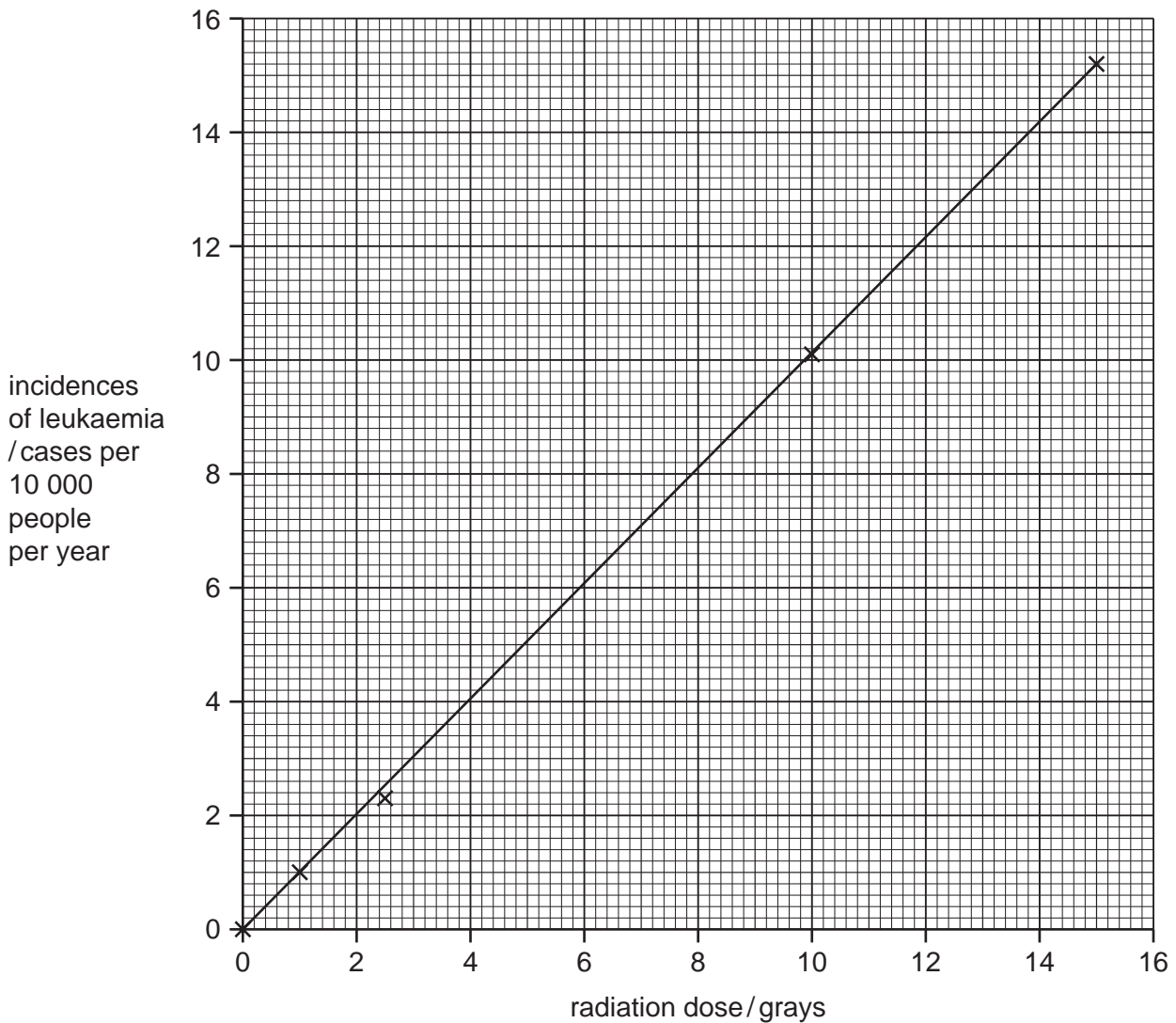


Fig. 4.1

(i) The result for 5.0 grays has been missed out of the table.

Use the graph to help you fill in the missing value in the table. [1]

(ii) What is the relationship between the ionising radiation and the incidence of leukaemia?

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

(b) Two types of nuclear radiation from naturally occurring sources are alpha and beta. They can be identified by their different penetrating powers.

Describe how you could distinguish between alpha and beta radiation by their penetrating powers.

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

(c) Radon-222 (^{222}Rn) is a radioactive element. The chart in Fig. 4.2 shows the number of protons and neutrons in the nuclei of the elements formed when radon decays.

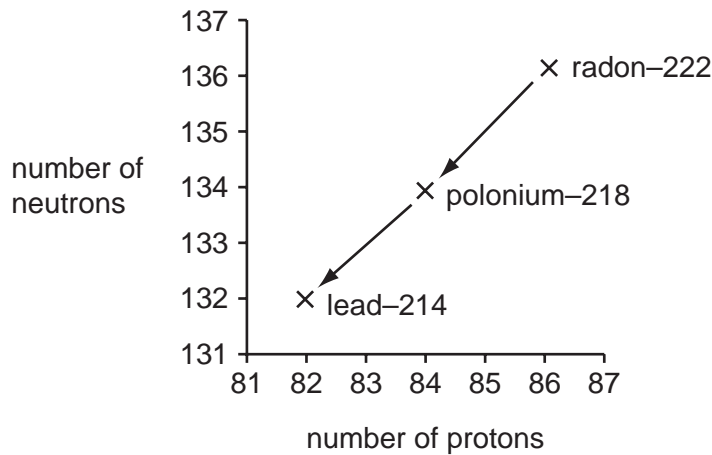


Fig. 4.2

(i) Describe how the graph shows that radon-222 (^{222}Rn) and polonium-218 (^{218}Po) emit alpha particles.

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

(ii) State why radon and polonium are different elements.

..... [1]

(iii) Radioactive decay can also produce gamma radiation.

Explain why gamma emission does **not** result in the formation of a new element.

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

(iv) Radon-222 has a half-life of 4 days.

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

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

(v) 1 mg of radon-222 is allowed to decay.

Calculate after how many days there would be 0.125 mg of radon-222 remaining.

Show your working.

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

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Please turn over for Question 5.

5 Fig. 5.1 shows three arthropods.

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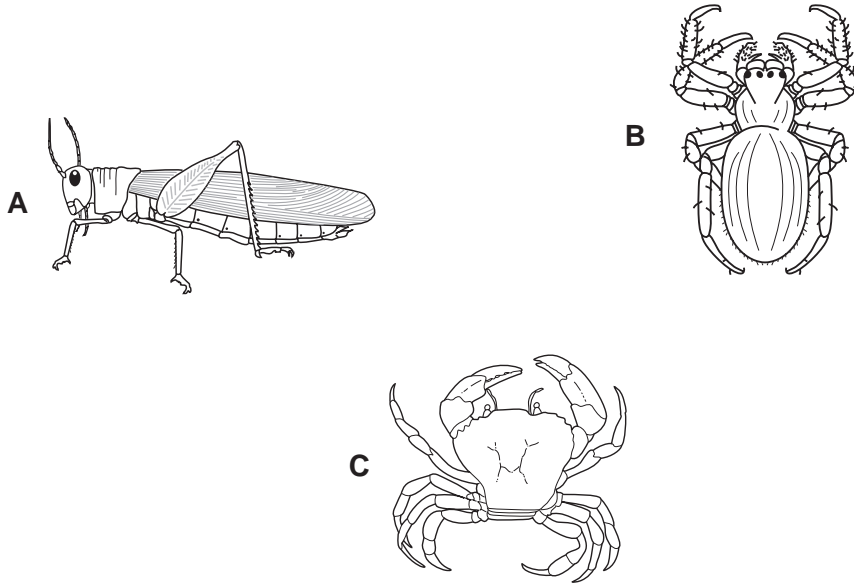


Fig. 5.1

(a) (i) The arthropod **A** is a locust, which belongs to the insect class.

State **two** features, visible on the locust in Fig. 5.1, which are characteristic of insects.

- 1 [2]
 2

(ii) Name the classes to which arthropods **B** and **C** belong.

- B**
C [2]

(b) In one species of locust, the body colour may be brown or green. This is controlled by a gene with two alleles, **G** and **g**. If two locusts with brown bodies are mated, the offspring are always brown. If two locusts with green bodies are mated, some of the offspring may be brown.

(i) Write the possible genotype or genotypes for each of the following phenotypes.

brown body

green body

[2]

(ii) Use a genetic diagram to explain why some of the offspring of two locusts with green bodies may have brown bodies.

[4]

(c) State whether the variation in body colour in these locusts is an example of *continuous* variation or *discontinuous* variation. Explain your answer.

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

(d) Locusts sometimes form huge swarms, which can fly long distances, and can eat and completely destroy whole fields of crops. These swarms are sometimes sprayed with pesticides from aeroplanes.

Suggest **two** possible disadvantages of using pesticides in this way.

1

2

[2]

- 6 Fig. 6.1 shows apparatus a student used to investigate electrolysis using concentrated sodium chloride solution as the electrolyte.

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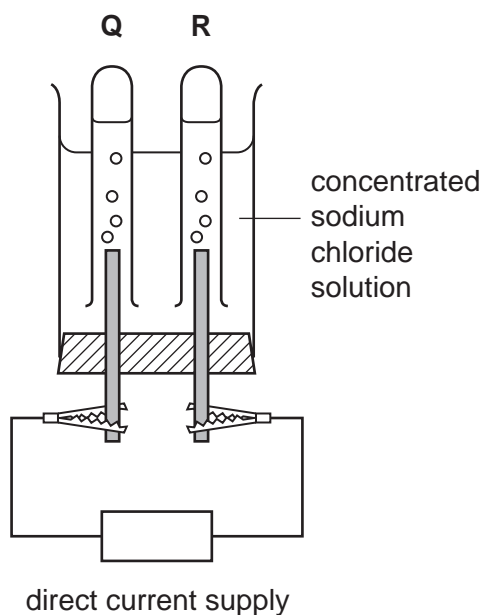
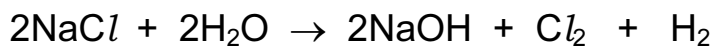


Fig. 6.1

When an electric current flowed through the circuit, chlorine gas collected in tube **Q** and hydrogen gas collected in tube **R**.

The balanced equation below describes the overall chemical change which takes place.



- (a) On Fig. 6.1 label the anode.

Give a reason for your choice.

.....

 [2]

- (b) The student allowed the current to flow through the apparatus until 0.01 moles of hydrogen gas had been produced.

- (i) State the number of moles of chlorine which were produced during the experiment.

..... [1]

- (ii) Calculate the mass of sodium hydroxide which was produced during the experiment. (Relative atomic masses Na = 23, O = 16, H = 1)

Show your working.

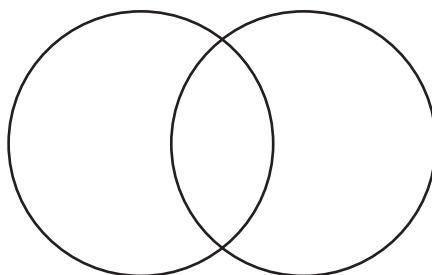
..... [3]

- (c) When chlorine gas is bubbled through a colourless solution of potassium bromide, KBr, the solution turns orange because the element bromine is produced.

- (i) Write a balanced equation for the reaction between chlorine and potassium bromide.

..... [2]

- (ii) Complete the bonding diagram of a bromine molecule to show the arrangement of the outer electrons of each atom.



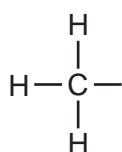
[2]

- (iii) Describe how bromine is used to test hydrocarbons to find out whether or not they are unsaturated.

.....

 [2]

- (iv) Complete the displayed formula to show the **alkene** which contains four carbon atoms in each of its molecules.



[2]

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7 A student carried out an investigation into the response of plant shoots to light.

He grew six maize seedlings and treated them as follows.

- He did nothing to seedlings **A** and **D**.
- He cut the tips off seedlings **B** and **E**.
- He covered the tips of seedlings **C** and **F** with black paper.

He placed one group of seedlings where they received light from all directions. He placed the second group of seedlings in a container where they received light from one side only.

Fig. 7.1 shows the appearance of the six seedlings when the experiment was first set up, and after one day.

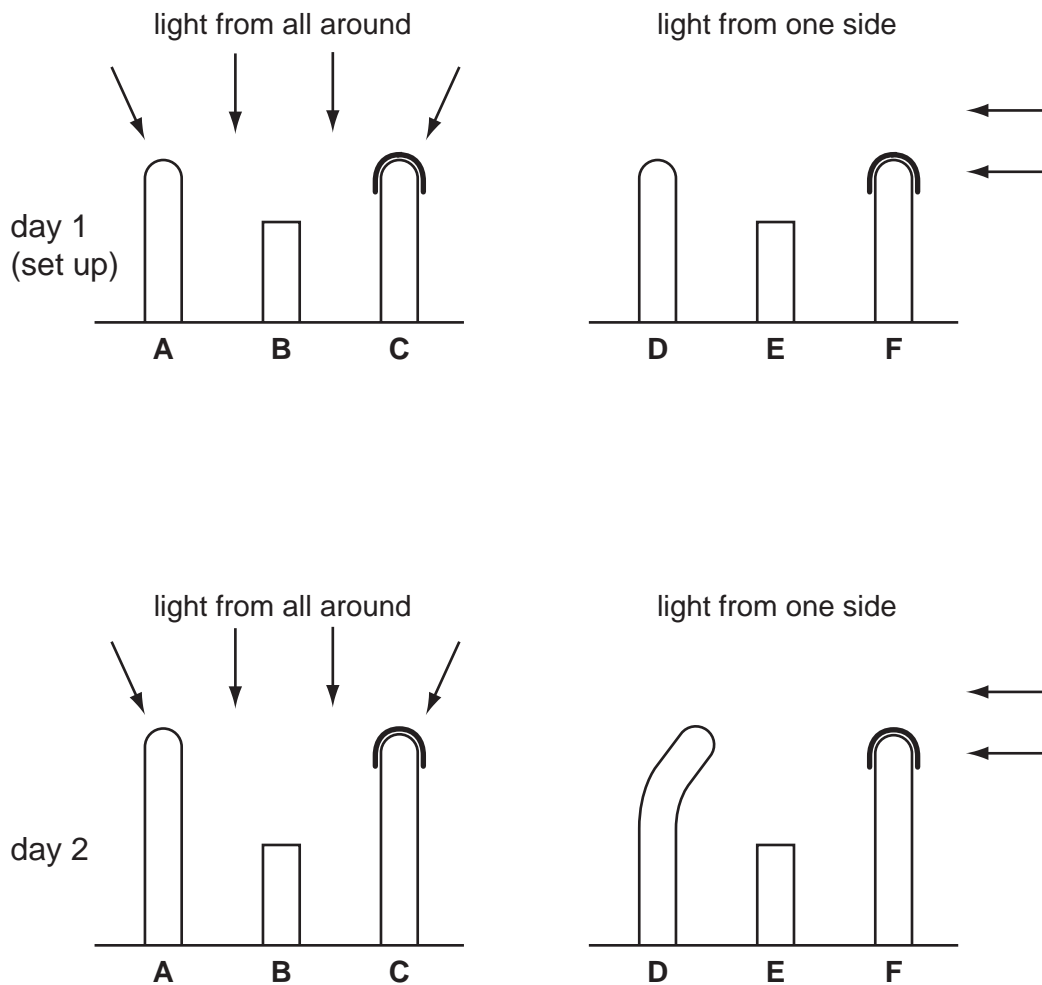


Fig. 7.1

(a) The student concluded that the tip of a shoot is needed for growth. Describe the evidence in Fig. 7.1 that supports this conclusion.

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

(b) Using the information in Fig. 7.1, deduce the positions of the receptor and the effector that are responsible for the growth response of a seedling towards light.

Explain the evidence for your deductions.

position of receptor

evidence

.....

position of effector

evidence

..... [4]

(c) Describe how auxin may be involved in the growth of shoots towards the light. You can use a diagram if it helps your answer.

.....
.....
.....
..... [3]

8 A diver is working under water, wearing a diving suit and helmet.

(a) The diving helmet has a plastic window of area 100 cm^2 . The air pressure inside the helmet is the same as the water pressure outside.

(i) At a depth of 40 m, the diver breathes air at a pressure of 50 N/cm^2 .

Calculate the force exerted by the air on the helmet window at this depth.

Use the formula

$$\text{pressure} = \text{force} / \text{area}$$

Show your working.

..... [1]

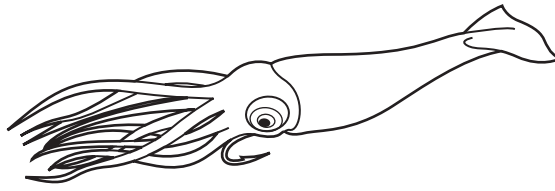
(ii) At the surface of the sea, the pressure of the atmosphere is 10 N/cm^2 .

Estimate a value for the pressure at a depth of 10 m. Explain your answer.

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

(b) The diver sees a squid. A squid moves by forcing out a jet of water from its body.

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Use



This moving water has momentum.

(i) The mass of water forced out is 1.2 kg and has a velocity of 10 m/s.

Show that the momentum of the moving water is 12 kg m/s.

State the formula that you use and show your working.

formula

working

..... [1]

(ii) To conserve momentum, the squid's momentum must equal the momentum of the water jet in the opposite direction.

The mass of the squid is 4 kg.

Calculate the velocity of the squid.

State the formula that you use and show your working.

formula

working

..... [3]

- (c) (i) A dolphin near the surface is able to communicate underwater by emitting ultrasonic waves with a frequency of 39 000 Hz.

The speed of these waves in water is 1500 m/s.

Calculate the wavelength of the waves.

State the formula that you use and show your working.

formula

working

..... [2]

- (ii) The hearing range for a dolphin is from 1 kHz to 100 kHz. State the hearing range of an average adult human.

..... [1]

- (iii) Fig. 8.1 shows the speed of the dolphin travelling through water.

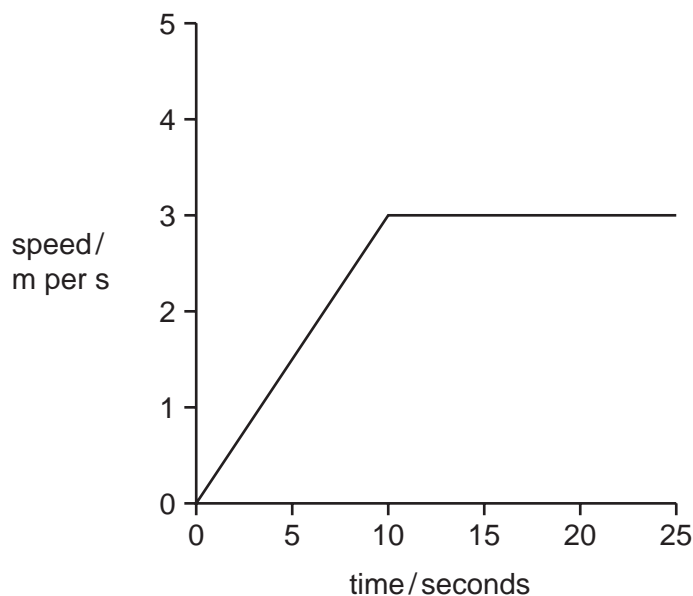


Fig. 8.1

Calculate the distance covered by the dolphin in the first 20 seconds.

Show your working.

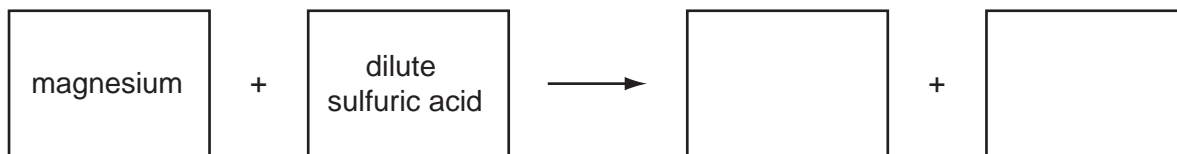
..... [2]

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Please turn over for Question 9.

9 Many metals react with dilute acids.

(a) Complete the word equation for the reaction of magnesium with dilute sulfuric acid.



[1]

(b) A student used the apparatus shown in Fig. 9.1 to investigate the rate of reaction between sulfuric acid and magnesium.

To start the reaction, she tilted the flask to mix the reactants.

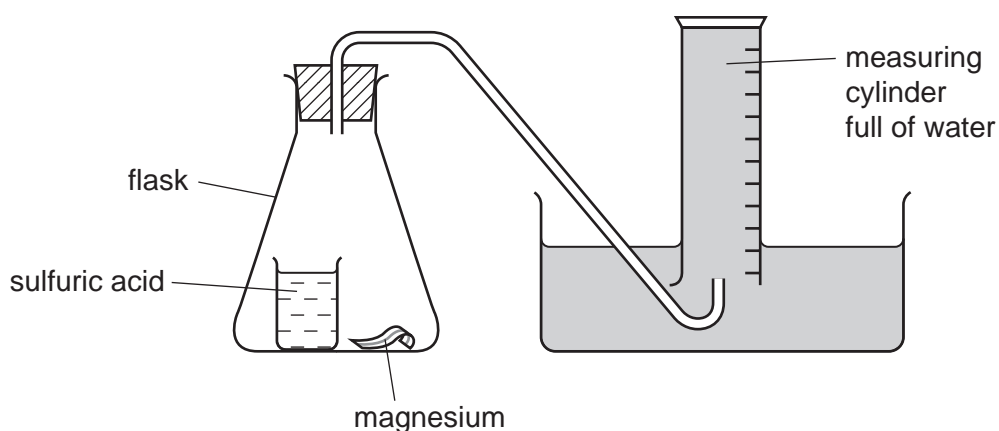


Fig. 9.1

She measured the volume of gas which had collected in the measuring cylinder every minute for several minutes.

Her results are shown in Fig. 9.2.

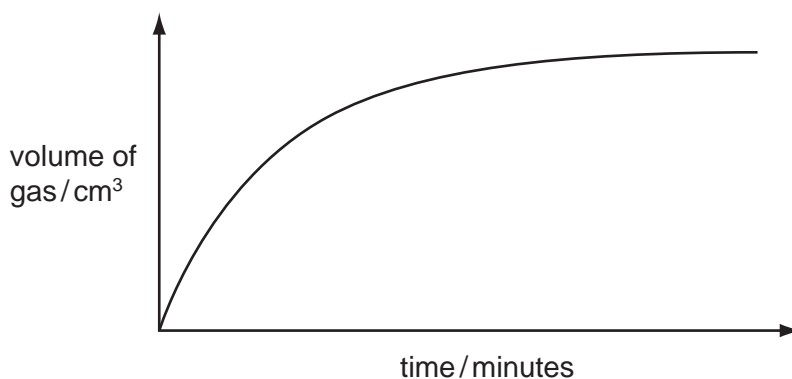


Fig. 9.2

Explain these results in terms of the collisions between particles in the reacting mixture.

For
Examiner's
Use

.....

.....

.....

.....

..... [3]

(c) Fig. 9.3 shows a pencil sharpener. Both the case and the blades are made using alloys.

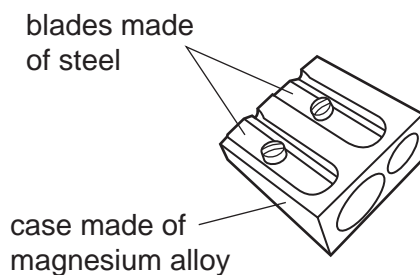


Fig. 9.3

Alloys rather than pure metals are used because they are stronger and less malleable.

Draw diagrams to show part of the giant structures of a pure metal and an alloy.
Use your diagrams to help you to explain why alloys are less malleable than the pure metals they contain.

diagram of the structure of a pure metal

diagram of the structure of an alloy

.....

.....

.....

..... [4]

- (d) Table 9.1 shows information about the atomic structures of four particles **W**, **X**, **Y** and **Z**.

For
Examiner's
Use

Table 9.1

	number of protons	number of neutrons	electrons in 1st shell	electrons in 2nd shell	electrons in 3rd shell
W	11	12	2	8	-
X	9	10	2	8	-
Y	12	12	2	8	2
Z	12	13	2	8	2

Explain which **two** particles from **W**, **X**, **Y** and **Z** in the table would attract one another very strongly.

.....

.....

.....

.....

.....

.....

..... [3]

DATA SHEET
The Periodic Table of the Elements

		Group																											
I	II	III	IV	V	VI	VII	0																						
7 Li Lithium 3	9 Be Beryllium 4	1 H Hydrogen 1	11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10	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	101 Ru Ruthenium 44	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	122 Sb Antimony 51	128 Te Tellurium 52	131 Xe Xenon 54	133 Cs Caesium 55	137 Ba Barium 56	178 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	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	210 Po Polonium 84	210 At Astatine 85	222 Rn Radon 86
226 Ra Radium 88	227 Ac Actinium 89											140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	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	238 U Uranium 92	238 Pa Protactinium 91	238 Np Neptunium 93	238 Pu Plutonium 94	238 Am Americium 95	238 Cm Curium 96	238 Bk Berkelium 97	238 Cf Californium 98	238 Es Einsteinium 99	238 Fm Fermium 100	238 Md Mendelevium 101	238 No Nobelium 102	238 Lr Lawrencium 103																

* 58-71 Lanthanoid series
† 90-103 Actinoid series

a = relative atomic mass

X = atomic symbol

b = proton (atomic) number

Key

a	X	b

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).

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UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

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NUMBER

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CO-ORDINATED SCIENCES

0654/32

Paper 3 (Extended)

May/June 2009

2 hours

Candidates answer on the Question Paper.

No Additional Materials are required.

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Answer **all** questions.

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Total	

This document consists of **23** printed pages and **5** blank pages.



- 1 (a) A student investigated how a change in potential difference across a lamp affected the current flowing through it.

She used wires to connect the components shown in Fig. 1.1 to make a circuit.

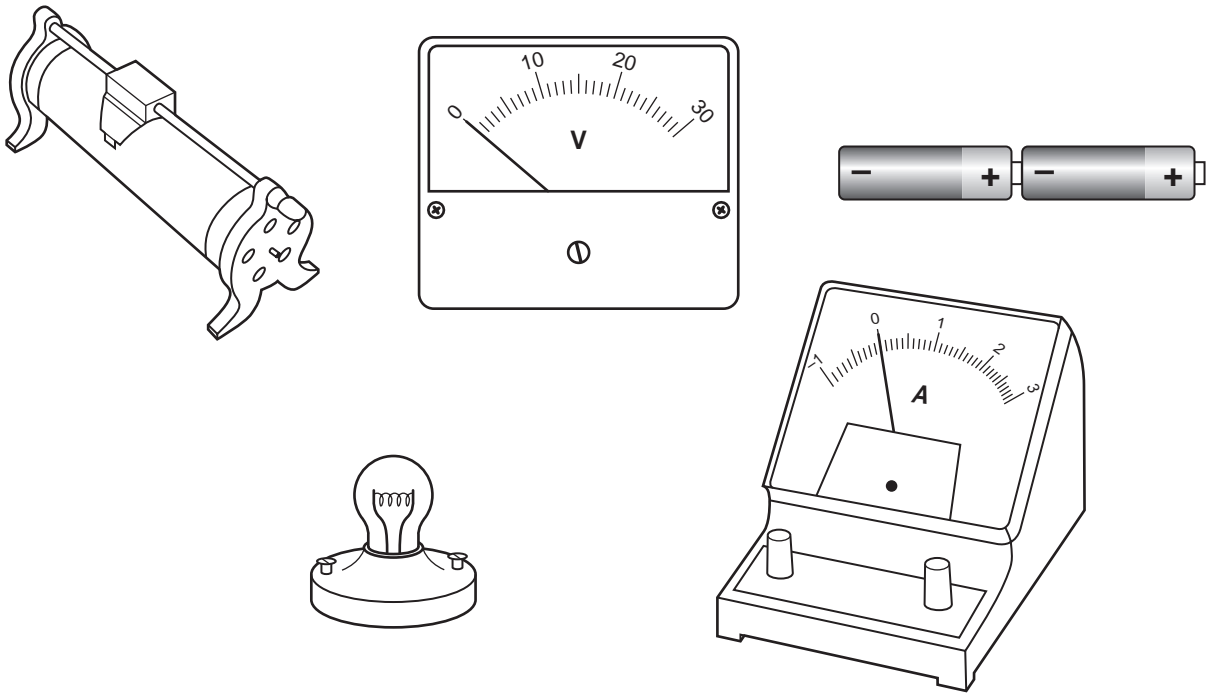


Fig. 1.1

- (i) Using the correct symbols, draw a diagram to show the circuit she used.

[2]

- (ii) Explain why the variable resistor is included in the circuit.

.....
 [1]

(iii) Her results are shown in Table 1.1.

Table 1.1

potential difference across lamp/V	current through lamp/A	resistance of lamp filament/ Ω
4	1.2	3.3
8	1.5	
12	1.7	7.1

Complete the table by calculating the missing resistance and writing your answer in the empty box.

State the formula that you use and show your working.

formula

working

[2]

(iv) The student concluded that the relationship between potential difference and current did not correspond to Ohm's law.

Explain why the relationship between potential difference and current for the lamp did not correspond to Ohm's law.

.....

 [2]

- (b) Fig. 1.2 shows a wire moving upwards between the poles of two magnets. The ends of the wire are connected to a sensitive ammeter. The ammeter shows the induced current.

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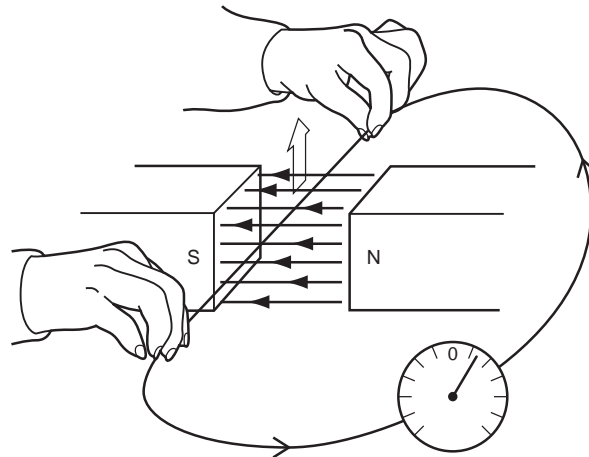


Fig. 1.2

- (i) Draw on the ammeter in Fig. 1.3 the reading obtained if the wire was moved twice as quickly in the same direction.

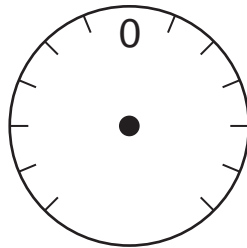


Fig. 1.3

[1]

- (ii) Draw on the ammeter in Fig. 1.4 the reading obtained if the wire was moved in the opposite direction.

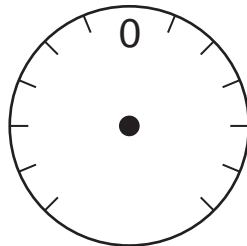


Fig. 1.4

[1]

- (iii) Suggest why the ammeter must be a sensitive ammeter.

.....
 [1]

- (iv) Name a device which uses this principle of inducing an electric current when a wire moves in a magnetic field.

..... [1]

2 (a) Fig. 2.1 shows a transverse section of an artery.

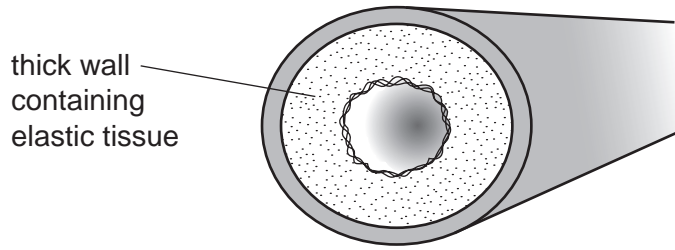


Fig 2.1

(i) Explain why arteries have elastic tissue in their walls.

.....

.....

..... [2]

(ii) Veins contain valves. Explain why arteries do **not** contain valves.

.....

.....

..... [2]

(b) A man ran steadily on a running track for 10 minutes. Fig. 2.2 shows the rate of oxygen consumption by the muscles of his heart before, during and after the run.

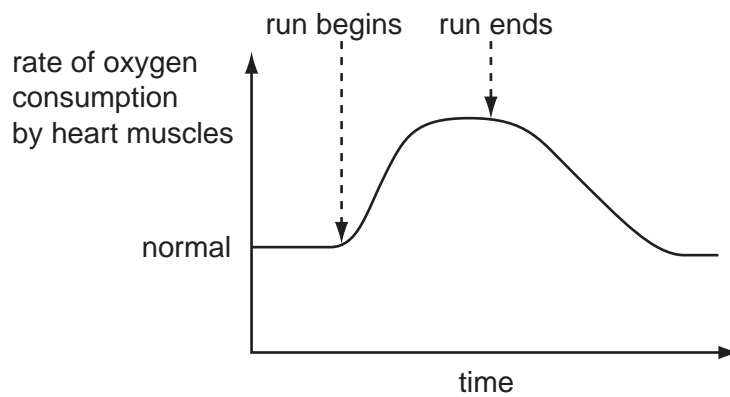


Fig. 2.2

- (i) Explain why his heart muscle consumed oxygen at a greater rate during the run than before it.

.....
.....
.....
..... [3]

- (ii) Explain why the rate of oxygen consumption by the heart muscle did not return to normal immediately after the run.

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

- (c) In 1968, the Olympic Games were held in Mexico City. This is at a high altitude, and there is less oxygen in the air than at sea level.

Athletes running in 100 m races had no difficulties and times were fast. However, athletes running in long distance races became very tired while they were running and their times were slow.

Suggest an explanation for this.

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

- (d) Competitive athletes need to have plenty of iron in their diet.

Describe the function of iron in the body.

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

3 Food colourings are natural or synthetic dyes added to make food look more attractive.

(a) Describe the difference between natural and synthetic dyes.

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

(b) Fig. 3.1 shows a piece of cloth which is stained with food colouring.

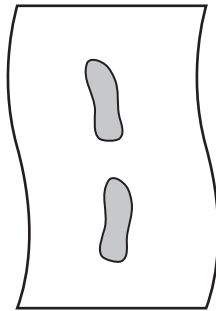


Fig. 3.1

The cloth is washed in water containing soap solution.

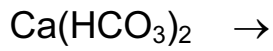
Describe how soap molecules help to remove stains from the cloth. You may wish to draw some simple diagrams to help you answer this question.

.....
.....
.....
..... [3]

(c) Some water supplied to houses contains calcium hydrogencarbonate, $\text{Ca}(\text{HCO}_3)_2$. When heated, calcium hydrogencarbonate undergoes thermal decomposition.

For
Examiner's
Use

- (i) Complete the symbolic equation below which describes the thermal decomposition of calcium hydrogencarbonate.



[2]

- (ii) The ionic charge of a calcium ion is $2+$. Deduce the ionic charge of a hydrogencarbonate ion.

Show how you obtained your answer.

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

- 4 (a) Many people have survived accidents where they have been exposed to ionising radiation from radioactive materials. Such exposure can have serious effects on their health.

The table and graph show how the dose (amount) of radiation received is linked to a type of cancer called leukaemia. The radiation dose is measured in units called grays.

Table 4.1

radiation dose/grays	incidences of leukaemia/cases per 10 000 people per year
1.0	1.0
2.5	2.3
5.0	
10.0	10.1
15.0	15.2

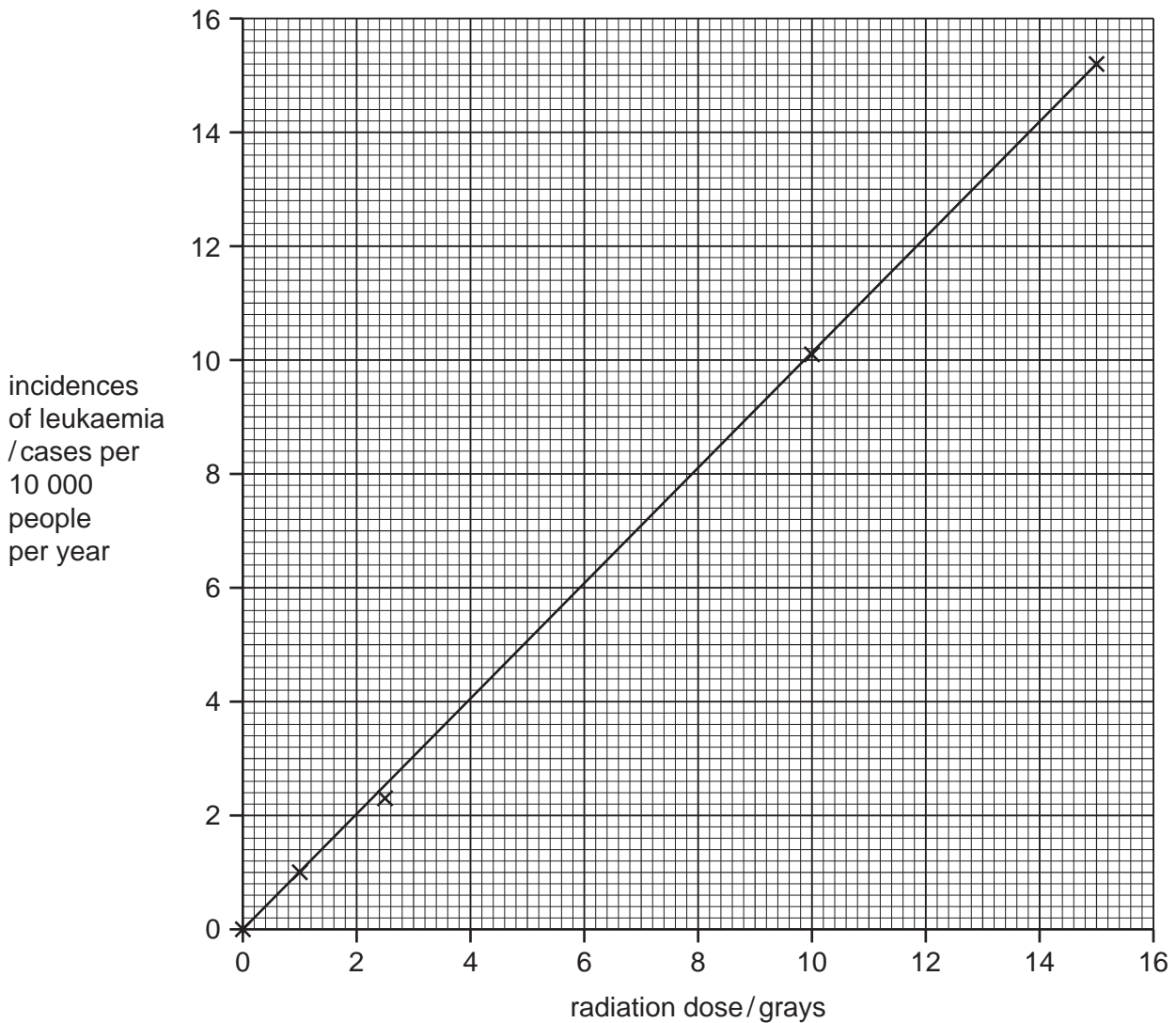


Fig. 4.1

(i) The result for 5.0 grays has been missed out of the table.

Use the graph to help you fill in the missing value in the table. [1]

(ii) What is the relationship between the ionising radiation and the incidence of leukaemia?

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

(b) Two types of nuclear radiation from naturally occurring sources are alpha and beta. They can be identified by their different penetrating powers.

Describe how you could distinguish between alpha and beta radiation by their penetrating powers.

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

(c) Radon-222 (^{222}Rn) is a radioactive element. The chart in Fig. 4.2 shows the number of protons and neutrons in the nuclei of the elements formed when radon decays.

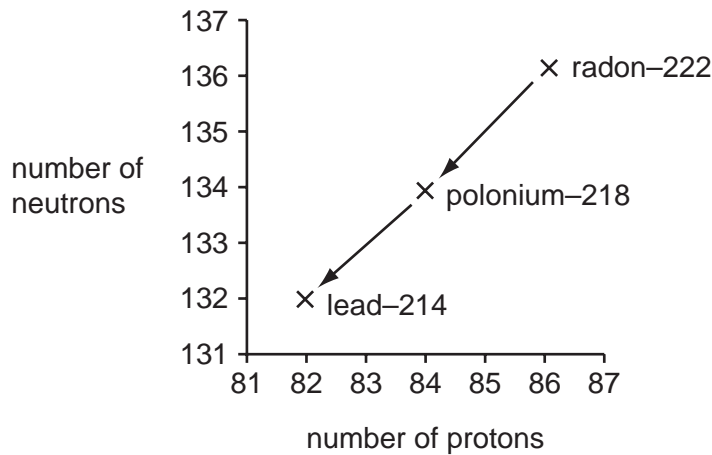


Fig. 4.2

(i) Describe how the graph shows that radon-222 (^{222}Rn) and polonium-218 (^{218}Po) emit alpha particles.

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

(ii) State why radon and polonium are different elements.

..... [1]

(iii) Radioactive decay can also produce gamma radiation.

Explain why gamma emission does **not** result in the formation of a new element.

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

(iv) Radon-222 has a half-life of 4 days.

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

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

(v) 1 mg of radon-222 is allowed to decay.

Calculate after how many days there would be 0.125 mg of radon-222 remaining.

Show your working.

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

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Please turn over for Question 5.

5 Fig. 5.1 shows three arthropods.

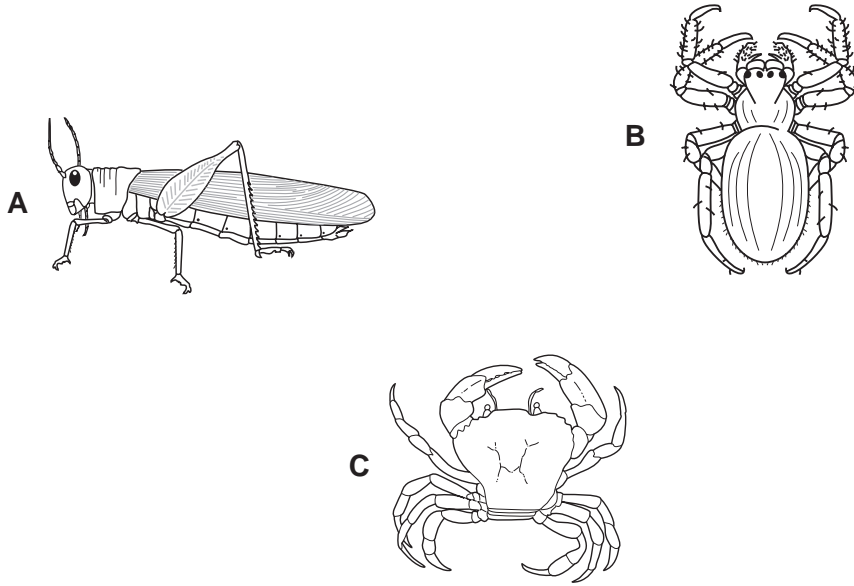


Fig. 5.1

(a) (i) The arthropod **A** is a locust, which belongs to the insect class.

State **two** features, visible on the locust in Fig. 5.1, which are characteristic of insects.

- 1
- 2 [2]

(ii) Name the classes to which arthropods **B** and **C** belong.

- B**
- C** [2]

(b) In one species of locust, the body colour may be brown or green. This is controlled by a gene with two alleles, **G** and **g**. If two locusts with brown bodies are mated, the offspring are always brown. If two locusts with green bodies are mated, some of the offspring may be brown.

(i) Write the possible genotype or genotypes for each of the following phenotypes.

brown body

green body

[2]

(ii) Use a genetic diagram to explain why some of the offspring of two locusts with green bodies may have brown bodies.

[4]

(c) State whether the variation in body colour in these locusts is an example of *continuous* variation or *discontinuous* variation. Explain your answer.

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

(d) Locusts sometimes form huge swarms, which can fly long distances, and can eat and completely destroy whole fields of crops. These swarms are sometimes sprayed with pesticides from aeroplanes.

Suggest **two** possible disadvantages of using pesticides in this way.

1

2

[2]

- 6 Fig. 6.1 shows apparatus a student used to investigate electrolysis using concentrated sodium chloride solution as the electrolyte.

For
Examiner's
Use

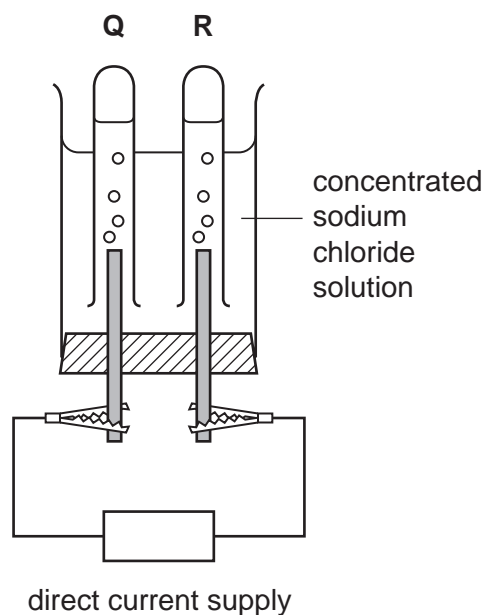


Fig. 6.1

When an electric current flowed through the circuit, chlorine gas collected in tube **Q** and hydrogen gas collected in tube **R**.

The balanced equation below describes the overall chemical change which takes place.



- (a) On Fig. 6.1 label the anode.

Give a reason for your choice.

.....

 [2]

- (b) The student allowed the current to flow through the apparatus until 0.01 moles of hydrogen gas had been produced.

- (i) State the number of moles of chlorine which were produced during the experiment.

..... [1]

- (ii) Calculate the mass of sodium hydroxide which was produced during the experiment. (Relative atomic masses Na = 23, O = 16, H = 1)

Show your working.

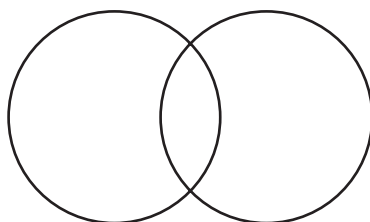
..... [3]

- (c) When chlorine gas is bubbled through a colourless solution of potassium bromide, KBr, the solution turns orange because the element bromine is produced.

- (i) Write a balanced equation for the reaction between chlorine and potassium bromide.

..... [2]

- (ii) Complete the bonding diagram of a bromine molecule to show the arrangement of the outer electrons of each atom.



[2]

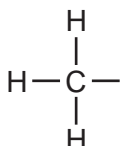
- (iii) Describe how bromine is used to test hydrocarbons to find out whether or not they are unsaturated.

.....

.....

..... [2]

- (iv) Complete the displayed formula to show the **alkene** which contains four carbon atoms in each of its molecules.



[2]

For
Examiner's
Use

7 A student carried out an investigation into the response of plant shoots to light.

He grew six maize seedlings and treated them as follows.

- He did nothing to seedlings **A** and **D**.
- He cut the tips off seedlings **B** and **E**.
- He covered the tips of seedlings **C** and **F** with black paper.

He placed one group of seedlings where they received light from all directions. He placed the second group of seedlings in a container where they received light from one side only.

Fig. 7.1 shows the appearance of the six seedlings when the experiment was first set up, and after one day.

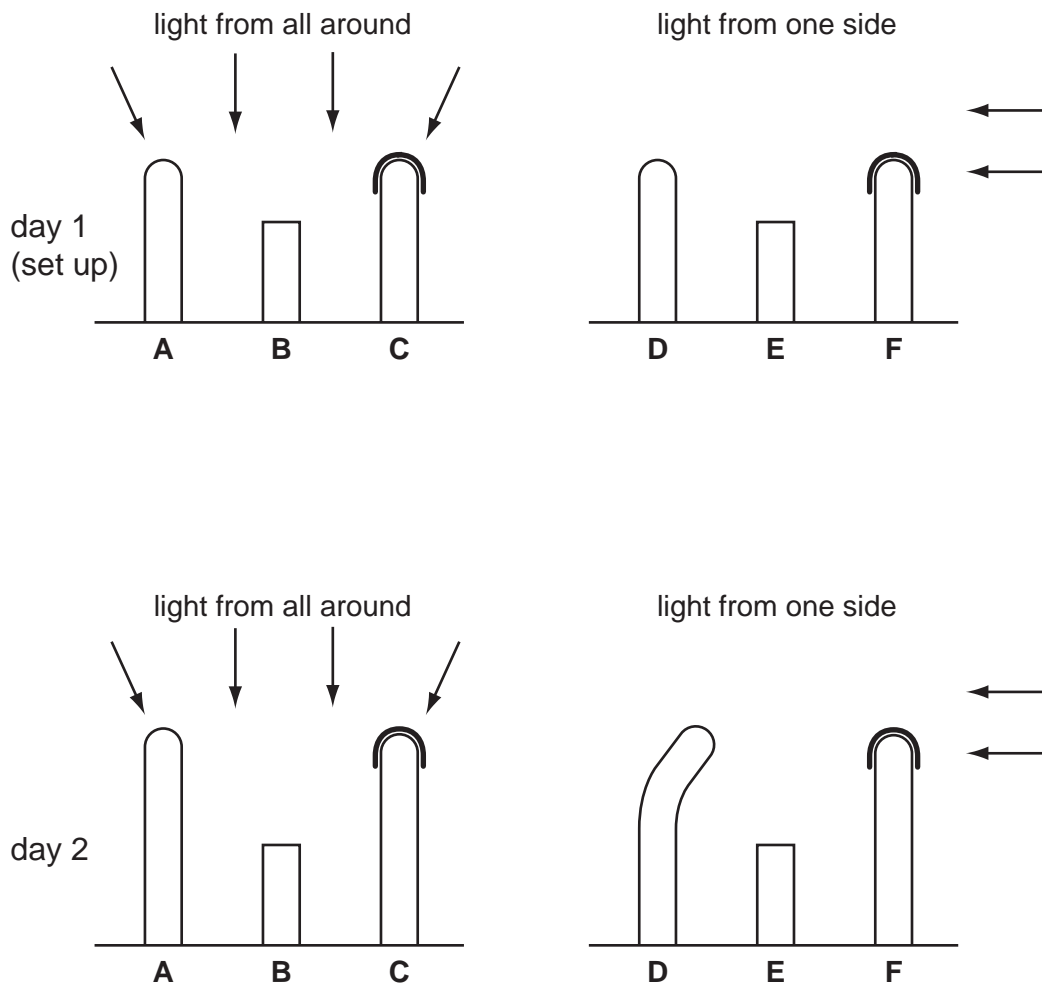


Fig. 7.1

(a) The student concluded that the tip of a shoot is needed for growth. Describe the evidence in Fig. 7.1 that supports this conclusion.

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

(b) Using the information in Fig. 7.1, deduce the positions of the receptor and the effector that are responsible for the growth response of a seedling towards light.

Explain the evidence for your deductions.

position of receptor

evidence

.....

position of effector

evidence

..... [4]

(c) Describe how auxin may be involved in the growth of shoots towards the light. You can use a diagram if it helps your answer.

.....
.....
.....
..... [3]

8 Two skiers **A** and **B** start a straight downhill race.

For
Examiner's
Use

Fig 8.1 shows how the motion of skier **A** changes during the race. Skier **A** finishes the race after 40 seconds and then slows down and stops after 50 seconds.

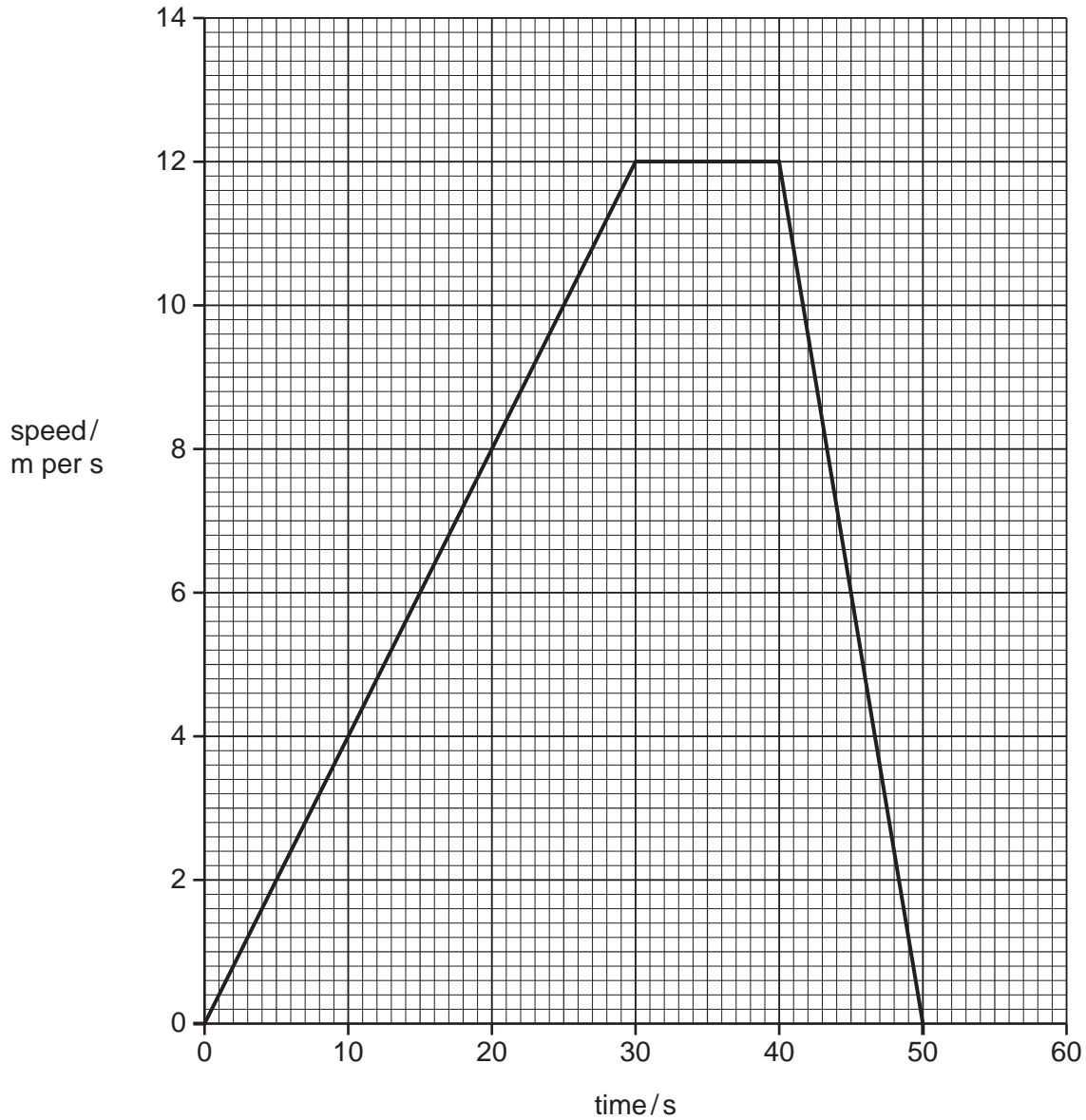


Fig. 8.1

(a) (i) Describe the motion of skier **A** between 0 and 30 seconds.

.....
 [2]

(ii) Calculate the distance skier **A** travels between 0 and 30 seconds.

Show your working.

..... [2]

(b) The mass of skier **A** is 60 kg. Calculate the kinetic energy of the skier when her speed is 10 m/s.

For
Examiner's
Use

State the formula that you use and show your working.

formula

working

..... [2]

(c) (i) Calculate the deceleration of skier **A** between 40 and 50 seconds.

State the formula that you use and show your working.

formula

working

..... [2]

(ii) Calculate the force on skier **A** which causes this deceleration.

State the formula that you use and show your working.

formula

working

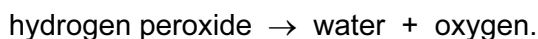
..... [2]

(d) Skier **B** wins the race. On Fig. 8.1 show how the motion of skier **B** might change during the race.

Explain your answer.

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

- 9 Hydrogen peroxide, H_2O_2 , is a colourless liquid which slowly decomposes according to the equation below.



If the black solid compound manganese dioxide, MnO_2 , is added to a solution of hydrogen peroxide, it acts as a catalyst and the rate of reaction is greatly increased.

- (a) Describe the test for oxygen gas.

.....
 [1]

- (b) A student uses the apparatus shown in Fig. 9.1 to study the rate of reaction when hydrogen peroxide solution decomposes.

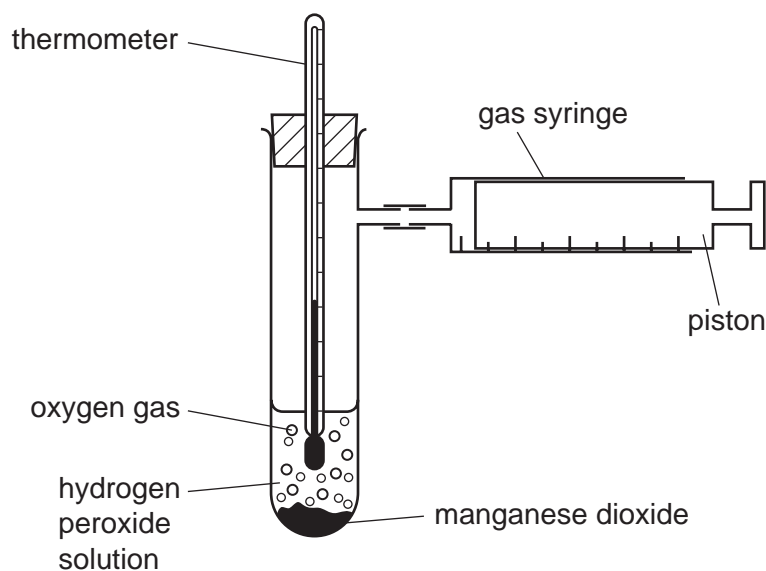


Fig. 9.1

The student carries out three trials to investigate the effect of changing the concentration of the hydrogen peroxide solution. She attempts to keep all other variables the same in each trial.

Her results are shown in Table 9.1.

Table 9.1

trial number	hydrogen peroxide concentration in mol / dm ³	volume of oxygen collected / cm ³	time taken to collect oxygen / s	rate of production of oxygen in cm ³ / s
1	0.4	50	10	5.0
2	0.2	50	20	
3	0.1	50	40	1.25

For
Examiner's
Use

(i) Calculate the rate of production of oxygen for Trial 2 and write the value in Table 9.1. [1]

(ii) Using the data in Table 9.1, explain in terms of collisions of molecules, the relation between the rate of production of oxygen and the concentration of hydrogen peroxide solution in this experiment.

.....

.....

.....

.....

.....

.....

..... [4]

(iii) Describe how the student could show that manganese dioxide is behaving as a catalyst and is therefore not used up or chemically changed.

.....

.....

.....

.....

..... [2]

(c) Table 9.2 shows information about the atomic structure of four particles **P**, **Q**, **R** and **S**.

For
Examiner's
Use

Table 9.2

	number of protons	number of neutrons	electrons in 1 st shell	electrons in 2 nd shell	electrons in 3 rd shell
P	17	20	2	8	8
Q	10	10	2	8	-
R	9	10	2	8	-
S	17	18	2	8	7

(i) Explain which two particles from **P**, **Q**, **R** and **S** are isotopes of the same element.

.....

 [2]

(ii) State which particle from **P**, **Q**, **R** and **S** is an **atom** of a very unreactive element.

..... [1]

DATA SHEET
The Periodic Table of the Elements

		Group												
I	II	III	IV	V	VI	VII	0							
7 Li Lithium 3	9 Be Beryllium 4	1 H Hydrogen 1	11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10	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	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	91 Nb Niobium 41	96 Mo Molybdenum 42	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	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	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	209 Pb Lead 82	209 Bi Bismuth 83	209 Po Polonium 84	209 Rn Radon 86	
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	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	238 U Uranium 92	238 Np Neptunium 93	238 Pu Plutonium 94	95 Am Americium 95	96 Cm Curium 96	97 Bk Berkelium 97	98 Cf Californium 98	99 Es Einsteinium 99	100 Fm Fermium 100	101 Md Mendelevium 101	102 No Nobelium 102	103 Lr Lawrencium 103

a	X	b	a = relative atomic mass	X = atomic symbol	b = proton (atomic) number
Key					

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).

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