Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME	
CENTRE NUMBER	
CANDIDATE NUMBER	

COMBINED SCIENCE **0653/42**

Paper 4 (Extended) **October/November 2017**

1 hour 15 minutes

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 24.

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 **22** printed pages and **2** blank pages.

CAMBRIDGE International Examinations

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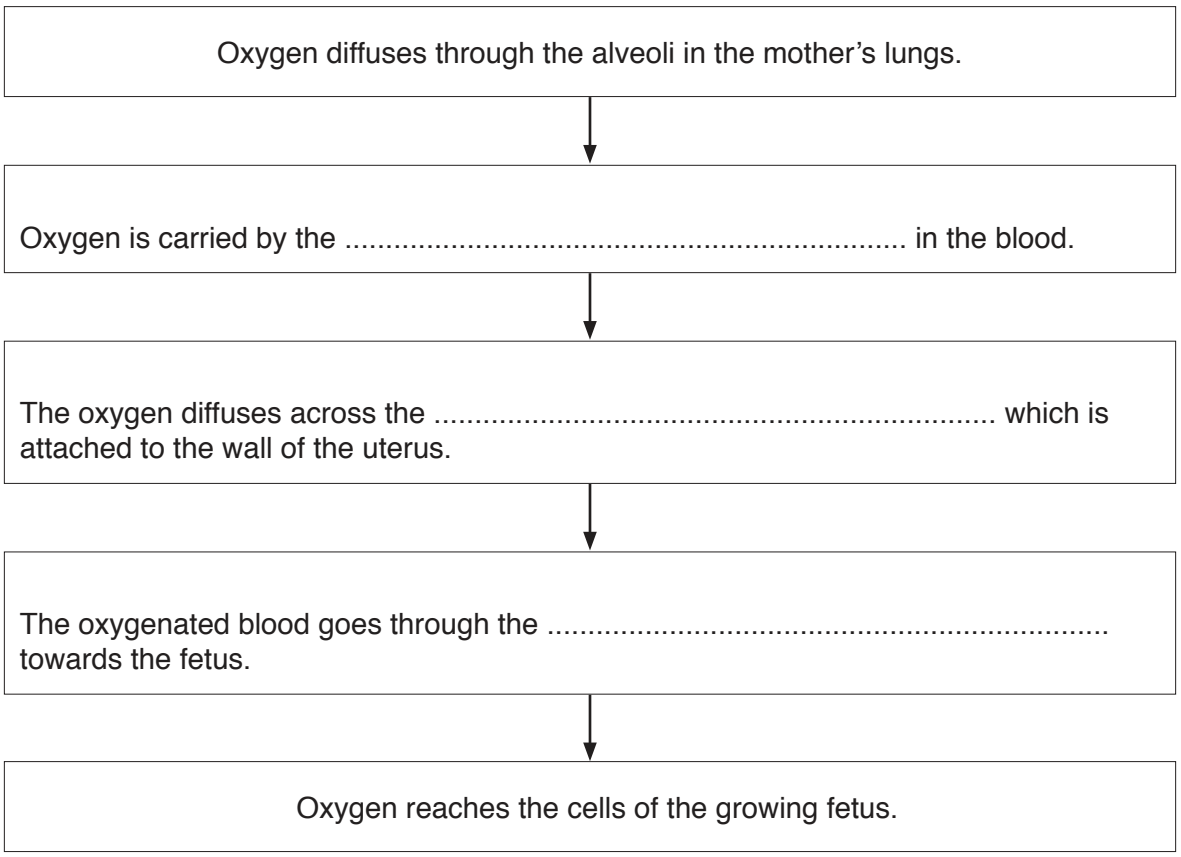
1 **(a)** A fetus is the name given to a developing baby in the later stages of pregnancy.

Use the following words or phrases to complete the flow chart about the supply of oxygen to a growing fetus.

Each word or phrase may be used once, more than once or not at all.

amniotic fluid **diaphragm** **placenta** **plasma**

red blood cells **trachea** **umbilical cord** **white blood cells**



[3]

(b) Fig. 1.1 shows flow charts of how identical and non-identical twins occur.

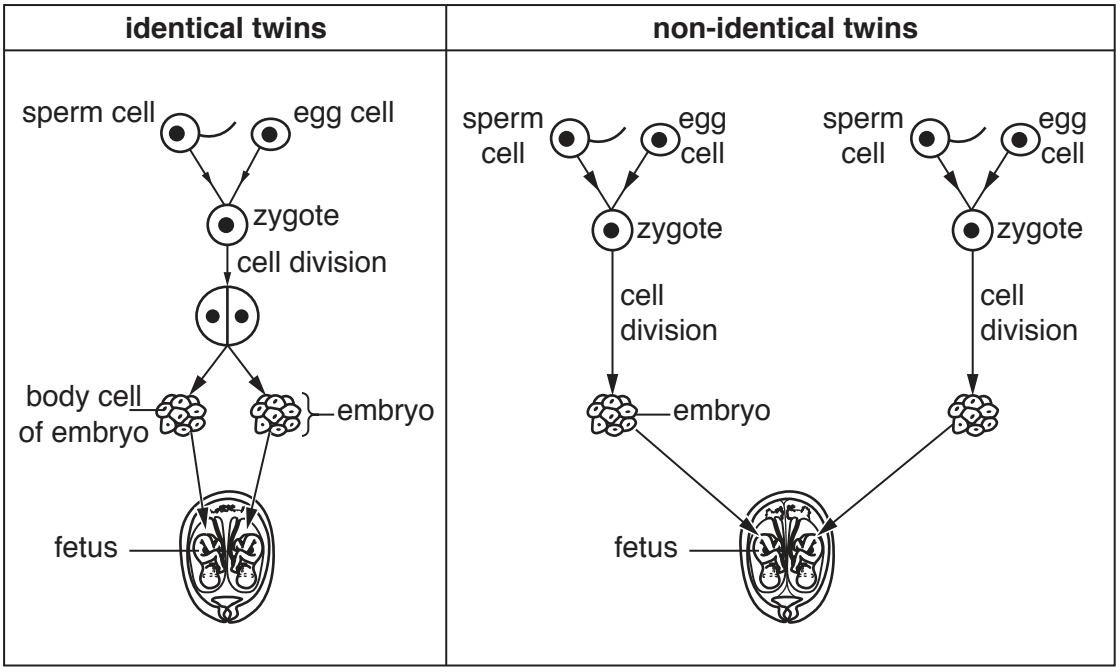


Fig. 1.1

Use Fig. 1.1 to name

1. a haploid cell, ...

2. a diploid cell. .....

[2]

(c) Fig. 1.1 shows how the genetic material in the nuclei of the cells is passed from the egg and sperm to the fetus.

Taking each pair of twins in turn, predict whether the genetic material in their body cells is similar or different from each other.

Explain your answers.

identical twins .....

.....

.....

non-identical twins .....

.....

.....

[3]

(d) Fig. 1.2 shows one of the cells from a growing fetus.

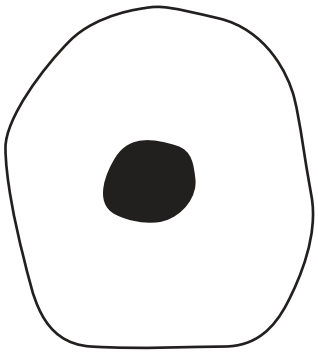


Fig. 1.2

(i) Identify the cell parts on Fig. 1.2 using label lines and the letters **C** and **R**.

Use **C** to show the part which controls what enters and leaves the cell.

Use **R** to show where chemical reactions, such as respiration, take place. [2]

(ii) Complete the balanced symbolic equation for aerobic respiration.

..... + ...O_2 → .....CO_2 + ... [2]

2 **(a)** A student places identical sized pieces of four metals, **A**, **B**, **C** and **D**, into separate beakers containing dilute hydrochloric acid, HC*l*, of the same concentration, volume and temperature.

The gas made during the reactions with the acid is collected, as shown in Fig. 2.1.

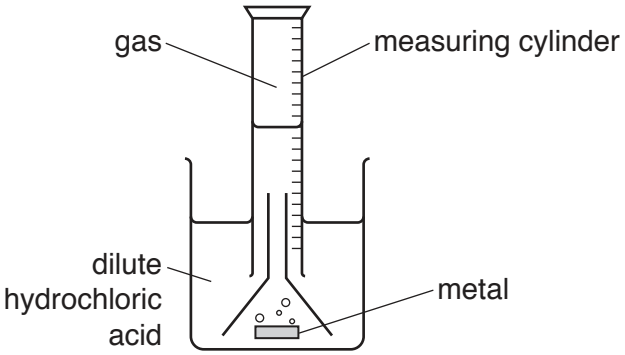


Fig. 2.1

The total volume of the gas that is collected is measured every two minutes.

Table 2.1 shows the volumes of the gas that the student records.

Table 2.1

metal	total volume of gas collected / cm^3			
	2 minutes	4 minutes	6 minutes	8 minutes
A	7	13	17	20
B	1	2	3	4
C	3	5	6	7
D	10	15	18	20

(i) Using the information in Table 2.1, deduce the order of reactivity of the four metals, from most to least reactive.

..... most reactive

.....

.....

..... least reactive

[1]

(ii) State which of these four metals forms positive ions

most readily, ...

least readily. .....

[1]

(iii) Using the information in Table 2.1, state when the rate of the reaction between metal **D** and dilute hydrochloric acid is the greatest.

.....[1]

(iv) Describe and explain, in terms of particle collisions, the effect of increasing the temperature on the rate of reaction.

effect .....

explanation .....

.....

.....
[2]

(b) When iron reacts with dilute hydrochloric acid, a solution of an iron salt is made.

The student thinks that this salt contains iron(II) ions.

Another student thinks that the salt contains iron(III) ions.

They add dilute sodium hydroxide solution to a sample of the iron salt solution.

Describe the observations that are expected for iron(II) ions and for iron(III) ions.

iron(II) ions .....

iron(III) ions .....
[2]

(c) The arrangements of particles in four substances are shown in Fig. 2.2.

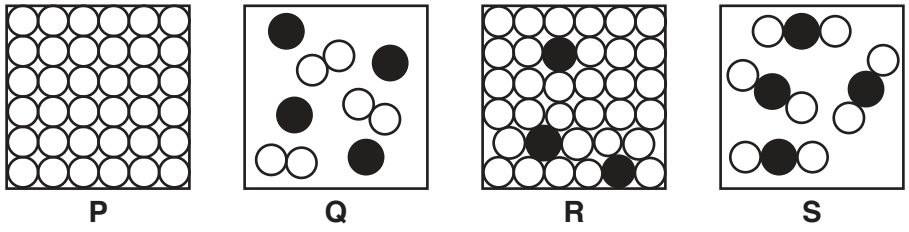


Fig. 2.2

(i) State which arrangement, **P**, **Q**, **R** or **S**, represents the structure of an alloy.

..... [1]

(ii) Explain why iron is used in the form of alloys, rather than as pure iron, for kitchen knives.

.....

.....

.....[1]

3 Fig. 3.1 shows a helicopter hovering above the ground.

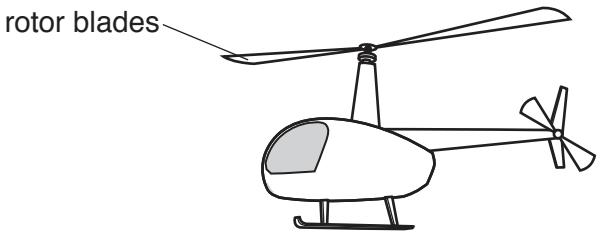


Fig. 3.1

(a) The helicopter stays in one place as it hovers. The turning rotor blades provide the uplift force to keep it in the air.

On Fig. 3.1 draw two force arrows to show the vertical forces acting on the helicopter.

Label each arrow with the name of the force acting on the helicopter. [3]

(b) The helicopter uses fuel to power its engines which turn the rotor blades. The pilot increases the speed of the rotor blades and the helicopter climbs vertically to a height of 1000 m. It then hovers again at this height.

Complete the sequence of energy transfers for the helicopter below.

..... energy in the fuel

→ kinetic ..... energy of the rotor blades

→ kinetic ..... energy of the climbing helicopter

→ ..... energy of the helicopter at 1000 m. [2]

(c) Fig. 3.2 shows the speed-time graph for a helicopter journey.

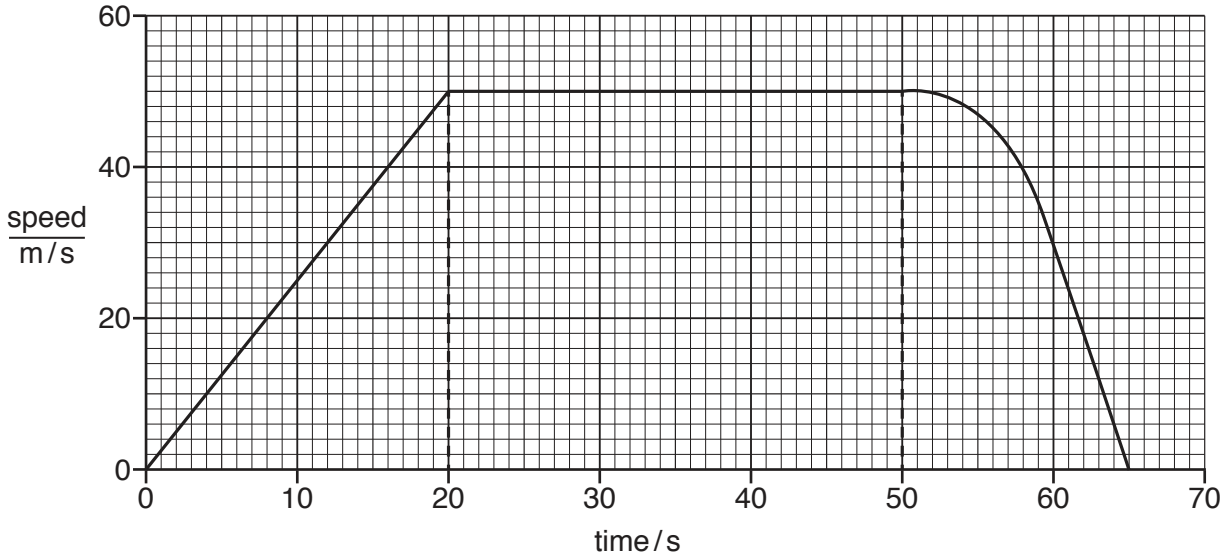


Fig. 3.2

(i) Use Fig. 3.2 to calculate the initial acceleration of the helicopter from rest to constant speed.

Show your working and give the units of your answer.

acceleration = ... unit ..... [2]

(ii) Use Fig. 3.2 to calculate the distance moved by the helicopter in the first 50 seconds of this journey.

Show your working on the graph or below.

distance = ... m [2]

(iii) Describe the motion of the helicopter between 50 s and 65 s.

.....

.....[1]

4 **(a)** A student does an experiment to investigate the germination of barley seeds. The treatment of the seeds before the experiment is shown in Table 4.1.

Table 4.1

seed	treatment of seeds before the experiment	pH of soaking solution
A	boiled in water for 10 minutes	7
B	soaked at room temperature for a few hours	3
C	soaked at room temperature for a few hours	7

- After treatment, a piece of each seed is placed on an agar plate containing starch.
- After two days an iodine solution is added to the plate which shows the area of starch remaining on the plate.

The results are shown in Fig. 4.1.

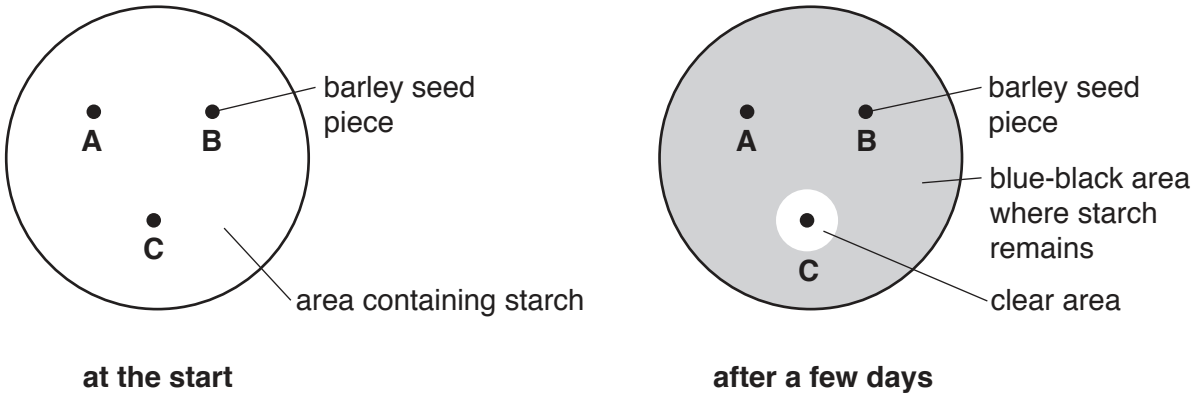


Fig. 4.1

The student thinks that an enzyme is produced by the barley seed which causes the starch to be broken down in the clear area.

Explain in detail how the results for seed **A** and seed **B**, shown in Fig. 4.1, support this idea.

seed **A** .....

.....

.....

seed **B** .....

.....

.....

[3]

(b) Germinating seeds use their store of energy until the young seedlings have chlorophyll in their leaves. Chlorophyll is needed for photosynthesis.

Describe the role of chlorophyll in photosynthesis.

.....

.....

.....[2]

5 **(a)** Explain why the proportion of carbon dioxide in the air is increasing.

Suggest why some people are concerned about this increase.

.....

.....

.....[2]

(b) The structure of ethanol is shown in Fig. 5.1.

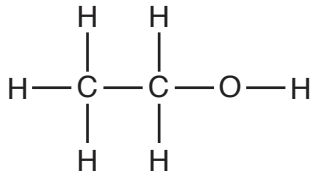


Fig. 5.1

Deduce the formula of ethanol.

.....[1]

(c) Octane, C_8H_{18}, and methane are obtained from petroleum by fractional distillation.

(i) State and explain the difference in the boiling points of octane and methane.

Use ideas about molecular size and intermolecular attractive forces in your answer.

.....

.....

.....

.....

.....[2]

(ii) Complete the balanced symbolic equation for the complete combustion of octane.

$2C_8H_{18}$ + ... O_2 → ..... + ...

[2]

(d) Ethene is manufactured by breaking down larger hydrocarbon molecules obtained from the fractional distillation of petroleum.

(i) Name this process.

.....[1]

(ii) Ethene and ethane are two different types of hydrocarbon.

Name these two different types of hydrocarbon.

ethene .....

ethane .....
[1]

6 Fig. 6.1 shows a radiator which uses hot water to provide heating for people sitting in a room watching television.

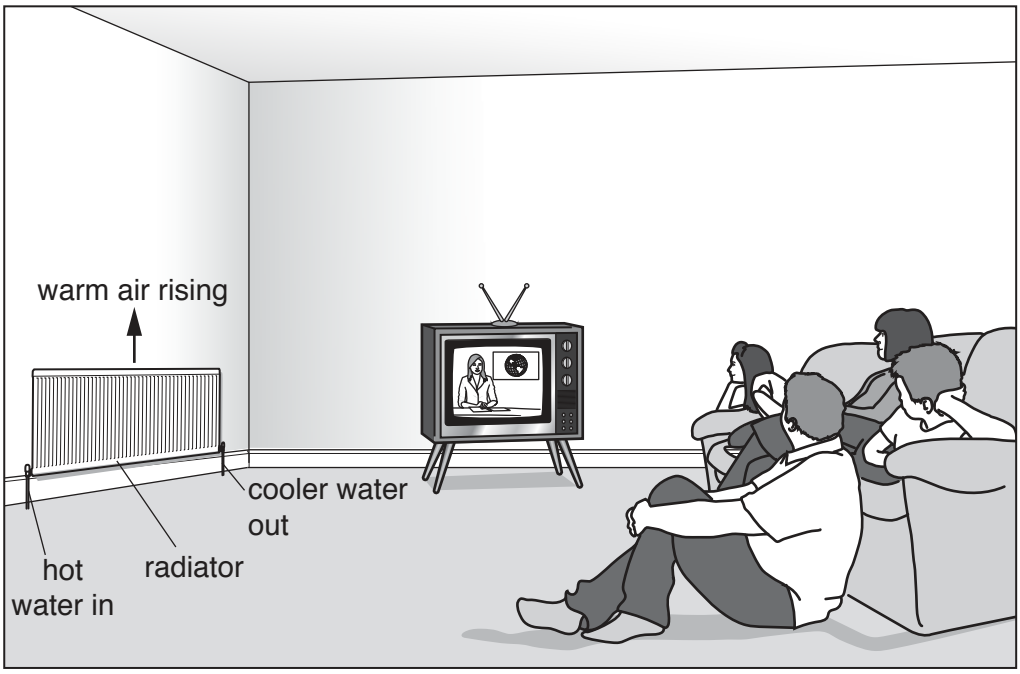


Fig. 6.1

(a) Describe, in terms of the motion of the atoms and molecules, how thermal energy is conducted from the hot water inside the radiator through the solid radiator.

.....

.....

.....

.....[2]

(b) **(i)** On Fig. 6.1 complete a sequence of **five** arrows to show how the warm air from the radiator is able to transfer thermal energy to the people sitting in the room and return as cool air to the radiator. [2]

(ii) Explain why the air moves around the room in this way.

.....

.....

.....

.....[2]

(c) Television signals use electromagnetic waves.

Fig. 6.2 shows the electromagnetic spectrum.

gamma	X-rays	ultraviolet	visible	infra-red	microwaves	radio

Fig. 6.2

The aerial on the television set receives a signal from a television transmitter on a nearby hill.

State the type of electromagnetic waves received by the television set.

.....[1]

(d) The people in the room are watching a game of football on the television. The game is being played in a stadium two kilometres away.

A goal is scored and the crowd shouts very loudly. The people in the room hear the sound on the television, and a few seconds later they hear the sound directly from the stadium coming through the window.

Explain why they hear the sound of the crowd at different times.

.....

.....

.....[2]

[Turn over

7 **(a)** Fig. 7.1 shows a longitudinal section of a capillary next to some tissue cells.

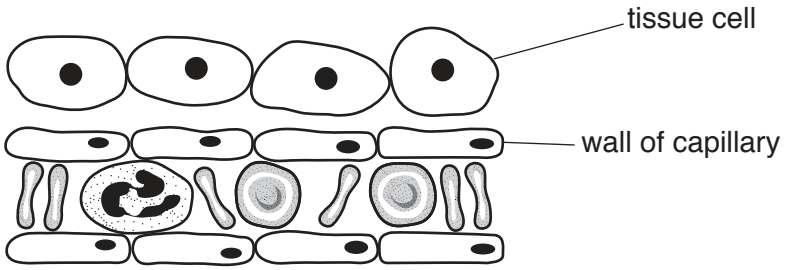


Fig. 7.1

(i) On Fig. 7.1 draw an arrow to show the direction of the net movement of oxygen molecules by diffusion. [1]

(ii) Explain your answer to **(i)**.

.....

.....[1]

(b) Fig. 7.2 shows a diagram of a root hair cell. It absorbs water by diffusion.

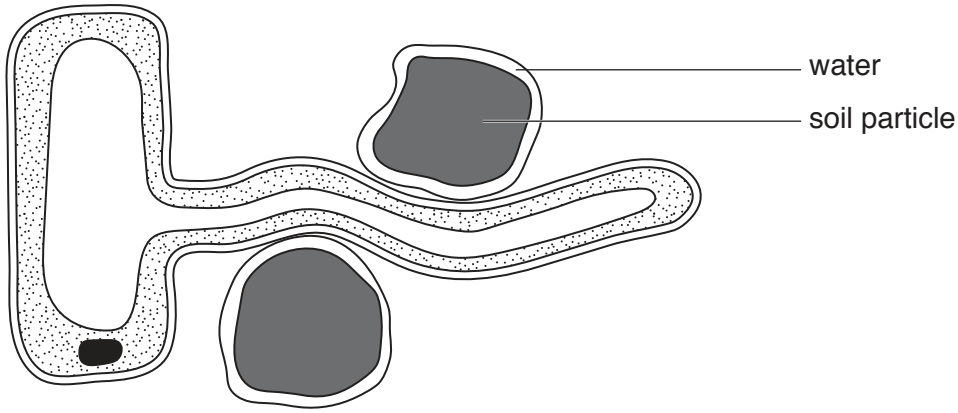


Fig. 7.2

(i) Describe how the structure of the root hair cell is adapted for its function.

.....

.....

.....[2]

(ii) A large amount of salt is added to the soil. The salt dissolves in the water in the soil.

Suggest what happens to the rate of diffusion of water into the root hair cell.

Explain your answer.

.....

.....

.....[2]

(c) Some fertiliser is washed by rain into a pond.

The fertiliser causes the algae on the surface of the pond to reproduce rapidly and cover the surface of the pond. Many algae and plants beneath the surface die due to lack of light.

Describe the changes that follow in the pond which can cause fish in the pond to die.

.....

.....

.....

.....[3]

8 **(a)** A student tries to produce chlorine gas and copper by electrolysis.

He uses solid copper chloride, as shown in Fig. 8.1.

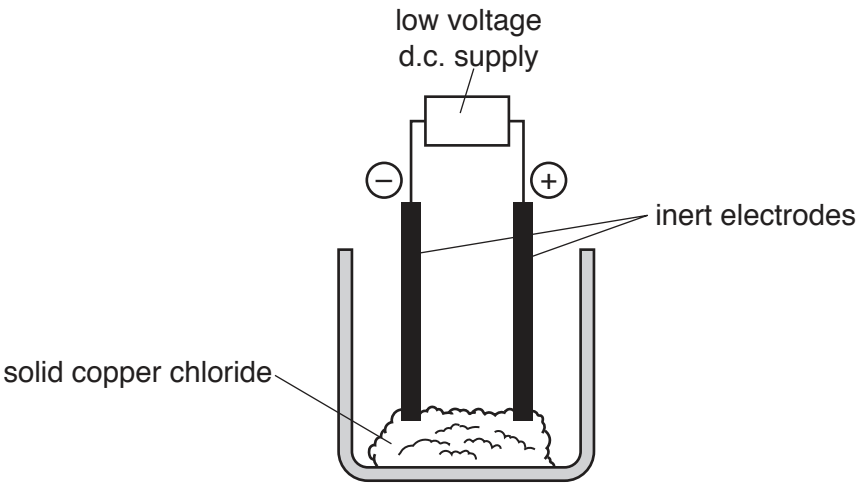


Fig. 8.1

(i) Describe **one** change that the student must make to produce chlorine gas and copper.

Explain, in terms of the ions present, why the student must do this.

change .....

explanation .....

.....

[2]

(ii) The atomic number of chlorine is 17.

Complete Fig. 8.2 to show the electronic structure of a chlorine atom.

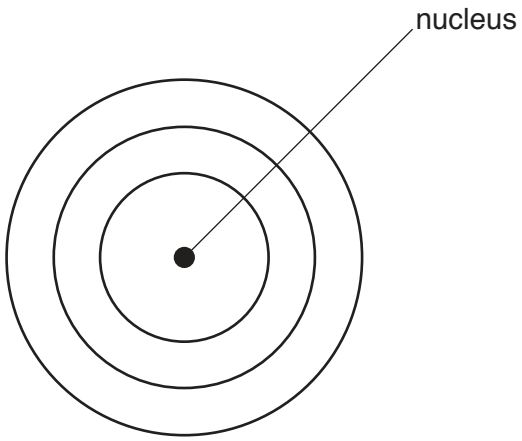


Fig. 8.2

[1]

(iii) Complete the dot-and-cross diagram of a molecule of chlorine, Cl_2, in Fig. 8.3.

Show all of the outer shell electrons only.

Cl Cl

Fig. 8.3

[2]

(b) Copper can be produced by heating copper oxide with carbon.

(i) The reaction between carbon and copper oxide is endothermic.

State the energy change that occurs in an endothermic reaction.

..... energy → ..... energy [1]

(ii) In the reaction between carbon and copper oxide, oxygen is removed from copper.

State the type of reaction that involves the loss of oxygen.

.....[1]

(iii) Copper can be extracted from its ore by reaction with carbon and by electrolysis.

Group I metals are only extracted by electrolysis.

Relate the method of extraction of a metal from its ore to its position in the reactivity series.

.....

.....

.....

.....[2]

9 In a theatre, spotlights are used to shine a beam of light on one person on the stage.

Fig. 9.1 shows a spotlight shining a parallel beam of light on a singer.

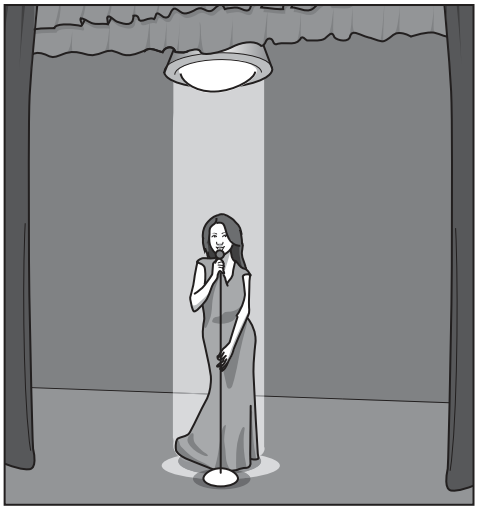


Fig. 9.1

(a) Fig. 9.2 shows a powerful lamp shining through a narrow hole in front of a lens inside the spotlight.

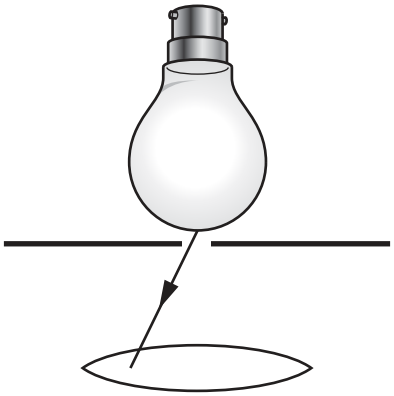


Fig. 9.2

On Fig. 9.2 use a ruler to draw three rays that come through the narrow hole, pass through the lens and emerge parallel to each other to form a narrow beam of light.

One ray has been started for you. [2]

(b) Fig. 9.3a shows the way the lamps in two identical spotlights are connected to the electricity supply. The circuit contains a dimmer control so that the brightness of the lights can be changed.

Fig. 9.3b shows part of the circuit diagram for this.

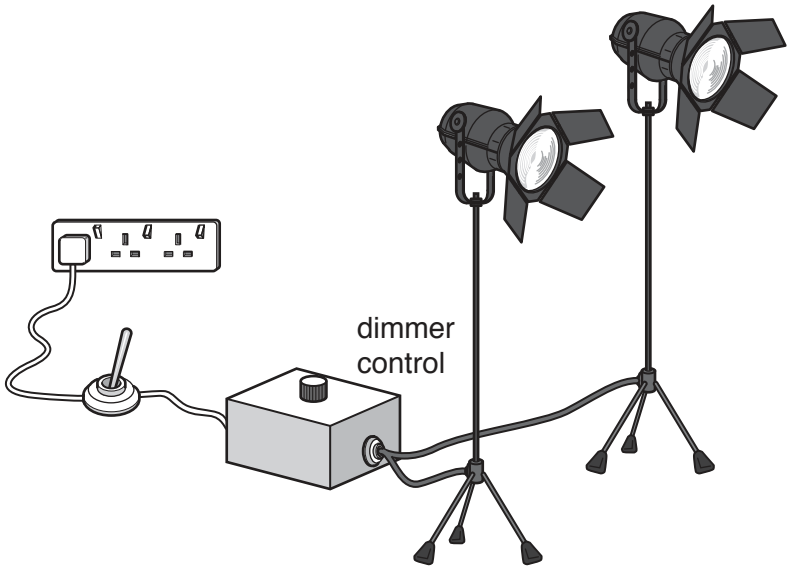


Fig. 9.3a

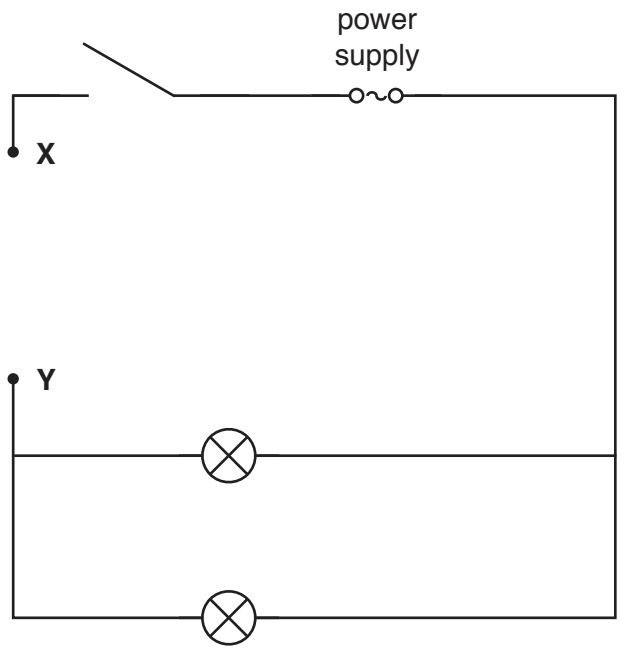


Fig. 9.3b

(i) The dimmer control contains a variable resistor.

On Fig. 9.3b complete the circuit diagram by connecting the variable resistor into the circuit between **X** and **Y** using the correct circuit symbol. [1]

(ii) The dimmer control is set so that the current through one of the lamps is 10 A.

State the current in the main circuit. Explain your answer.

current = ... A

explanation .....

.....

[2]

(iii) The filament of one of the lamps breaks.

State what will happen to the other lamp. Give a reason for your answer.

.....

.....

.....[1]

(c) One lamp has a label as shown in Fig. 9.4.

Voltage = 240 V
Maximum power = 3000 W

Fig. 9.4

(i) Use the formula $P = IV$ to calculate the maximum current through the lamp.

Show your working.

current = ... A [1]

(ii) Describe how to set the variable resistor in the dimmer control to provide maximum power in the lamp.

.....

.....[1]

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The Periodic Table of Elements

Group I	Group II											Group III	Group IV	Group V	Group VI	Group VII	Group 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 –		

Key

atomic number
atomic symbol
name
relative atomic mass

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.).