



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS  
General Certificate of Education Ordinary Level

CANDIDATE  
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**COMBINED SCIENCE**

**5129/21**

Paper 2

**October/November 2012**

**2 hours 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 a soft pencil for any diagrams, graphs 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 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.

**For Examiner's Use**

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This document consists of **23** printed pages and **1** blank page.



1 Use words from the list to complete the sentences below.

**antibodies**    **enzymes**    **fibrin**    **fibrinogen**    **hormones**  
**platelets**    **plasma**    **red**    **white**    **water**

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

The liquid part of the blood is called .....

This liquid contains several different types of blood cell.

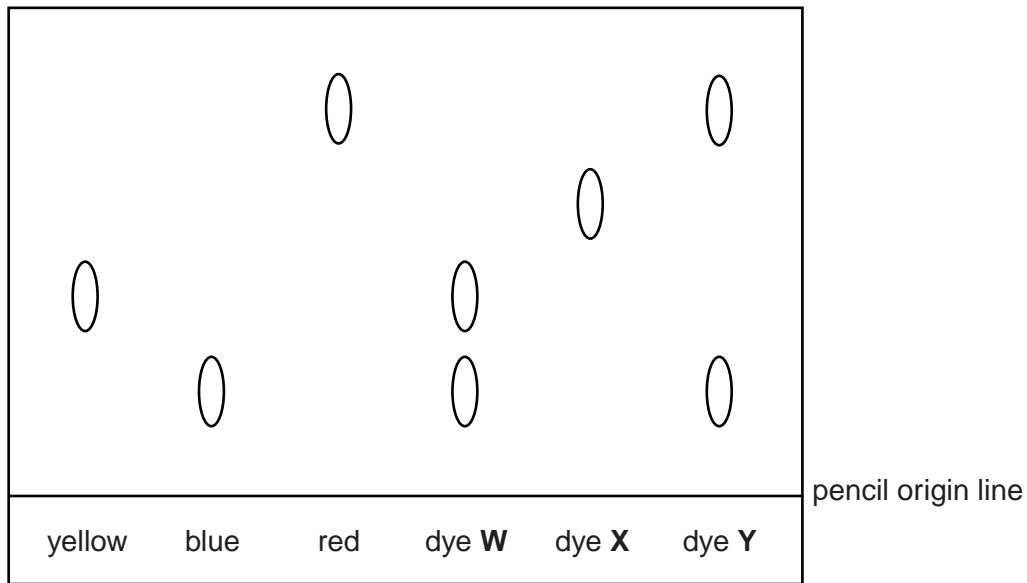
The function of the ..... blood cells is to carry oxygen.

The ..... blood cells carry out phagocytosis and produce  
.....

The platelets help the blood to clot by turning .....  
into .....

[6]

- 2 Fig. 2.1 shows a paper chromatogram obtained from three coloured dyes and three unknown dyes **W**, **X** and **Y**.



**Fig. 2.1**

- (a) Explain why the origin line on the chromatography paper is drawn using a pencil rather than a pen.

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

- (b) Which coloured dyes are present in dye **W**?

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

- (c) Which of the unknown dyes **W**, **X** or **Y** is a pure substance?

Explain your answer.

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

- 3 A student measures the time for 20 complete oscillations of a pendulum. She repeats the experiment for different lengths of the pendulum.

The results are shown in Fig. 3.1.

length/m	time for 20 oscillations/s	period/s
0.30	22.0	1.10
0.80	35.8	
1.20	44.0	2.20

**Fig. 3.1**

- (a) (i) Complete Fig. 3.1 by calculating the period of the pendulum for a length of 0.80 m.

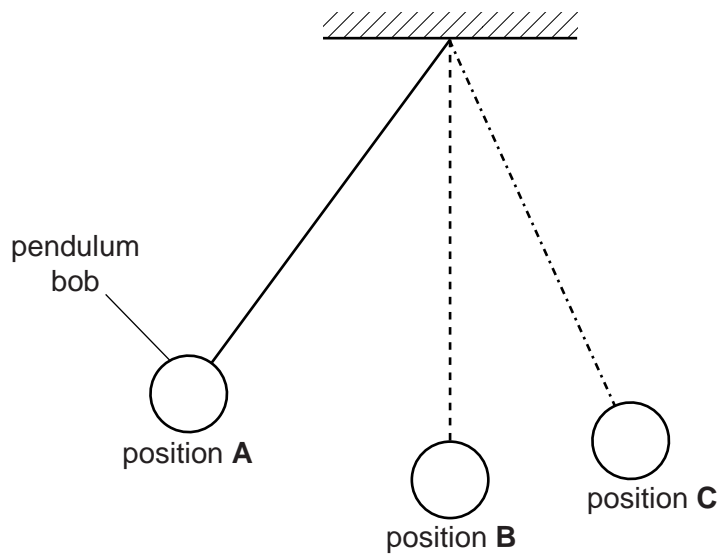
[1]

- (ii) Using the results from Fig. 3.1, state how the period of a pendulum varies with its length.

.....

..... [1]

- (b) Three different positions of a swinging pendulum are shown in Fig. 3.2.



**Fig. 3.2**

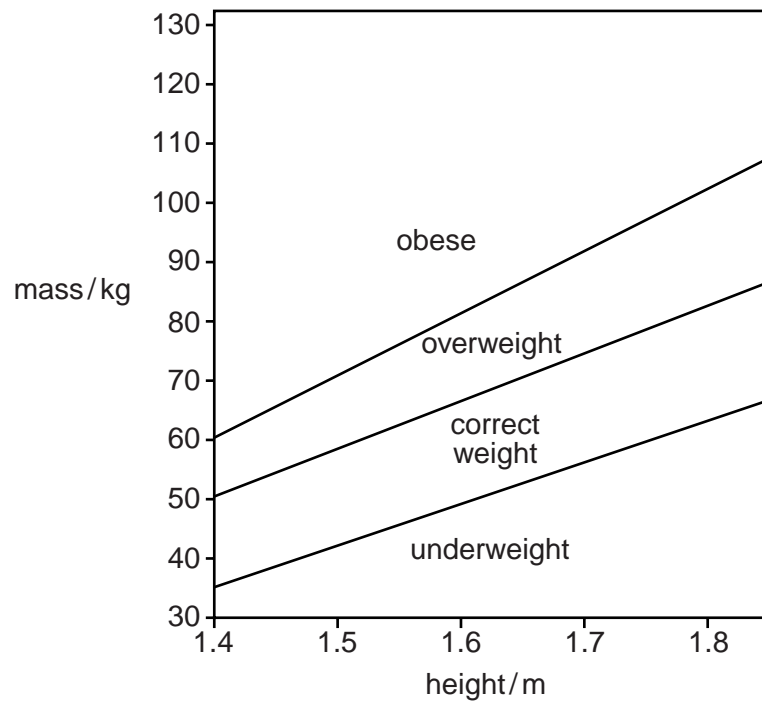
- (i) State the letter of the position or positions where the pendulum has most kinetic energy.

..... [1]

- (ii) State the energy changes that take place as the pendulum swings from position A to position B.

from ..... to ..... [1]

4 Information about the height and mass of humans is given in Fig. 4.1.



**Fig. 4.1**

The heights and masses of four students are:

student A	1.75 m and 88 kg
student B	1.65 m and 65 kg
student C	1.82 m and 58 kg
student D	1.45 m and 70 kg

(a) State which student is obese and which student has the correct weight.

obese student .....

student with correct weight .....

[2]

(b) Table 4.1 gives information about the energy and nutrients provided by 1.0 kg types of food.

**Table 4.1**

food	energy /kJ	protein /g	fat /g	carbohydrate /g
oily fish	9700	170	190	0
eggs	6700	120	120	0
cheese	16000	250	310	0
milk	2900	31	39	50
beef	13000	150	280	0
leafy vegetables	1100	27	0	38

(i) An obese student wishes to reach a correct body mass.

Name two foods in Table 4.1 that he should avoid.

1 .....

2 .....

[2]

(ii) Suggest **another** way, other than eating different foods, by which this student could reduce his body mass.

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

(c) Leafy vegetables provide fibre in the diet.

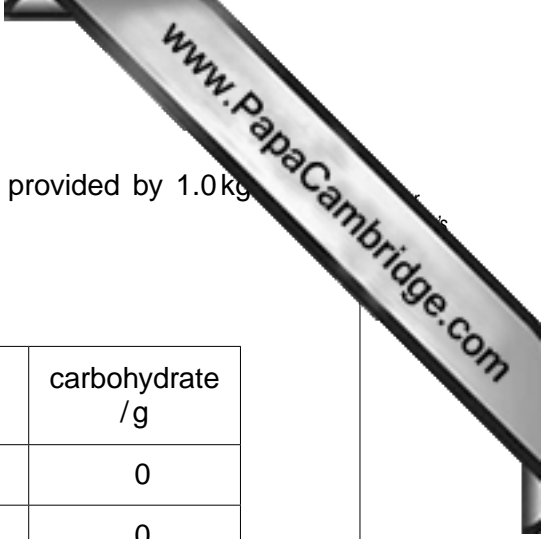
Explain

(i) what is meant by fibre,

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

(ii) why it is important to include fibre in the diet.

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



5 Fig. 5.1 shows the structure of an atom of carbon.

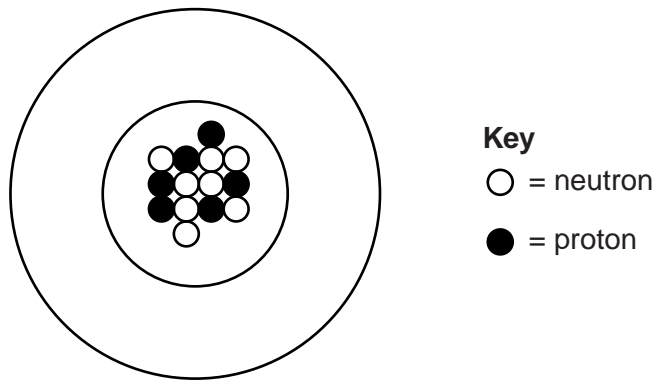


Fig. 5.1

(a) For this atom, state

(i) the nucleon number, .....

(ii) the proton number. ....

[2]

(b) Complete Fig. 5.1 to show the electronic structure of an atom of carbon.

[1]

(c) Carbon combines with hydrogen to form methane,  $\text{CH}_4$ .

State the type of bonding present in methane and explain fully how the bonds are formed.

type of bonding .....

explanation .....

.....

.....

[3]



6 Two lamps are connected in parallel, as shown in Fig. 6.1.

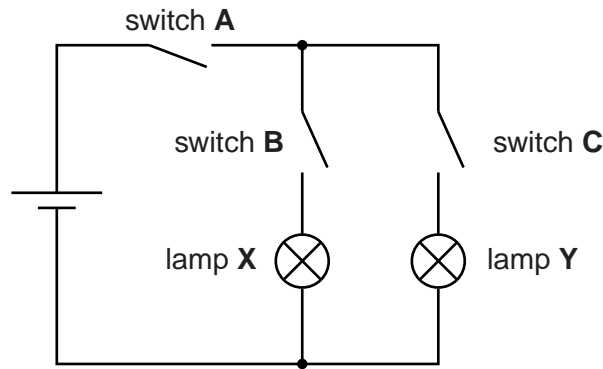


Fig. 6.1

(a) There are three switches **A**, **B** and **C** in the circuit.

State which switch, or switches, are closed to light lamp **Y** only.

..... [1]

(b) With all the switches closed, the current in lamp **X** is 0.2 A.

(i) The current from the cell is 0.5 A.

Calculate the current in lamp **Y**.

current = ..... A [1]

(ii) The potential difference across lamp **X** is 1.5 V.

Calculate the resistance of lamp **X**.

resistance = ..... unit ..... [3]

7 The boxes on the left state processes carried out in the body.

The boxes on the right represent organs in the body.

Draw **one** line from each process to the organ where the process takes place.

**process**

breaks down  
alcohol

destroys  
hormones

excretes  
carbon dioxide

excretes urea

forms urea

**organ**

kidney

liver

lung

[5]

8 The formula of sulfuric acid is  $\text{H}_2\text{SO}_4$ .

The formula of sodium hydroxide is  $\text{NaOH}$ .

(a) (i) Name the ion that causes acidity.

..... [1]

(ii) Name the ion that causes alkalinity.

..... [1]

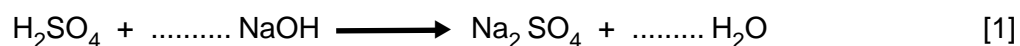
(b) When sulfuric acid is added to sodium hydroxide the solution becomes neutral.

(i) What is the pH of the solution when it is exactly neutral? ..... [1]

(ii) What is the colour of Universal Indicator in the neutral solution?

..... [1]

(iii) Balance the equation for the reaction between sulfuric acid and sodium hydroxide.

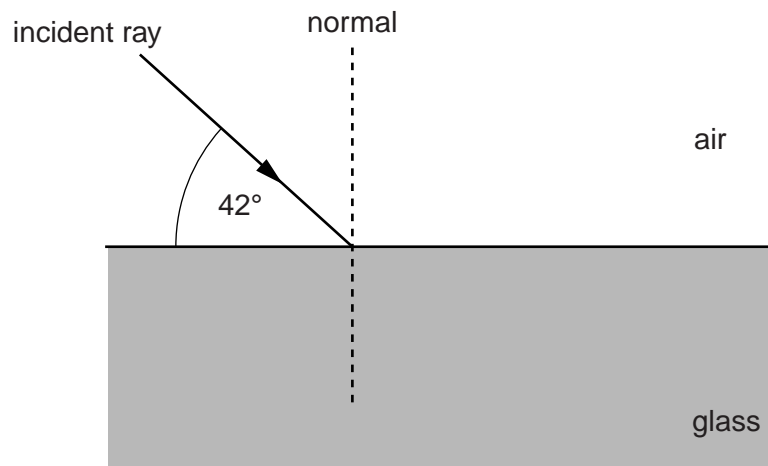


(iv) Construct the ionic equation for the reaction between an acid and an alkali.

..... [1]



- 9 Fig. 9.1 shows a ray of light incident on the surface of a glass block. The glass block is



**Fig. 9.1**

- (a) (i) Some of the incident light is reflected.

On Fig. 9.1, draw the reflected ray.

[1]

- (ii) Calculate the angle of reflection.

angle of reflection = ..... $^\circ$  [1]

- (b) Some of the incident light is refracted.

On Fig. 9.1, draw the refracted ray.

[1]

10 Fig. 10.1 shows the male reproductive system.

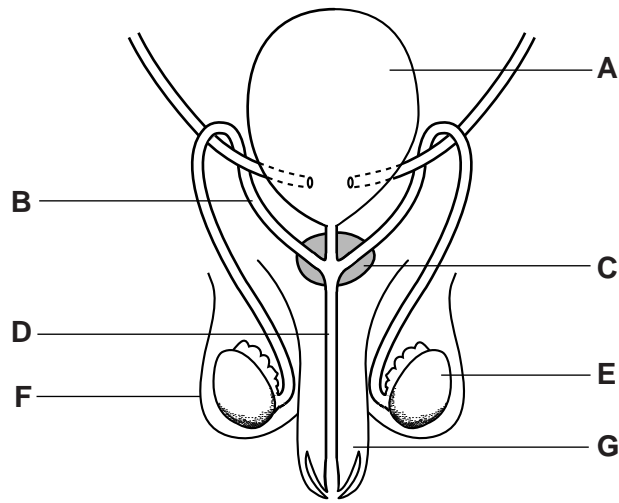


Fig. 10.1

(a) (i) Use the letters on Fig. 10.1 to identify the

prostate gland .....

testis .....

urethra .....

[3]

(ii) State a reproductive function of each of the following structures.

prostate gland .....

.....

testis .....

.....

urethra .....

.....

[3]



(iii) Explain the importance of the scrotum for the production of healthy sperm.

.....

.....

.....

..... [2]

(b) One method of male birth control involves a surgical procedure.

On Fig. 10.1, mark with an **X** one of the tubes a surgeon would cut when carrying out this procedure. [1]

11 Study the reaction scheme in Fig. 11.1.

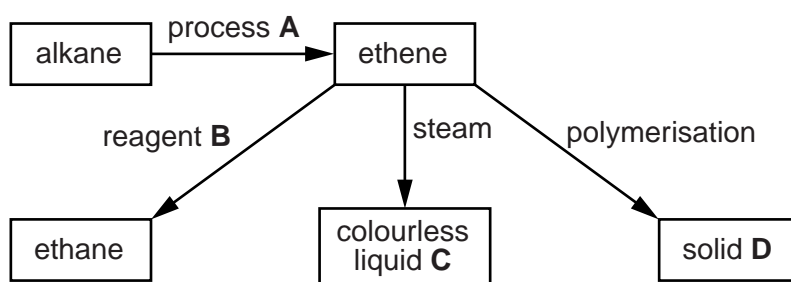


Fig. 11.1

(a) (i) Identify the process **A**. ..... [1]

(ii) Identify substances **B**, **C** and **D**.

reagent **B** .....

colourless liquid **C** .....

solid **D** ..... [3]

(b) Bromine water is used to show that ethene is an unsaturated hydrocarbon.

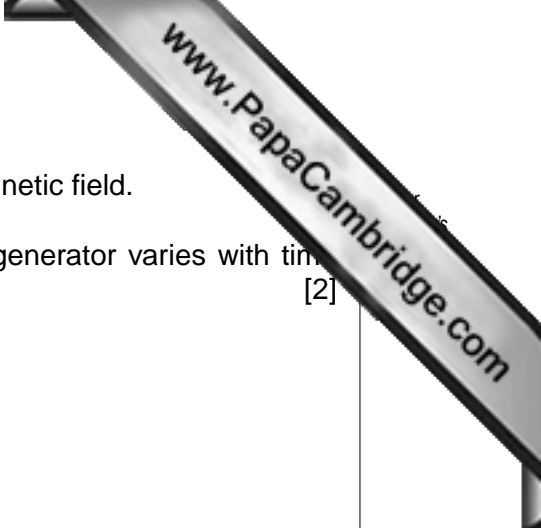
(i) What is meant by the term *unsaturated*?

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

(ii) How does the colour of the bromine water change when it is added to ethene?

..... [1]





12 A simple a.c. generator consists of a coil rotating in a uniform magnetic field.

- (a) Complete Fig. 12.1 to show how the voltage output of the generator varies with time during one rotation of the coil. [2]

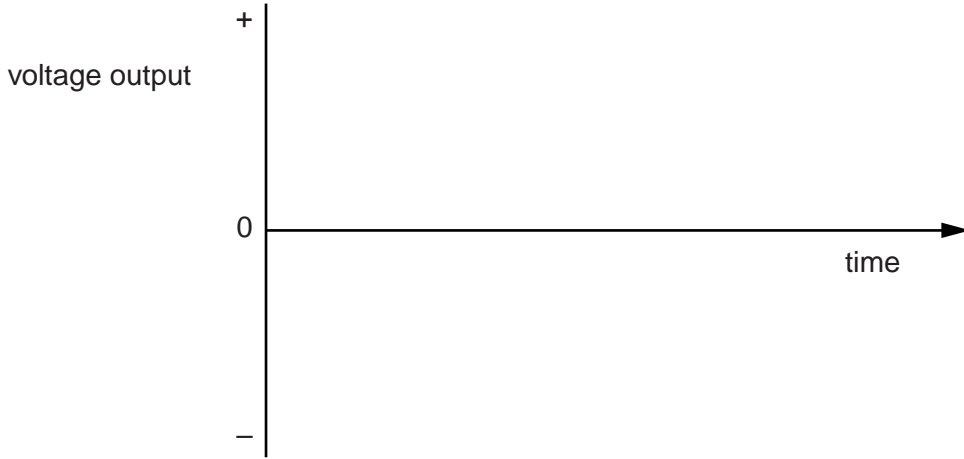


Fig. 12.1

- (b) State two factors affecting the size of the maximum voltage output of the generator.

1. ....

2. .... [2]

- (c) The generator has an average power output of 200W.

Calculate the electrical energy produced in 5 minutes.

energy = ..... J [2]

13 (a) Describe the intake of water by plants.

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

(b) Fig. 13.1 shows the appearance of a healthy plant at 07.00 hours.

Fig. 13.2 shows the appearance of the same plant 14 hours later.

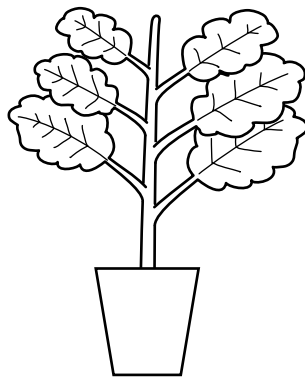


Fig. 13.1

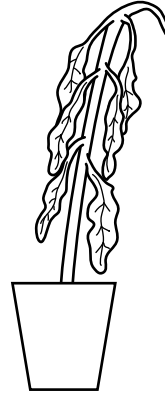


Fig. 13.2

(i) State what has happened to this plant.

..... [1]

(ii) Explain what has caused this change.

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

14 (a) Define *relative molecular mass*.

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

(b) When it is heated, sodium hydrogen carbonate decomposes to form sodium carbonate, carbon dioxide and water.

The equation for the reaction is



The relative molecular mass,  $M_r$ , of sodium hydrogen carbonate is 84.  
( $A_r$ : Na, 23; O, 16; C, 12; H, 1)

Complete the following sentences.

168 g of sodium hydrogen carbonate produces .....g of sodium carbonate and .....g of carbon dioxide.

16.8 g of sodium hydrogen carbonate produces .....g of sodium carbonate and .....g of carbon dioxide.

4.2 g of sodium hydrogen carbonate produces .....g of sodium carbonate. [4]

15 A measuring cylinder contains  $32\text{ cm}^3$  of water.

A stone is added to the measuring cylinder, as shown in Fig. 15.1.

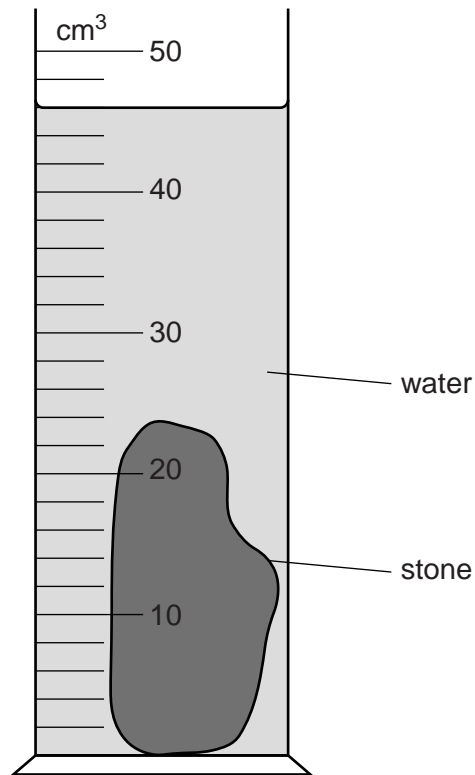


Fig. 15.1

(a) Use Fig. 15.1 to calculate the volume of the stone.

volume = .....  $\text{cm}^3$  [1]

(b) The density of the stone is  $3.0\text{ g/cm}^3$ .

Calculate the mass of the stone.

mass =

g [2]

16 A metal can is filled with hot water and placed on a metal table, as shown in Fig. 16.1.

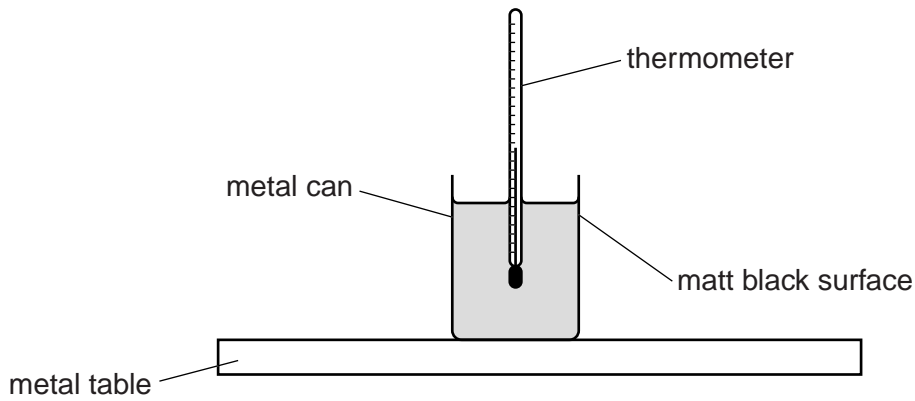


Fig. 16.1

The surface of the metal can is matt black.

The temperature is seen to fall quickly.

(a) Explain why the temperature falls more slowly when

(i) the can is placed on a wooden table,

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

(ii) the surface of the can is shiny white instead of matt black.

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

(b) Air above the can becomes heated and rises.

Explain why hot air rises.

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

(c) A laboratory liquid-in-glass thermometer is used to measure the temperature of the water.

Explain two differences between a laboratory liquid-in-glass thermometer and a clinical liquid-in-glass thermometer.

1. ....  
.....
2. ....  
.....

17 Fig. 17.1 shows some properties of five elements, **A**, **B**, **C**, **D** and **E**.

The letters are not the symbols of the elements.

element	melting point /°C	boiling point /°C	electronic structure
<b>A</b>	-248	-246	2,8,8
<b>B</b>	-7	59	2,8,18,7
<b>C</b>	63	766	2,8,1
<b>D</b>	119	444	2,8,6
<b>E</b>	659	2447	2,8,3

**Fig. 17.1**

Use the letters **A–E** to answer the questions.

(a) Which element is a liquid at room temperature? ..... [1]

(b) Which element is in Group 3 of the Periodic Table? ..... [1]

(c) Which element is a **solid** non-metal at room temperature?

Explain why you have chosen this element.

element .....

explanation .....

.....

[3]

18 (a) State the sign of the charge on the nucleus of an atom.

..... [1]

(b) Explain why an electron is attracted to the nucleus of an atom.

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

(c) Some nuclei are unstable and emit gamma-rays.

State the speed of gamma-rays in a vacuum. ....m/s [1]

19 Fig. 19.1 shows a mains plug.

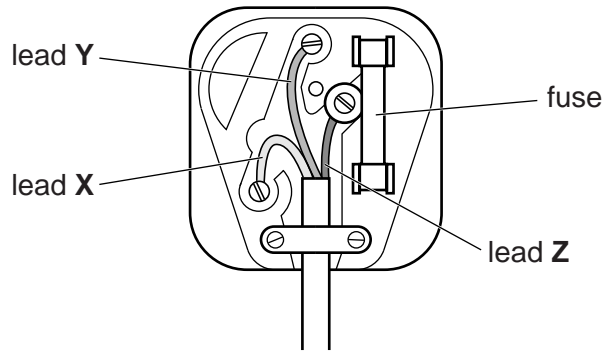


Fig. 19.1

(a) Identify the leads X, Y and Z.

X .....

Y .....

Z .....

[2]

(b) The fuse has a rating of 10A.

Explain what is meant by a fuse *rating*.

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

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**DATA SHEET**  
**The Periodic Table of the Elements**

		Group																															
I	II	III	IV	V	VI	VII	0					0																					
7 <b>Li</b> Lithium 4	9 <b>Be</b> Beryllium 4	1 <b>H</b> Hydrogen 1	11 <b>B</b> Boron 5	12 <b>C</b> Carbon 6	13 <b>Al</b> Aluminium 13	14 <b>Si</b> Silicon 14	15 <b>P</b> Phosphorus 15	16 <b>S</b> Sulfur 16	17 <b>Cl</b> Chlorine 17	18 <b>Ar</b> Argon 18	19 <b>F</b> Fluorine 9	20 <b>Ne</b> Neon 10																					
23 <b>Na</b> Sodium 12	24 <b>Mg</b> Magnesium 12	27 <b>Fe</b> Iron 26	28 <b>Ni</b> Nickel 28	29 <b>Cu</b> Copper 29	30 <b>Zn</b> Zinc 30	31 <b>Ga</b> Gallium 31	32 <b>Ge</b> Germanium 32	33 <b>As</b> Arsenic 33	34 <b>Se</b> Selenium 34	35 <b>Br</b> Bromine 35	36 <b>Kr</b> Krypton 36	40 <b>Ar</b> Argon 18																					
39 <b>K</b> Potassium 20	40 <b>Ca</b> Calcium 20	41 <b>Ti</b> Titanium 22	42 <b>Mo</b> Molybdenum 42	43 <b>Cr</b> Chromium 24	44 <b>Ru</b> Ruthenium 44	45 <b>Rh</b> Rhodium 45	46 <b>Pd</b> Palladium 46	47 <b>Ag</b> Silver 47	48 <b>Cd</b> Cadmium 48	49 <b>In</b> Indium 49	50 <b>Tl</b> Thallium 81	51 <b>Sb</b> Antimony 51	52 <b>Te</b> Tellurium 52	53 <b>I</b> Iodine 53	54 <b>Xe</b> Xenon 54																		
85 <b>Rb</b> Rubidium 38	86 <b>Sr</b> Strontium 38	87 <b>Y</b> Yttrium 39	88 <b>Zr</b> Zirconium 40	89 <b>Sc</b> Scandium 21	90 <b>Nb</b> Niobium 41	91 <b>Ta</b> Tantalum 73	92 <b>Hf</b> Hafnium 72	93 <b>W</b> Tungsten 74	94 <b>Re</b> Rhenium 75	95 <b>Os</b> Osmium 76	96 <b>Ir</b> Iridium 77	97 <b>Pt</b> Platinum 78	98 <b>Au</b> Gold 79	99 <b>Hg</b> Mercury 80	100 <b>Pb</b> Lead 82	101 <b>Bi</b> Bismuth 83	102 <b>Po</b> Polonium 84	103 <b>At</b> Astatine 85	104 <b>Rn</b> Radon 86														
133 <b>Cs</b> Caesium 56	137 <b>Ba</b> Barium 56	138 <b>La</b> Lanthanum 57	139 <b>Ce</b> Cerium 58	140 <b>Pr</b> Praseodymium 59	141 <b>Nd</b> Neodymium 60	142 <b>Pm</b> Promethium 61	143 <b>Sm</b> Samarium 62	144 <b>Eu</b> Europium 63	145 <b>Gd</b> Gadolinium 64	146 <b>Tb</b> Terbium 65	147 <b>Dy</b> Dysprosium 66	148 <b>Ho</b> Holmium 67	149 <b>Er</b> Erbium 68	150 <b>Tm</b> Thulium 69	151 <b>Yb</b> Ytterbium 70	152 <b>Lu</b> Lutetium 71	153 <b>Fr</b> Francium 88	154 <b>Ra</b> Radium 88	155 <b>Ac</b> Actinium 89	156 <b>Th</b> Thorium 90	157 <b>Pa</b> Protactinium 91	158 <b>U</b> Uranium 92	159 <b>Np</b> Neptunium 93	160 <b>Pu</b> Plutonium 94	161 <b>Am</b> Americium 95	162 <b>Cm</b> Curium 96	163 <b>Bk</b> Berkelium 97	164 <b>Cf</b> Californium 98	165 <b>Es</b> Einsteinium 99	166 <b>Fm</b> Fermium 100	167 <b>Md</b> Mendelevium 101	168 <b>No</b> Nobelium 102	169 <b>Lr</b> Lawrencium 103
223 <b>Fr</b> Francium 88	226 <b>Ra</b> Radium 88	227 <b>Ac</b> Actinium 89	228 <b>Th</b> Thorium 90	231 <b>Pa</b> Protactinium 91	232 <b>U</b> Uranium 92	233 <b>Np</b> Neptunium 93	234 <b>Pu</b> Plutonium 94	235 <b>Am</b> Americium 95	236 <b>Cm</b> Curium 96	237 <b>Bk</b> Berkelium 97	238 <b>Cf</b> Californium 98	239 <b>Es</b> Einsteinium 99	240 <b>Fm</b> Fermium 100	241 <b>Md</b> Mendelevium 101	242 <b>No</b> Nobelium 102	243 <b>Lr</b> Lawrencium 103	244 <b>Fr</b> Francium 88	245 <b>Ra</b> Radium 88	246 <b>Ac</b> Actinium 89	247 <b>Th</b> Thorium 90	248 <b>Pa</b> Protactinium 91	249 <b>U</b> Uranium 92	250 <b>Np</b> Neptunium 93	251 <b>Pu</b> Plutonium 94	252 <b>Am</b> Americium 95	253 <b>Cm</b> Curium 96	254 <b>Bk</b> Berkelium 97	255 <b>Cf</b> Californium 98	256 <b>Es</b> Einsteinium 99	257 <b>Fm</b> Fermium 100	258 <b>Md</b> Mendelevium 101	259 <b>No</b> Nobelium 102	260 <b>Lr</b> Lawrencium 103

The volume of one mole of any gas is 24dm<sup>3</sup> at room temperature and pressure (r.t.p.).

$a$   
 $X$   
 $b$

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

58–71 Lanthanoid series  
90–103 Actinoid series

