



Cambridge Assessment International Education
Cambridge International General Certificate of Secondary Education

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COMBINED SCIENCE

0653/31

Paper 3 (Core)

October/November 2019

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.



- 1 (a) Fig. 1.1 shows diagrams of cells as they are seen under a light microscope. They are not drawn to scale.

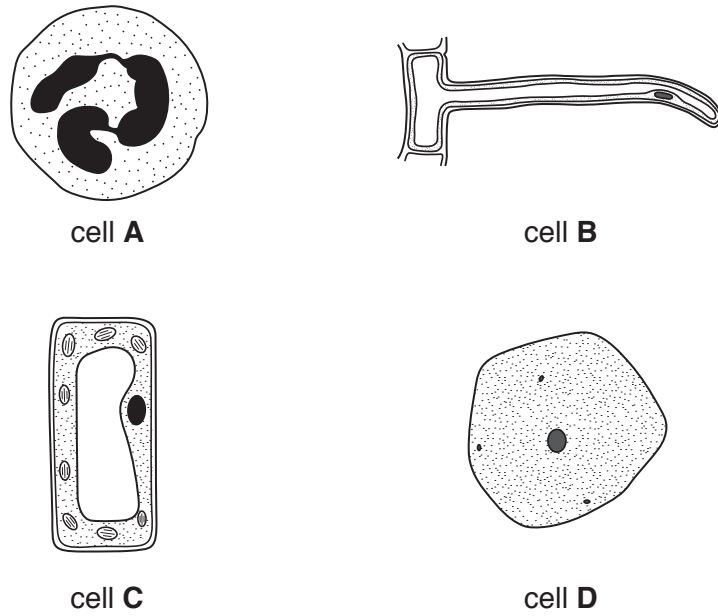


Fig. 1.1

- (i) State the letters of **two** plant cells shown in Fig. 1.1.

..... and [1]

- (ii) Give **two** reasons for your answer to (i).

1.

 2.
 [2]

- (iii) Name cell **A** shown in Fig. 1.1 and state its function.

cell **A**
 function of cell **A**
 [2]

(b) Fig. 1.2 shows a simplified diagram of some body cells surrounded by capillaries. Substances in the blood can reach the body cells by moving out of the capillaries.

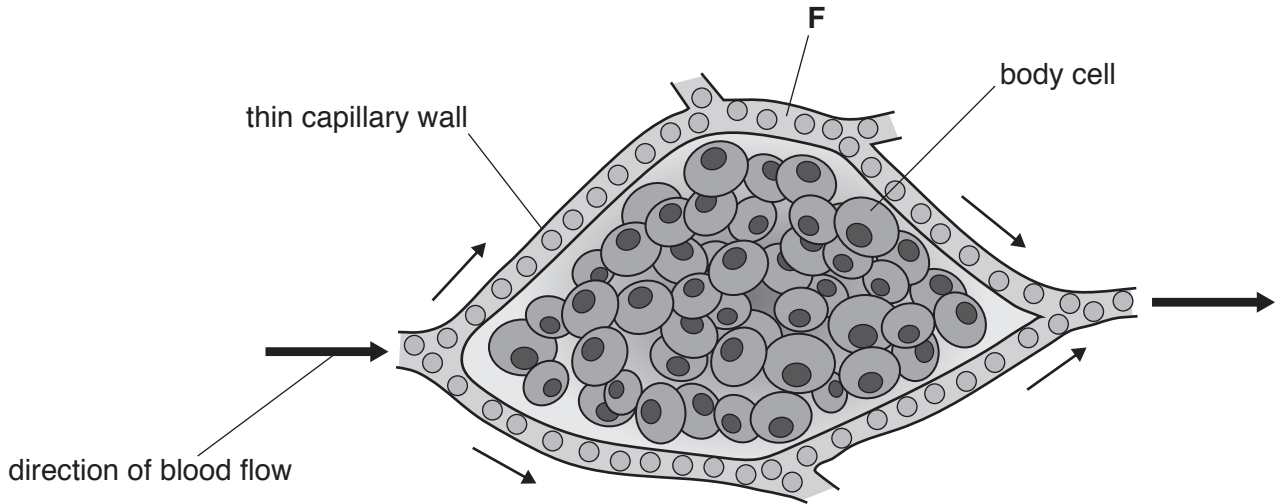


Fig. 1.2

(i) Name the part of the **blood** labelled **F**.

..... [1]

(ii) Small molecules move from the blood in the capillaries to the body cells.

Underline **two** substances that move from the blood in the capillaries to the body cells.

- fat** **glucose** **glycogen** **oxygen** **starch**

[2]

(iii) Complete the sentences.

Carbon dioxide is produced in body cells by the process of

.....

Carbon dioxide is removed from the blood in the

[2]

[Total: 10]

- 2 (a) Element **A** is in Group III in the Periodic Table.

Element **B** is in Group VII in the Periodic Table.

Elements **A** and **B** are in the same period in the Periodic Table.

- (i) Suggest which element, **A** or **B**, has more metallic character.

Explain your answer.

element

explanation

[1]

- (ii) Element **C** is below element **B** in Group VII.

Suggest which element, **B** or **C**, has:

a darker colour

a lower boiling point.

[1]

- (b) Element **D** is a monoatomic gas that is used to provide an inert atmosphere.

Element **E** has a high density and is often used as a catalyst.

State the group number or the name of the collection of elements for elements **D** and **E** in the Periodic Table.

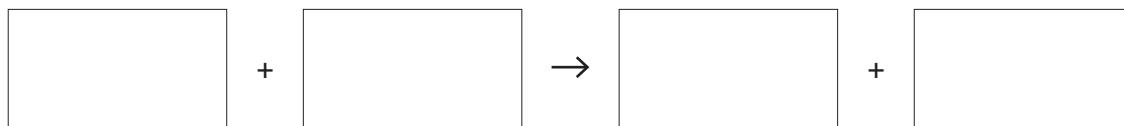
element **D**

element **E**

[2]

- (c) A student adds excess copper oxide powder to dilute sulfuric acid to make copper sulfate and one other product.

- (i) Complete the word equation for the reaction between copper oxide and dilute sulfuric acid.



[2]

- (ii) Explain why copper oxide is added in excess.

.....

..... [1]

- (iii) The type of chemical bond that forms between copper and oxygen is the same as the type of chemical bond that forms between sodium and chlorine.

State this type of chemical bond.

Use ideas about electrons to explain how these bonds form.

bond

explanation

.....

[2]

[Total: 9]

3 Fig. 3.1 shows how a small hydroelectric power station is used to supply electricity.

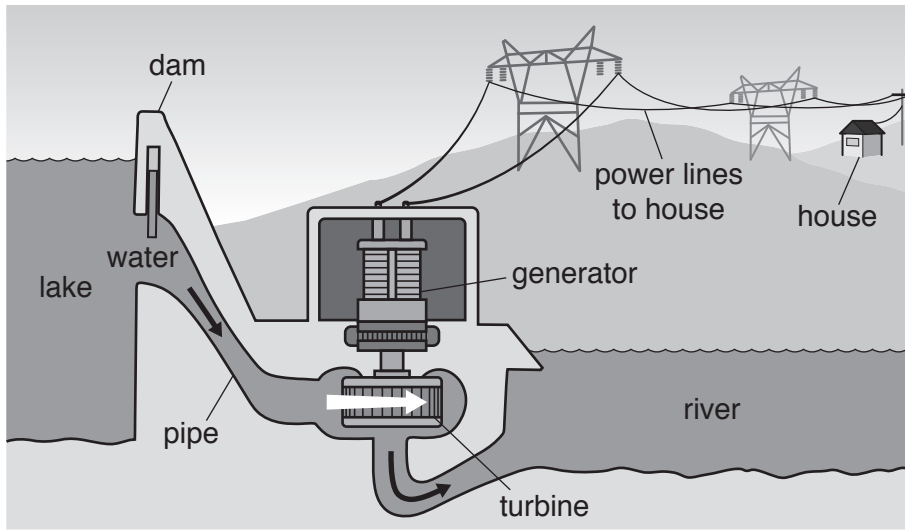


Fig. 3.1

(a) The flowing water turns the turbine (a type of waterwheel), which then turns the generator.

Use words from the list to complete the sequence of energy changes that take place.

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

- chemical
- elastic
- electrical
- gravitational
- kinetic
- light
- sound
- thermal

..... potential energy of water in the lake
 → energy of flowing water in the pipe
 → energy of the turning turbine and generator
 → energy in the power lines.

[3]

(b) In a house, the electricity is used to power a television set.

The aerial for the television set receives one type of electromagnetic wave.

The television set emits a different type of electromagnetic wave.

Fig. 3.2 shows the electromagnetic spectrum.

gamma radiation	X-rays	ultraviolet	visible light	infrared	microwaves	radio waves
-----------------	--------	-------------	---------------	----------	------------	-------------

Fig. 3.2

(i) Name the type of electromagnetic wave received by the aerial.

..... [1]

(ii) Name the type of electromagnetic wave emitted by the television set.

..... [1]

(c) A man in the house is listening to music on the television.

Fig. 3.3 shows the sound waves coming from three different instruments, **A**, **B** and **C**, playing musical notes at the same time.

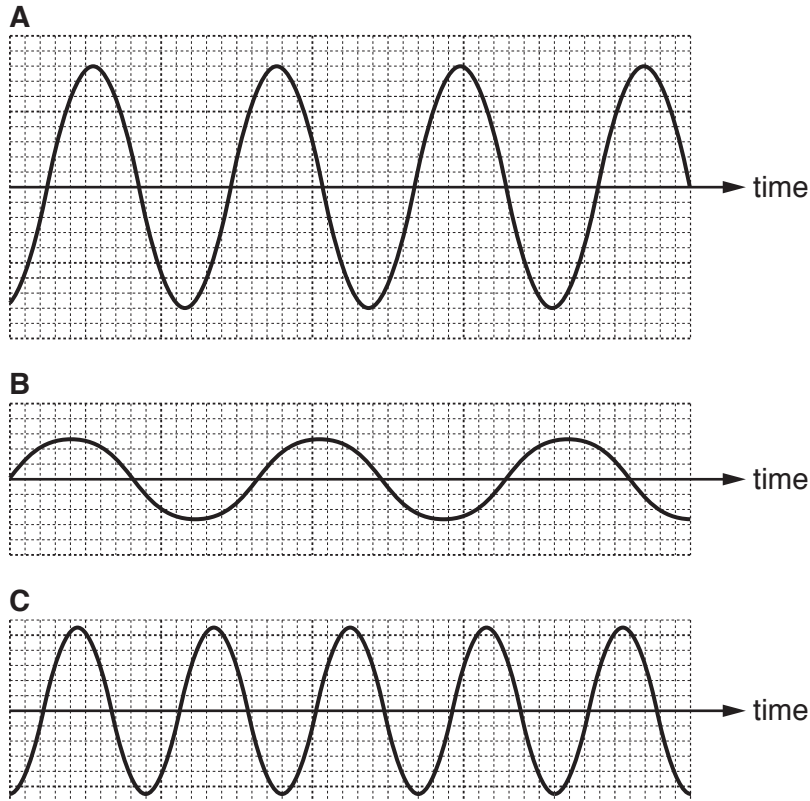


Fig. 3.3

(i) State which instrument was playing the note with the highest pitch.

Explain your answer.

instrument

explanation

..... [1]

(ii) State which instrument was playing the loudest note.

Explain your answer.

instrument

explanation

..... [1]

(iii) The man says he could hear two of the notes, but not the one with the lowest frequency.

Suggest a value for the frequency that the man could **not** hear. State the unit of frequency in your answer.

frequency = unit [2]

(iv) Give a reason for your answer to (iii).

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

[Total: 10]

4 (a) Plants need water to survive.

(i) State **two** functions of water in plants.

1.

2.

[2]

(ii) Fig. 4.1 shows the pathway taken by water through a plant.

Use words from the list to complete the pathway.

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

cortex **cuticle** **mesophyll**
middle **phloem** **skin** **xylem**

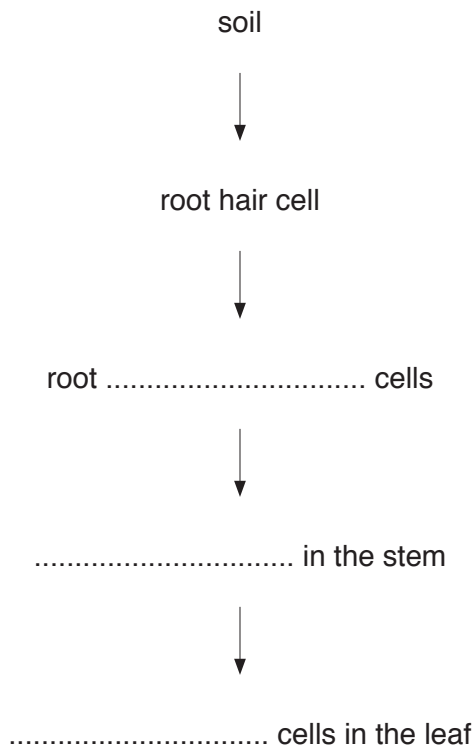


Fig. 4.1

[3]

(b) Plants show growth responses to different stimuli.

The plant shown in Fig. 4.2 is placed on its side in the dark. It is observed over the next few days.

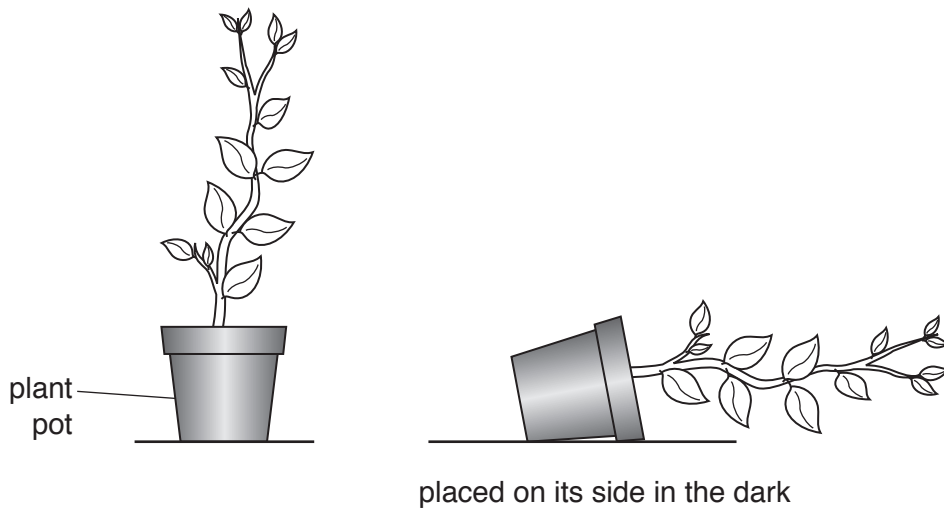


Fig. 4.2

Fig. 4.3 shows the appearance of the plant after a few days in the dark.

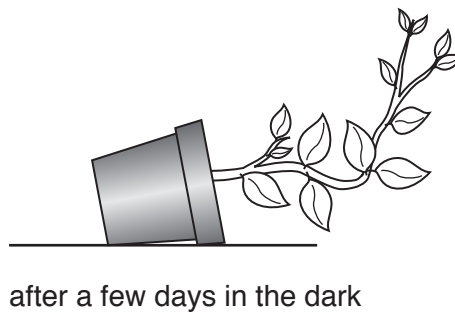


Fig. 4.3

Name the response shown by the plant in Fig. 4.3.

..... [1]

(c) One of the roots of the plant shown in Fig. 4.3 starts to grow out of a hole in the bottom of the plant pot.

(i) On Fig. 4.4 continue the diagram of the root to show the direction of growth. [1]

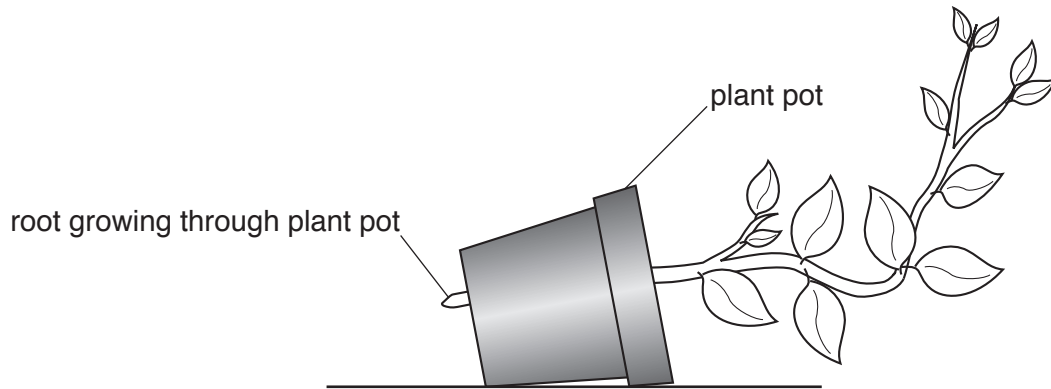


Fig. 4.4

(ii) Explain your answer in (i).

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

(d) Explain why a plant will eventually die if it is left in the dark.

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

[Total: 9]

- 5 (a) Some of the apparatus a student uses to investigate the rate of reaction between a piece of zinc and dilute hydrochloric acid is shown in Fig. 5.1.

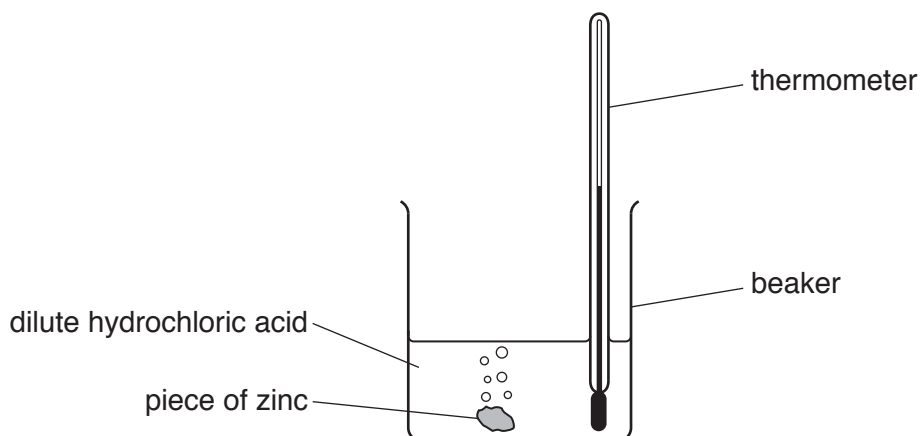


Fig. 5.1

- (i) Identify the gas formed in the reaction between zinc and dilute hydrochloric acid.

..... [1]

- (ii) Suggest the **change** in the pH of the mixture in the beaker during this reaction.

..... [1]

- (iii) Describe the effect of increasing the temperature on the rate of this reaction.

..... [1]

- (iv) The experiment is repeated using the same mass of zinc powder instead of the piece of zinc.

Describe how this change affects the rate of the reaction.

..... [1]

- (b) Zinc oxide is heated with carbon.

Reduction occurs during the reaction.

The reaction is endothermic.

- (i) State what is meant by *reduction*.

.....
 [1]

- (ii) State what is meant by *endothermic*.

.....
 [1]

(c) Complete Fig. 5.2 by drawing one straight line from each gas to the test for that gas.

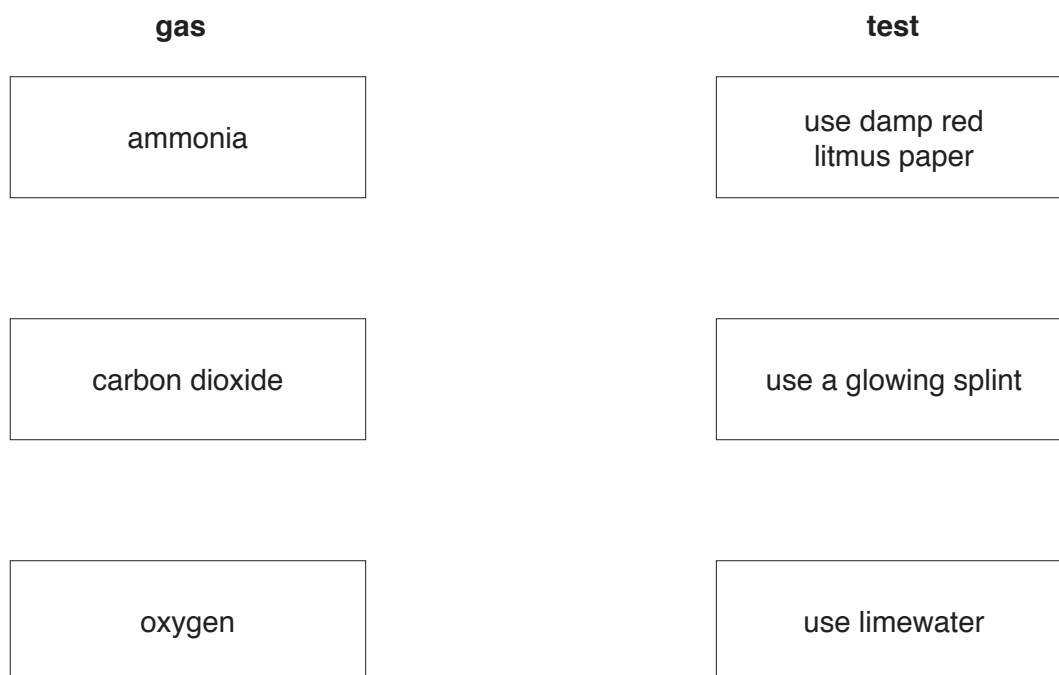


Fig. 5.2

[2]

[Total: 8]

6 Table 6.1 gives some data about the planets Earth, Mars and Venus.

Table 6.1

	Earth	Mars	Venus
surface temperature	15 °C	−63 °C	462 °C
average distance from the Sun	150 × 10 ⁶ km	225 × 10 ⁶ km	108 × 10 ⁶ km
time for one orbit around the Sun	365 days	687 days	225 days

(a) (i) Use Table 6.1 to deduce which of these planets could have liquid water on the surface.
 [1]

(ii) Use data from Table 6.1 to explain your answer to (i).

 [2]

(b) (i) State the method of thermal energy transfer from the Sun to these planets.

 [1]

(ii) Explain why other methods of energy transfer cannot transfer thermal energy from the Sun to these planets.

 [1]

(c) The Earth travels a distance of 940 million kilometres in one orbit around the Sun.
 Use data from Table 6.1 to calculate the speed in kilometres/hour (km/h) at which the Earth travels around the Sun.

Show your working.

speed = km/h [3]

(d) At the Earth's surface the Sun's energy is not usually sufficient to start a fire.

If the Sun's rays are focused by a lens, they can cause a fire.

On Fig. 6.1, complete the ray diagram to show how a lens can focus the Sun's rays and set fire to some dry grass.

You should draw **two** complete rays.

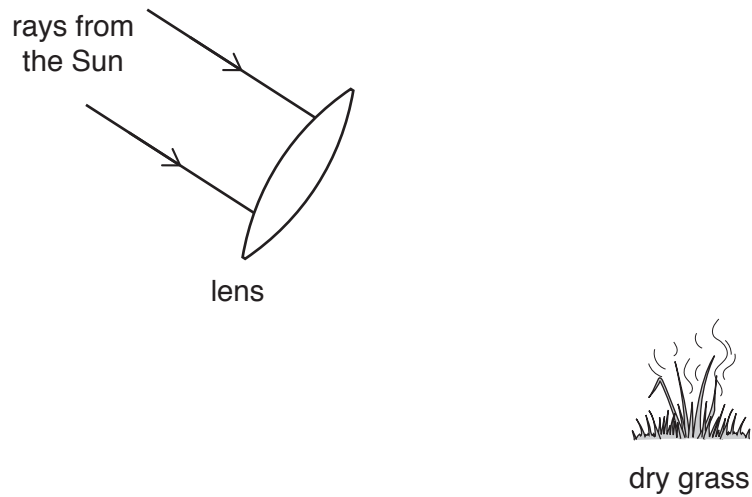


Fig. 6.1

[2]

[Total: 10]

7 (a) Fig. 7.1 shows information about the organisms in a food chain.

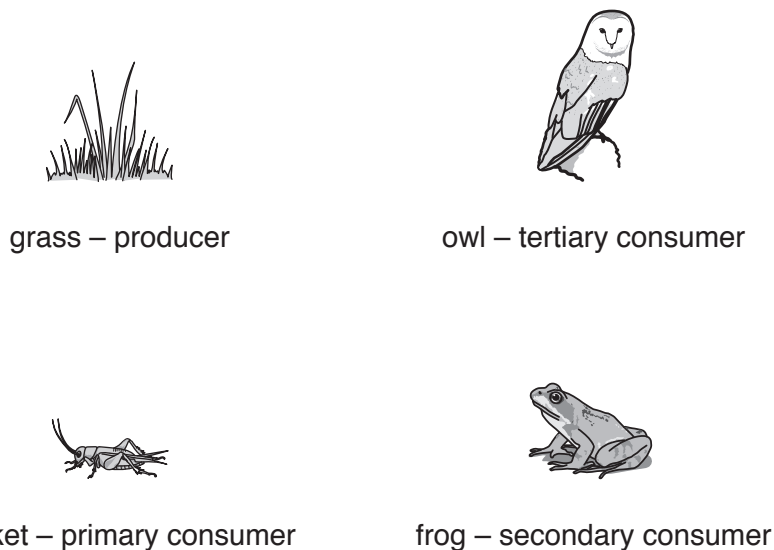


Fig. 7.1

(i) Write down the food chain using the information in Fig. 7.1.

..... [2]

(ii) Define the term *producer*.

.....

 [2]

(b) Explain why chemical digestion is needed in the alimentary canals of consumers.

.....

 [2]

(c) (i) State why deforestation can disrupt the food chains in a forest.

.....
 [1]

(ii) State **one** other harmful effect of deforestation.

..... [1]

[Total: 8]

- 8 (a) The hydrocarbons in petroleum are separated into useful products using the process shown in Fig. 8.1.

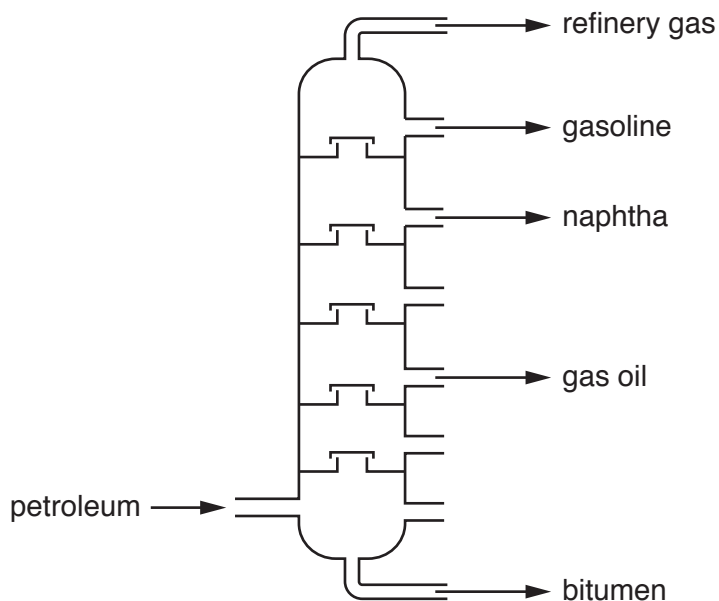


Fig. 8.1

- (i) Name this process.

..... [1]

- (ii) State what is meant by *hydrocarbon*.

.....
 [2]

- (iii) State **one** use for naphtha.

..... [1]

- (b) When hydrocarbons burn, they may produce carbon dioxide, carbon monoxide and water.

- (i) Describe **one** test to show the presence of water.

State the positive result.

test

result

[2]

- (ii) Describe **one** adverse effect of carbon monoxide on humans.

.....

..... [1]

(iii) Suggest the percentage of carbon dioxide in clean air.

percentage = % [1]

(iv) Using your knowledge of the amounts of other gases in clean air, explain your answer to (iii).

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

[Total: 9]

- 9 (a) Fig. 9.1 shows a circuit diagram.

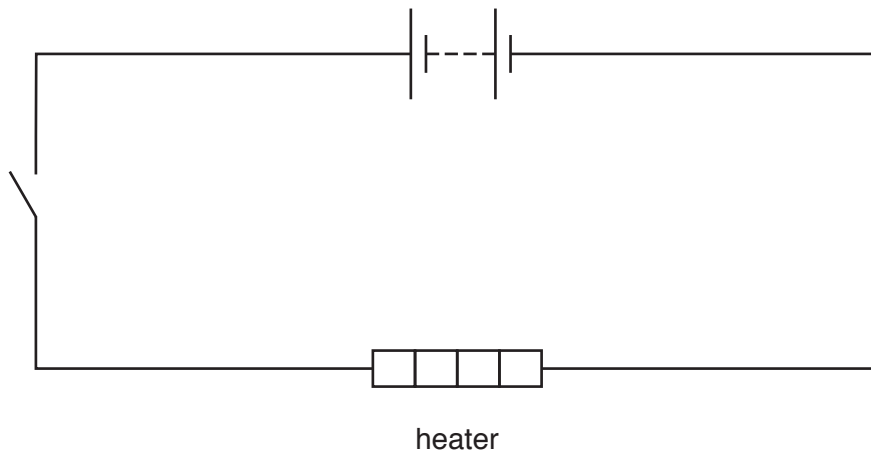


Fig. 9.1

On Fig. 9.1, add a suitable meter to measure the e.m.f. of the battery. [2]

- (b) The current in a heater circuit is 10.0A.

Select from the list below the correct rating for a fuse to use in this circuit.

Put a circle around your choice.

3 A 5 A 10 A 13 A [1]

(c) Fig. 9.2 shows a heater fixed to a wall in a room.

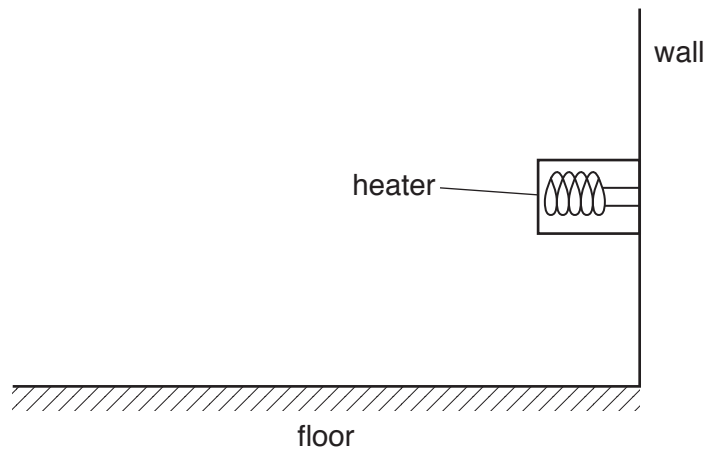


Fig. 9.2

On Fig. 9.2 draw arrows to show the direction in which air flows from the heater as the air is heated. [1]

(d) On Fig. 9.3, complete the circuit by adding:

- a lamp in parallel with the motor
- a variable resistor to change the current through the motor, but not through the lamp.

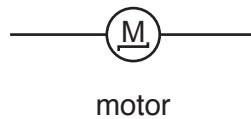
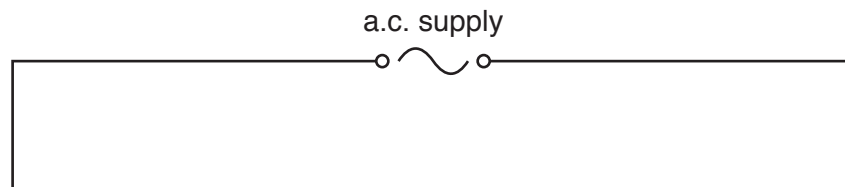


Fig. 9.3

[3]

[Total: 7]

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The Periodic Table of Elements

Group																																																																													
I	II	III										IV	V	VI	VII	VIII																																																													
3 Li lithium 7	4 Be beryllium 9	<div style="border: 1px solid black; padding: 5px; text-align: center;"> Key atomic number atomic symbol name relative atomic mass </div>										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 —																																																																
<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>lanthanoids</p> <table border="1"> <tr><td>57</td><td>La lanthanum 139</td><td>58</td><td>Ce cerium 140</td><td>59</td><td>Pr praseodymium 141</td><td>60</td><td>Nd neodymium 144</td><td>61</td><td>Pm promethium —</td><td>62</td><td>Sm samarium 150</td><td>63</td><td>Eu europium 152</td><td>64</td><td>Gd gadolinium 157</td><td>65</td><td>Tb terbium 159</td><td>66</td><td>Dy dysprosium 163</td><td>67</td><td>Ho holmium 165</td><td>68</td><td>Er erbium 167</td><td>69</td><td>Tm thulium 169</td><td>70</td><td>Yb ytterbium 173</td><td>71</td><td>Lu lutetium 175</td></tr> </table> </div> <div style="width: 45%;"> <p>actinoids</p> <table border="1"> <tr><td>89</td><td>Ac actinium —</td><td>90</td><td>Th thorium 232</td><td>91</td><td>Pa protactinium 231</td><td>92</td><td>U uranium 238</td><td>93</td><td>Np neptunium —</td><td>94</td><td>Pu plutonium —</td><td>95</td><td>Am americium —</td><td>96</td><td>Cm curium —</td><td>97</td><td>Bk berkelium —</td><td>98</td><td>Cf californium —</td><td>99</td><td>Es einsteinium —</td><td>100</td><td>Fm fermium —</td><td>101</td><td>Md mendelevium —</td><td>102</td><td>No nobelium —</td><td>103</td><td>Lr lawrencium —</td></tr> </table> </div> </div>																		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	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 —
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																																																
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 dm³ at room temperature and pressure (r.t.p.).