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) **February/March 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 20.

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.

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1 **(a)** Use lines to connect the box on the left to different boxes on the right.

As an example one has been done for you. The sentence reads 'Human liver cells take in oxygen by diffusion'.

Draw **three** more lines to form three more correct sentences.

	contain genetic material in the nucleus.
	build up starch molecules from glucose molecules.
	destroy hormones.
Human liver cells	contain chloroplasts.
	take in oxygen by diffusion.
	carry out cell respiration in the nucleus.
	have a cell membrane.

[3]

(b) Fig. 1.1 shows a diagram of the human alimentary canal. The acidity and alkalinity of some of the parts are also shown.

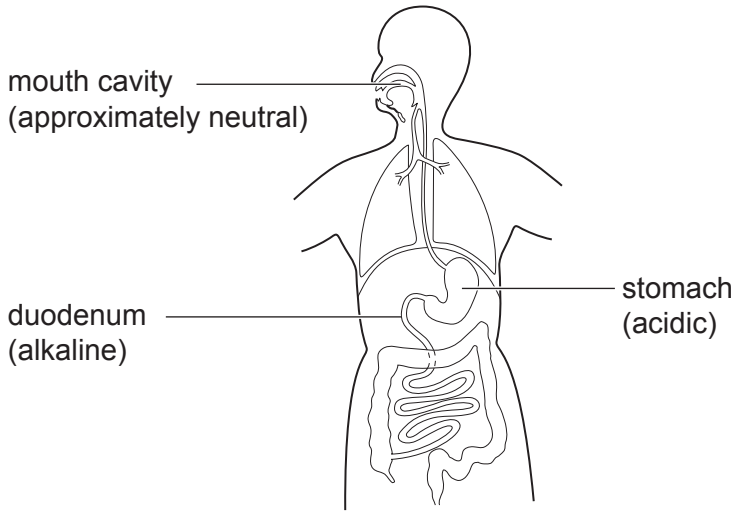

Fig. 1.1

During digestion food is broken down by mechanical and chemical processes.

Explain the meaning of the term *chemical digestion*.

.....

.....

.....[2]

(c) Fig. 1.2 shows a graph of how the activity of three different enzymes varies with temperature.

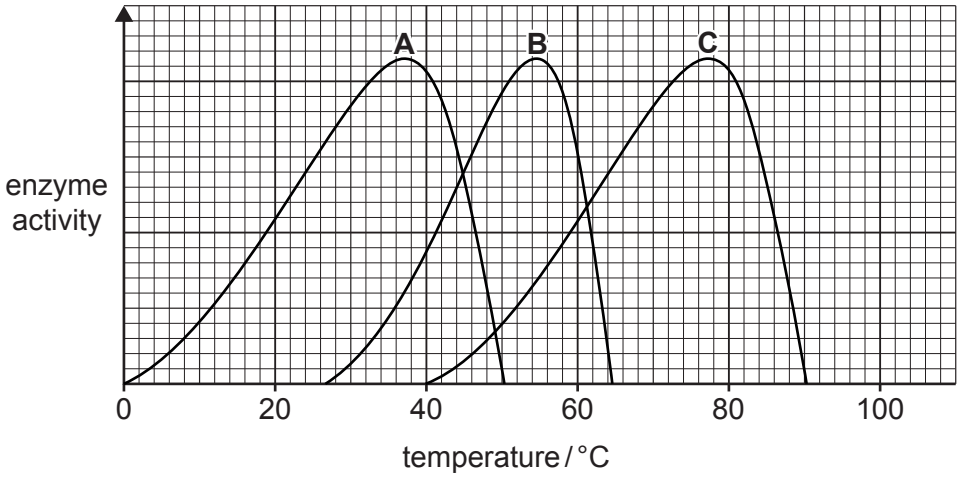

Fig. 1.2

(i) Use information from Fig. 1.2 to decide which curve shows the activity of an enzyme in the duodenum.

Complete the sentences.

Curve ..... is from the duodenum because

.....

.....[1]

(ii) Fig. 1.3 shows a graph of how the activity of three different enzymes varies with pH.

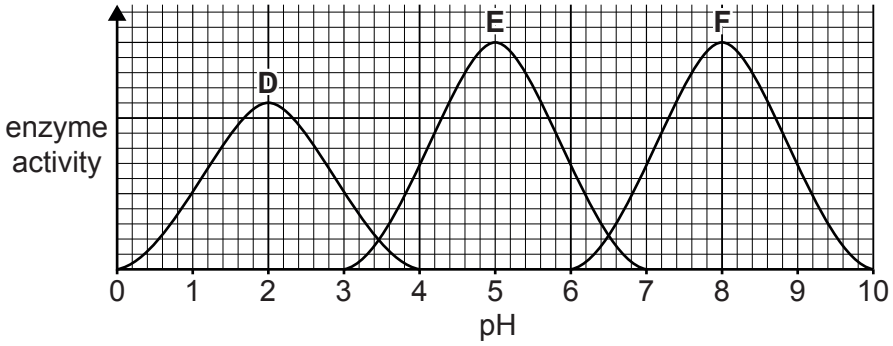

Fig. 1.3

Use information from Fig. 1.1 to decide which curve in Fig. 1.3 shows the activity of an enzyme in the duodenum of the alimentary canal.

Complete the sentences.

Curve ..... is from the duodenum because

.....

.....[1]

(iii) Explain why there is no activity shown by any of the enzymes in Fig. 1.2 at the following temperatures.

0 °C

.....

.....

100 °C

.....

.....
[2]

2 A student investigates the rate of reaction between calcium carbonate and dilute hydrochloric acid. The reaction produces carbon dioxide.

Fig. 2.1 shows some of the apparatus that the student uses.

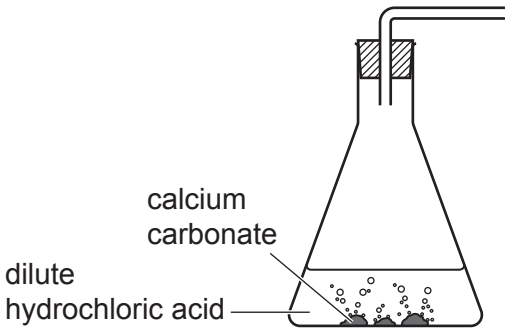

Fig. 2.1

The student measures the volume of carbon dioxide produced every minute for 10 minutes.

(a) Complete Fig. 2.1 to show the labelled apparatus that he uses to measure the volume of carbon dioxide produced. [2]

(b) Fig. 2.2 shows the volume of carbon dioxide produced during the investigation.

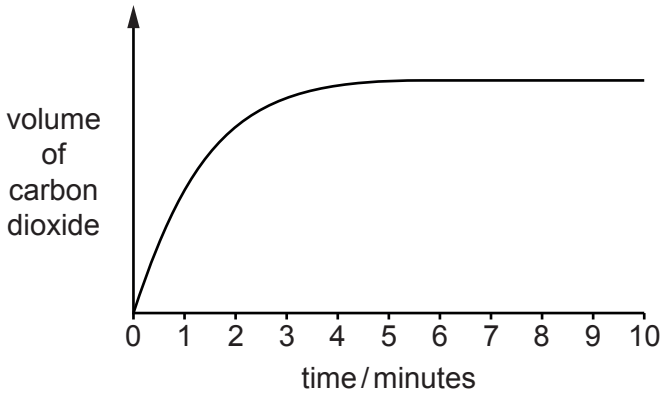

Fig. 2.2

Describe and explain the change in the rate of the reaction during the first three minutes.

Use ideas about concentration and particle collisions in your answer.

change .....

explanation .....

.....

.....

[3]

(c) Complete the balanced symbol equation for the reaction between dilute hydrochloric acid and calcium carbonate, $CaCO_3$.

..... + ... → $CaCl_2$ + ... + ... [2]

(d) Describe the test for carbon dioxide and the positive result.

test .....

result .....
[2]

(e) Suggest the names of an acid and of a base that react together to produce magnesium sulfate.

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

3 Fig. 3.1 shows an elevator (lift) which takes people to different floors in a tall building. The elevator travels up the lift shaft pulled by a long rope. There are no people in the elevator, which has stopped at the bottom floor.

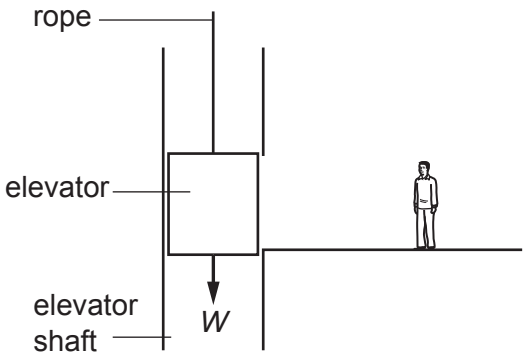

Fig. 3.1

(a) The weight *W* of the empty lift is 5000 N.

(i) On Fig. 3.1 draw an arrow to show the action of the other main force acting on the elevator while it is stopped. [1]

(ii) State whether the other force is 5000 N or has a different value. Give a reason for your answer.

.....

.....[1]

(iii) A man of mass 80 kg enters the elevator on the bottom floor.

Calculate the new value of the total downward force caused by the man entering the elevator. Show your working.

(*g* = 10 N / kg)

downward force = ... N [1]

(b) The elevator moves upwards at an average speed of 2 m / s. It moves 30 m up the elevator shaft, and stops at the top floor.

(i) Calculate the time taken by the elevator to travel from the bottom floor to the top floor.

State the formula that you use and show your working.

formula

working

time = ... s [2]

(ii) Calculate the kinetic energy of the man (mass = 80 kg) when the elevator is travelling at 2 m / s.

State the formula that you use and show your working.

formula

working

kinetic energy = ... J [2]

(iii) Calculate the potential energy gained by the man as he arrives at the top floor.

(g = 10 N / kg)

State the formula you use and show your working.

formula

working

potential energy gained = ... J [2]

(c) On Fig. 3.2 sketch the shape of the speed-time graph for the journey of the elevator from the bottom floor to the top floor.

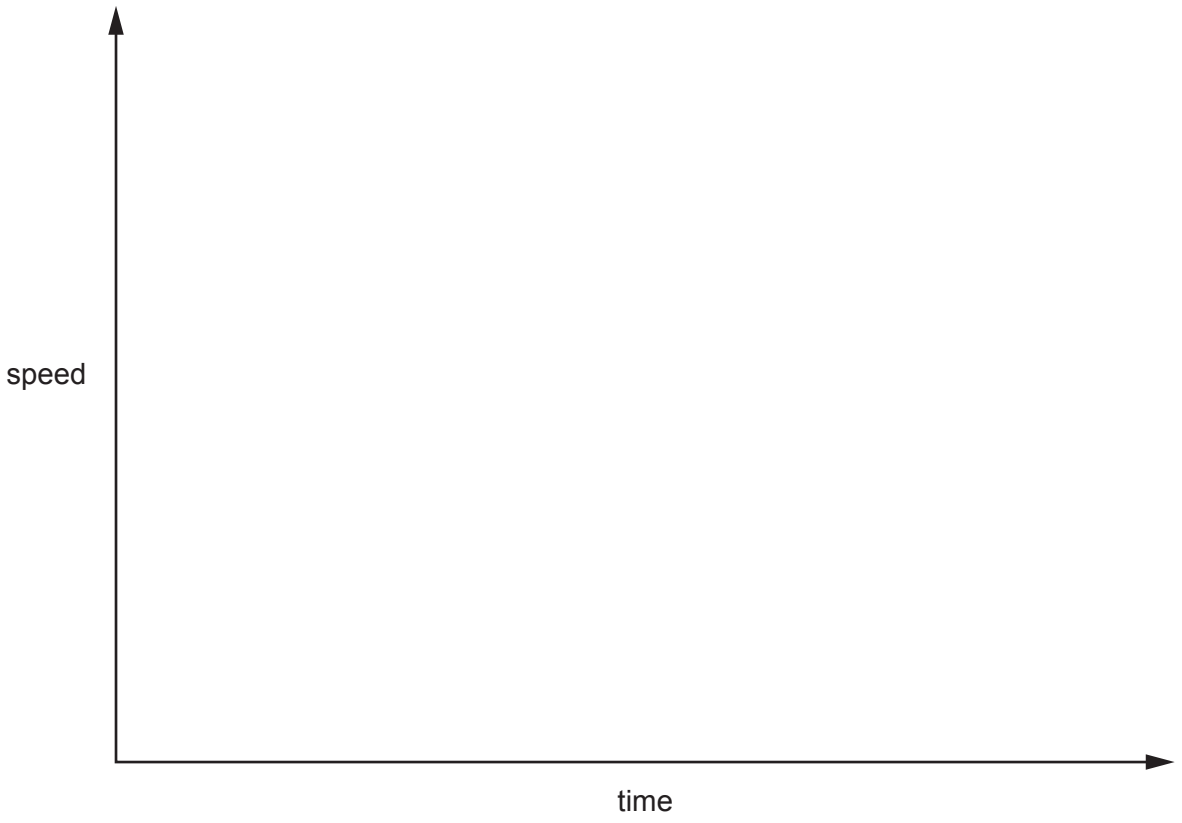

Fig. 3.2

[1]

4 Fig. 4.1 shows a diagram of part of the carbon cycle. The numbers show processes by which carbon is transferred between compounds in organisms and carbon dioxide in the atmosphere.

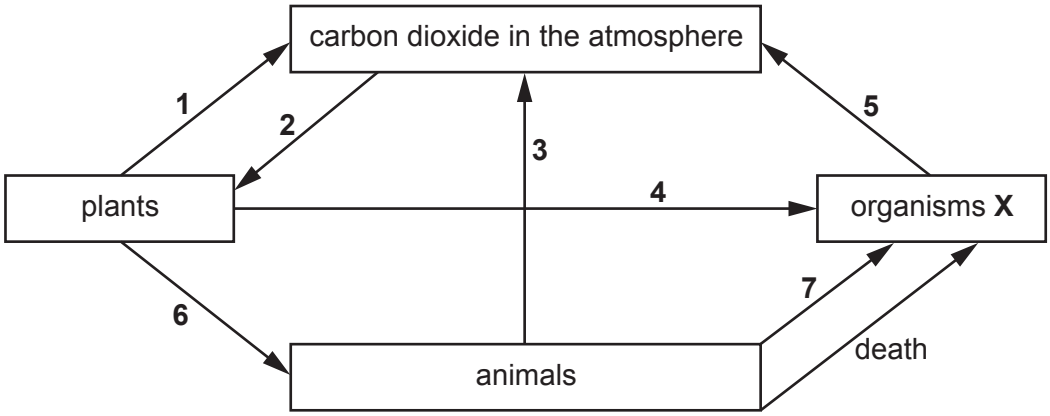

Fig. 4.1

(a) A carbon atom starts off in a molecule of carbon dioxide in the atmosphere. The carbon is transferred during process **2** to another molecule in a plant.

(i) Name process **2** and suggest a compound contained in the plant that may contain the carbon atom.

name of process **2** .....

compound .....
[2]

(ii) The carbon atom in the plant compound in **(i)** is transferred to animals by process **6** and finally returned to the atmosphere during process **3**.

Describe in detail how carbon is transferred from the plants to the atmosphere during these processes.

.....

.....

.....

.....[3]

(b) **(i)** Organisms **X** obtain their energy and nutrients from dead organisms and their waste products.

Identify the organisms **X**.

.....[1]

(ii) Describe how carbon is transferred from animals to organisms **X** by process **7**.

.....

.....

.....[2]

(c) Carbon and sulfur are contained in fossil fuels. When the fossil fuels are burned these elements are oxidised to carbon dioxide and sulfur dioxide. These products are released to the atmosphere.

(i) Describe how the carbon dioxide released contributes to global warming.

.....

.....

.....[2]

(ii) Describe the harmful effects caused by releasing sulfur dioxide to the atmosphere.

.....

.....

.....[2]

[Turn over

5 **(a)** Iron is extracted from iron oxide in the blast furnace, as shown in Fig. 5.1.

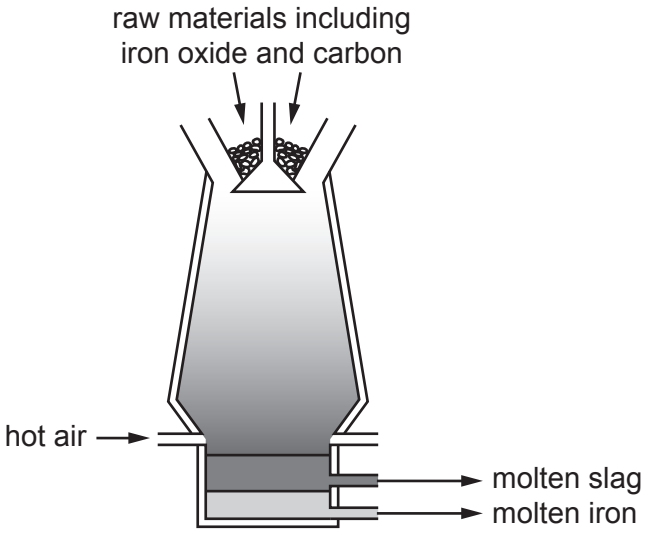

Fig. 5.1

(i) Some of the iron oxide reacts with carbon to form iron.

Name **one other** substance that reacts with iron oxide in the blast furnace to form iron.

.....[1]

(ii) Deduce the formula of iron oxide containing Fe^{3+} and O^{2-} ions.

formula .....[1]

(b) **(i)** Explain why aluminium cannot be extracted from aluminium oxide in a blast furnace.

.....[1]

(ii) State the method used to extract aluminium from aluminium oxide.

.....[1]

(c) Copper can be extracted from aqueous copper chloride using the apparatus shown in Fig. 5.2.

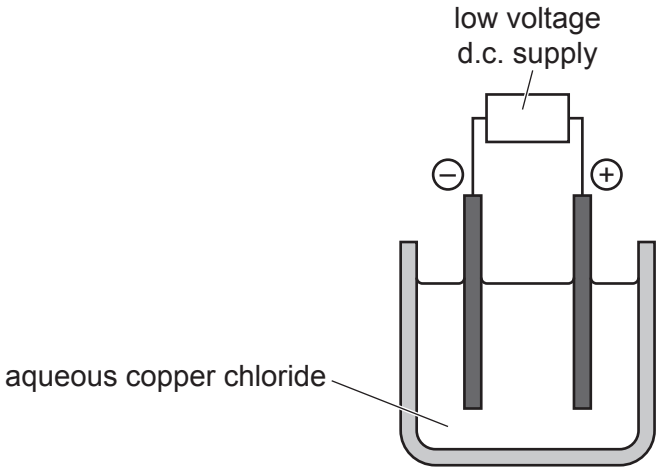

Fig. 5.2

(i) Predict the products that form at

the anode, ...

the cathode. .....
[1]

(ii) Describe how copper ions, Cu^{2+}, change into copper atoms in this process.

.....

.....[2]

(d) Potassium is a very reactive metal.

Argon is a noble gas.

Potassium does not react with argon.

(i) Suggest **one** reason why potassium does not react with argon.

.....

.....[1]

(ii) State **one** use of argon.

.....[1]

6 Fig. 6.1 shows a boat sailing near a lighthouse at night. The light from the lighthouse warns passing boats to beware of dangerous rocks nearby.

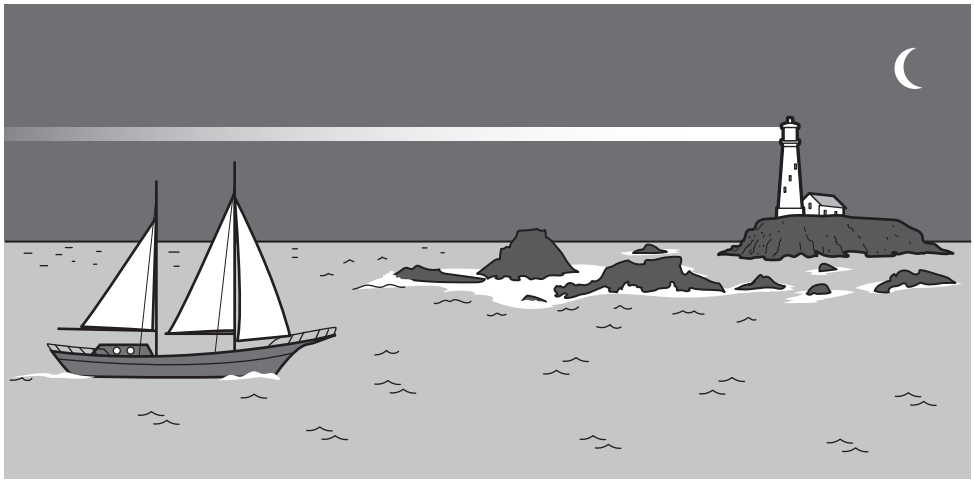

Fig. 6.1

(a) The lighthouse has a very bright lamp placed at the principal focus of a converging lens.

Fig. 6.2 shows one ray from the lamp passing through the lens. Two more rays are shown coming from the same point in the lamp. On Fig. 6.2 complete these rays to show how the lens produces a narrow parallel beam of light.

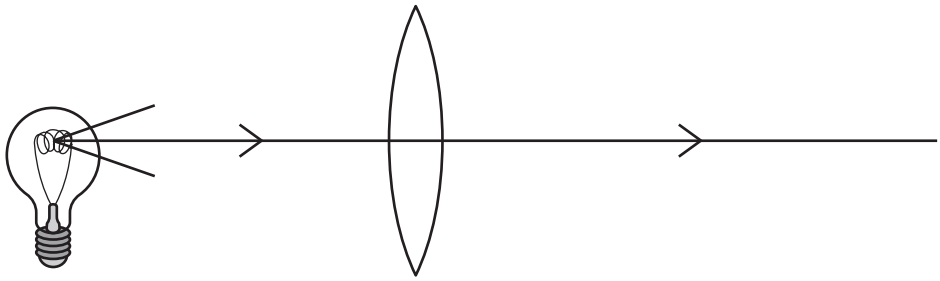

Fig. 6.2

[2]

(b) Fog at sea is caused by water vapour in the air condensing to form tiny water droplets.

Water vapour in the air comes from the evaporation of water in the sea.

Describe how the motion of water molecules, and the forces and distances between them, change as water evaporates and condenses.

.....

.....

.....

.....

.....

.....

.....

.....[3]

(c) When there is fog at sea, it is difficult for sailors to see the rocks. A fog-horn at the lighthouse produces a very loud sound to warn sailors about the rocks.

The sound produced by a fog-horn has a frequency of 50 Hz.

Use the formula, $v = f\lambda$, to calculate the wavelength of the sound produced.

Speed of sound in air = 330 m / s.

Show your working.

wavelength = ... m [1]

(d) Climate change across the world is causing the average temperature of sea water to increase.

Explain why this may result in flooding of low-lying areas of land near the sea.

.....

.....

.....

.....[2]

7 Fig. 7.1 shows a diagram of a germinating pea seed. The radicle (young root) is responding to gravity and it is growing so that it is pointing downwards.

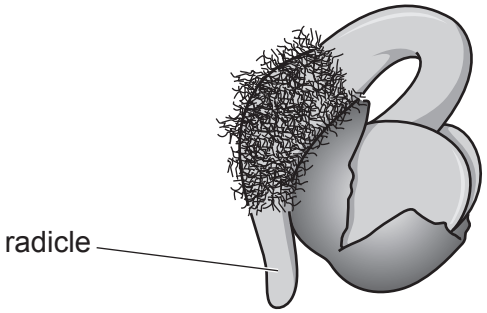

Fig. 7.1

(a) (i) State **two** environmental conditions needed for germination to take place.

1. .....

2. .....
[1]

(ii) Describe in detail how the action of auxins in the radicle causes the response in Fig. 7.1.

.....

.....

.....

.....

.....[3]

(b) (i) Suggest whether the root hairs respond to gravity in a similar way as the radicle in Fig. 7.1.

Explain your answer.

.....

.....[1]

(ii) Suggest why your answer to **(b)(i)** is an advantage for the survival of the seedling.

.....

.....

.....[1]

8 **(a)** Methane, CH_4, and butane, C_4H_{10}, are both alkanes.

Methane boils at –162 °C. Butane boils at –1 °C.

Explain this difference in terms of molecular size and intermolecular attractive forces.

.....

.....

.....

.....

.....[2]

(b) Ethene, C_2H_4, is produced by a process that uses long-chain hydrocarbon molecules.

(i) Name this process.

.....[1]

(ii) A catalyst is used in this process.

Describe the change, if any, to the catalyst at the end of this process.

.....[1]

(c) Carbon dioxide is produced during the complete combustion of hydrocarbons.

(i) State the formula of the other product of the complete combustion of hydrocarbons.

.....[1]

(ii) Complete the dot-and-cross diagram to show the bonding electrons in carbon dioxide.

O C O

[1]

(iii) State the type of chemical bond that forms between oxygen, a non-metal, and sodium, a metal.

.....[1]

9 Fig. 9.1 shows a simple circuit set up to investigate the electrical properties of a lamp.

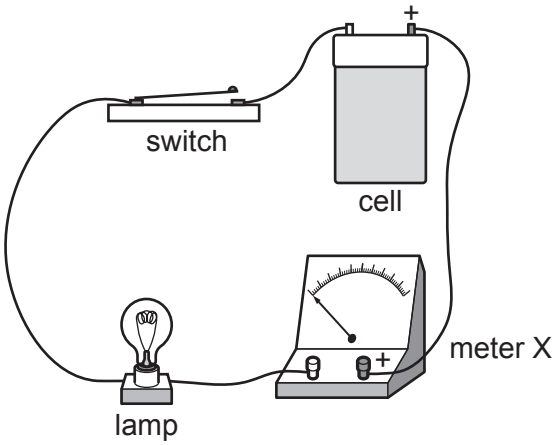

Fig. 9.1

(a) On Fig. 9.2 use the correct circuit symbols to complete the circuit diagram for the circuit shown in Fig. 9.1.

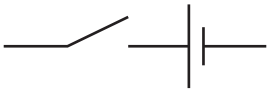

Fig. 9.2

[2]

(b) The lamp in Fig. 9.1 has a filament made of a long length of very thin wire.

The lamp is replaced in the circuit in Fig. 9.1 by another lamp with a filament wire of half the length but the same diameter.

Predict the effect on the meter reading.

Explain your answer.

.....

.....

.....[2]

(c) The voltage across the lamp is 1.5 V, and the current through the lamp is 0.6 A.

(i) Use the equation $P = IV$ to calculate the power consumption when the lamp is lit.

Show your working and give the unit of your answer.

power = ... unit ..... [2]

(ii) The cell transfers a total of 540 J of energy to the lamp before the cell runs down and the lamp goes out.

Calculate the time for which the cell will keep the lamp lit.

State any formula you use, show your working and state the unit of your answer.

formula

working

time = ... unit ..... [2]

The Periodic Table of Elements

Key

atomic number atomic symbol name relative atomic mass

Group																	
I	II											III	IV	V	VI	VII	VIII
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 A*l* aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 C*l* 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 T*l* 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 F*l* flerovium –		116 Lv livermorium –		

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

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