



# Cambridge IGCSE™

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**COMBINED SCIENCE**

**0653/32**

Paper 3 Theory (Core)

**October/November 2020**

**1 hour 15 minutes**

You must answer on the question paper.

No additional materials are needed.

## INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

## INFORMATION

- The total mark for this paper is 80.
- The number of marks for each question or part question is shown in brackets [ ].
- The Periodic Table is printed in the question paper.

This document has **20** pages. Blank pages are indicated.

1 (a) Fig. 1.1 shows a food web for a pond habitat.

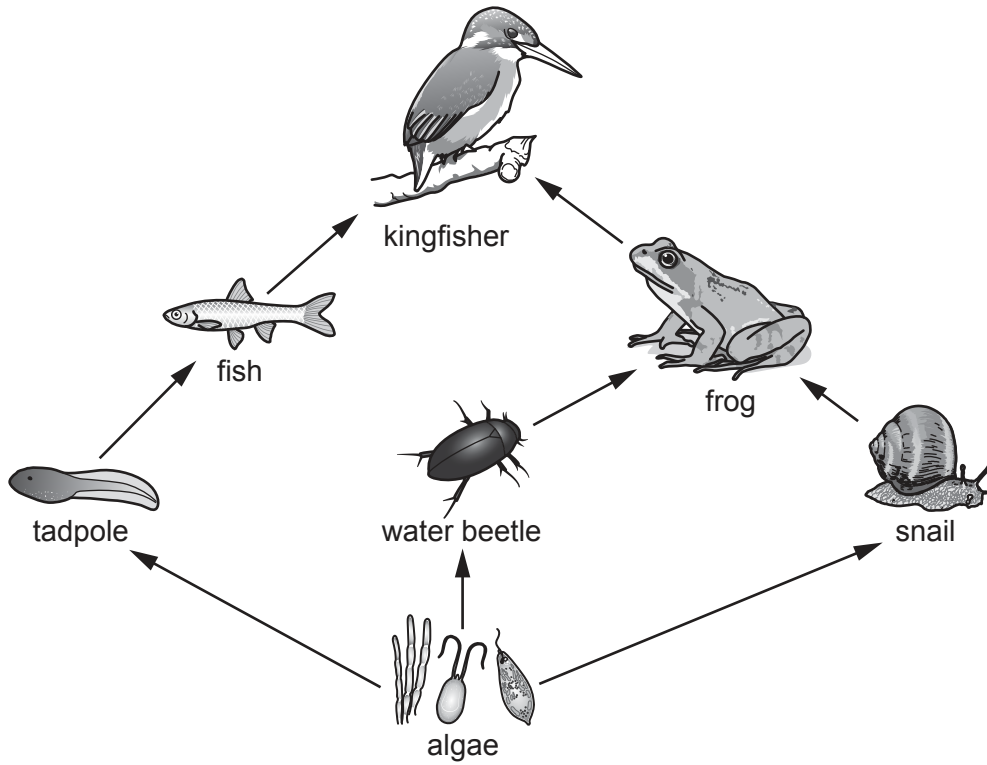


Fig. 1.1

(i) Identify the producer shown in Fig. 1.1.

..... [1]

(ii) State the process used by producers to make glucose using energy from sunlight.

..... [1]

(iii) Identify **one** carnivore shown in Fig. 1.1.

..... [1]

(iv) Use the information in Fig. 1.1 to construct a food chain including the frog.

..... [1]

(b) Decomposers are also found in pond habitats.

Define a *decomposer*.

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

(c) Decomposers are an important part of the carbon cycle.

Fig. 1.2 shows a diagram of the carbon cycle.

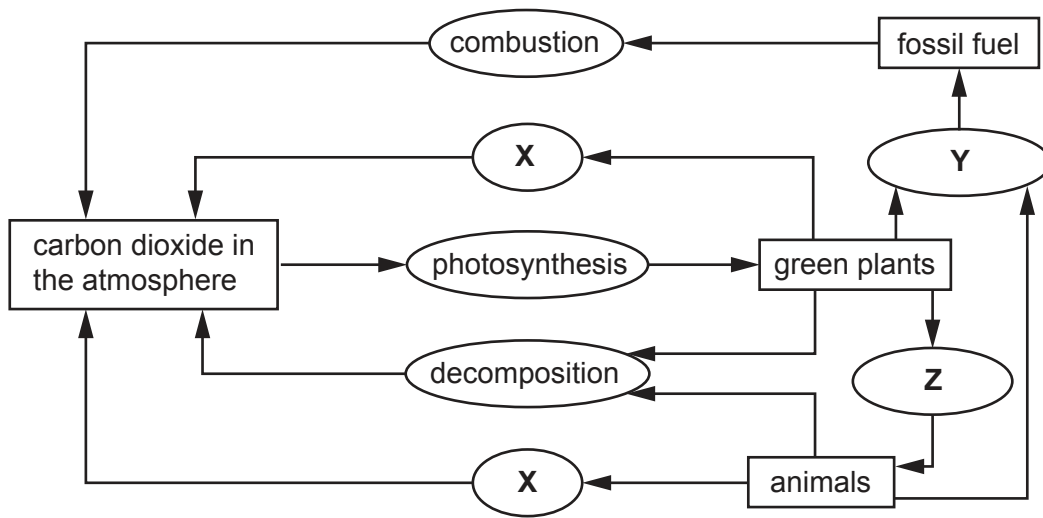


Fig. 1.2

Identify processes X, Y and Z shown in Fig. 1.2.

X .....

Y .....

Z .....

[3]

[Total: 8]

- 2 (a) Brass is a mixture of copper and zinc.

The water tap in Fig. 2.1 is made of brass.

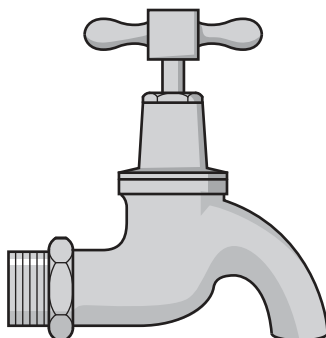


Fig. 2.1

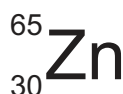
- (i) Name the type of substance that contains a metal mixed with other elements.

..... [1]

- (ii) Suggest **one** property of brass that makes it suitable for use as a water tap.

..... [1]

- (b) An atom of zinc is represented by the symbol shown.



- (i) Deduce the number of neutrons in this atom of zinc.

number of neutrons = ..... [1]

- (ii) State the number of electrons in this atom of zinc.

number of electrons = ..... [1]

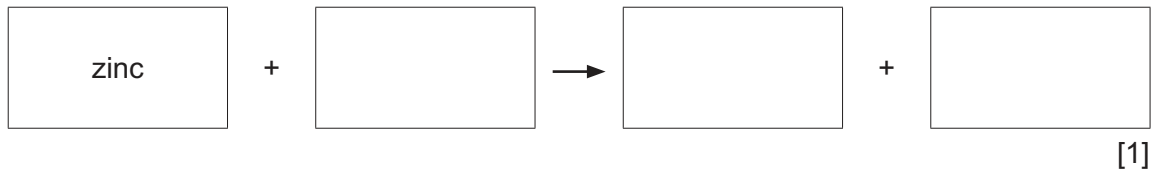
- (iii) Zinc atoms form zinc ions,  $\text{Zn}^{2+}$ .

Deduce the number of electrons in a  $\text{Zn}^{2+}$  ion.

number of electrons = ..... [1]

(c) Zinc reacts with dilute hydrochloric acid to form zinc chloride and hydrogen.

(i) Complete the word equation for this reaction.



(ii) Zinc chloride contains twice as many chloride ions as zinc ions.

Deduce the formula of zinc chloride.

.....

[1]

[Total: 7]

- 3 (a) Fig. 3.1 shows the forces acting on a wheelbarrow full of sand as a man pushes it along a straight path at a constant speed.

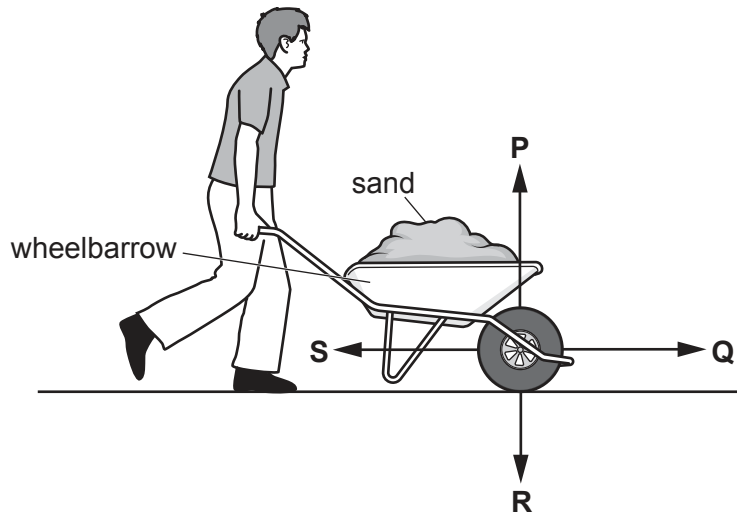


Fig. 3.1

- (i) State the letter, **P**, **Q**, **R** or **S**, of the force due to the man pushing the wheelbarrow.

.....

[1]

- (ii) State the letter, **P**, **Q**, **R** or **S**, of the force due to friction.

.....

[1]

- (iii) State whether the two forces in (i) and (ii) are equal in size.

Give a reason for your answer.

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

(b) Fig. 3.2 shows the distance–time graph for the man pushing the wheelbarrow along the straight path.

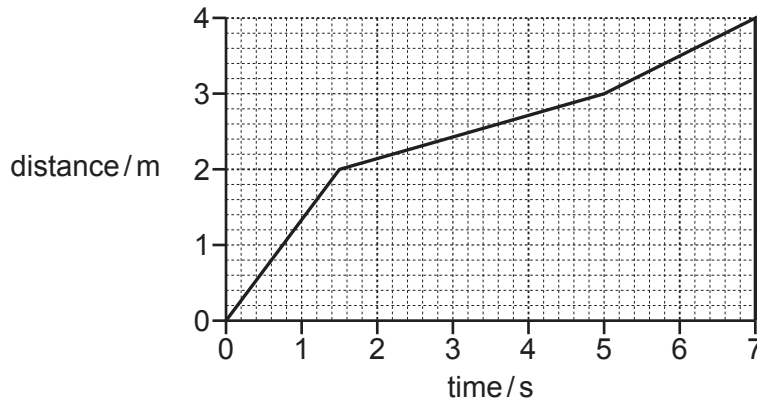
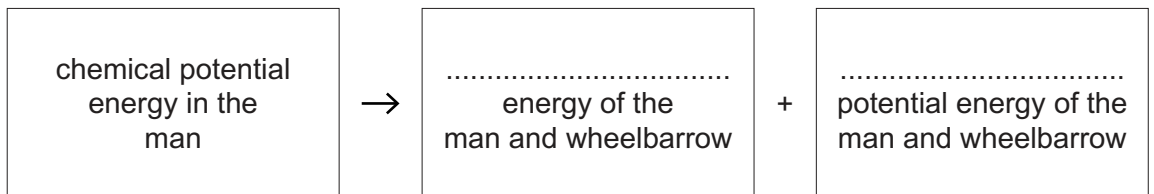


Fig. 3.2

- (i) On Fig. 3.2, draw an **X** on the graph to show a point when the man and wheelbarrow change speed. [1]
- (ii) On Fig. 3.2, draw a **Y** on the graph to show a point when the man and wheelbarrow are moving at maximum speed. [1]

(c) The man pushes the wheelbarrow full of sand up a slope.

(i) Complete the sequence of **useful** energy changes.



[2]

(ii) Not all the energy changes taking place are useful. Some energy is lost as thermal energy.

Identify **two** ways that energy is lost as thermal energy.

1 .....

2 .....

[2]

(d) The man pushes the wheelbarrow up the same slope again but this time with the wheelbarrow **empty**.

Explain why the man does less work on this second journey up the slope.

.....

..... [1]

[Total: 10]

- 4 (a) Fig. 4.1 shows a cross-section of a plant stem as seen under a microscope.

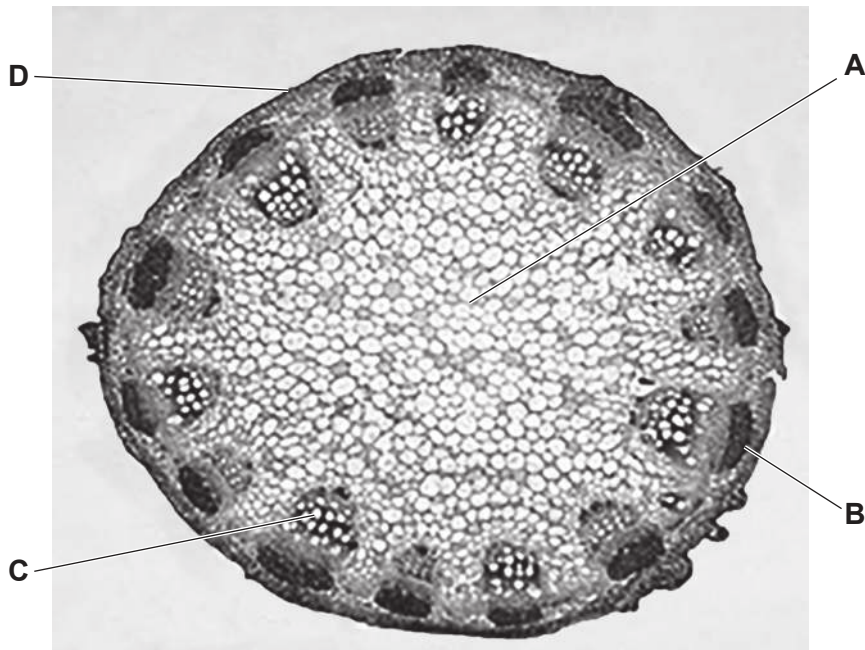


Fig. 4.1

- (i) State the letter, **A**, **B**, **C** or **D**, that shows the position of xylem vessels in the plant stem in Fig. 4.1.

..... [1]

- (ii) Name the cells that transport sugar through the plant stem.

..... [1]

- (b) Use words from the list to complete the definition of *transpiration*.

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

**absorption      diffusion      egestion      evaporation      fusion**

Transpiration is the loss of water vapour from plant leaves by ..... of water at the surface of the mesophyll cells followed by ..... of water vapour through the stomata.

[2]



(c) Fig. 4.2 shows a plant that has been next to a window for a few weeks.



Fig. 4.2

(i) Name the tropic response shown by the plant in Fig. 4.2 that causes the plant to grow towards the light.

..... [1]

(ii) The plant has flowers with pink petals.

State the function of petals.

..... [1]

(d) Some responses in humans are controlled by hormones.

(i) Describe how hormones are transported to their target organs.

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

(ii) Adrenaline is a hormone.

Describe **two** effects of adrenaline on the body.

1 .....  
.....  
2 .....  
..... [2]

[Total: 10]

- 5 (a) In an experiment, carbon electrodes are used to pass an electric current through concentrated aqueous sodium chloride, as shown in Fig. 5.1.

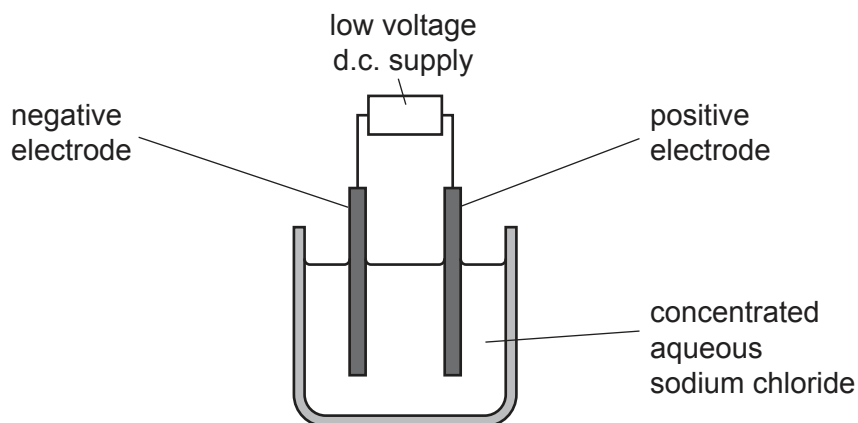


Fig. 5.1

- (i) Name the process shown in Fig. 5.1.  
 ..... [1]
- (ii) Identify the solvent in concentrated aqueous sodium chloride.  
 ..... [1]
- (iii) Identify the products which form at the negative electrode and at the positive electrode.  
 negative electrode product .....  
 positive electrode product ..... [2]
- (iv) Name the negative electrode and the positive electrode.  
 negative electrode .....  
 positive electrode ..... [2]

(b) Some metals are extracted from their ores by heating with carbon.

(i) Identify **one** metal that is extracted from its ore by this method.

..... [1]

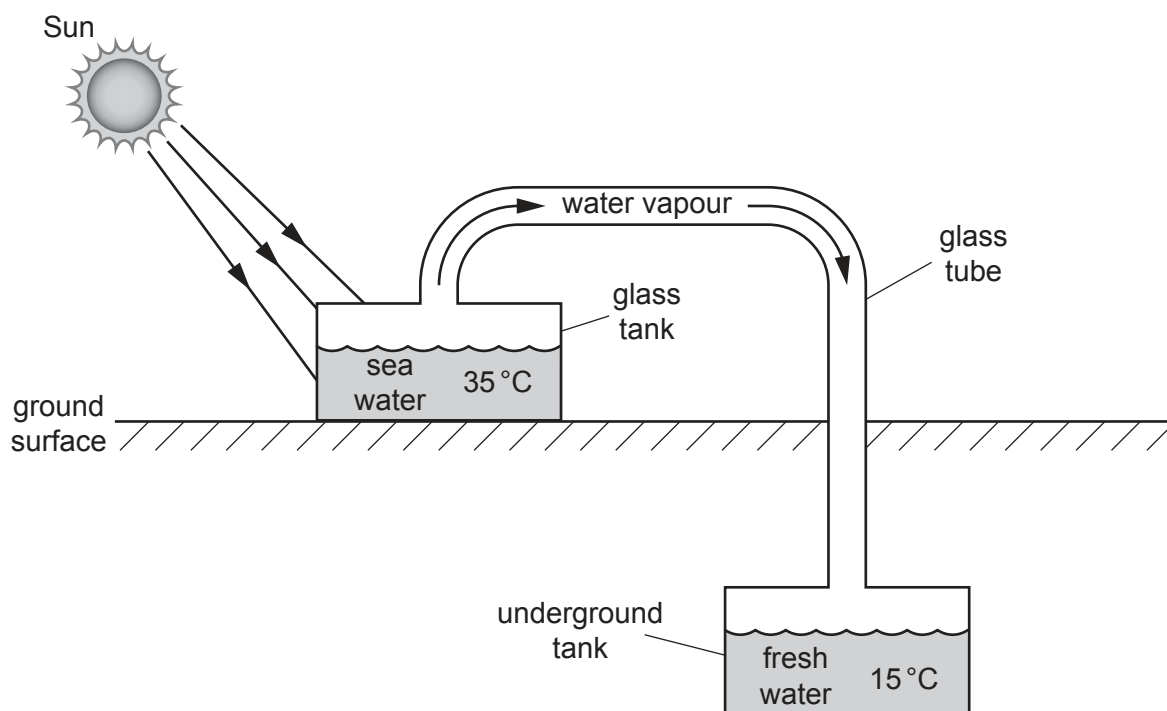
(ii) In this extraction process, oxygen is removed from the metal.

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

..... [1]

[Total: 8]

- 6 Fig. 6.1 shows a device called a 'solar still'. A solar still is used to produce fresh water from sea water.



**Fig. 6.1**

Sea water is added to a glass tank. The glass tank is in full sunlight.

The temperature of the sea water in the glass tank increases to a maximum of 35°C.

Water vapour travels through a glass tube to an underground tank. The water vapour cools and condenses.

Fresh water collects in the underground tank.

- (a) (i) Name the process that occurs at the surface of the sea water in the glass tank.

..... [1]

- (ii) State why some water molecules leave the surface of the sea water in this process.

.....

..... [1]

- (iii) State what happens to the temperature of the sea water remaining in the glass tank as a result of this process.

..... [1]

(b) State whether the sea water in the glass tank boils.

Give a reason for your answer.

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

(c) The sea water is heated by electromagnetic radiation from the Sun.

(i) Name the type of electromagnetic radiation involved in heating the sea water.

..... [1]

(ii) On Fig. 6.2, write a tick (✓) in the part of the electromagnetic spectrum where this type of radiation is found.

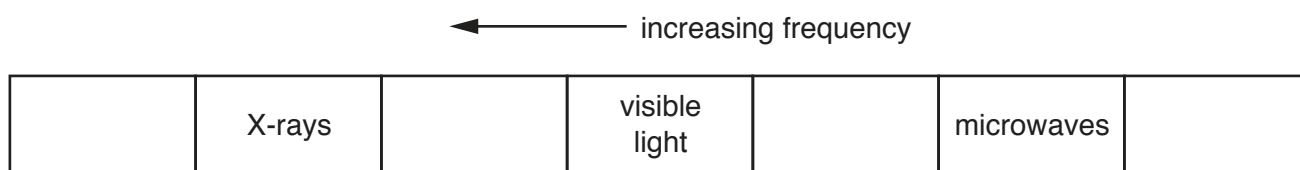


Fig. 6.2

[1]

(iii) State the meaning of *frequency*.

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

(d) Fig. 6.3 shows a ray from the Sun being refracted as it passes into the glass tank.

On Fig. 6.3, label the angle of incidence *i* and the angle of refraction *r* for the ray.

[2]

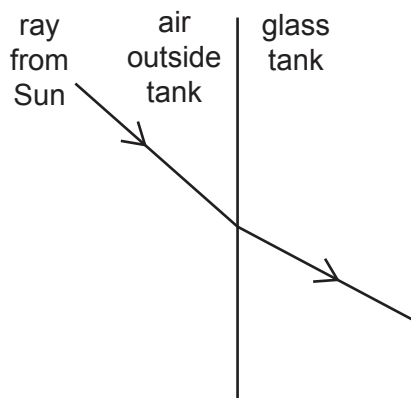


Fig. 6.3

[Total: 9]

7 (a) Fig. 7.1 shows parts of the human gas exchange system.

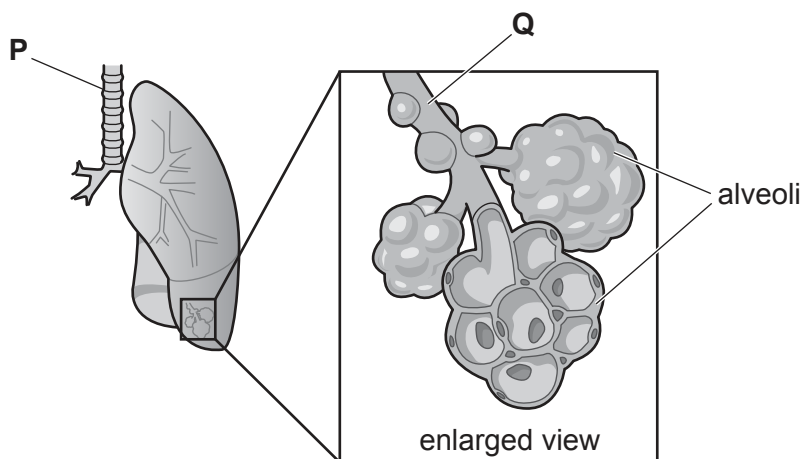


Fig. 7.1

Identify parts P and Q shown in Fig. 7.1.

P .....

Q .....

[2]

(b) The lungs remove carbon dioxide from the body. Excess carbon dioxide in the body is toxic.

State the characteristic of living organisms that removes toxic materials from the body.

..... [1]

(c) The lungs are connected to the heart by blood vessels.

(i) Name the blood vessel that transports blood from the lungs to the heart.

..... [1]

(ii) Name the component of the blood that produces antibodies.

..... [1]

(d) Fig. 7.2 is a diagram of the female reproductive organs.

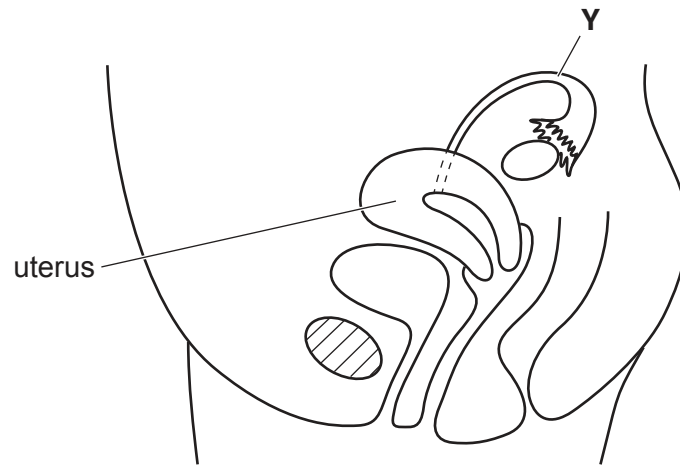


Fig. 7.2

(i) Draw an **X** on Fig. 7.2 to show where gametes are made. [1]

(ii) Name structure **Y** in Fig. 7.2.  
 ..... [1]

(iii) Describe the changes that occur to the uterus lining during the first five days of the menstrual cycle.  
 .....  
 .....  
 ..... [2]

[Total: 9]

8 (a) Methane,  $\text{CH}_4$ , is an alkane.

(i) Methane is the main constituent of a fossil fuel.

Name this fossil fuel.

..... [1]

(ii) Name the type of chemical bonds in a molecule of methane.

..... [1]

(iii) Fig. 8.1 is an incomplete dot-and-cross diagram of a molecule of methane.

On Fig. 8.1, draw dots and crosses to show **all** of the outer shell electrons in a molecule of methane.

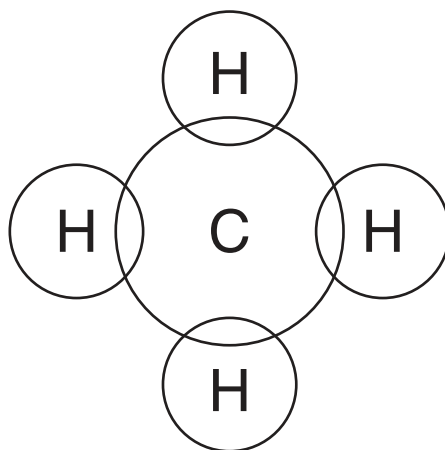


Fig. 8.1

[2]

(b) A sample of refinery gas contains only alkane molecules.

(i) Name the process used to obtain refinery gas from petroleum.

..... [1]

(ii) Describe the effect, if any, of this sample of refinery gas on aqueous bromine.

..... [1]



(c) Fossil fuels are used for heating.

- (i) State the type of chemical reaction that produces a temperature increase during the combustion of fossil fuels.

..... [1]

- (ii) Suggest the effect of the combustion of methane on the number of nitrogen molecules and on the number of oxygen molecules in a limited supply of air.

nitrogen molecules .....

oxygen molecules .....

[2]

- (iii) During the combustion of fossil fuels, carbon dioxide is produced.

State the test and the positive result for carbon dioxide.

test .....

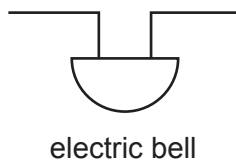
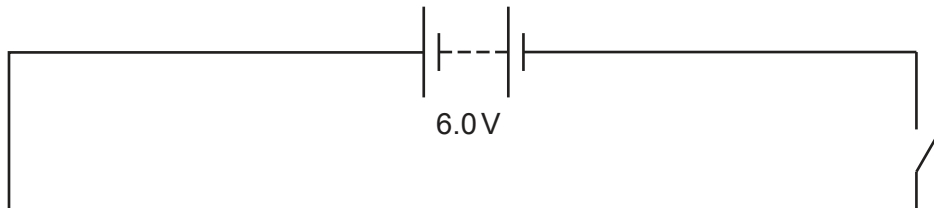
result .....

[2]

[Total: 11]

- 9 The front door of a house has an electric bell and a lamp.
- The electric bell and lamp are connected in parallel to a 6.0 V battery.
  - One switch controls both the electric bell and the lamp.

Fig. 9.1 shows part of the circuit.



**Fig. 9.1**

- (a) (i) On Fig. 9.1, complete the circuit diagram. [2]
- (ii) Explain why a parallel connection allows the bell to ring even if the lamp is broken.

.....

..... [1]

- (b) A meter is needed to measure the potential difference (p.d.) across the bell.

On Fig. 9.1, draw the circuit symbol for this meter and show how the meter is connected to measure the p.d. across the bell. [2]

- (c) The bell is switched on.

There is a potential difference (p.d.) of 6.0V across the bell.

There is a current of 0.48A in the bell.

Calculate the resistance of the bell. Give the unit of your answer.

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

[Total: 8]

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## The Periodic Table of Elements

Group																																																																																																																																																																																																																																																																																																										
I	II	Key										III	IV	V	VI	VII	VIII																																																																																																																																																																																																																																																																																									
		atomic number	atomic symbol	name	relative atomic mass																																																																																																																																																																																																																																																																																																					
3 <b>Li</b> lithium 7	4 <b>Be</b> beryllium 9	1 <b>H</b> hydrogen 1	5 <b>B</b> boron 11	6 <b>C</b> carbon 12	7 <b>N</b> nitrogen 14	8 <b>O</b> oxygen 16	9 <b>F</b> fluorine 19	10 <b>Ne</b> neon 20	11 <b>Na</b> sodium 23	12 <b>Mg</b> magnesium 24	13 <b>Al</b> aluminium 27	14 <b>Si</b> silicon 28	15 <b>P</b> phosphorus 31	16 <b>S</b> sulfur 32	17 <b>Cl</b> chlorine 35.5	18 <b>Ar</b> argon 40	19 <b>K</b> potassium 39	20 <b>Ca</b> calcium 40	21 <b>Sc</b> scandium 45	22 <b>Ti</b> titanium 48	23 <b>V</b> vanadium 51	24 <b>Cr</b> chromium 52	25 <b>Mn</b> manganese 55	26 <b>Fe</b> iron 56	27 <b>Co</b> cobalt 59	28 <b>Ni</b> nickel 59	29 <b>Cu</b> copper 64	30 <b>Zn</b> zinc 65	31 <b>Ga</b> gallium 70	32 <b>Ge</b> germanium 73	33 <b>As</b> arsenic 75	34 <b>Se</b> selenium 79	35 <b>Br</b> bromine 80	36 <b>Kr</b> krypton 84	37 <b>Rb</b> rubidium 85	38 <b>Sr</b> strontium 88	39 <b>Y</b> yttrium 89	40 <b>Zr</b> zirconium 91	41 <b>Nb</b> niobium 93	42 <b>Mo</b> molybdenum 96	43 <b>Tc</b> technetium —	44 <b>Ru</b> ruthenium 101	45 <b>Rh</b> rhodium 103	46 <b>Pd</b> palladium 106	47 <b>Ag</b> silver 108	48 <b>Cd</b> cadmium 112	49 <b>In</b> indium 115	50 <b>Sn</b> tin 119	51 <b>Sb</b> antimony 122	52 <b>Te</b> tellurium 128	53 <b>I</b> iodine 127	54 <b>Xe</b> xenon 131	55 <b>Cs</b> caesium 133	56 <b>Ba</b> barium 137	57–71 lanthanoids	58 <b>Hf</b> hafnium 178	59 <b>Ta</b> tantalum 181	60 <b>W</b> tungsten 184	61 <b>Re</b> rhenium 186	62 <b>Os</b> osmium 190	63 <b>Ir</b> iridium 192	64 <b>Pt</b> platinum 195	65 <b>Au</b> gold 197	66 <b>Hg</b> mercury 201	67 <b>Tl</b> thallium 204	68 <b>Pb</b> lead 207	69 <b>Bi</b> bismuth 209	70 <b>Po</b> polonium —	71 <b>At</b> astatine —	72 <b>Rn</b> radon —	73 <b>Fr</b> francium —	74 <b>Ra</b> radium —	75–103 actinoids	76 <b>Hs</b> hassium —	77 <b>Mt</b> meitnerium —	78 <b>Ds</b> darmstadtium —	79 <b>Rg</b> roentgenium —	80 <b>Cn</b> copernicium —	81 <b>Fl</b> flerovium —	82 <b>Uu</b> ununbium —	83 <b>Uub</b> ununbium —	84 <b>Uut</b> ununtrium —	85 <b>Uuq</b> ununquadium —	86 <b>Uuq</b> ununquadium —	87 <b>Uuq</b> ununquadium —	88 <b>Uuq</b> ununquadium —	89 <b>Uuq</b> ununquadium —	90 <b>Uuq</b> ununquadium —	91 <b>Uuq</b> ununquadium —	92 <b>Uuq</b> ununquadium —	93 <b>Uuq</b> ununquadium —	94 <b>Uuq</b> ununquadium —	95 <b>Uuq</b> ununquadium —	96 <b>Uuq</b> ununquadium —	97 <b>Uuq</b> ununquadium —	98 <b>Uuq</b> ununquadium —	99 <b>Uuq</b> ununquadium —	100 <b>Uuq</b> ununquadium —	101 <b>Uuq</b> ununquadium —	102 <b>Uuq</b> ununquadium —	103 <b>Uuq</b> ununquadium —	104 <b>Uuq</b> ununquadium —	105 <b>Uuq</b> ununquadium —	106 <b>Uuq</b> ununquadium —	107 <b>Uuq</b> ununquadium —	108 <b>Uuq</b> ununquadium —	109 <b>Uuq</b> ununquadium —	110 <b>Uuq</b> ununquadium —	111 <b>Uuq</b> ununquadium —	112 <b>Uuq</b> ununquadium —	113 <b>Uuq</b> ununquadium —	114 <b>Uuq</b> ununquadium —	115 <b>Uuq</b> ununquadium —	116 <b>Uuq</b> ununquadium —	117 <b>Uuq</b> ununquadium —	118 <b>Uuq</b> ununquadium —	119 <b>Uuq</b> ununquadium —	120 <b>Uuq</b> ununquadium —	121 <b>Uuq</b> ununquadium —	122 <b>Uuq</b> ununquadium —	123 <b>Uuq</b> ununquadium —	124 <b>Uuq</b> ununquadium —	125 <b>Uuq</b> ununquadium —	126 <b>Uuq</b> ununquadium —	127 <b>Uuq</b> ununquadium —	128 <b>Uuq</b> ununquadium —	129 <b>Uuq</b> ununquadium —	130 <b>Uuq</b> ununquadium —	131 <b>Uuq</b> ununquadium —	132 <b>Uuq</b> ununquadium —	133 <b>Uuq</b> ununquadium —	134 <b>Uuq</b> ununquadium —	135 <b>Uuq</b> ununquadium —	136 <b>Uuq</b> ununquadium —	137 <b>Uuq</b> ununquadium —	138 <b>Uuq</b> ununquadium —	139 <b>Uuq</b> ununquadium —	140 <b>Uuq</b> ununquadium —	141 <b>Uuq</b> ununquadium —	142 <b>Uuq</b> ununquadium —	143 <b>Uuq</b> ununquadium —	144 <b>Uuq</b> ununquadium —	145 <b>Uuq</b> ununquadium —	146 <b>Uuq</b> ununquadium —	147 <b>Uuq</b> ununquadium —	148 <b>Uuq</b> ununquadium —	149 <b>Uuq</b> ununquadium —	150 <b>Uuq</b> ununquadium —	151 <b>Uuq</b> ununquadium —	152 <b>Uuq</b> ununquadium —	153 <b>Uuq</b> ununquadium —	154 <b>Uuq</b> ununquadium —	155 <b>Uuq</b> ununquadium —	156 <b>Uuq</b> ununquadium —	157 <b>Uuq</b> ununquadium —	158 <b>Uuq</b> ununquadium —	159 <b>Uuq</b> ununquadium —	160 <b>Uuq</b> ununquadium —	161 <b>Uuq</b> ununquadium —	162 <b>Uuq</b> ununquadium —	163 <b>Uuq</b> ununquadium —	164 <b>Uuq</b> ununquadium —	165 <b>Uuq</b> ununquadium —	166 <b>Uuq</b> ununquadium —	167 <b>Uuq</b> ununquadium —	168 <b>Uuq</b> ununquadium —	169 <b>Uuq</b> ununquadium —	170 <b>Uuq</b> ununquadium —	171 <b>Uuq</b> ununquadium —	172 <b>Uuq</b> ununquadium —	173 <b>Uuq</b> ununquadium —	174 <b>Uuq</b> ununquadium —	175 <b>Uuq</b> ununquadium —	176 <b>Uuq</b> ununquadium —	177 <b>Uuq</b> ununquadium —	178 <b>Uuq</b> ununquadium —	179 <b>Uuq</b> ununquadium —	180 <b>Uuq</b> ununquadium —	181 <b>Uuq</b> ununquadium —	182 <b>Uuq</b> ununquadium —	183 <b>Uuq</b> ununquadium —	184 <b>Uuq</b> ununquadium —	185 <b>Uuq</b> ununquadium —	186 <b>Uuq</b> ununquadium —	187 <b>Uuq</b> ununquadium —	188 <b>Uuq</b> ununquadium —	189 <b>Uuq</b> ununquadium —	190 <b>Uuq</b> ununquadium —	191 <b>Uuq</b> ununquadium —	192 <b>Uuq</b> ununquadium —	193 <b>Uuq</b> ununquadium —	194 <b>Uuq</b> ununquadium —	195 <b>Uuq</b> ununquadium —	196 <b>Uuq</b> ununquadium —	197 <b>Uuq</b> ununquadium —	198 <b>Uuq</b> ununquadium —	199 <b>Uuq</b> ununquadium —	200 <b>Uuq</b> ununquadium —	201 <b>Uuq</b> ununquadium —	202 <b>Uuq</b> ununquadium —	203 <b>Uuq</b> ununquadium —	204 <b>Uuq</b> ununquadium —	205 <b>Uuq</b> ununquadium —	206 <b>Uuq</b> ununquadium —	207 <b>Uuq</b> ununquadium —	208 <b>Uuq</b> ununquadium —	209 <b>Uuq</b> ununquadium —	210 <b>Uuq</b> ununquadium —	211 <b>Uuq</b> ununquadium —	212 <b>Uuq</b> ununquadium —	213 <b>Uuq</b> ununquadium —	214 <b>Uuq</b> ununquadium —	215 <b>Uuq</b> ununquadium —	216 <b>Uuq</b> ununquadium —	217 <b>Uuq</b> ununquadium —	218 <b>Uuq</b> ununquadium —	219 <b>Uuq</b> ununquadium —	220 <b>Uuq</b> ununquadium —	221 <b>Uuq</b> ununquadium —	222 <b>Uuq</b> ununquadium —	223 <b>Uuq</b> ununquadium —	224 <b>Uuq</b> ununquadium —	225 <b>Uuq</b> ununquadium —	226 <b>Uuq</b> ununquadium —	227 <b>Uuq</b> ununquadium —	228 <b>Uuq</b> ununquadium —	229 <b>Uuq</b> ununquadium —	230 <b>Uuq</b> ununquadium —	231 <b>Uuq</b> ununquadium —	232 <b>Uuq</b> ununquadium —	233 <b>Uuq</b> ununquadium —	234 <b>Uuq</b> ununquadium —	235 <b>Uuq</b> ununquadium —	236 <b>Uuq</b> ununquadium —	237 <b>Uuq</b> ununquadium —	238 <b>Uuq</b> ununquadium —	239 <b>Uuq</b> ununquadium —	240 <b>Uuq</b> ununquadium —	241 <b>Uuq</b> ununquadium —	242 <b>Uuq</b> ununquadium —	243 <b>Uuq</b> ununquadium —	244 <b>Uuq</b> ununquadium —	245 <b>Uuq</b> ununquadium —	246 <b>Uuq</b> ununquadium —	247 <b>Uuq</b> ununquadium —	248 <b>Uuq</b> ununquadium —	249 <b>Uuq</b> ununquadium —	250 <b>Uuq</b> ununquadium —	251 <b>Uuq</b> ununquadium —	252 <b>Uuq</b> ununquadium —	253 <b>Uuq</b> ununquadium —	254 <b>Uuq</b> ununquadium —	255 <b>Uuq</b> ununquadium —	256 <b>Uuq</b> ununquadium —	257 <b>Uuq</b> ununquadium —	258 <b>Uuq</b> ununquadium —	259 <b>Uuq</b> ununquadium —	260 <b>Uuq</b> ununquadium —	261 <b>Uuq</b> ununquadium —	262 <b>Uuq</b> ununquadium —	263 <b>Uuq</b> ununquadium —	264 <b>Uuq</b> ununquadium —	265 <b>Uuq</b> ununquadium —	266 <b>Uuq</b> ununquadium —	267 <b>Uuq</b> ununquadium —	268 <b>Uuq</b> ununquadium —	269 <b>Uuq</b> ununquadium —	270 <b>Uuq</b> ununquadium —	271 <b>Uuq</b> ununquadium —	272 <b>Uuq</b> ununquadium —	273 <b>Uuq</b> ununquadium —	274 <b>Uuq</b> ununquadium —	275 <b>Uuq</b> ununquadium —	276 <b>Uuq</b> ununquadium —	277 <b>Uuq</b> ununquadium —	278 <b>Uuq</b> ununquadium —	279 <b>Uuq</b> ununquadium —	280 <b>Uuq</b> ununquadium —	281 <b>Uuq</b> ununquadium —	282 <b>Uuq</b> ununquadium —	283 <b>Uuq</b> ununquadium —	284 <b>Uuq</b> ununquadium —	285 <b>Uuq</b> ununquadium —	286 <b>Uuq</b> ununquadium —	287 <b>Uuq</b> ununquadium —	288 <b>Uuq</b> ununquadium —	289 <b>Uuq</b> ununquadium —	290 <b>Uuq</b> ununquadium —	291 <b>Uuq</b> ununquadium —	292 <b>Uuq</b> ununquadium —	293 <b>Uuq</b> ununquadium —	294 <b>Uuq</b> ununquadium —	295 <b>Uuq</b> ununquadium —	296 <b>Uuq</b> ununquadium —	297 <b>Uuq</b> ununquadium —	298 <b>Uuq</b> ununquadium —	299 <b>Uuq</b> ununquadium —	300 <b>Uuq</b> ununquadium —

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

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