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COMBINED SCIENCE

0653/32

Paper 3 Theory (Core)

May/June 2021

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 **24** pages. Any blank pages are indicated.

1 (a) Reproduction is one of the characteristics of living organisms.

Identify the characteristics of living organisms defined as

the removal of toxic material from the body

an action allowing an organism to change position

[2]

(b) Fig. 1.1 shows the parts of a flower.

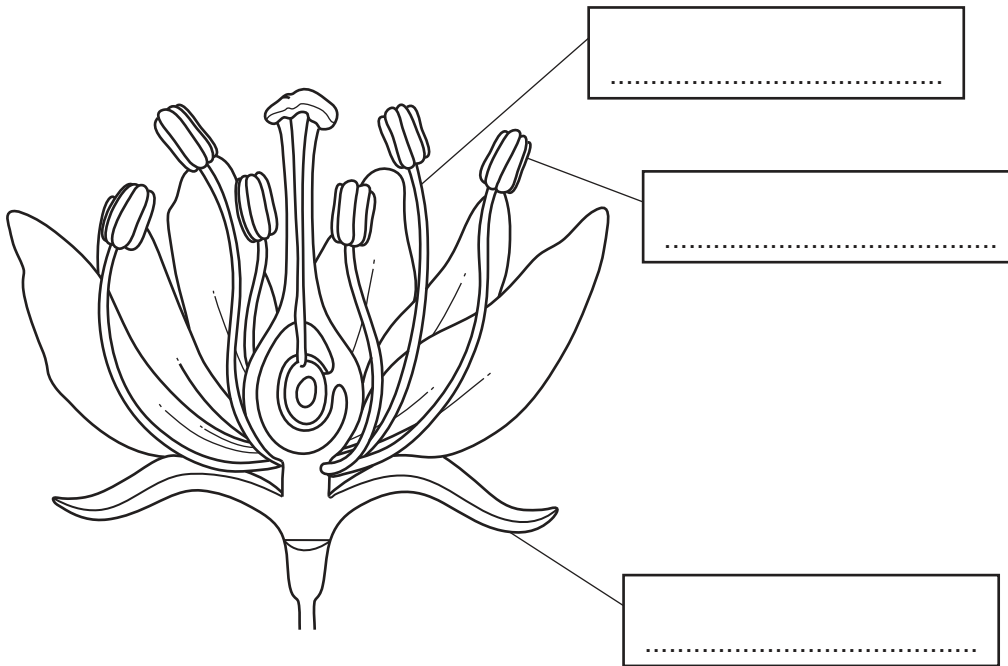


Fig. 1.1

(i) Complete the labels on Fig. 1.1.
Choose words from the list.

- anther carpel filament ovary stigma sepal style**
[3]

(ii) Name the part of the plant that receives pollen from another plant.

..... [1]

(iii) Name the part of the plant where fertilisation takes place.

..... [1]

- (c) (i) The boxes on the left show parts of the female reproductive system in humans. The boxes on the right show functions of these parts.

Draw one straight line from each part to its function.

name of part	function
cervix	ring of muscle at the opening of the uterus
ovaries	receives penis during sexual intercourse
vagina	release of female gametes (eggs)

[2]

- (ii) During reproduction in humans, a ball of cells implants into the uterus wall.

State the name of this ball of cells.

..... [1]

[Total: 10]

2 (a) A mixture contains water, dissolved sodium chloride and an insoluble solid compound.

(i) State what is meant by insoluble and compound.

insoluble
.....
compound
..... [2]

(ii) Describe how crystals of sodium chloride are obtained from this mixture.

.....
.....
.....
.....
..... [3]

(b) Water is a covalent molecule.
Complete Fig. 2.1 to show the dot-and-cross diagram of a molecule of water.
Show all the outer shell electrons.



Fig. 2.1

[2]

- (c) An atom of oxygen contains 8 electrons and it has the nucleon number (mass number) 16.

State what is meant by nucleon number.

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

- (d) Complete Table 2.1 to show the charges and approximate relative masses of neutrons and protons.

Table 2.1

particle	charge	relative mass
neutron		
proton		

[2]

[Total: 10]

- 3 (a) Fig. 3.1 shows a cylinder made of solid copper.

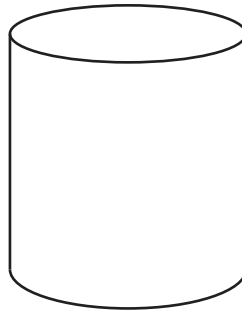


Fig. 3.1

The cylinder has a:

- height of 25 cm
 - radius of 10 cm
 - mass of 70 000 g.
- (i) Show that the volume of the copper cylinder is 7850 cm^3 .
 $\pi = 3.14$

[2]

- (ii) Use the information above to calculate the density of copper in g/cm^3 .

density = g/cm^3 [2]

(b) Fig. 3.2 shows two electrically charged copper spheres next to each other.

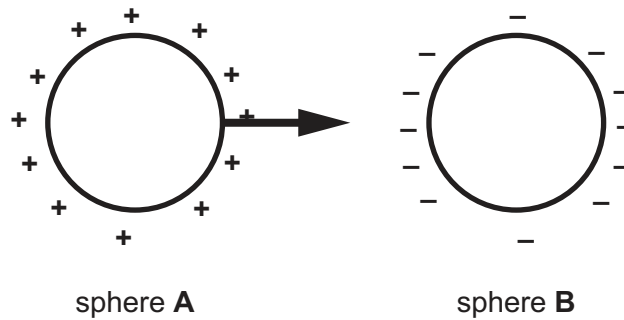


Fig. 3.2

- (i) State which sphere is charged with an excess of electrons.
Give a reason for your answer.

sphere

reason

..... [1]

- (ii) On Fig. 3.2 the force arrow shows the direction of the force exerted on sphere **A** by sphere **B**.

Explain why sphere **B** exerts this force on sphere **A**.

.....

..... [2]

- (c) A length of thin copper wire has a resistance of $3\ \Omega$.
The potential difference (p.d.) across the wire is $12\ \text{V}$.
Calculate the current in the copper wire.
State the unit of your answer.

current = unit [3]

[Total: 10]

- 4 (a) A student investigates water loss from the leaves of a plant.

The student takes four leaves from the same plant and covers each leaf with petroleum jelly as described in Table 4.1.

The petroleum jelly stops water loss from the leaves.

The mass of each leaf is recorded and then the leaves are placed on a line for 48 hours as shown in Fig. 4.1.

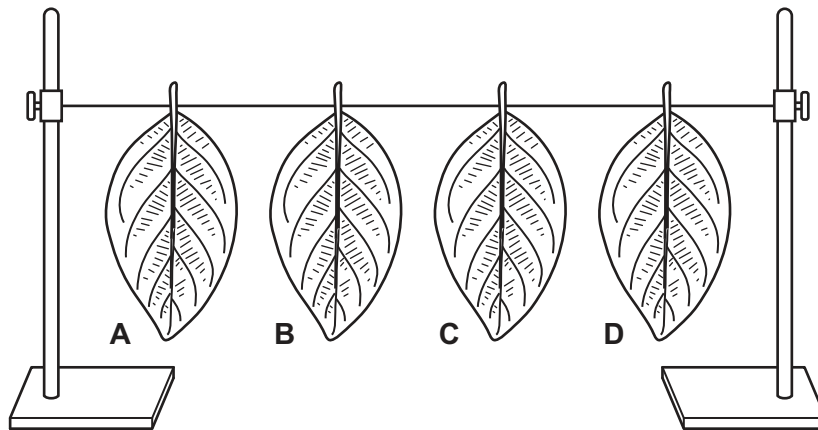


Fig. 4.1

After 48 hours the mass of each leaf is recorded again.

Table 4.1 shows the results.

Table 4.1

leaf	treatment with petroleum jelly	mass at start /g	mass after 48 hours /g	change in mass /g
A	both surfaces covered	3.2	3.2	0.0
B	lower surface covered	3.3	3.2	0.1
C	upper surface covered	3.4	2.8	0.6
D	not covered	3.3	2.6	

- (i) Calculate the change in mass for leaf **D**.

mass = g [1]

- (ii) Explain why leaf **C** lost more mass than leaf **B**.

Include ideas about stomata in your answer.

.....

 [2]

(b) Water is transported from the roots to the leaves in the xylem vessels.

Fig. 4.2 shows a cross-section of a root.

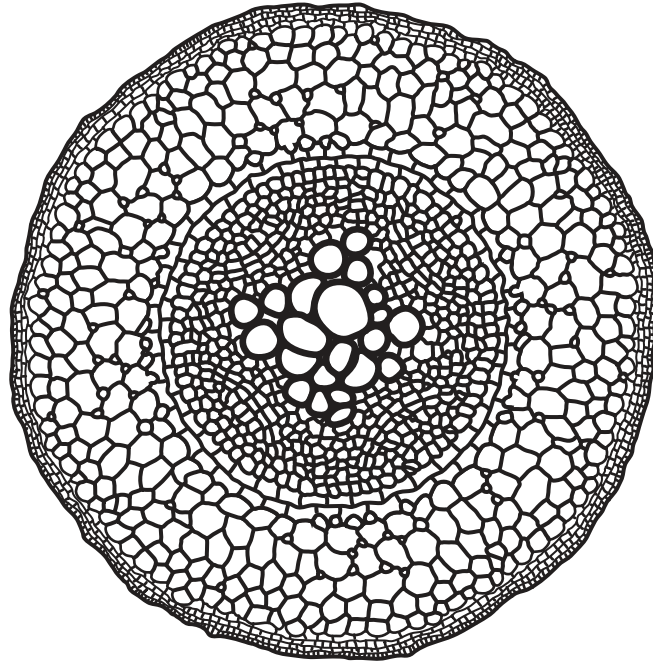


Fig. 4.2

- (i) Use a label line and the letter **X** to show the position of xylem vessels in Fig. 4.2. [1]
- (ii) Xylem vessels also transport mineral ions.

State the name of the mineral ions needed to make amino acids.

..... [1]

(c) A clinostat can be used to investigate tropic responses in plants.

Fig. 4.3 shows a plant growing in a pot placed on its side (plant **A**) and a plant growing on a clinostat (plant **B**). The clinostat slowly turns plant **B**.

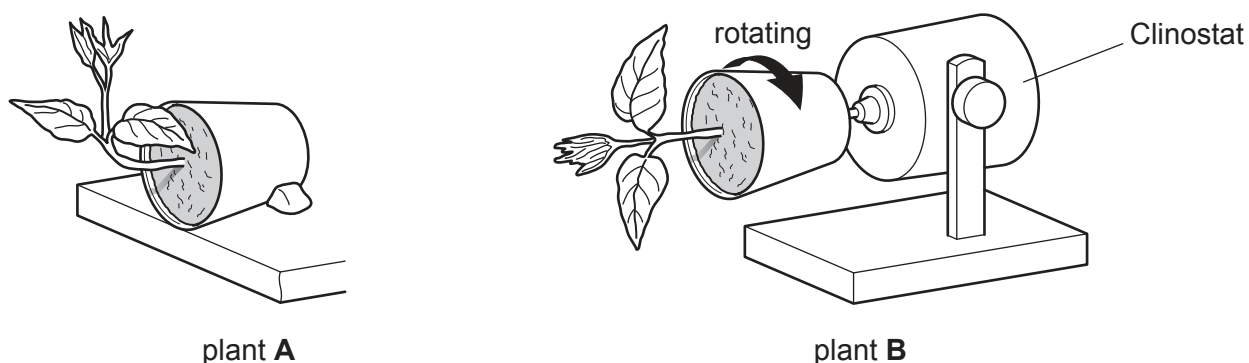


Fig. 4.3

The plants are left to grow in these positions for one week. They receive plenty of light from all directions.

(i) Complete the sentences to explain the results.

Plant **A** grows upwards from gravity.

This response is called

Plant **B** grows because each side of the plant experiences the same gravitational force.

[3]

(ii) Responses in humans are controlled by chemical substances.

Place a tick (✓) in **one** box to show a correct statement about these chemical substances.

They are enzymes transported in red blood cells.

They are enzymes transported in blood plasma.

They are hormones transported in red blood cells.

They are hormones transported in blood plasma.

[1]

[Total: 9]

- 5 (a) A student investigates the reaction between dilute hydrochloric acid and a 5.0 g piece of zinc using the apparatus shown in Fig. 5.1.

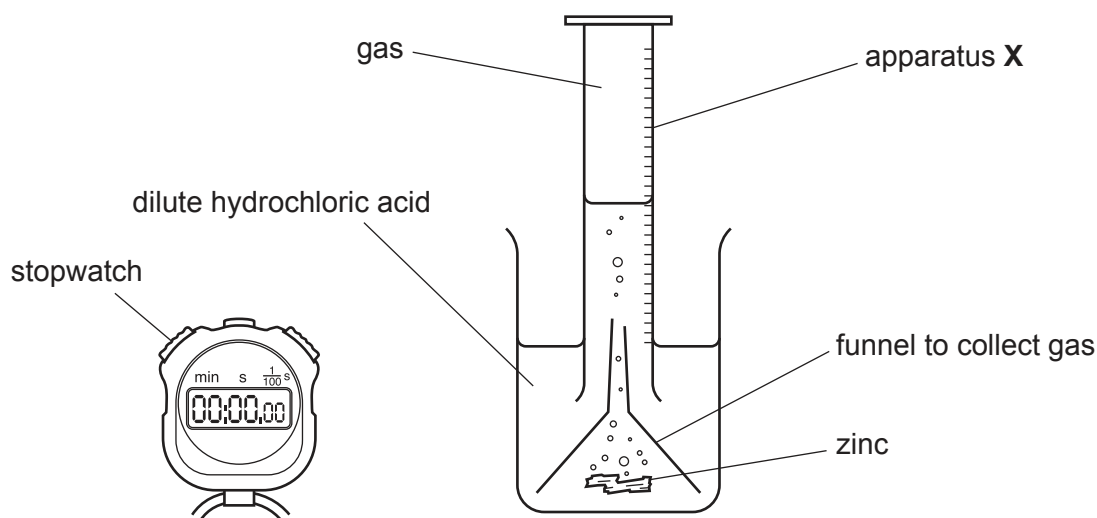
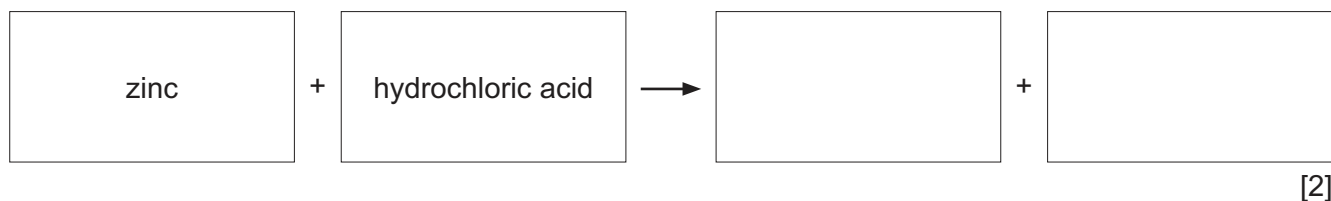


Fig. 5.1

The reaction forms a gas and a solution containing a zinc salt.

- (i) Complete the word equation for this reaction.



- (ii) Name apparatus X.

..... [1]

- (iii) Describe a chemical test to show that the solution contains zinc ions, Zn^{2+} .

test

result

..... [2]

- (iv) The student repeats the experiment under the same conditions, using 5.0 g of magnesium instead of zinc.
State the change to the rate of the reaction, if any, that occurs when magnesium is used instead of zinc.

Explain your answer.

rate change

explanation

..... [1]

(b) Zinc and other metals are obtained from their ores. They are also obtained by recycling.

Recycling metals costs less than obtaining metals from their ores.

State one **other** reason why metals are recycled.

..... [1]

(c) Lithium, sodium and potassium are Group I metals.

Describe **one** chemical trend and **one** physical trend in the properties of these metals going down Group I from lithium to potassium.

chemical trend

.....

physical trend

.....

[2]

[Total: 9]

6 Fig. 6.1 shows a battery-powered electric bus.

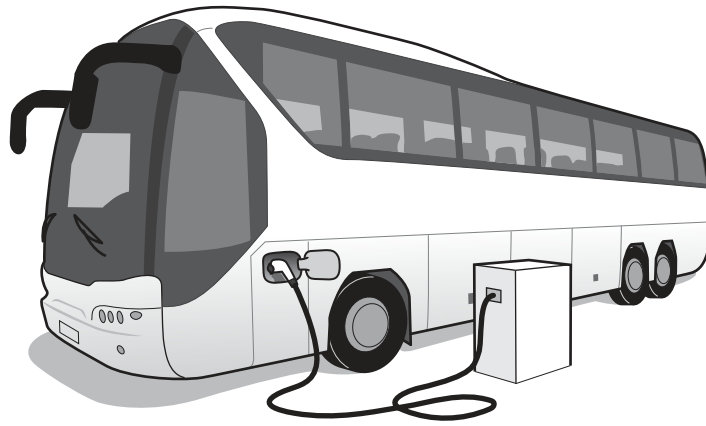


Fig. 6.1

The batteries are charged from the electricity supply through the cables. When the batteries are fully charged, the cable is unplugged and the bus is driven away.

(a) (i) Complete the useful energy change when the batteries are being charged.

electrical energy → energy [1]

(ii) State the useful form of energy the bus has as it moves along the road.

..... [1]

(b) The bus accelerates.

Describe how the driving force on the bus compares with the frictional forces acting on the bus as it accelerates.

.....
 [1]

(c) The bus travels 15 km in 20 minutes.

Calculate the average speed of the bus in metres per second.

speed = m/s [3]

(d) Fig. 6.2 shows the electric circuit in the bus that:

- powers the electric motor
- lights the headlamps.

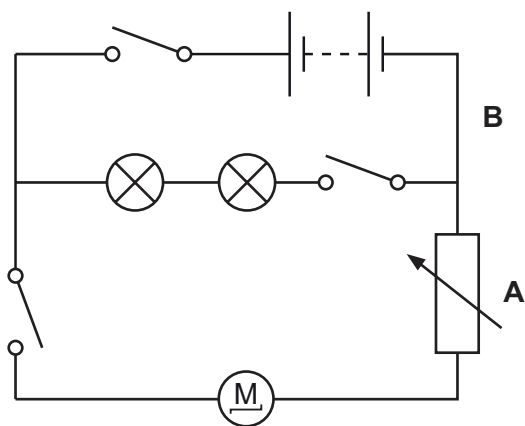
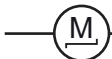


Fig. 6.2

 is the symbol for an electric motor

(i) Name the component at point **A**.

..... [1]

(ii) State the type of circuit connection for the two lamps.

..... [1]

(iii) Suggest why the component at point **A** is not connected at point **B** in the circuit. Include ideas about the motor and the lamps in your answer.

.....

 [2]

[Total: 10]

7 (a) Fig. 7.1 is a diagram of the human heart.

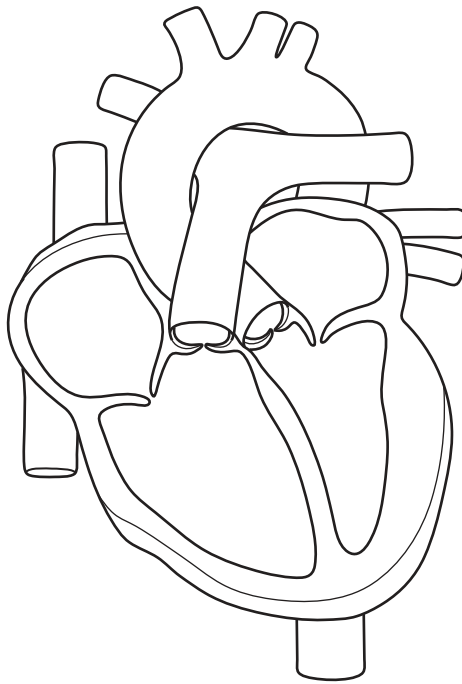


Fig. 7.1

(i) Draw a label line and the letter **A** on Fig. 7.1 to show the position of the septum. [1]

(ii) Circle the name of the blood vessel that brings blood to the right atria from the body.

- aorta pulmonary artery pulmonary vein vena cava**

[1]

(iii) The muscular wall pumps blood out of the right atria.

State the type of structure that stops the blood returning to the right atria.

..... [1]

(iv) Arteries and veins are connected to the heart.

State **two** differences between arteries and veins.

1

.....

2

.....

[2]

(b) Vaccinations protect us from infection.

When given a vaccination our body produces antibodies.

(i) Name the part of the blood that produces antibodies.

..... [1]

(ii) Fig. 7.2 shows the number of antibodies in the blood after a vaccination for measles and after being infected by the measles virus.

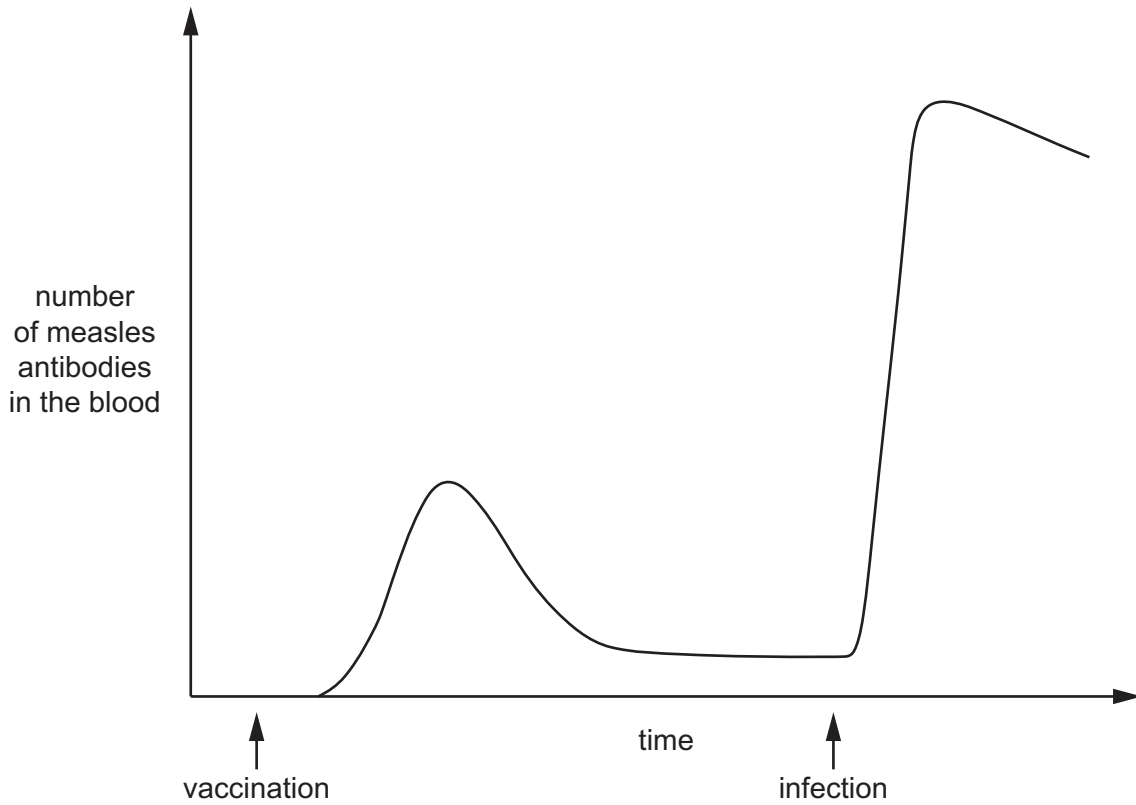


Fig. 7.2

Describe **two** differences between the antibody production after the vaccination and after the infection shown in Fig. 7.2.

1

.....

2

.....

[2]

[Total: 8]

8 The structures of ethane and of ethene are shown in Fig. 8.1.

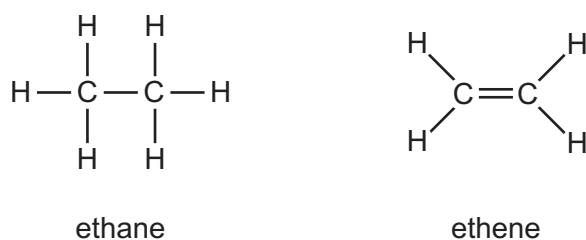


Fig. 8.1

- (a) Ethane is an alkane.
Ethene is an alkene.

Describe one similarity and one difference between the chemical bonds in alkane molecules and in alkene molecules.

similarity

.....

difference

.....

[2]

- (b) During the complete combustion of ethane, water and one other substance form.

- (i) Identify this other substance.

..... [1]

- (ii) Describe **one** chemical test for water and state the observation for a positive result.

test

observation

[2]

- (iii) Explain why the combustion of ethane is described as an oxidation reaction.

.....

..... [1]

- (c) Fractional distillation of petroleum produces naphtha.
Cracking naphtha produces ethene.
Addition polymerisation of ethene produces polymer Y.

Name polymer Y.

..... [1]

[Total: 7]

- 9 Fig. 9.1 shows thermal energy being transferred to a beaker full of water.

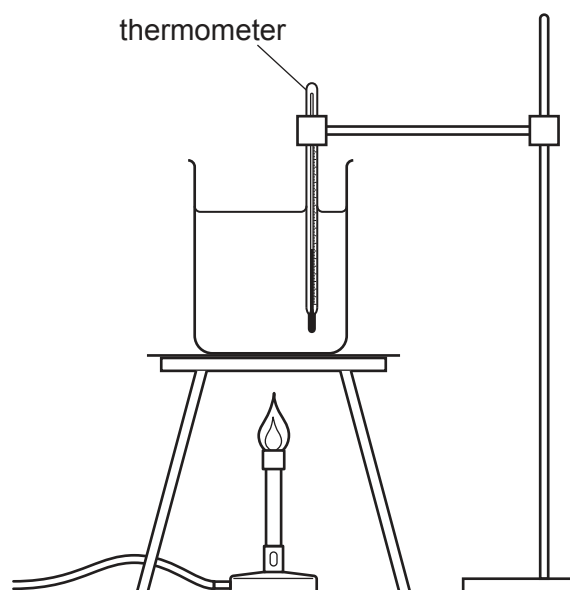


Fig. 9.1

- (a) A student measures the temperature of the water every five minutes.

Explain why the level of the liquid **in the thermometer** changes as the temperature increases.

.....
 [1]

- (b) Table 9.1 shows the results.

Table 9.1

time/min	temperature/°C
0	20
5	40
10	60
15	80
20	100
25	100

- (i) Name the process taking place as the water is heated between 20 and 25 minutes.

..... [1]

- (ii) Describe the changes in the separation and motion of the water molecules between 5 minutes and 10 minutes.

separation

motion

[2]

- (c) The student puts the thermometer in a cup of water. When the student looks down into the cup, the thermometer appears to bend as it goes into the water.

Fig. 9.2 shows what the student can see.



Fig. 9.2

Name the property of light demonstrated by this observation.

..... [1]

(d) The student sends a message containing the results of the experiment by mobile phone (cell phone) to a friend.

(i) State the type of electromagnetic waves used by the mobile phone to send the message.

..... [1]

(ii) Fig. 9.3 shows an incomplete electromagnetic spectrum.

	X-rays		visible light	infrared		
--	--------	--	------------------	----------	--	--

Fig. 9.3

On Fig. 9.3 write your answer to (d)(i) in the correct position in the electromagnetic spectrum. [1]

[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	1 H hydrogen 1						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	Key atomic number atomic symbol name relative atomic mass						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 —	—	—	—	—	—

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 dm³ at room temperature and pressure (r.t.p.).