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6348178696

COMBINED SCIENCE **0653/43**

Paper 4 Theory (Extended) **May/June 2023**

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.

DC (LK/CT) 316984/2

[Turn over

1 **(a)** Fig. 1.1 is a diagram of the male reproductive system in humans.

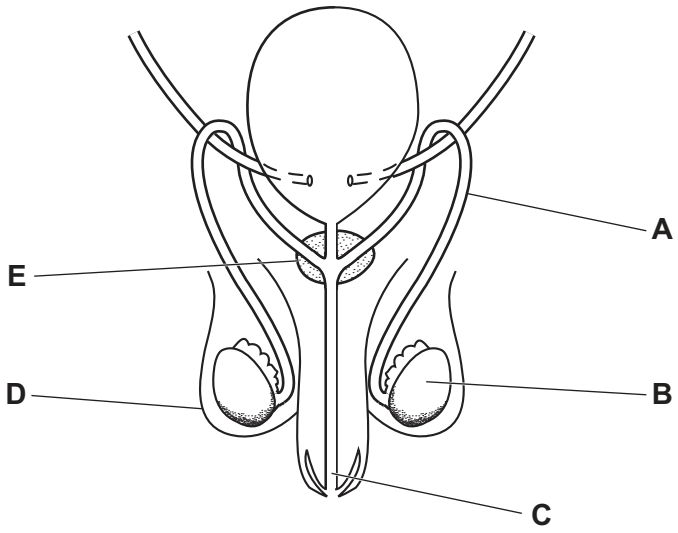

Fig. 1.1

The letters **A** – **E**, in Fig. 1.1 indicate parts of the male reproductive system.

Complete Table 1.1 to show the letter, name and function of some of these parts.

Table 1.1

letter	name of part	function
	scrotum	
B		
		carries urine and semen out of the body

[3]

(b) The female reproductive system in humans produces egg cells.

Complete the sentences about egg cells.

Egg cells are specialised cells. Each cell has an energy store and a ..... coating which changes after fertilisation.

Fertilisation is the fusion of the ..... from a sperm and an egg cell.

[2]

(c) During pregnancy a placenta develops.

Describe **two** different functions of the placenta.

1 .....

.....

2 .....

.....

[2]

[Total: 7]

2 Dilute sulfuric acid is electrolysed, as shown in Fig. 2.1.

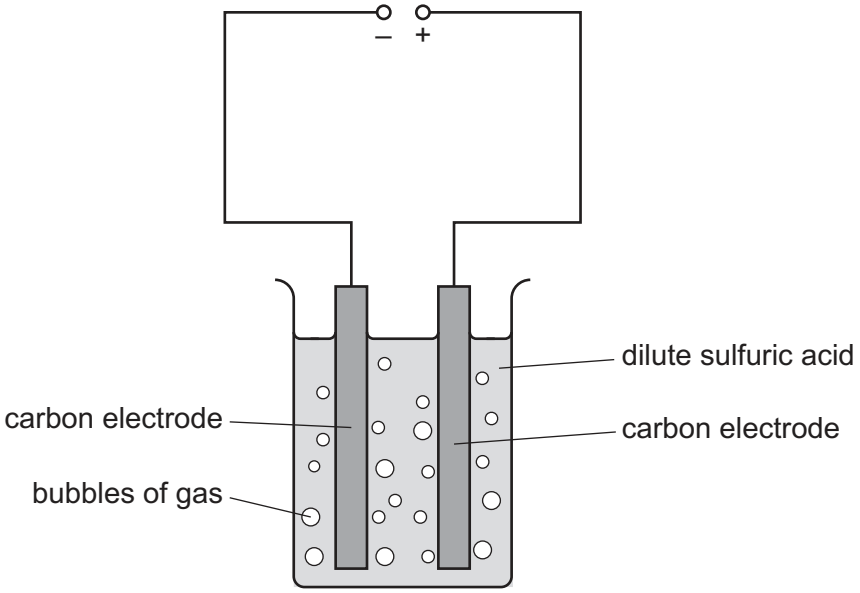

Fig. 2.1

Bubbles of gas form at both electrodes during the electrolysis.

(a) The ionic equation for the reaction at the positive electrode is shown.

$$4OH^-(aq) \rightarrow 2H_2O(l) + O_2(g) + 4e^-$$

(i) Describe **in words** the reaction at the positive electrode.

.....

.....

.....

..... [3]

(ii) Complete the ionic equation for the reaction at the negative electrode.

$$2H^+(aq) + \text{.....} \rightarrow \text{.....}(g) \quad [2]$$

(b) Dilute sulfuric acid is the electrolyte in this electrolysis.

State the meaning of electrolyte.

.....

.....

..... [2]

(c) A different aqueous solution is electrolysed.

The products of this electrolysis are hydrogen and chlorine.

Suggest the identity of this aqueous solution.

..... [1]

[Total: 8]

3 Fig. 3.1 shows a football player kicking a football. The ball travels straight up in the air before falling to the ground and stopping.

Fig. 3.1

(a) Fig. 3.2 shows the speed–time graph of the ball after leaving the player's foot until it hits the ground.

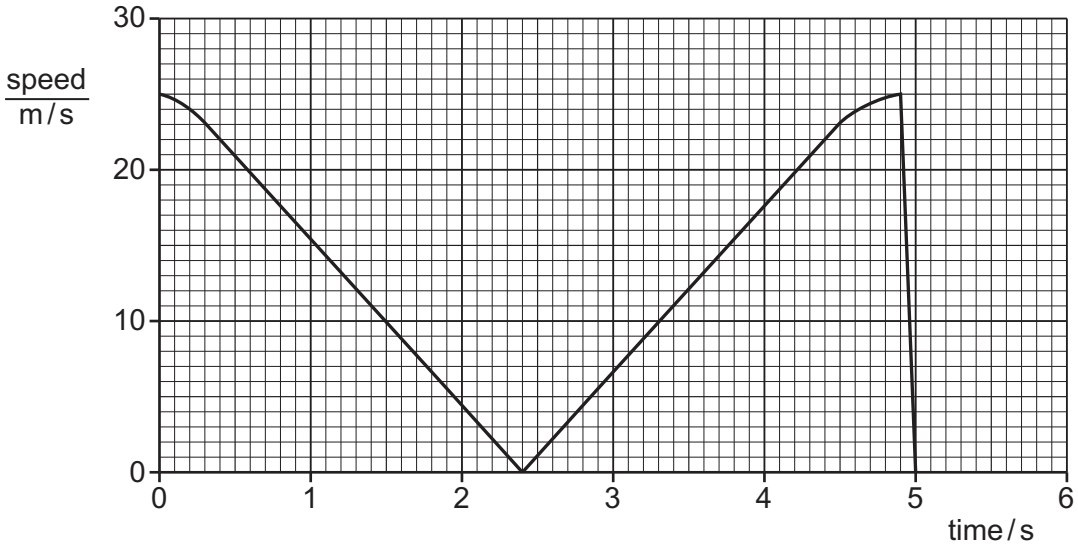

Fig. 3.2

(i) State the speed of the ball as it leaves the player's foot.

speed = ... m / s [1]

(ii) On Fig. 3.2, mark with an **X** a time when the ball has non-constant deceleration. [1]

(iii) Give **two** reasons why the ball decreases in speed after leaving the player's foot but before it hits the ground.

1 .....

.....

2 .....

[2]

(b) Fig. 3.3 shows the player holding the football on his hand without the ball moving.

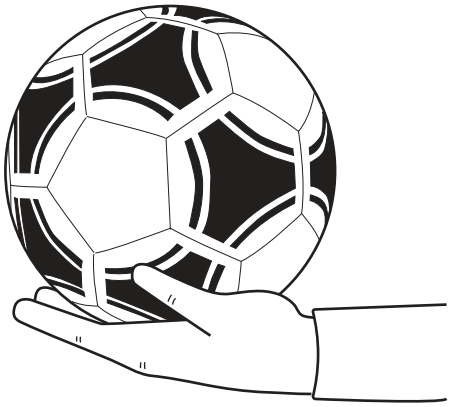

Fig. 3.3

The mass of the ball is 0.40 kg.

(i) Calculate the upward force used by the player to hold the ball without it moving.

The gravitational force on unit mass is 10 N / kg.

force = ... N [2]

(ii) Explain why you need to know that the ball is not moving to calculate your answer to **(b)(i)**.

.....

..... [1]

(c) Fig. 3.4 shows a rugby ball.

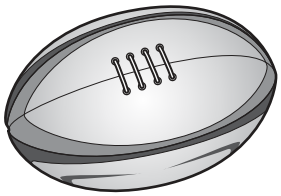

Fig. 3.4

The mass of the ball is 450 g. The ball has a volume of 4100 cm^3.

Calculate the average density of the ball in kg / m^3.

density = ... kg / m^3 [3]

[Total: 10]

4 **(a)** Fig. 4.1 is a diagram of a palisade cell and a root hair cell.

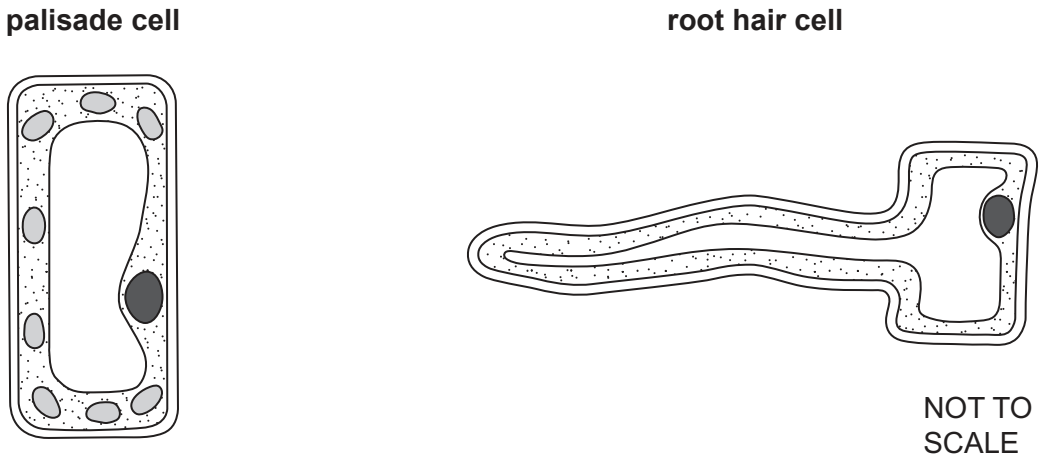

Fig. 4.1

(i) State the name of two structures visible in **both** the palisade cell and the root hair cell in Fig. 4.1.

..... **and** ..... [1]

(ii) Explain how the root hair cell is adapted for its function.

.....

.....

..... [2]

(iii) Palisade cells are involved in the synthesis of carbohydrates by photosynthesis.

Explain the role of palisade cells in photosynthesis.

.....

.....

.....

.....

..... [3]

(b) Plants lose water by transpiration.

A scientist measures the surface area of a plant and the mass of water it loses at different times of the day.

The scientist also takes regular measurements of the temperature and humidity of the plant's environment.

Table 4.1 shows the results.

Table 4.1

time of day / hours	temperature / °C	percentage humidity	rate of transpiration / g per m^2 per hour
08:00	12	87	54
10:00	18	86	81
12:00	26	78	170
14:00	29	62	182
16:00	27	68	126
18:00	16	78	76

(i) Calculate the percentage increase in the rate of transpiration between **08:00** and **12:00** hours.

Give your answer to the nearest whole number.

percentage increase = ... % [3]

(ii) Table 4.1 shows that between **14:00** and **18:00** hours the temperature and humidity of the environment changes.

Explain how each of these changes can affect the rate of transpiration.

Change in temperature .....

.....

Change in humidity .....

.....

[3]

[Total: 12]

5 Solid ammonium nitrate, NH_4NO_3, dissolves to form aqueous ammonium nitrate.

(a) Name the solute and the solvent in aqueous ammonium nitrate.

solute .....

solvent .....

[2]

(b) The energy level diagram for dissolving ammonium nitrate is shown in Fig. 5.1.

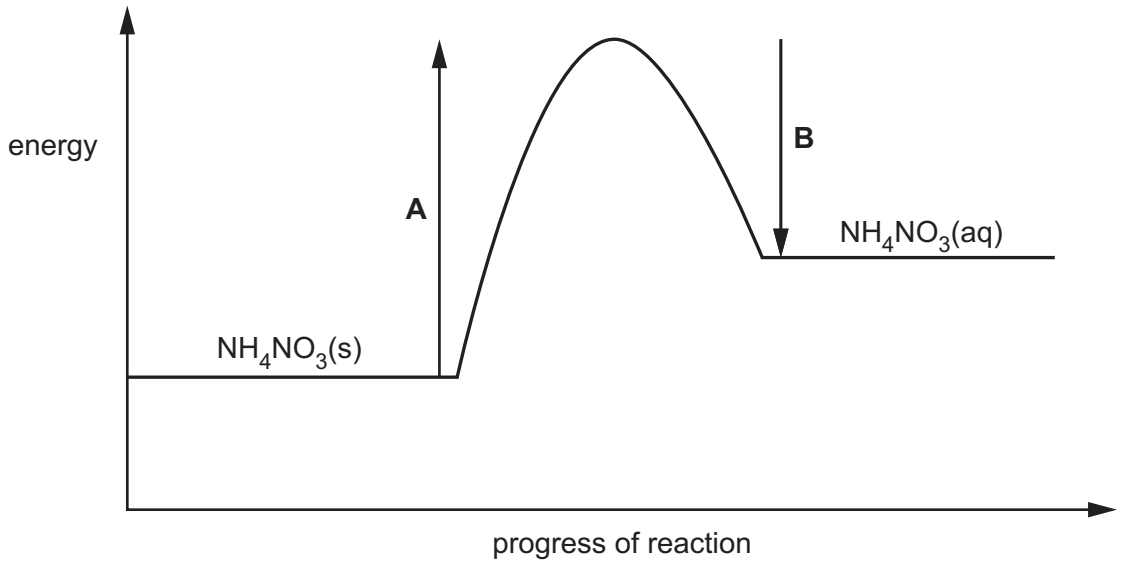

Fig. 5.1

(i) Describe the overall energy change that occurs when ammonium nitrate dissolves.

Explain your answer.

.....

.....

..... [2]

(ii) Describe the changes that are represented by arrow **A** and arrow **B**.

Use ideas about energy and bonds in your answer.

arrow **A** .....

.....

arrow **B** .....

.....

[3]

(c) Complete Table 5.1 about the elements in ammonium nitrate, NH_4NO_3.

Table 5.1

element	symbol	metal or non-metal	number of atoms in one molecule of ammonium nitrate
nitrogen	N		
hydrogen	H		
oxygen	O		

[2]

[Total: 9]

6 Fig. 6.1 shows an electric fan and a lighting unit with two lamps, connected to a car battery.

The fan blades rotate and blow cool air when the fan is switched on.

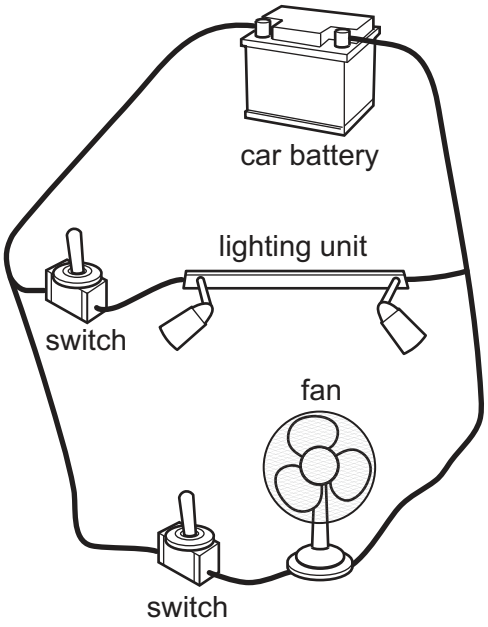

Fig. 6.1

(a) State the type of circuit connection for the fan and lighting unit.

..... [1]

(b) State the form of useful energy output by the working fan.

..... [1]

(c) The battery supplies a voltage of 12.0 V. The current from the battery is 8.0 A.

The power rating of the lighting unit is 11 W.

(i) Show that the current in the lighting unit is 0.92 A.

[1]

(ii) Calculate the power rating of the fan.

power ..... W [2]

(d) The circuit should also contain a fuse to protect the components.

A fuse rated at 10 A is added into the main circuit.

Explain why this fuse:

- will give protection to the fan
- will **not** give protection to the lighting unit.

.....

.....

.....

..... [1]

(e) Fig. 6.2 shows an incomplete circuit diagram for the circuit in Fig. 6.1.

The light fitting contains two lamps in series. The fan contains an electric motor.

The complete circuit needs two fuses.

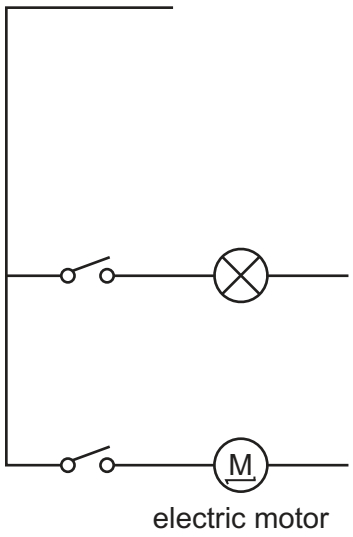

Fig. 6.2

On Fig. 6.2, complete the circuit diagram to include:

- the second lamp
- one fuse to protect the fan
- one fuse to protect the lamps
- the battery and all connecting wires.

[3]

[Total: 9]

7 **(a)** Fig. 7.1 shows the structure of the human heart.

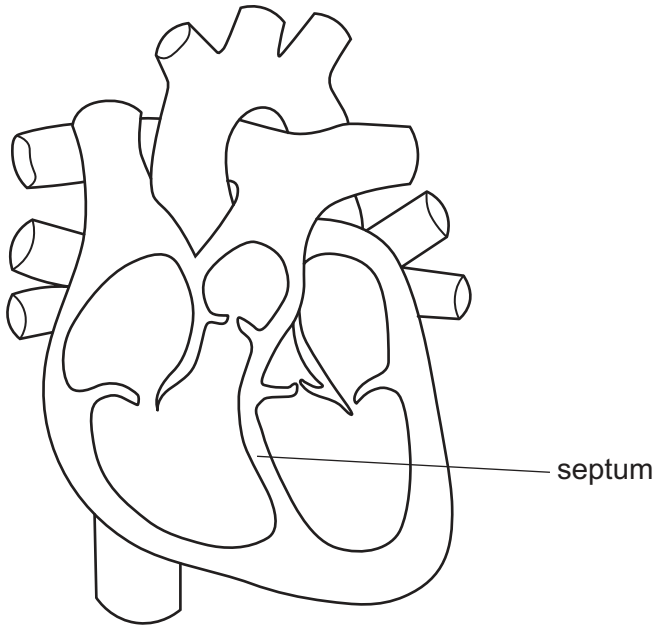

Fig. 7.1

(i) Draw a label line and the letter **X** on Fig. 7.1 to show **one** atrium. [1]

(ii) Some babies are born with a hole in the septum. This affects the double circulation system of their blood.

Explain how this can affect the blood circulating in the body.

.....

.....

.....

..... [2]

(b) An unhealthy diet is one risk factor for coronary heart disease.

(i) Describe what is meant by coronary heart disease.

.....

..... [1]

(ii) State **two** other risk factors for coronary heart disease.

1 .....

2 .....

[2]

(c) Glucose is transported in the blood.

Glucose is needed for aerobic respiration.

Define aerobic respiration.

.....

.....

..... [2]

[Total: 8]

8 Cracking decane, $C_{10}H_{22}$, forms three compounds, as shown in Fig. 8.1.

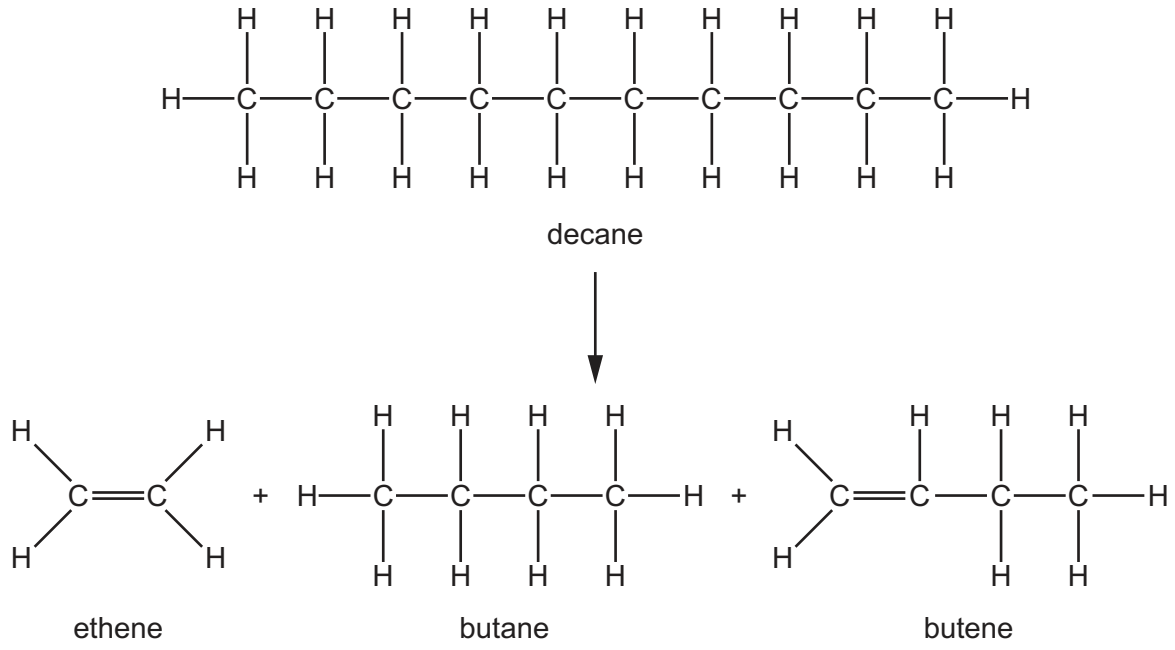

Fig. 8.1

(a) State the **two** compounds shown in Fig. 8.1 that turn aqueous bromine colourless.

Give a reason for your answer.

compounds ..... and .....

reason .....

.....

[2]

(b) State the name and formula of the **two** products formed in the complete combustion of decane.

name ..... formula .....

name ..... formula .....

[2]

(c) Name the homologous series that contains butane and decane.

..... [1]

(d) State **two** reasons why cracking is described as a chemical change and not a physical change.

1 .....

2 .....
[2]

(e) The boiling points of butane and decane are shown in Table 8.1.

Table 8.1

compound	boiling point / °C
butane	–1
decane	174

(i) Explain why the boiling point of butane is lower than the boiling point of decane.

Use ideas about forces in your answer.

.....

..... [1]

(ii) Suggest **one** reason why propane and butane are in the same fraction obtained by fractional distillation of petroleum.

..... [1]

[Total: 9]

9 **(a)** Fig. 9.1 represents a sound wave travelling through air between two people.

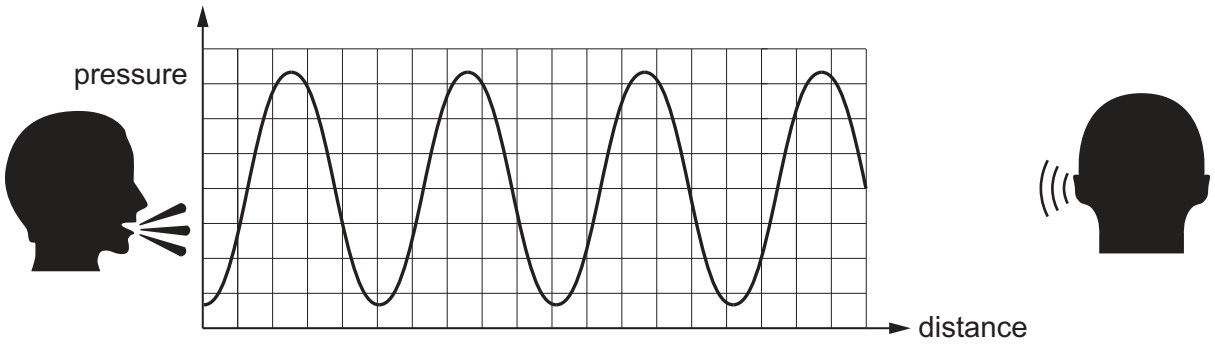

Fig. 9.1

(i) Describe in terms of particle separation what the peaks and troughs on the graph represent for a sound wave in air.

.....

.....

..... [2]

(ii) Fig. 9.2 shows a person wearing ear defenders to protect their hearing from loud noise.

Fig. 9.2

Sound waves are absorbed by material in the ear defenders.

Suggest what happens to the sound energy absorbed.

.....

..... [1]

(b) Light waves travel much faster than sound waves.

State **two** other ways in which light waves differ from sound waves.

1 .....

2 .....
[2]

(c) Mobile phones use microwaves of wavelength 0.030 m. The speed of microwaves in air is 3×10^8 m/s.

Calculate the frequency of the microwaves used by mobile phones.

Give the unit of your answer.

frequency = ... unit ..... [3]

[Total: 8]

The Periodic Table of Elements

Group I	Group II											Group III	Group IV	Group V	Group VI	Group VII	Group 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 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 –		

Key

atomic number
atomic symbol
name
relative atomic mass

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.).