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COMBINED SCIENCE

0653/32

Paper 3 Theory (Core)

May/June 2022

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) Fig. 1.1 is a diagram of the human gas exchange system.

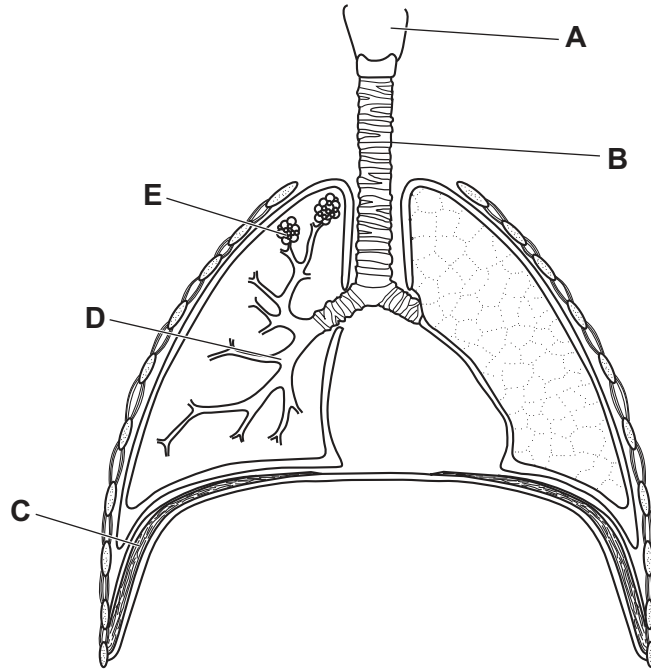


Fig. 1.1

Identify the letter in Fig. 1.1 that shows:

the position of the larynx

the position of the alveoli.

[2]

(b) The composition of inspired air is different from expired air.

Complete these sentences.

Expired air contains carbon dioxide than inspired air.

Expired air also contains vapour.

Both of these substances are products of, the process used to release energy from nutrients.

[3]

- (c) A student investigates the relationship between height and lung volume in five different people.

Fig. 1.2 shows the apparatus the student uses.

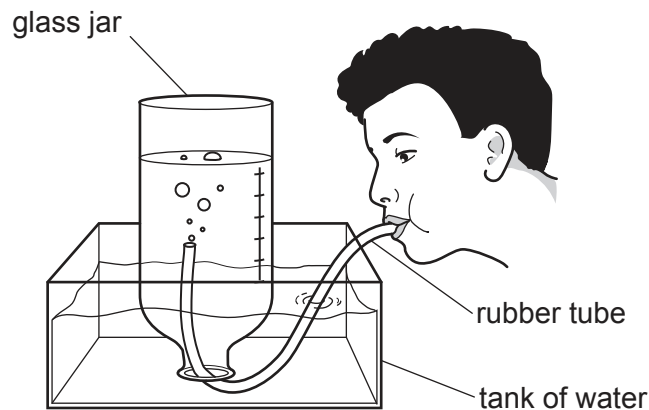


Fig. 1.2

Each person blows into the rubber tube.

The student records the volume of expired air that is blown into the glass jar by each person.

This volume of expired air is used as an estimate of their lung volume.

The student also records the height of each person.

Table 1.1 shows the results.

Table 1.1

person	height /cm	estimated lung volume /dm ³
A	155	3.2
B	122	1.8
C	145	2.9
D	136	2.3
E	140	2.5

- (i) Identify the person with the largest estimated lung volume in Table 1.1. [1]
- (ii) Describe the relationship between height and estimated lung volume in Table 1.1.

.....

..... [1]

(d) Fig. 1.3 is a diagram of the human circulatory system.

The arrows show the direction of blood flow.

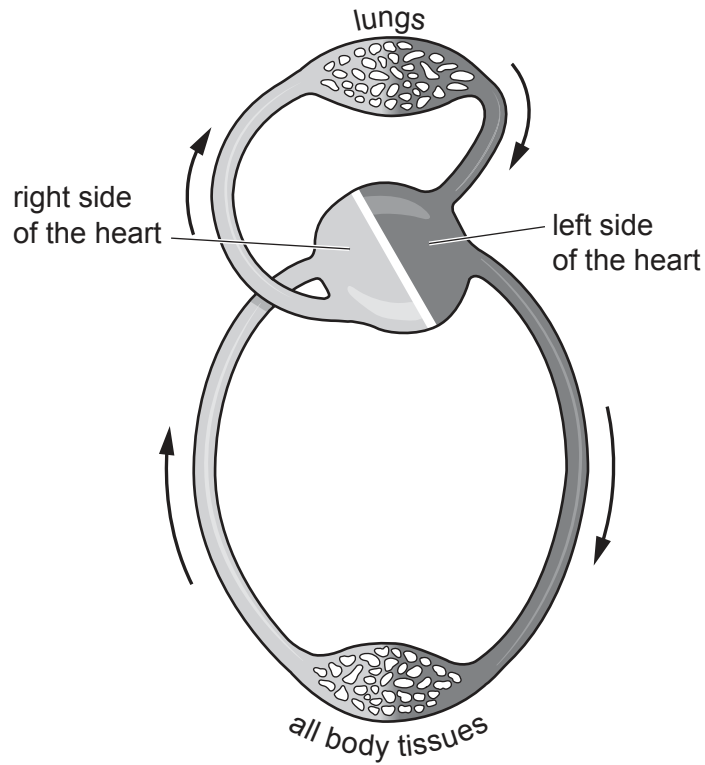


Fig. 1.3

(i) Draw a label line and the letter **P** to show the position of the pulmonary vein on Fig. 1.3. [1]

(ii) State the name of the structures inside the circulatory system that ensure one-way flow of blood.

..... [1]

(e) Blood contains red blood cells.

Describe the function of red blood cells.

.....

 [2]

[Total: 11]

- 2 (a) Zinc is extracted from zinc oxide by heating with carbon.

The equation for this reaction is shown.



- (i) State the type of chemical change that occurs when compounds lose oxygen.

..... [1]

- (ii) State the name given to any chemical reaction that absorbs (takes in) heat energy.

..... [1]

- (iii) Explain why zinc **can** be extracted from zinc oxide by heating with carbon but magnesium **cannot** be extracted from magnesium oxide by heating with carbon.

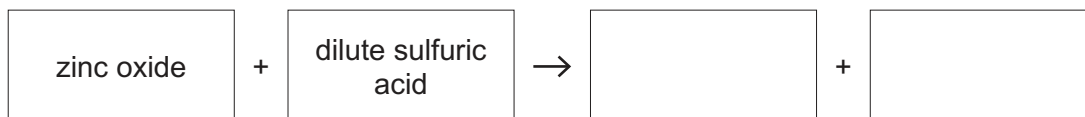
.....

 [2]

- (b) Excess zinc oxide is added to dilute sulfuric acid.

A zinc salt and one other compound are formed.

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

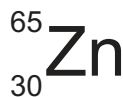


[2]

- (ii) Describe what happens to the pH value of the reaction mixture during this reaction.

.....
 [1]

- (c) An atom of zinc is represented as shown.



Deduce the number of electrons and the number of neutrons in this atom of zinc.

electrons

neutrons

[2]

[Total: 9]

- 3 Fig. 3.1 shows the forces acting as a student rides on a moving scooter.

The scooter has an electric motor.

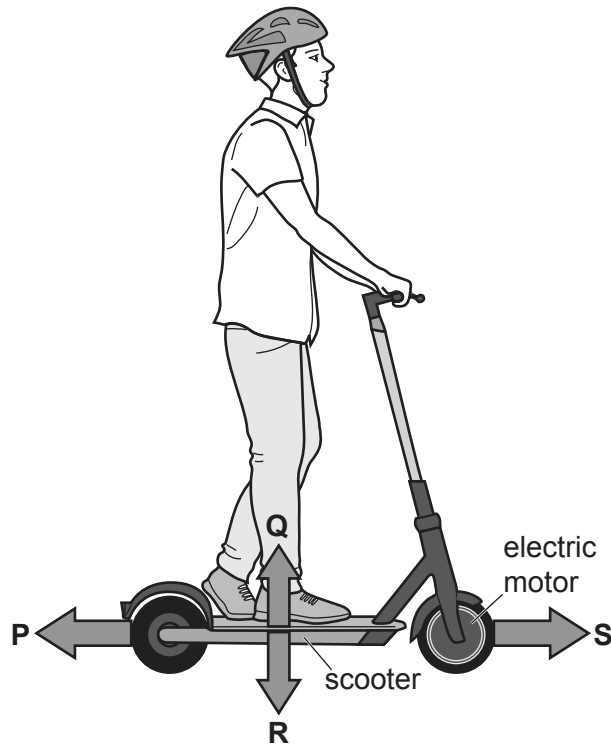


Fig. 3.1

- (a) (i) Force **R** is the result of the Earth's gravitational field acting on the total mass of the student and the scooter.

Name force **R**.

.....

[1]

- (ii) The total mass of the student and the scooter is 35 kg.

Calculate the magnitude of force **R**.

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

force **R** = N [2]

(b) Fig. 3.2 shows a speed-time graph for the motion of the scooter.

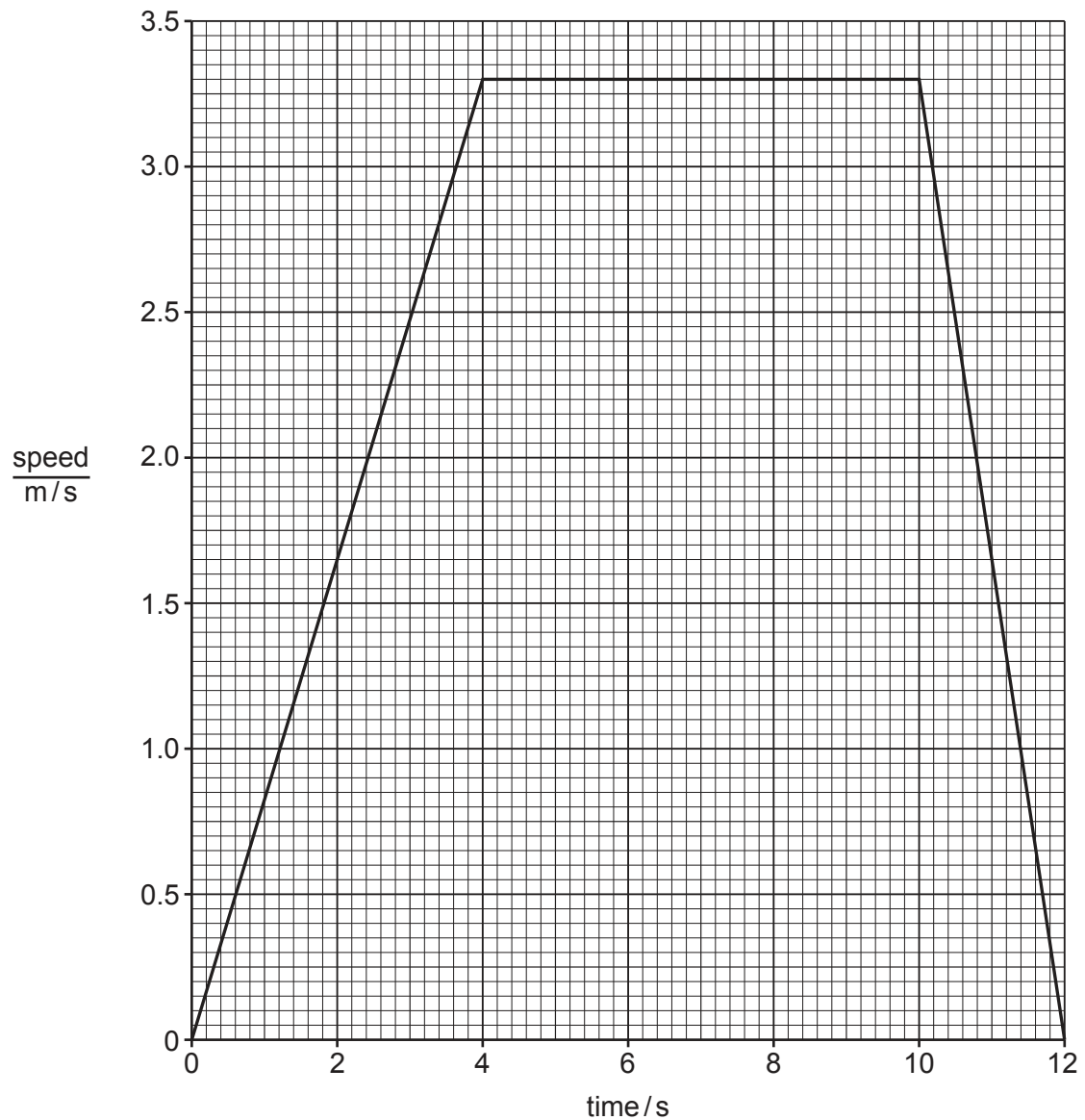


Fig. 3.2

(i) State the maximum speed of the scooter in Fig. 3.2.

maximum speed = m/s [1]

(ii) Calculate the distance travelled by the scooter while at maximum speed.

distance = m [2]

(iii) The scooter has a speedometer that shows the speed in km/h.

At one point the speedometer reads 3.6 km/h.

Show that 3.6 km/h is the same as 1.0 m/s.

[2]

[Total: 8]

4 (a) Fig. 4.1 is a diagram of the male reproductive system in humans.

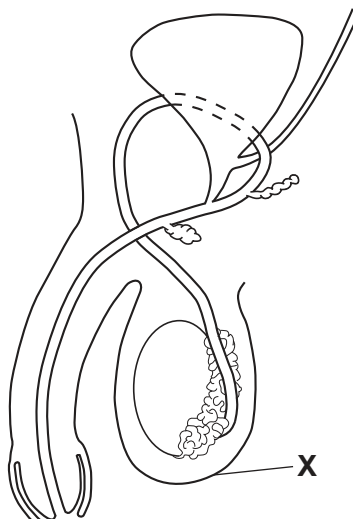


Fig. 4.1

(i) State the name of the part labelled X in Fig. 4.1.

..... [1]

(ii) Name the gland that secretes fluids for sperm to swim in.

..... [1]

(b) Complete these sentences about reproduction.

Choose words from the list.

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

- | | | | |
|---------------|---------------|---------------|----------------|
| embryo | gamete | ovary | oviduct |
| uterus | vagina | zygote | |

The male releases sperm from the penis into the of the female.

The sperm swim to the where fertilisation takes place.

The fertilised egg is called a

[3]

(c) The menstrual cycle in females is controlled by hormones.

Fig. 4.2 shows the relationship between the lining of the uterus and one of these hormones.

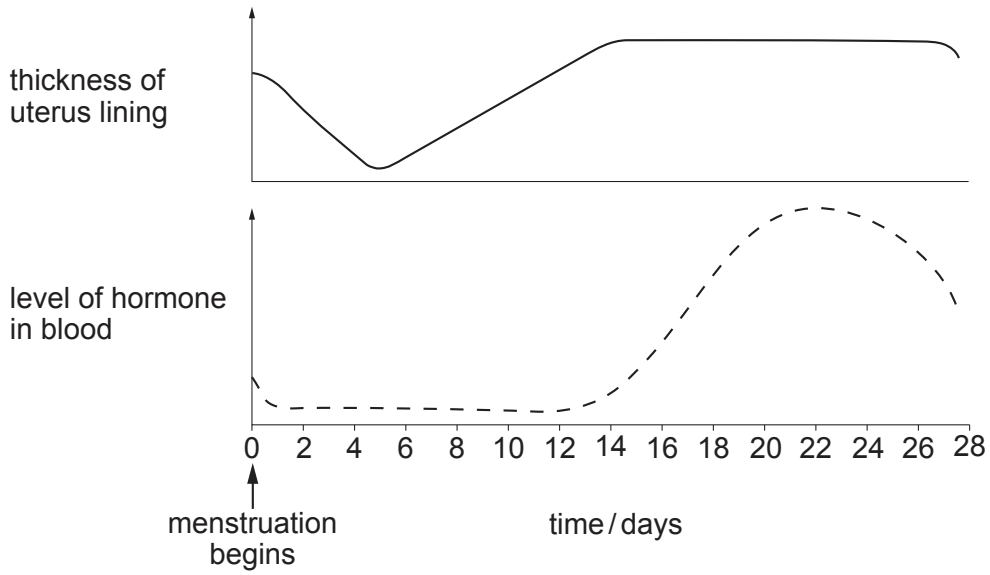


Fig. 4.2

(i) Use Fig. 4.2 to identify the day when the blood contains the highest level of the hormone.

..... [1]

(ii) Describe how the thickness of the uterus lining changes during the menstrual cycle.

Include data from Fig. 4.2 in your answer.

.....

 [2]

(d) During pregnancy a female is advised to increase the amount of protein in her diet.

State the importance of protein in the diet.

.....
 [1]

[Total: 9]

- 5 (a) An electric current is passed through an aqueous solution of compound **X** using inert electrodes. Compound **X** is broken down by this process.

The apparatus used is shown in Fig. 5.1.

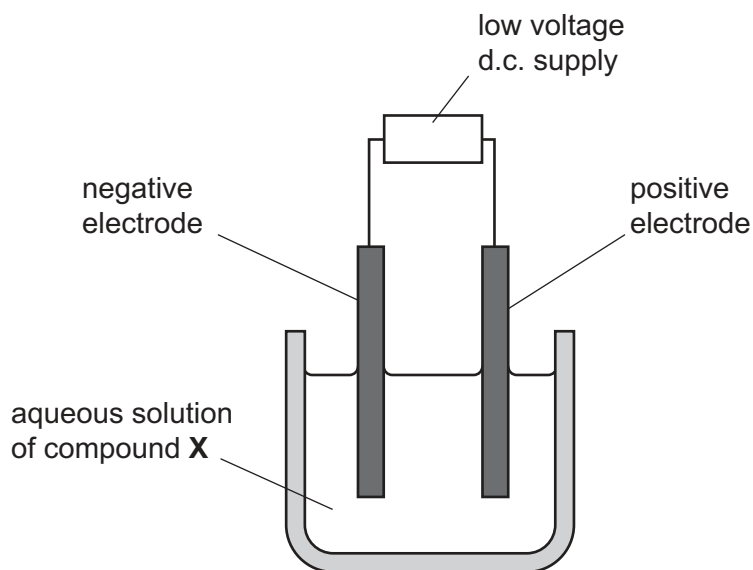


Fig. 5.1

- (i) Name this process.
 [1]
- (ii) State the name of the negative electrode.
 [1]
- (iii) Suggest the name of the element from which the electrodes are made.
 [1]
- (iv) Deduce the type of bonding present in compound **X**.
 [1]
- (v) During this process a gas is formed at the positive electrode.
 This gas bleaches damp litmus paper.
 Identify this gas.
 [1]

- (vi) State whether the type of change occurring when an electric current is passed through the aqueous solution of compound **X** is a chemical change or a physical change.

Explain your answer.

type of change

explanation

..... [1]

- (b) An aqueous solution of compound **X** is a mixture.

- (i) Describe the difference between a compound and an element.

.....
 [1]

- (ii) Describe the difference between a compound and a mixture.

.....
 [1]

- (c) An aqueous solution of compound **X** contains compound **X** dissolved in water.

- (i) Describe **one** chemical test that shows the presence of water.

State the observation for a positive result.

test

observation

..... [2]

- (ii) State **one** method of separation that can be used to collect pure water from an aqueous solution of compound **X**.

..... [1]

[Total: 11]

6 (a) Fig. 6.1 shows a heat lamp used to keep newborn chicks warm.

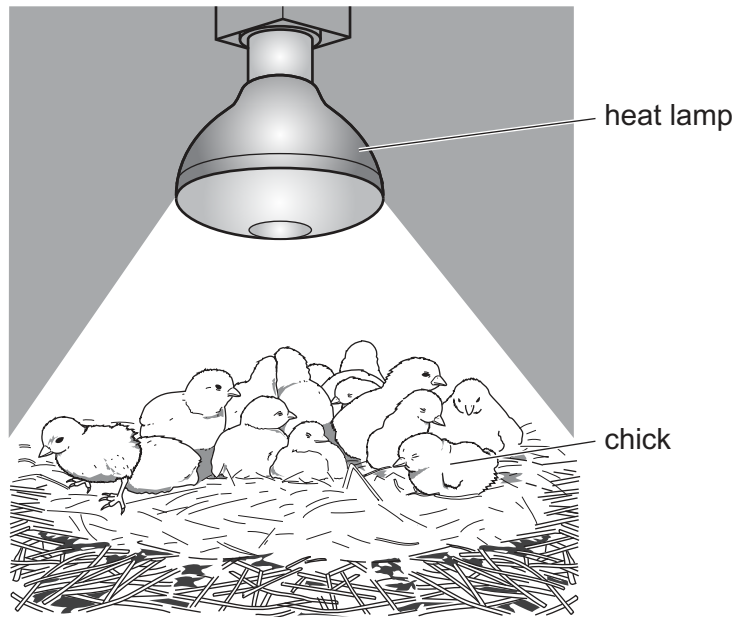


Fig. 6.1

The heat lamp emits radiation in the visible light and infrared regions of the electromagnetic spectrum.

Fig. 6.2 shows an incomplete electromagnetic spectrum.

On Fig. 6.2, write visible light and infrared radiation in the correct places.

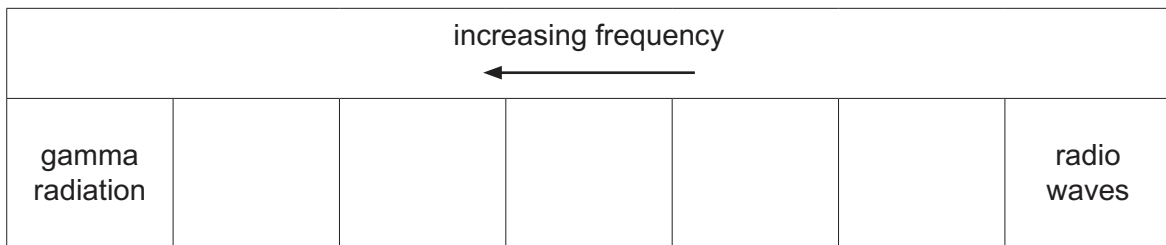


Fig. 6.2

[2]

(b) The heat lamp is connected to a 230 V electricity supply.

The current in the lamp when it is switched on is 1.1 A.

(i) Calculate the resistance of the lamp.

Give the unit of your answer.

resistance = unit [3]

(ii) A farmer connects two identical heat lamps in parallel.

State **two** advantages of connecting the heat lamps in parallel.

1

2

[2]

(c) A newborn chick emits a sound with a frequency of 3.5 kHz.

As the chick grows, the frequency of the sound changes.

After 36 weeks, the sound emitted is 1.5 kHz.

(i) Describe how the pitch of the sound emitted by the chick changes over 36 weeks.

.....

..... [1]

(ii) State whether all the sounds made by the chick as it grows over 36 weeks can be heard by a healthy human ear.

Give a reason for your answer.

.....

..... [1]

[Total: 9]

7 (a) Fig. 7.1 shows information about four organisms living in an ocean habitat.

- Krill eat microscopic producers called phytoplankton.
- Fish eat krill.
- Penguins eat fish.

Fig. 7.1

(i) Construct a food chain using the information in Fig. 7.1.

..... [2]

(ii) Identify the herbivore in Fig. 7.1.

..... [1]

(b) Fig. 7.2 shows a photomicrograph of phytoplankton.

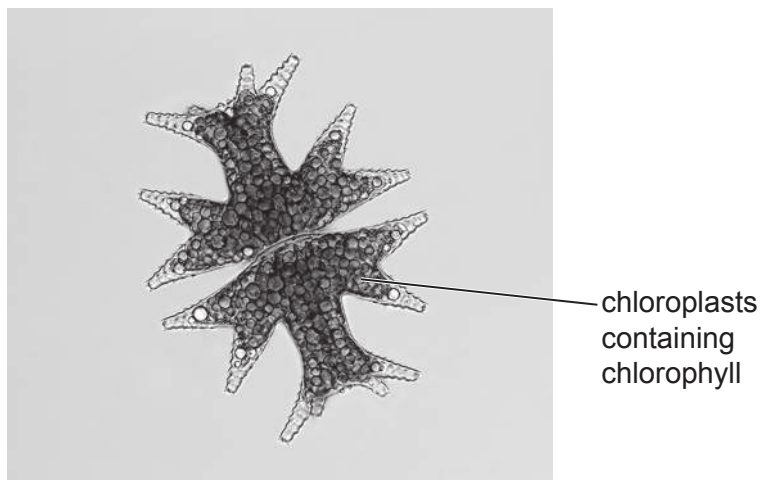


Fig. 7.2

Explain why phytoplankton need chlorophyll.

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

(c) Food is digested in the alimentary canal.

Fig. 7.3 shows some of the pathway taken by food in the human alimentary canal.

Complete Fig. 7.3.

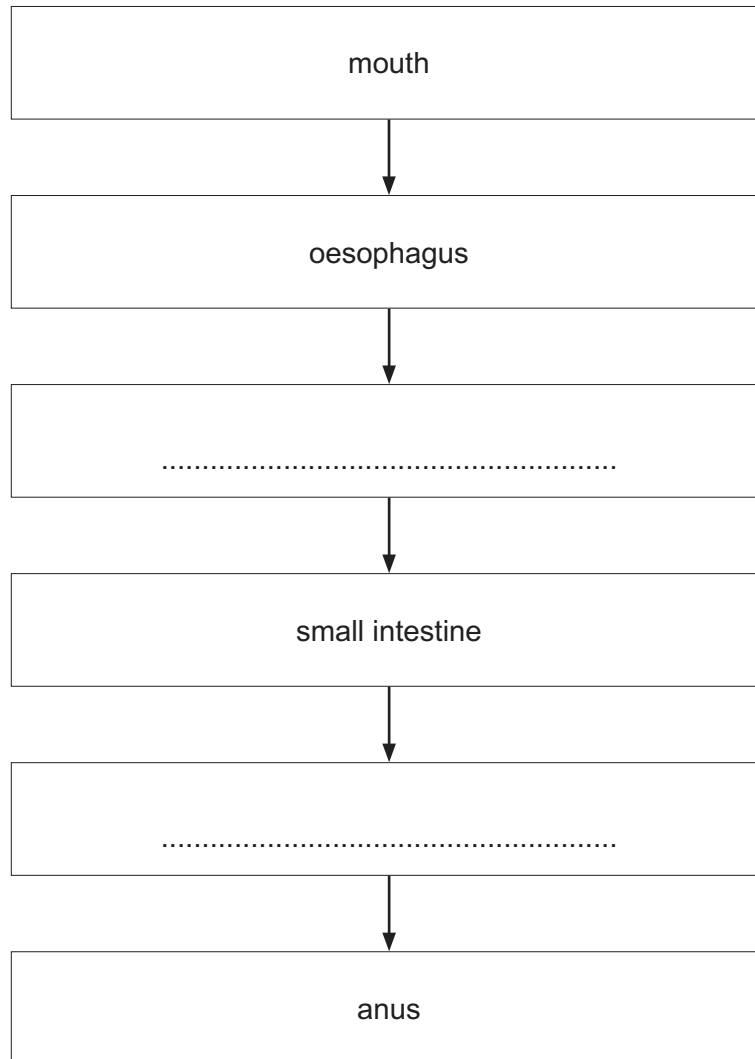
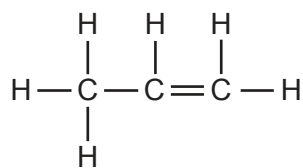


Fig. 7.3

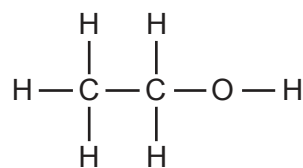
[2]

[Total: 7]

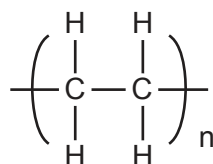
8 The molecular structures and names of three compounds are shown in Fig. 8.1.



propene



ethanol



poly(ethene)

Fig. 8.1

(a) Complete Table 8.1 using the information in Fig. 8.1.

Explain how the molecular structures in Fig. 8.1 help you to identify each type of compound.

Table 8.1

type of compound	name of compound	explanation
alkane
alkene
not a hydrocarbon

[3]

(b) The complete combustion of each of the three compounds shown in Fig. 8.1 produces the greenhouse gas carbon dioxide.

Identify the gas in the air that reacts with these compounds during combustion.

..... [1]

(c) Propene and poly(ethene) are made from compounds obtained from petroleum.

State the processes in which propene and poly(ethene) are made.

propene

poly(ethene)

[2]

[Total: 6]

- 9 (a) Some water is heated in a beaker using an electric heater.

Fig. 9.1 shows the circuit for the electric heater.

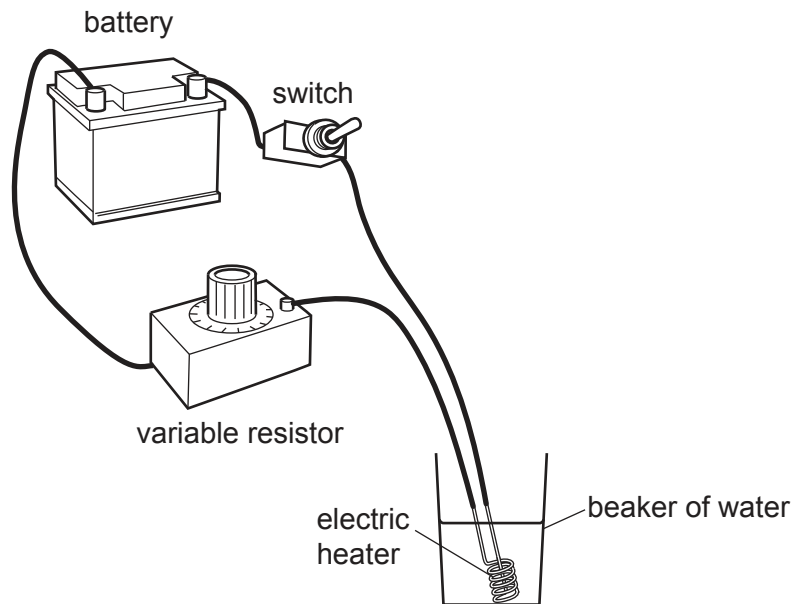
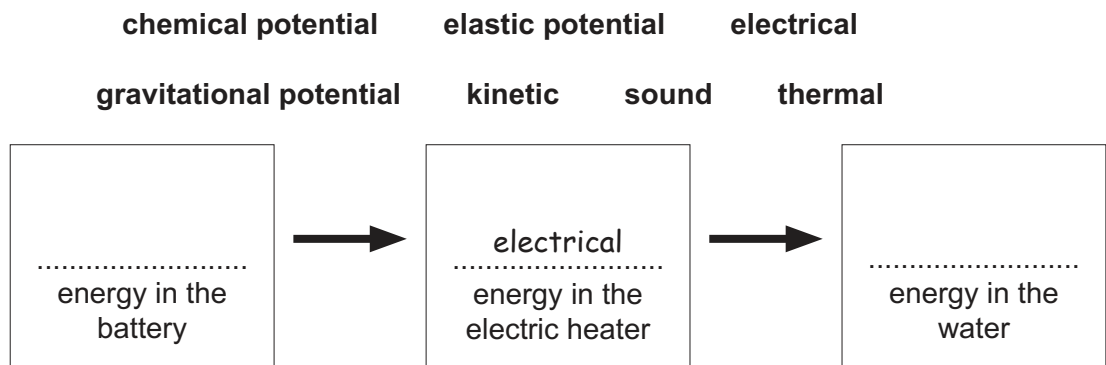


Fig. 9.1

- (i) Use words from the list to complete the boxes to show the sequence of useful energy transfers taking place in Fig. 9.1.

Each word may be used once or not at all.

One has been completed for you.



[2]

- (ii) On Fig. 9.2, complete the circuit diagram for the circuit shown in Fig. 9.1.

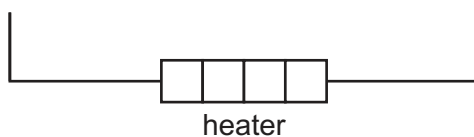


Fig. 9.2

[3]

- (b) Fig. 9.3 shows a liquid-in-glass thermometer without a scale.



Fig. 9.3

- (i) The thermometer is placed in a beaker of water. The beaker of water is heated.

State what happens to the level of liquid inside the thermometer while the water is being heated.

Give a reason for your answer.

level

reason

[2]

- (ii) The thermometer in Fig. 9.3 measures temperatures between -10°C and $+110^{\circ}\text{C}$.

Table 9.1 gives some information about four liquids, **A**, **B**, **C** and **D**.

Table 9.1

liquid	melting point/ $^{\circ}\text{C}$	boiling point/ $^{\circ}\text{C}$
A	-86	$+80$
B	-117	$+79$
C	-39	$+367$
D	$+17$	$+118$

Identify the liquid used in this thermometer.

liquid [1]

- (iii) Explain why the liquid you identified in (ii) is suitable for use in this thermometer.

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

[Total: 10]

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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	Key atomic number atomic symbol name relative atomic mass										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 —	113 Nh nihonium —	114 Fl flerovium —	115 Mc moscovium —	116 Lv livermorium —	117 Ts tennessine —	118 Og oganesson —																		

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.).