GradeMax

Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

6478594905

COMBINED SCIENCE **0653/42**

Paper 4 Theory (Extended) **October/November 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 **20** pages.

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1 **(a)** Fig. 1.1 is a diagram of the human heart.

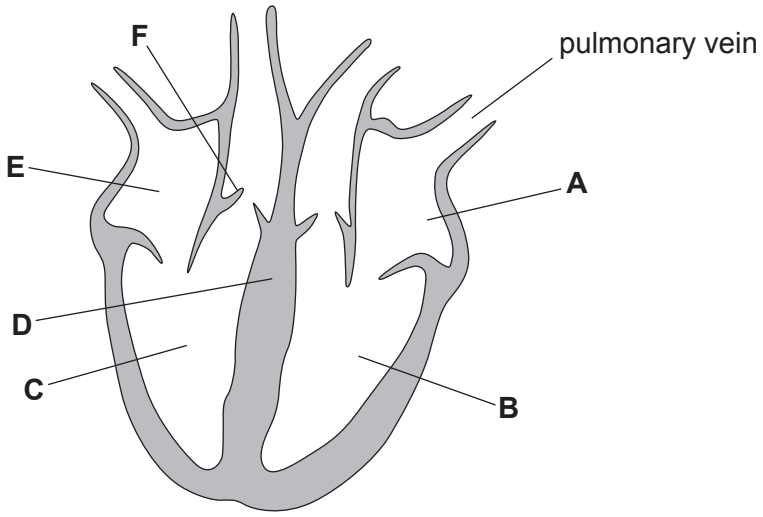


Fig. 1.1

(i) Table 1.1 lists some of the parts labelled in Fig. 1.1.

Complete Table 1.1.

Table 1.1

letter in Fig. 1.1	name of part
B	left .....
.....	septum
F	.....

[3]

(ii) On Fig. 1.1, draw arrows to show the direction of blood flow through the **left** side of the heart. [1]

(iii) The heart is part of a double circulation system.

Explain the advantages of a double circulation system.

.....

.....

.....

..... [2]

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(b) A hospital records the ages of patients with coronary heart disease.

Fig. 1.2 is a bar chart showing the number of patients in each age group.

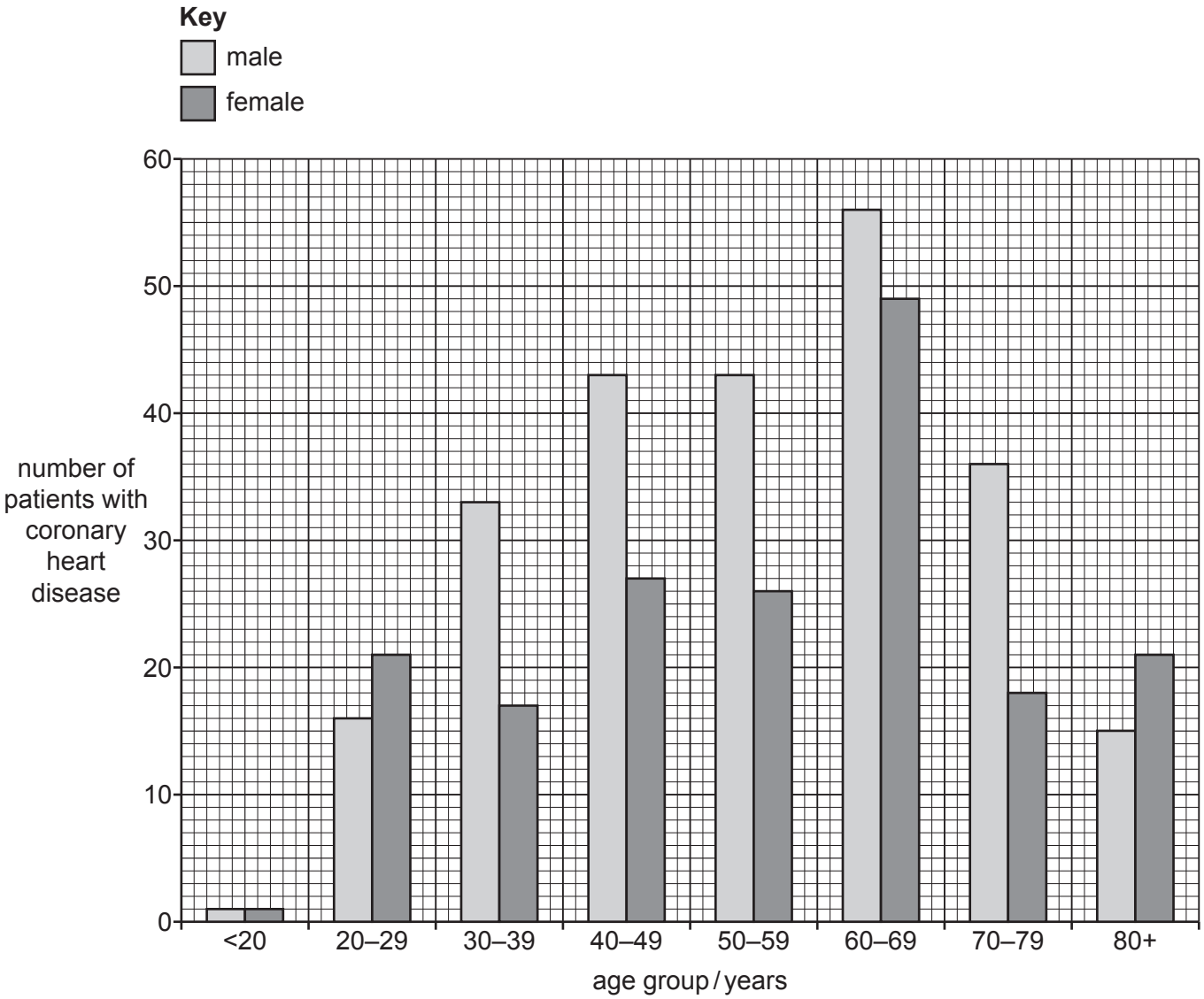


Fig. 1.2

(i) Use Fig. 1.2 to identify **one** age group that has more females with coronary heart disease than males.

..... [1]

(ii) Calculate the percentage of patients in the 70–79 age group that are female.

.....% [2]

[Total: 9]

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2 Iron is extracted from hematite in the blast furnace.

Fig. 2.1 shows some of the substances that enter and leave the blast furnace.

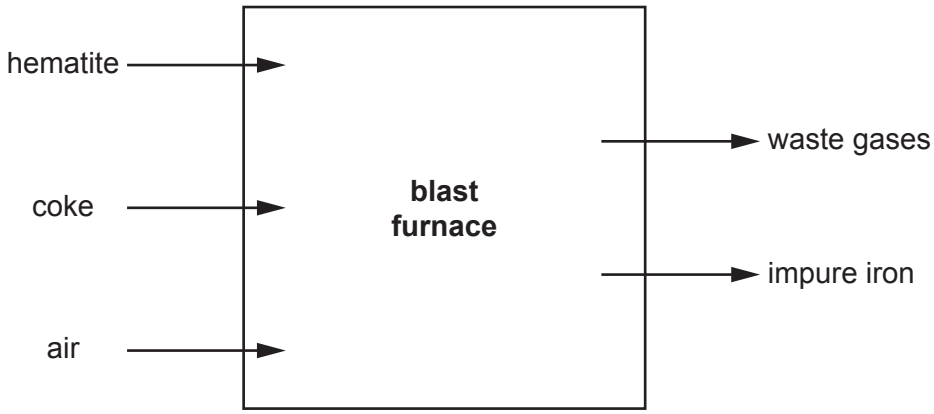


Fig. 2.1

(a) (i) The equations for some reactions in the blast furnace are shown.

Complete the balanced equations.

equation 1 $C + \text{.....} \rightarrow CO_2$

equation 2 $\text{.....} + CO_2 \rightarrow 2CO$

equation 3 $Fe_2O_3 + 3CO \rightarrow \text{.....} + 3CO_2$

[3]

(ii) State the name of the substance shown in Fig. 2.1 that contains Fe_2O_3.

..... [1]

(iii) State why the waste gases that leave the blast furnace also contain nitrogen.

.....

..... [1]

(iv) Carbon monoxide is an air pollutant.

State the name of **one** other air pollutant.

..... [1]

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(b) Stainless steel is an alloy that contains iron.

Stainless steel is used to make cutlery, such as knives and forks.

(i) Describe what is meant by the term alloy.

.....

..... [1]

(ii) Suggest **two** reasons why the alloy stainless steel, rather than pure iron, is used to make cutlery.

1 .....

2 .....
[2]

[Total: 9]

3 In 1997, the Thrust Supersonic Car set a world land speed record.

(a) Fig. 3.1 shows forces **R**, **S**, **V** and **T** acting on the moving car.

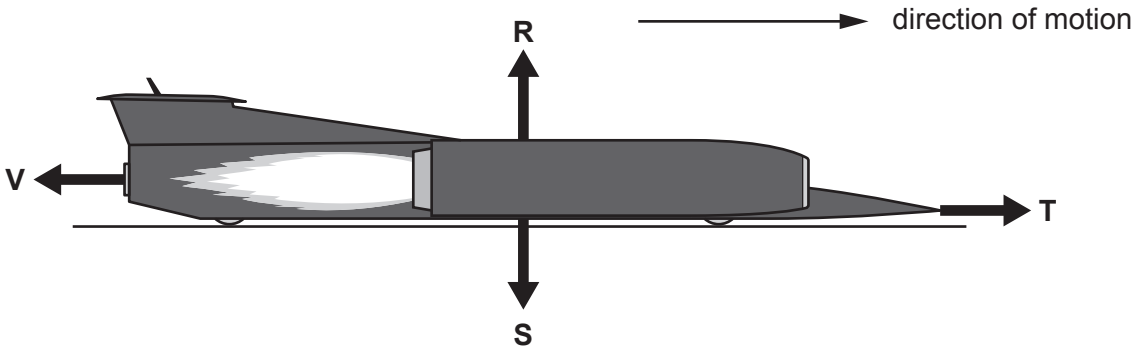


Fig. 3.1

State the letter for the weight of the car. ..... [1]

(b) The record speed of the car is 341 m / s.

(i) Show that 341 m / s is 1228 km / h.

[1]

(ii) The car changes speed from 0 to 341 m / s in 20.0 s.

Calculate the acceleration of the car.

Give the units of your answer.

acceleration = ... units ..... [3]

(iii) The mass of the car is 10 600 kg.

Calculate the kinetic energy of the car at the record speed of 341 m / s.

kinetic energy = ... J [2]

(iv) Use your answer to **(b)(iii)** to calculate the useful power output from the engines of the car as the car accelerates over the 20.0 s.

power = ... W [2]

[Total: 9]

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4 **(a)** Water moves from the roots of a plant through the stem to the leaves.

(i) Complete Fig. 4.1 to show the pathway of water through the plant.

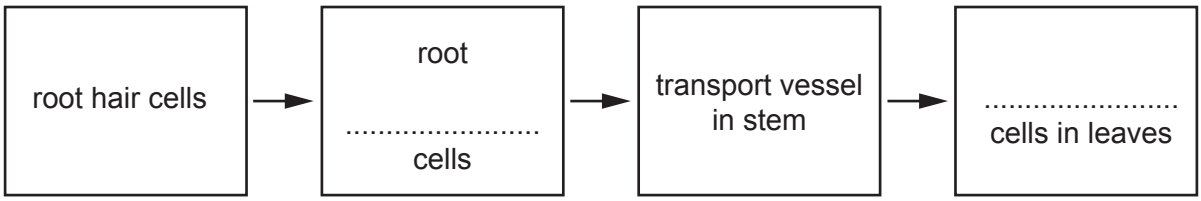


Fig. 4.1

[2]

(ii) Explain how root hair cells are adapted to their function.

.....

.....

..... [2]

(b) Fig. 4.2 is a graph showing the effect of increasing humidity on transpiration rate in plants.

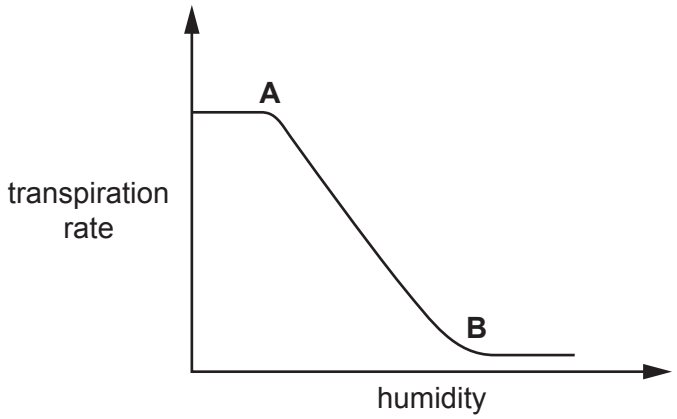


Fig. 4.2

Explain the shape of the graph between points **A** and **B** shown in Fig. 4.2.

.....

.....

.....

.....

..... [3]

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(c) Describe **two** differences between the pollen from insect-pollinated flowers and the pollen from wind-pollinated flowers.

1 .....

.....

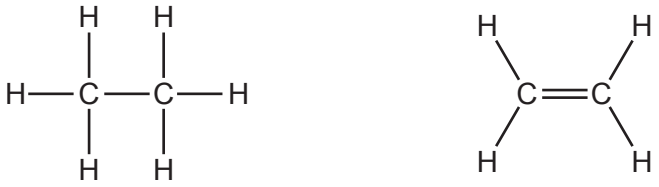
2 .....

.....

[2]

[Total: 9]

5 The structures of ethane and ethene are shown in Fig. 5.1.



ethane ethene

Fig. 5.1

(a) Put a tick (✓) in **one** box in each row of Table 5.1 to show which description is true for ethane only, which is true for ethene only and which is true for both ethane and ethene.

Table 5.1

	true for ethane only	true for ethene only	true for both ethane and ethene
is a hydrocarbon			
is a saturated compound			
changes the colour of aqueous bromine			

[2]

(b) State the number of bonding electrons between the two carbon atoms in ethene.

Explain your answer.

number of electrons .....

explanation .....

.....

[2]

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(c) A student investigates the combustion of ethane, as shown in Fig. 5.2.

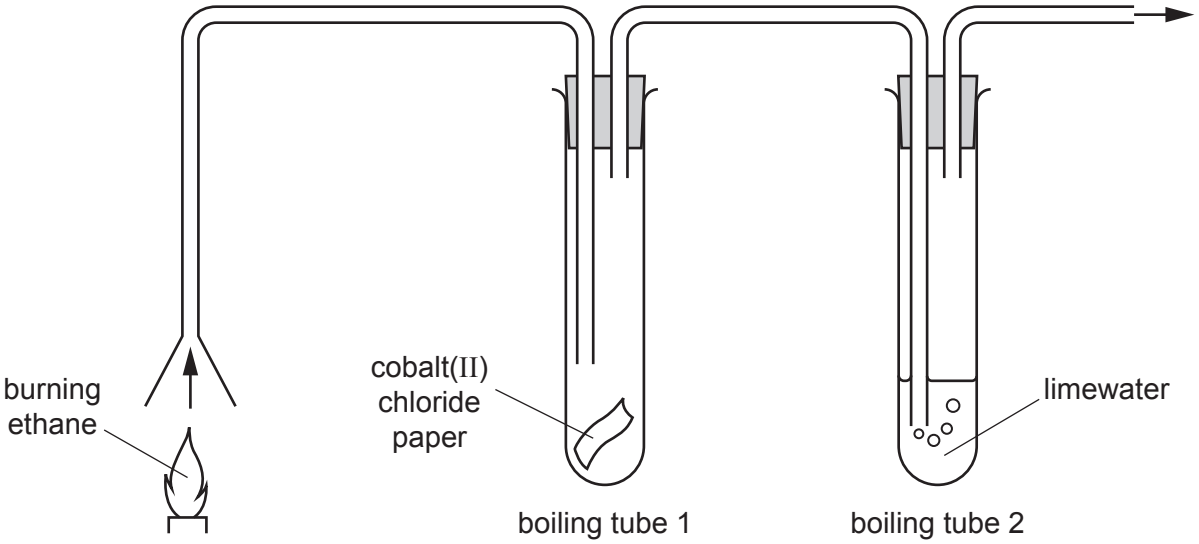


Fig. 5.2

The gases produced by the combustion of ethane pass through boiling tube 1 and boiling tube 2.

(i) State the change in colour of the cobalt(II) chloride paper in boiling tube 1.

Explain why this change happens.

colour changes from ..... to .....

explanation .....

.....

[2]

(ii) Explain what happens to the limewater in boiling tube 2.

.....

.....

..... [2]

(d) Describe the formation of poly(ethene) from ethene.

.....

.....

.....

..... [2]

[Total: 10]

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6 Fig. 6.1 shows an electric heater with two heating elements connected to a 240 V supply.

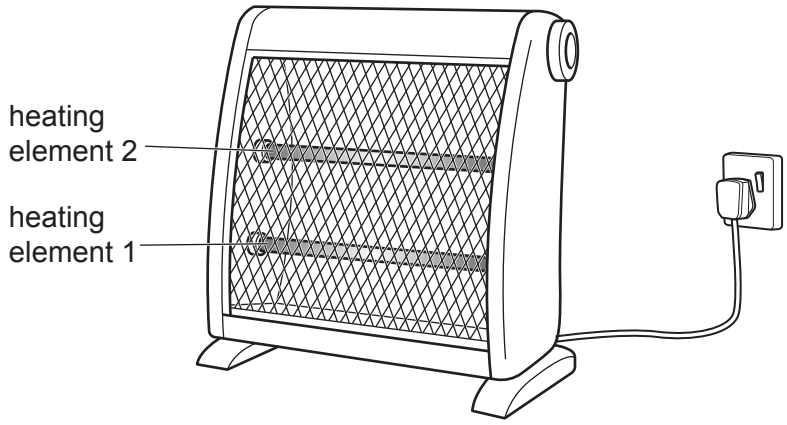


Fig. 6.1

Fig. 6.2 shows the circuit diagram for the heater.

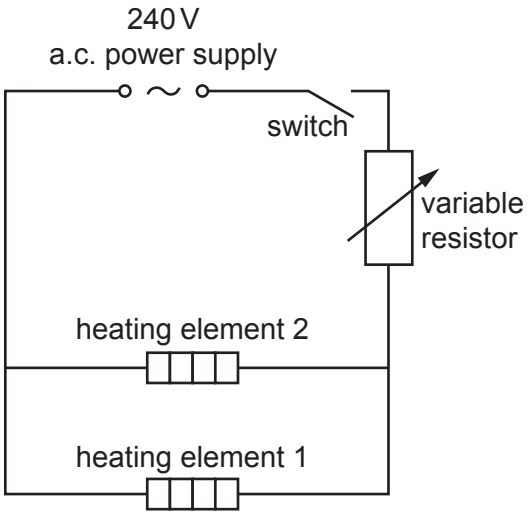


Fig. 6.2

Heating element 1 has a resistance of 72 Ω.

Heating element 2 has a resistance of 36 Ω.

(a) The heater is switched on. The variable resistor is set to have zero resistance.

(i) Show that the combined resistance of the two heating elements is 24 Ω.

[2]

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(ii) Calculate the current from the supply.

current = ...A [2]

(b) The resistance of the variable resistor is increased.

Explain the effect this has on the total thermal energy output from the heater.

.....

.....

.....

..... [3]

(c) Fig. 6.3 shows the structure of a heating element.

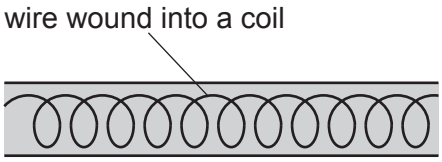


Fig. 6.3

The wire in heating element 2 is the same length as the wire in heating element 1.

The wire in heating element 2 is the same material as the wire in heating element 1.

Describe how heating element 2 has a lower resistance than heating element 1.

.....

.....

..... [2]

[Total: 9]

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7 **(a)** Chemical digestion and mechanical digestion take place in the alimentary canal.

Place ticks (✓) in the boxes next to the correct statements about chemical and mechanical digestion.

Both types of digestion **always** form soluble molecules.	☐
Both types of digestion take place in the mouth.	☐
Both types of digestion use enzymes.	☐
Only chemical digestion takes place in the stomach.	☐
Only mechanical digestion involves no chemical change.	☐

[2]

(b) The pancreas secretes the enzyme protease.

(i) State the name of **one** other enzyme secreted by the pancreas.

..... [1]

(ii) State the substrate and product of digestion of the enzyme protease.

substrate .....

product .....

[1]

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(c) Fig. 7.1 shows the effect of pH on protease activity.

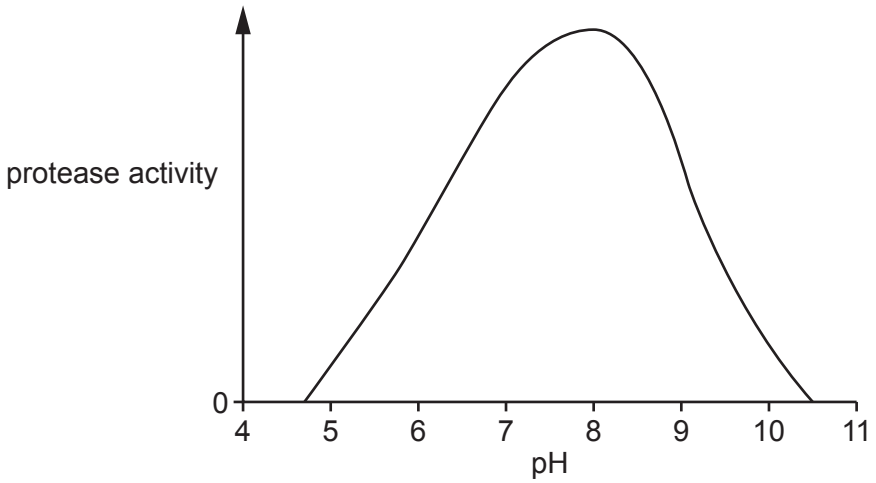


Fig. 7.1

(i) Explain why protease activity is zero at pH 10.5.

.....

.....

.....

.....

..... [3]

(ii) Use Fig. 7.1 to explain why this protease is from the pancreas and **not** from gastric juice.

.....

.....

..... [2]

[Total: 9]

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[Turn over

8 Lead(II) bromide is electrolysed using inert electrodes, as shown in Fig. 8.1.

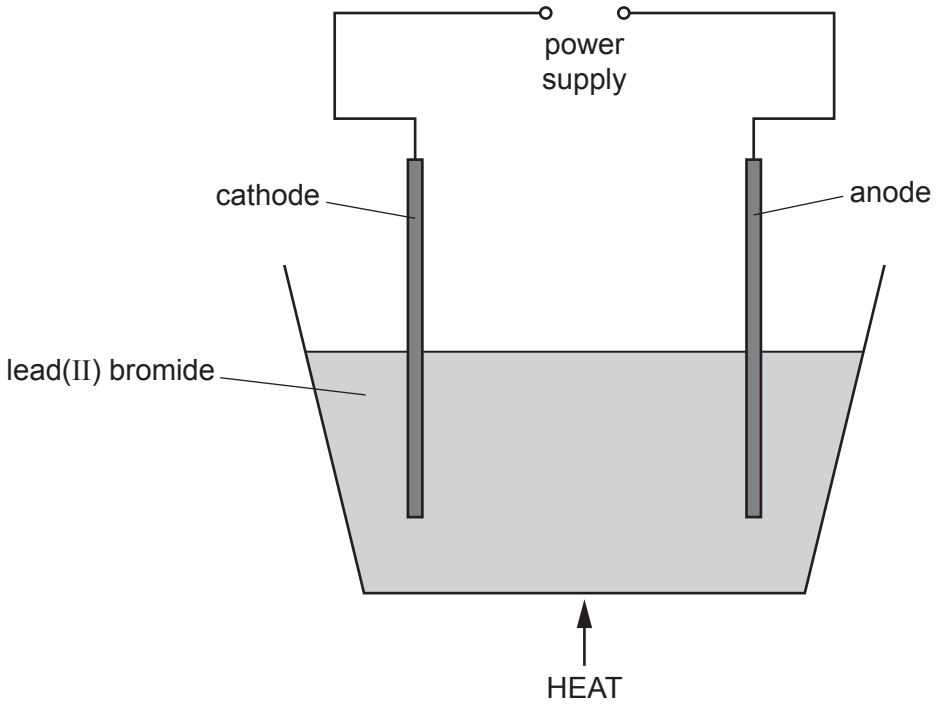


Fig. 8.1

(a) Lead forms during the electrolysis.

Table 8.1 shows the melting points of lead(II) bromide and lead.

Table 8.1

	melting point / °C
lead(II) bromide	373
lead	328

(i) Lead(II) bromide must be heated strongly for the electrolysis to work.

Explain why.

Use ideas about ions in your answer.

.....

.....

..... [2]

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(ii) Suggest a suitable temperature for the electrolysis to take place.

Explain your answer.

temperature ..... °C

explanation .....

.....

[1]

(iii) State whether lead forms as a solid or as a liquid during the electrolysis.

Use Table 8.1 to explain your answer.

lead forms as a .....

explanation .....

.....

[1]

(b) Complete the sentences about the electrolysis of lead(II) bromide.

Use words from the list.

You may use each word once, more than once or not at all.

anode **atoms** **cathode** **gain**

lose **molecules** **share**

Lead ions are attracted to the ..... .

The lead ions ..... electrons to form

lead ..... .

[2]

(c) Bromine gas forms during the electrolysis of lead(II) bromide.

State the colour of bromine gas.

..... [1]

[Total: 7]

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9 **(a)** The electromagnetic spectrum has seven different regions, including microwaves and X-rays.

(i) Fig. 9.1 shows an incomplete electromagnetic spectrum.

On Fig. 9.1, write microwaves and X-rays in their correct places.

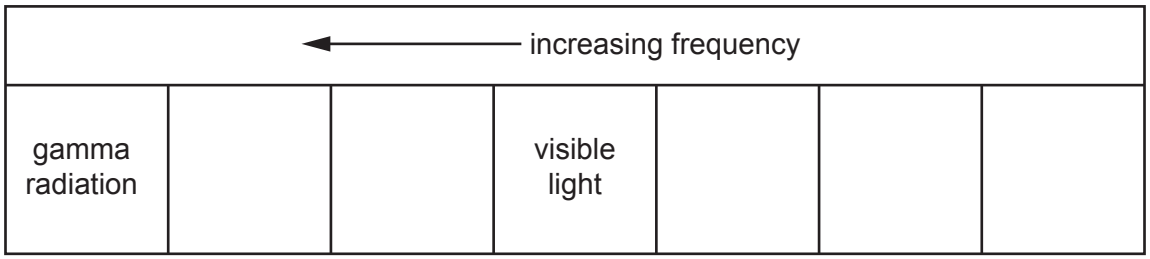


Fig. 9.1

[2]

(ii) Microwave ovens use microwaves to heat food.

A microwave oven uses microwaves with a frequency of 2.48×10^9 Hz.

The speed of the microwaves is 3×10^8 m/s.

Calculate the wavelength of the microwaves.

wavelength = ... m [2]

(iii) X-rays are used for medical imaging.

State **one** danger of X-rays to human health.

..... [1]

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(b) Fig. 9.2 shows two cups of hot water, **A** and **B**.

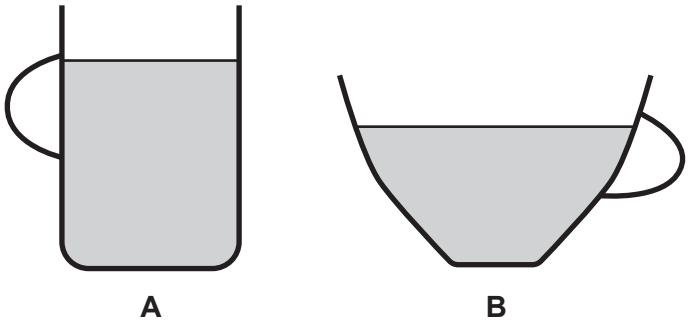


Fig. 9.2

Both cups:

- are made of the same material
- contain the same volume of hot water at the same temperature
- rest on the same surface in the same surroundings.

(i) Describe **two** ways in which both cups of water lose thermal energy to their surroundings.

1 .....

2 .....
[2]

(ii) Explain why the water in cup **B** cools more quickly than the water in cup **A**.

.....

.....

..... [2]

[Total: 9]

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The Periodic Table of Elements

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 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.).

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