GradeMax

Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

0529156872

COMBINED SCIENCE **0653/42**

Paper 4 Theory (Extended) **February/March 2024**

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.

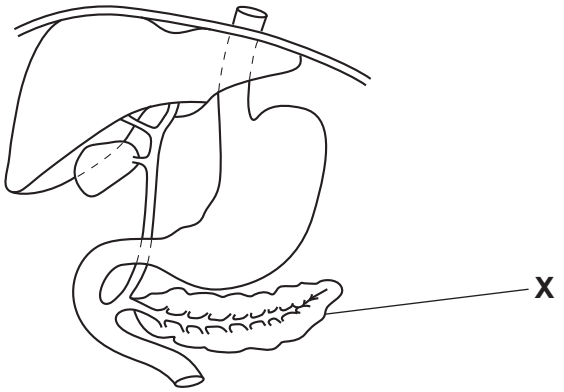
This document has **20** pages. Any blank pages are indicated.

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1 **(a)** Fig. 1.1 shows part of the human alimentary canal and associated organs.



not to scale

Fig. 1.1

(i) On Fig. 1.1, draw a line and the letter **L** to label the liver. [1]

(ii) State the name of the part labelled **X** shown on Fig. 1.1.

..... [1]

(b) Mechanical digestion takes place in the alimentary canal.

Complete the definition of mechanical digestion.

Mechanical digestion is the breakdown of food into smaller ..... without chemical change to the food ..... .

[2]

(c) Enzymes in the alimentary canal speed up chemical digestion.

State the function of the enzyme amylase.

.....

..... [2]

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(d) Fig. 1.2 is a graph showing the effect of pH on enzyme **A** and enzyme **B**.

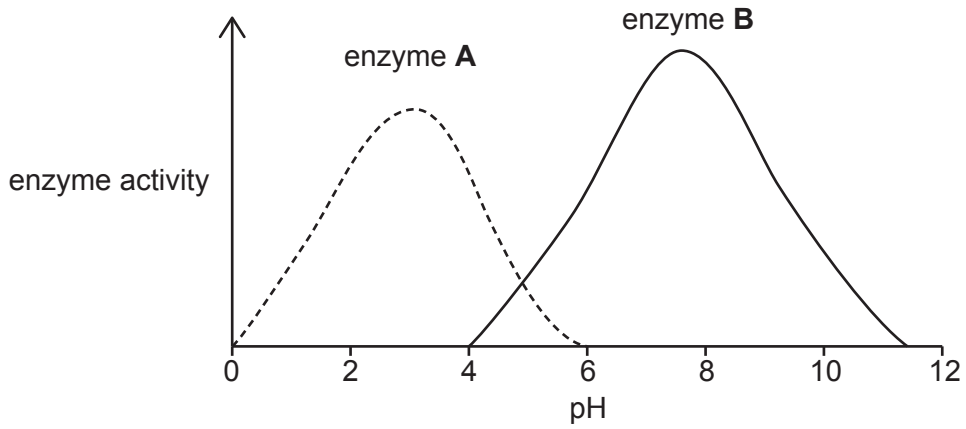


Fig. 1.2

State which of the enzymes in Fig. 1.2 is found in gastric juice.

Explain your answer using evidence from Fig. 1.2.

enzyme .....

explanation .....

.....

[2]

[Total: 8]

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2 **(a)** Answer the following questions using only the elements from this list.

aluminium

carbon

chlorine

helium

iron

magnesium

potassium

sodium

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

Give the name of **one** element that:

(i) contains a full outer shell of electrons.

..... [1]

(ii) burns with a lilac flame.

..... [1]

(iii) is extracted from hematite.

..... [1]

(iv) is extracted from bauxite by electrolysis.

..... [1]

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(b) Nitrogen forms a molecule with the formula N_2.

Complete Fig. 2.1 to show the dot-and-cross diagram for a molecule of nitrogen.

Show the outer shell electrons only.

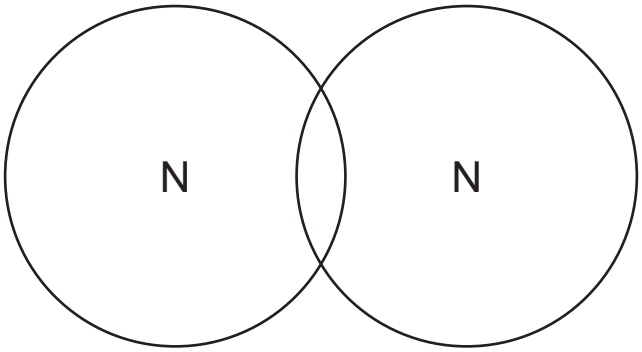


Fig. 2.1

[2]

(c) Table 2.1 shows the boiling points of nitrogen and potassium nitrate.

Table 2.1

	boiling point / °C
nitrogen	–196
potassium nitrate	400

Explain why potassium nitrate has a much higher boiling point than nitrogen.

.....

.....

.....

.....

..... [3]

[Total: 9]

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3 The Parker Solar Probe is a spacecraft designed to study the Sun and the planet Venus.

(a) During one part of its mission, the spacecraft travels a distance of 4.5×10^8 km at an average speed of 2.0×10^5 km / h.

Show that the time taken to travel this distance is 94 days.

[2]

(b) The spacecraft has a heat shield to reflect radiation from the Sun and prevent damage from overheating.

Suggest a suitable colour and texture for the surface of the heat shield.

.....

..... [2]

(c) Fig. 3.1 shows the electromagnetic spectrum, with the wavelengths that separate each of the regions of the spectrum.

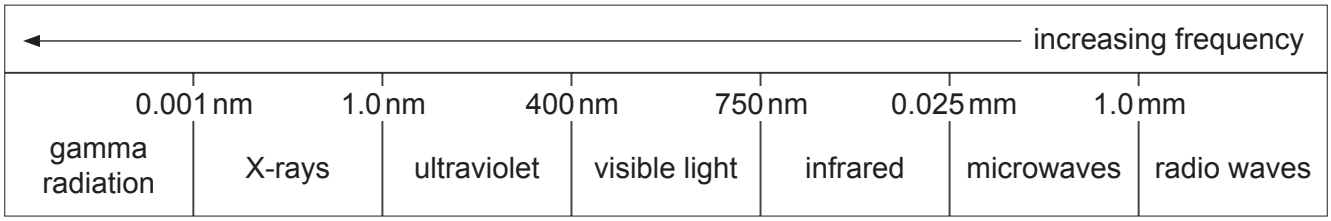


Fig. 3.1

The spacecraft detects electromagnetic radiation from Venus with wavelengths between 470 nm and 800 nm (1 nm = 1×10^{-9} m).

(i) Identify the **two** regions of the electromagnetic spectrum that the spacecraft detects.

1 .....

2 .....
[1]

(ii) Calculate the minimum frequency of radiation detected by the spacecraft.

The speed of electromagnetic waves in a vacuum is 3.0×10^8 m / s.

frequency = ... Hz [3]

[Total: 8]

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4 **(a)** A student draws diagrams to show the position of xylem in different parts of a plant.

Fig. 4.1 shows the student's drawings.

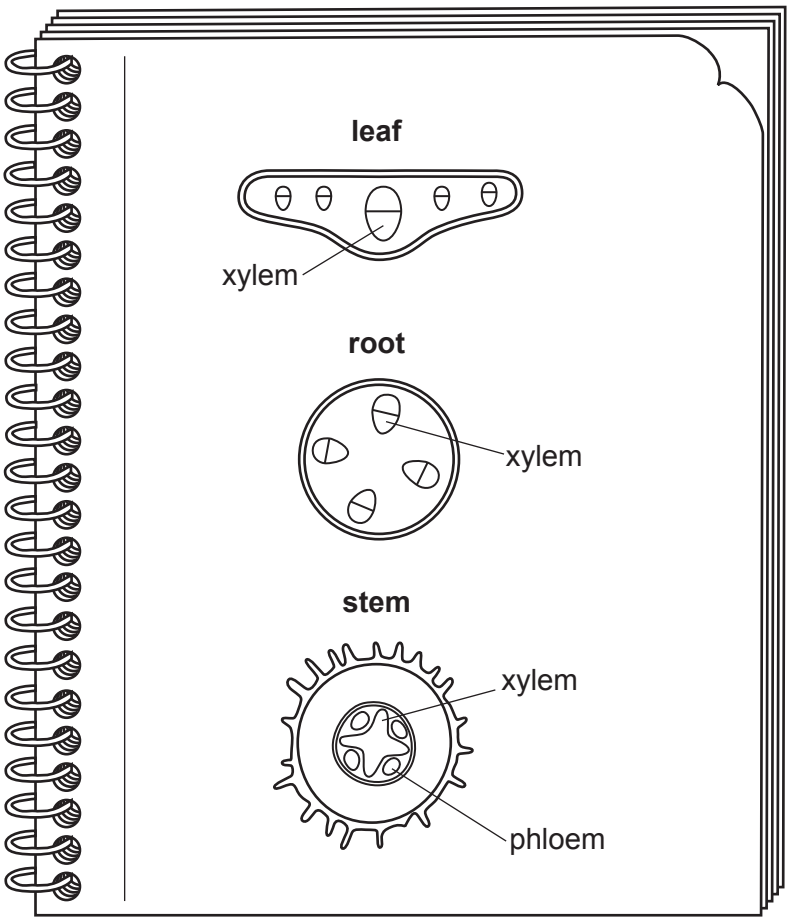


Fig. 4.1

The student made errors in labelling the drawings.

Identify **two** errors made by the student in Fig. 4.1.

1 .....

2 .....

[2]

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(b) Fig. 4.2 shows the effect of humidity on transpiration in plants.

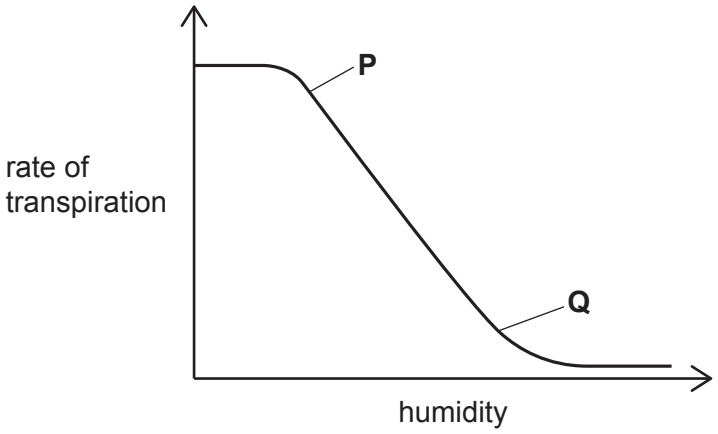


Fig. 4.2

Explain the pattern shown in Fig. 4.2 between **P** and **Q**.

.....

.....

.....

.....

.....

..... [3]

(c) Plants produce carbohydrates by the process of photosynthesis.

(i) State the balanced symbol equation for photosynthesis.

..... [2]

(ii) State the name of the cell structure where photosynthesis occurs.

..... [1]

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(d) Fig. 4.3 shows a food web for an area in Alaska.

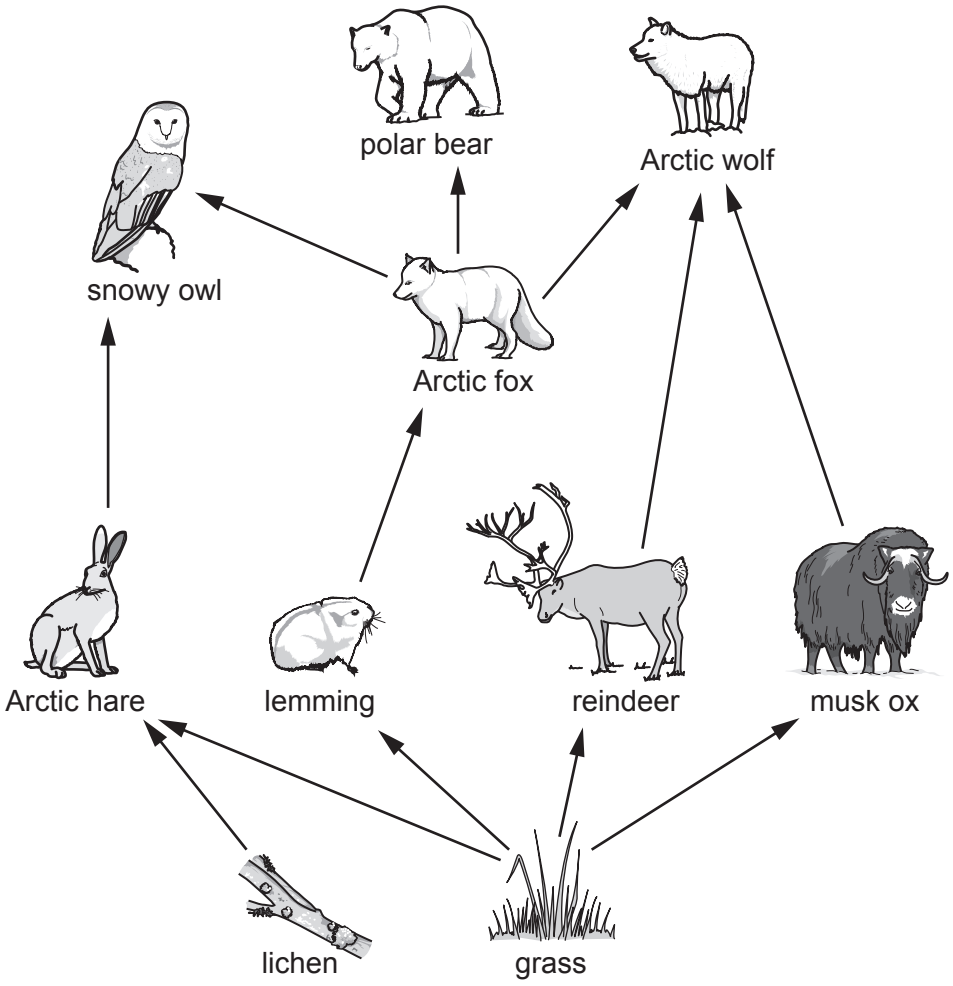


Fig. 4.3

Table 4.1 shows some information about two of the organisms in Fig. 4.3.

Complete Table 4.1.

Table 4.1

organism	trophic level	feeding relationship
musk ox	.....	gets its energy by eating .....
snowy owl	..... and	gets its energy by eating ..... and .....

[3]

[Total: 11]

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5 **(a)** Fig. 5.1 shows the electrolysis of molten zinc chloride using inert electrodes.

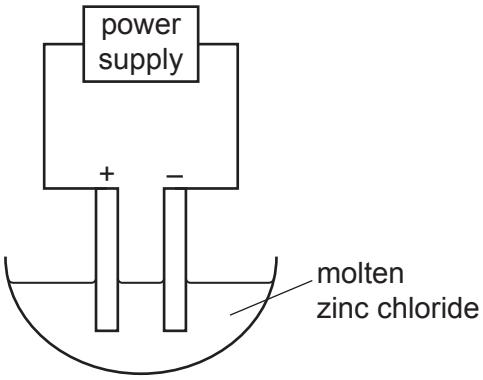


Fig. 5.1

(i) Explain why the zinc chloride must be molten in this electrolysis.

.....

..... [1]

(ii) Suggest why the electrodes are inert.

.....

..... [1]

(iii) Describe what happens at the negative electrode in terms of electron transfer.

.....

..... [1]

(b) Aqueous chlorine reacts with aqueous potassium bromide.

State the word equation for this reaction.

..... [2]

(c) Halogen molecules are diatomic.

State the meaning of diatomic.

.....

..... [1]

(d) Chlorine reacts with hydrogen to produce hydrogen chloride.

Write the balanced symbol equation for the reaction of chlorine with hydrogen.

..... [2]

[Total: 8]

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6 **(a)** The Sun is the source of energy for most of our energy resources.

(i) State the process in the Sun that releases energy.

..... [1]

(ii) State the process that releases energy in a nuclear power station.

..... [1]

(iii) Describe how the process that releases energy you have named in **(a)(i)** differs from the process you have named in **(a)(ii)**.

.....

.....

..... [1]

(b) Fig. 6.1 shows an electrical circuit containing a heater.

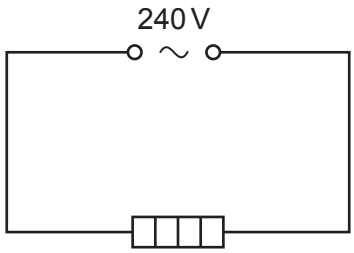


Fig. 6.1

The current in the heater is 8.0 A.

Calculate the power in kilowatts supplied to the heater.

power = ...kW [3]

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(c) Fig. 6.2 shows an electrical circuit for some components inside a house.

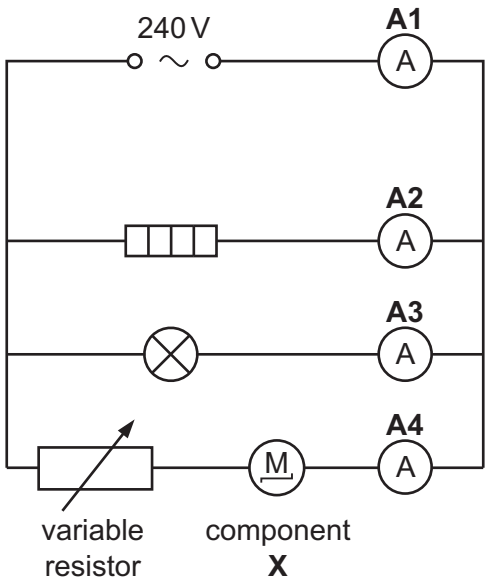


Fig. 6.2

(i) State the name of component **X**.

..... [1]

(ii) The reading on ammeter **A1** is 14.7A. The reading on ammeter **A2** is 13.0A and the reading on ammeter **A3** is 0.2A.

Determine the reading on ammeter **A4**.

reading = ... A [2]

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

Explain why the reading on ammeter **A1** decreases.

.....

.....

..... [1]

[Total: 10]

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7 **(a)** Egg cells and sperm cells are the gametes in human reproduction.

In Table 7.1:

- place **E** in **all** the boxes that describe features of egg cells
- place **S** in **all** the boxes that describe features of sperm cells
- place **N** in **all** the boxes that do **not** describe features of either egg cells **or** sperm cells.

Table 7.1

absence of a nucleus	
contains an energy store	
has a flagellum for movement	
has a jelly coating	
large numbers released at any one time	

[3]

(b) A fertilised egg develops into a fetus along with a placenta and umbilical cord.

Describe how the placenta supports the growing fetus.

.....

.....

.....

.....

.....

..... [3]

(c) A pregnant female is advised **not** to smoke tobacco.

State **one** major toxic component of tobacco smoke and describe its effect on the gas exchange system.

component .....

effect .....

.....

[2]

[Total: 8]

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8 **(a)** Petroleum contains a mixture of hydrocarbons.

(i) Refinery gas and bitumen are two components separated from petroleum by process **Z**.

State the name of process **Z**.

..... [1]

(ii) Describe the differences between refinery gas and bitumen.

In your answer include:

- the size of the molecules
- the volatility of the components.

.....

.....

..... [2]

(b) Methane is a member of the alkane homologous series.

Describe what is meant by the term homologous series.

.....

..... [2]

(c) Decane, $C_{10}H_{22}$, is an alkane.

The cracking of decane produces C_8H_{18} and **one** other molecule.

(i) Complete the symbol equation for the cracking of decane.

$$C_{10}H_{22} \longrightarrow C_8H_{18} + \text{.....}$$ [1]

(ii) State **two** conditions needed for cracking.

1 .....

2 .....
[2]

(iii) Decane is a saturated hydrocarbon.

Describe what is meant by saturated.

.....

..... [1]

[Total: 9]

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[Turn over

9 Fig. 9.1 shows the forces **P**, **Q**, **R** and **S** acting on a boat at sea.

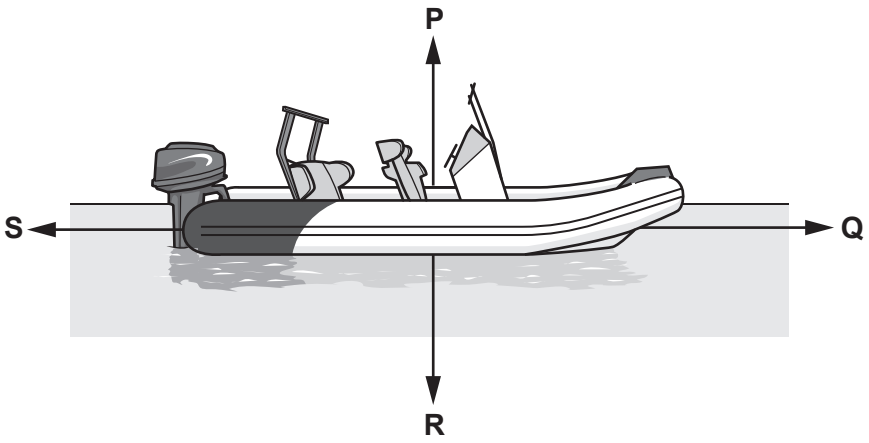


Fig. 9.1

(a) The boat is moving forward due to the force of the engine pushing from the back.

(i) State which letter, **P**, **Q**, **R** or **S**, labels the force due to the resistance of air and water on the boat.

..... [1]

(ii) Complete the sentence with **one** word from this list.

density **pressure** **speed** **temperature**

When the boat decelerates, its ..... decreases. [1]

(b) Fig. 9.2 shows a speed–time graph of the motion of the boat.

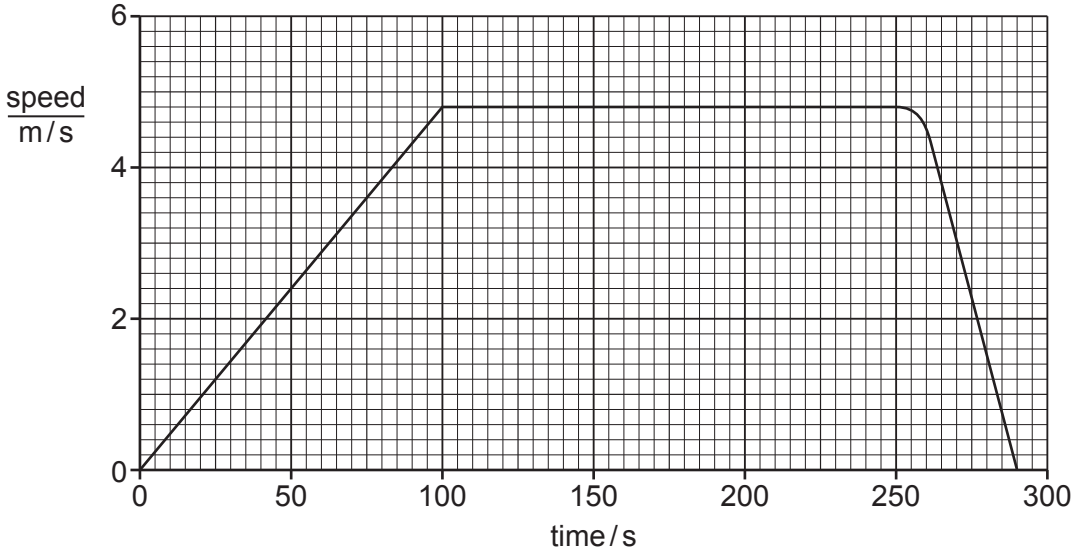


Fig. 9.2

(i) The distance travelled between time = 250 s and 290 s is half the distance travelled between time = 0 and 100 s.
Calculate the total distance travelled by the boat as shown in Fig. 9.2.

distance = ... m [3]

(ii) The engine of the boat supplies an output power of 2.0 kW to drive the boat forward at its maximum speed.

Show that the total energy supplied to drive the boat forward while it is travelling at the maximum speed shown in Fig. 9.2 is 300 kJ.

[2]

(iii) The mass of the boat is 450 kg.
Calculate the kinetic energy (KE) of the boat when it is travelling at the maximum speed in Fig. 9.2.

KE = ... kJ [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 –	113 Nh nihonium –	114 Fl flerovium –	115 Mc moscovium –	116 Lv livermorium –	117 Ts tennessine –	118 Og oganesson –

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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