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COMBINED SCIENCE

0653/31

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 **20** pages. Any blank pages are indicated.

- 1 (a) The boxes on the left show characteristics of living organisms.
The boxes on the right show some definitions of characteristics.

Draw one straight line from each characteristic to its correct definition.

characteristic	definition
excretion	responding to change
nutrition	removing waste from the body
sensitivity	permanent increase in size
	taking in materials for energy

[3]

- (b) Respiration is another characteristic of living organisms.
Aerobic respiration needs oxygen.

Complete these sentences to describe how oxygen from the air gets into the blood of a human.

As we breathe in, air passes from our bronchioles into the of the lungs.

The oxygen in this air then moves into red blood cells by the process of

[2]

(c) Organisms are made up of cells.

Fig. 1.1 is a photomicrograph of an animal cell.

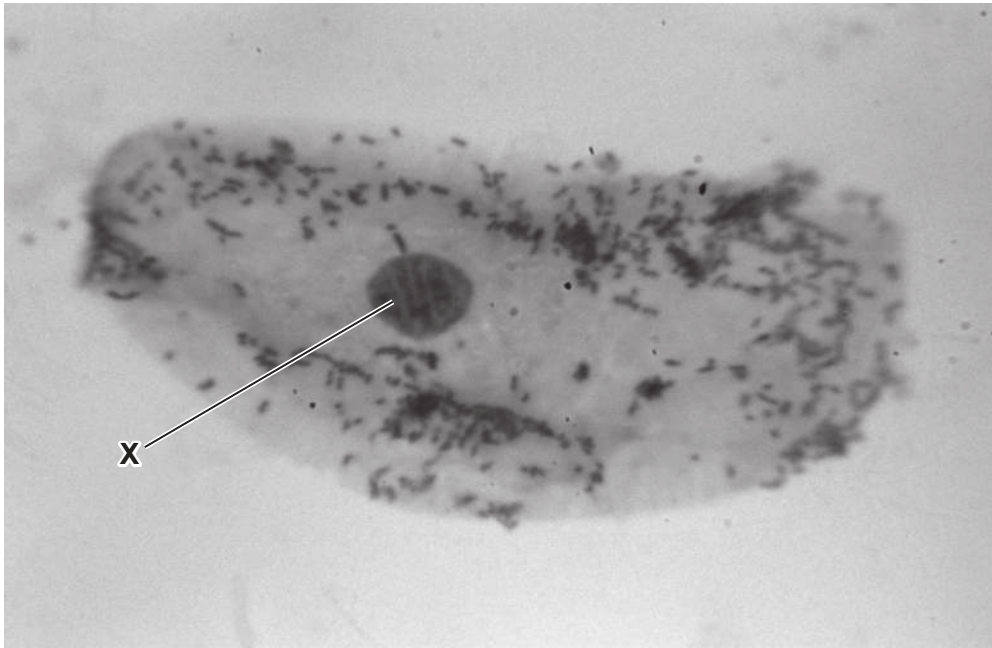


Fig. 1.1

(i) Identify the part labelled X in Fig. 1.1.

..... [1]

(ii) State **two** pieces of evidence from the cell in Fig. 1.1 that show it is **not** a plant cell.

1

2

[2]

[Total: 8]

- 2 (a) Fig. 2.1 shows part of Group I of the Periodic Table.

3 Li lithium 7
11 Na sodium 23
19 K potassium 39

Fig. 2.1

- (i) State the trend in the reactivity of the elements going down Group I.

..... [1]

- (ii) Explain why lithium does **not** react with helium, a Group VIII element.

.....
 [1]

- (iii) Lithium is a solid and helium is a gas.
 Describe **two** differences between the structures of a solid and a gas.

1

.....

2

.....

[2]

(b) A piece of sodium is added to water, as shown in Fig. 2.2.

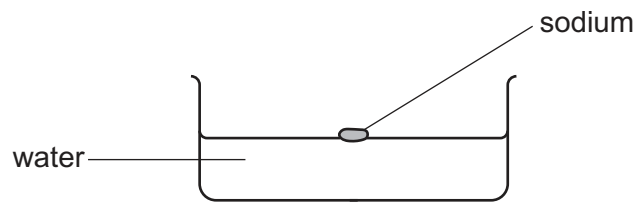


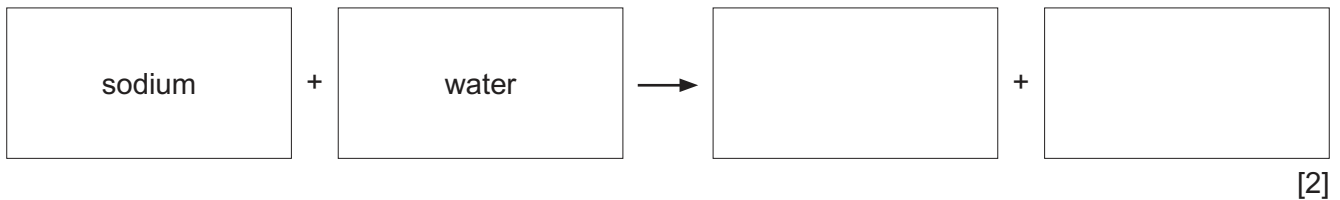
Fig. 2.2

The sodium reacts with water. The reaction is exothermic.

(i) State one **other** observation that is seen when sodium reacts with water.

..... [1]

(ii) Complete the word equation for the reaction of sodium with water.



(c) **X** is a compound that reacts with dilute hydrochloric acid to form sodium chloride and water.

Suggest the identity of **X**.

..... [1]

(d) Concentrated aqueous sodium chloride is broken down by electrolysis.

(i) State the type of chemical bond in sodium chloride.

..... [1]

(ii) Identify the product that forms at the anode (positive electrode).

..... [1]

[Total: 10]

- 3 (a) State the name of the particles that flow in an electric current in a metal wire.

..... [1]

- (b) Fig. 3.1 shows an incomplete circuit diagram.

- (i) Complete the circuit diagram by adding:

- an ammeter to measure the current in the lamp
- a voltmeter to measure the potential difference across the lamp.

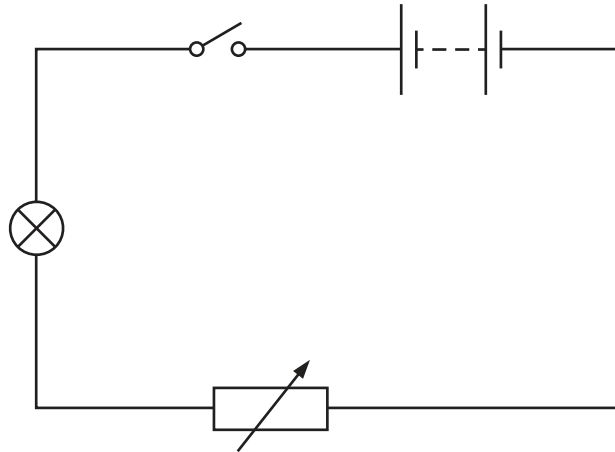


Fig. 3.1

[3]

- (ii) When the variable resistor is adjusted, the brightness of the lamp changes. Explain why this happens.

.....

 [2]

- (iii) The lamp has a resistance of $20\ \Omega$. The current in the lamp is 0.5 A .

Calculate the potential difference (p.d.) across the lamp.

p.d. = V [2]

(iv) A second lamp of resistance $20\ \Omega$ is connected in parallel with the first lamp.

State the effect this has on the total resistance of the circuit.

..... [1]

[Total: 9]

4 (a) A student investigates the effect of temperature on enzyme activity.

They use an enzyme called amylase to breakdown starch into a reducing sugar.

They measure the activity of the enzyme at different temperatures.

Fig. 4.1 is a graph of their results.

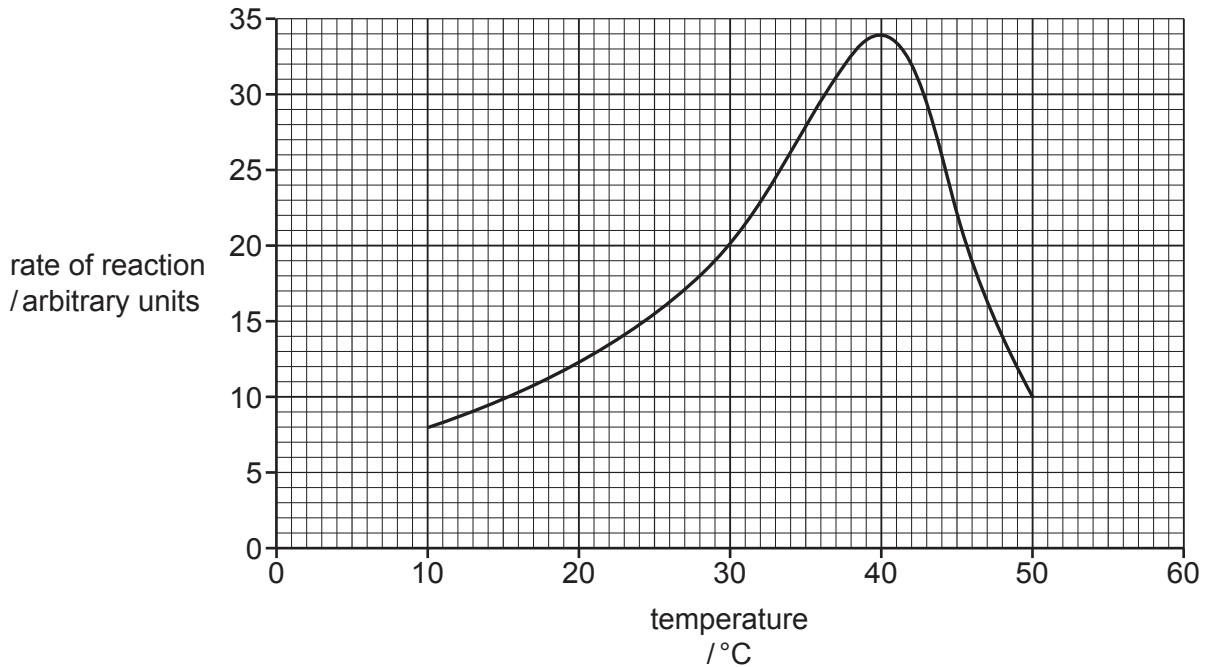


Fig. 4.1

(i) Describe the effect of temperature on the enzyme activity shown in Fig. 4.1.

Include data from the graph in your answer.

.....

.....

.....

..... [2]

(ii) Complete this sentence to define the term enzyme.

Enzymes are that function as

biological

[2]

(iii) Enzymes are transported in the blood plasma.

State the molecule in red blood cells that transports oxygen.

..... [1]

- (b) Glucose is made by plants during photosynthesis, transported as sucrose and stored as starch.

Fig. 4.2 shows apparatus used to investigate one factor that affects photosynthesis.

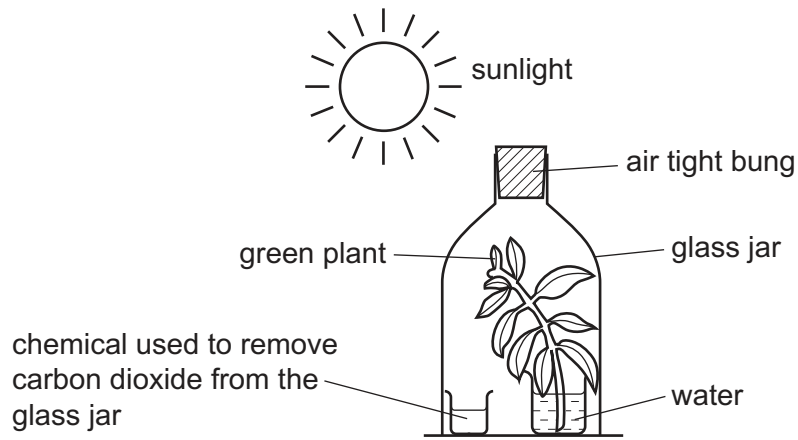


Fig. 4.2

- (i) Place a tick (✓) in **one** box to show the factor being investigated in Fig. 4.2.

carbon dioxide

chlorophyll

light

water

[1]

- (ii) The plant is left for 48 hours in the glass jar.

After 48 hours a leaf is prepared and then tested using iodine solution.

Complete these sentences about the expected result.

When placed on the leaf the iodine solution will be in colour.

This is because the plant does not make any

[2]

- (iii) State the name of the ions needed to make chlorophyll.

..... [1]

[Total: 9]

- 5 (a) Petroleum is a mixture of hydrocarbons. Useful products are obtained by process X and process Y, as shown in Fig. 5.1.

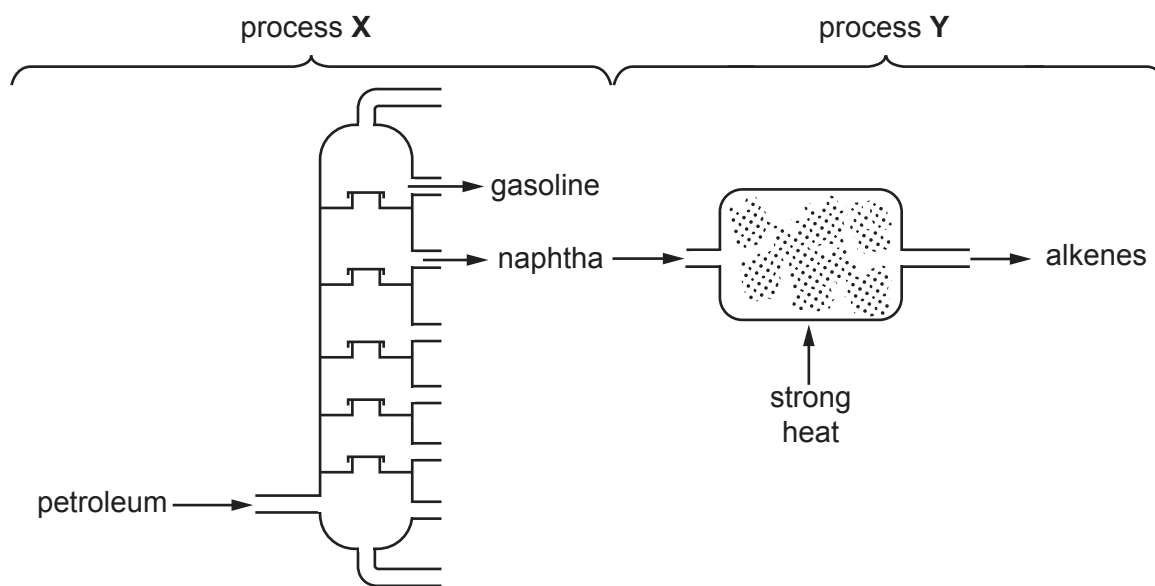


Fig. 5.1

- (i) Process X separates gasoline and naphtha from petroleum. Name process X.

..... [1]

- (ii) Process Y produces alkenes. Name process Y.

..... [1]

- (iii) State whether process Y is a chemical change or a physical change. Explain your answer.

change

explanation

..... [1]

- (iv) Describe a **chemical** test for alkenes, and state the observation for a positive result.

test

result

[2]

(b) The structure of a molecule of propene, an alkene, is shown in Fig. 5.2.

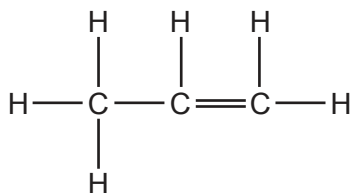


Fig. 5.2

Water is formed during the complete combustion of propene.

(i) Identify the other substance that is formed during this combustion.

..... [1]

(ii) Name the gas in air that reacts with propene during combustion, and state the percentage of this gas in clean air.

gas

percentage

[1]

(iii) Use Fig. 5.2 to deduce the formula of propene.

..... [1]

[Total: 8]

- 6 (a) Fig. 6.1 shows a thermometer in a solution of salt in water.
 Fig. 6.2 shows the thermometer reading as the salt solution freezes.
 Fig. 6.3 shows the thermometer reading as the same salt solution boils.

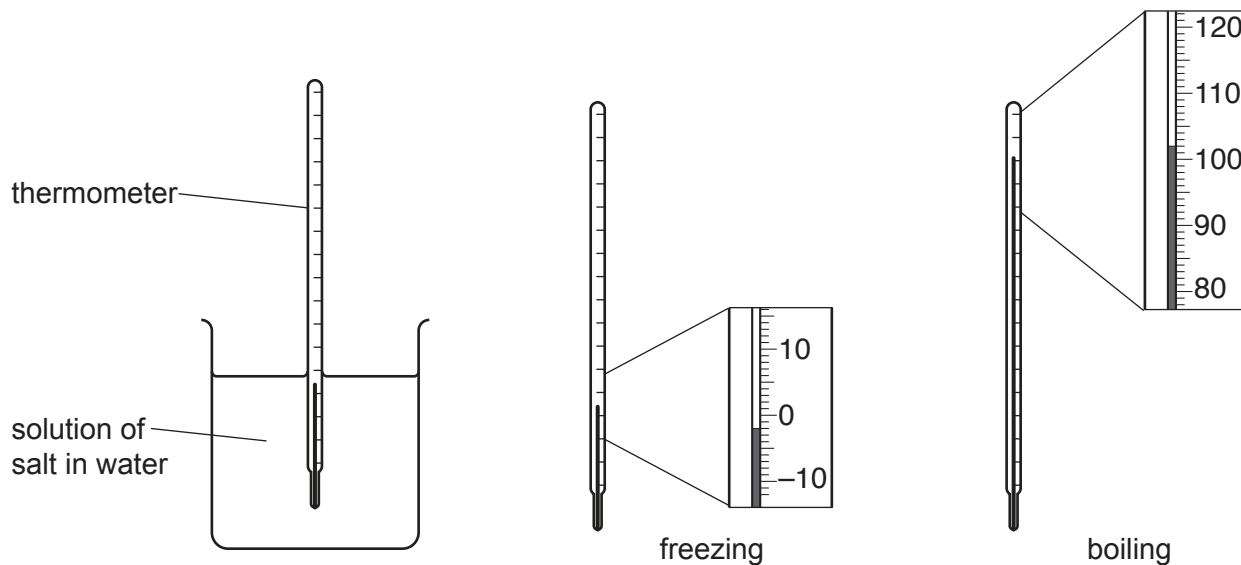


Fig. 6.1

Fig. 6.2

Fig. 6.3

- (i) State the temperature at which **pure water** melts. °C [1]
 (ii) State the temperature at which **pure water** boils. °C [1]
 (iii) Use the information in Fig. 6.2 and Fig. 6.3 to state how the addition of salt to water **changes** the melting point and boiling point of water.

melting point

boiling point

[1]

- (b) (i) The salt solution in the beaker has a volume of 0.00025 m^3 and a mass of 0.28 kg .

Calculate the density of the salt solution.

State the units of your answer.

density = units [3]

- (ii) A student carefully adds some pure water at 20°C to the beaker containing salt solution.

Suggest why the pure water floats on top of the salt solution before mixing.

.....

..... [1]

[Total: 7]

7 (a) Fig. 7.1 is a diagram of the alimentary canal and associated organs.

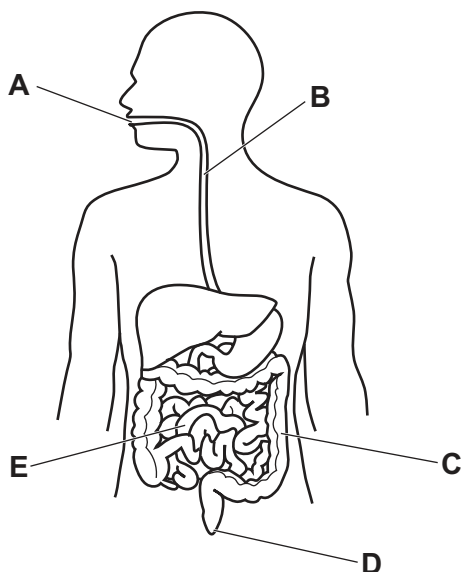


Fig. 7.1

(i) State the letters on Fig. 7.1 that identify where egestion and ingestion take place.

egestion

ingestion

[2]

(ii) State **one** function of the part labelled E in Fig. 7.1.

..... [1]

(iii) Name the part of the blood that transports the products of digestion around the body.

..... [1]

(b) In one day a person eats a diet that includes cheese, eggs, fish, kidney beans and meat. The protein, carbohydrate and fibre content of each food is shown in Table 7.1.

Table 7.1

foodstuff	protein /g per 100g of food	carbohydrate /g per 100g of food	fibre /g per 100g of food
cheese	18	1	0
eggs	13	1	0
fish	22	0	0
kidney beans	24	50	25
meat	26	0	0

One part of this diet is needed to move food through the alimentary canal.

Identify the part of the diet and explain your answer.

part of diet

explanation

[2]

(c) Fig. 7.2 shows the male reproductive system.

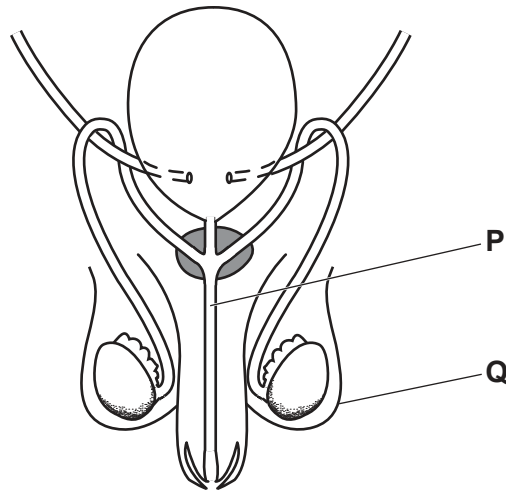


Fig. 7.2

Identify the parts labelled **P** and **Q** in Fig. 7.2.

P

Q

[2]

(d) Table 7.2 compares asexual and sexual reproduction.

Place ticks (✓) **and** crosses (✗) to show the correct features of asexual and sexual reproduction.

One row has been done for you.

Table 7.2

	asexual reproduction	sexual reproduction
genetically identical offspring		
involves fusion of nuclei		
involves gametes		
usually involves two parents	✗	✓

[2]

[Total: 10]

- 8 (a) A student reacts a piece of magnesium with dilute hydrochloric acid, as shown in Fig. 8.1. A funnel holds the magnesium under a measuring cylinder to collect the gas formed.

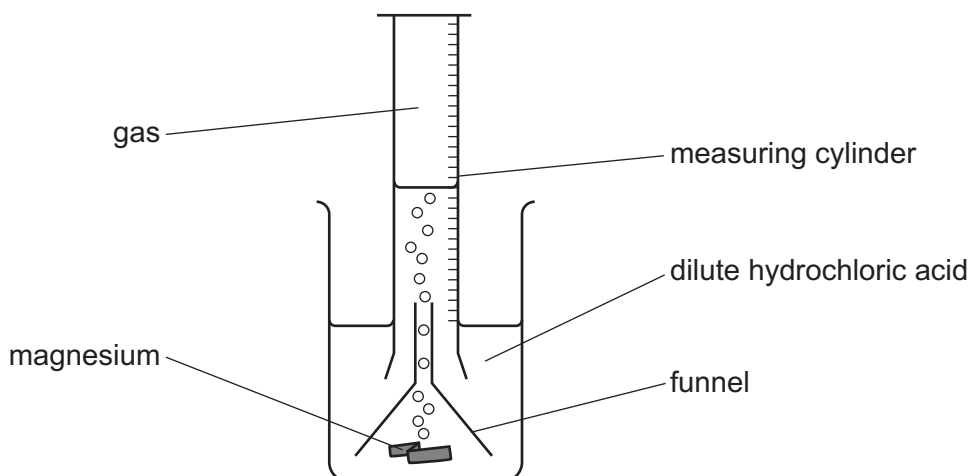


Fig. 8.1

- (i) State **one** other piece of apparatus that the student needs to use to determine the rate of this reaction.

..... [1]

- (ii) Suggest **one** change that increases the rate of this reaction.

..... [1]

- (iii) The student repeats the experiment under the same conditions, using the same mass of zinc instead of magnesium.

State and explain the effect of this change on the rate of reaction.

effect

explanation

[1]

- (b) Brass is a mixture of zinc and copper.

- (i) State the general name of mixtures such as brass that contain different metals.

..... [1]

- (ii) Suggest why brass, and not pure copper, is used to make coins.

.....

..... [1]

(c) Some copper compounds are used as catalysts.

Name the collection of metals in the Periodic Table that includes copper.

..... [1]

(d) Copper is extracted from copper oxide using carbon.

(i) Describe **one** condition needed for this process.

..... [1]

(ii) State and explain whether copper is oxidised or reduced in this process.

copper is

explanation

..... [1]

[Total: 8]

9 Fig. 9.1 shows a motor boat moving forward across the sea.

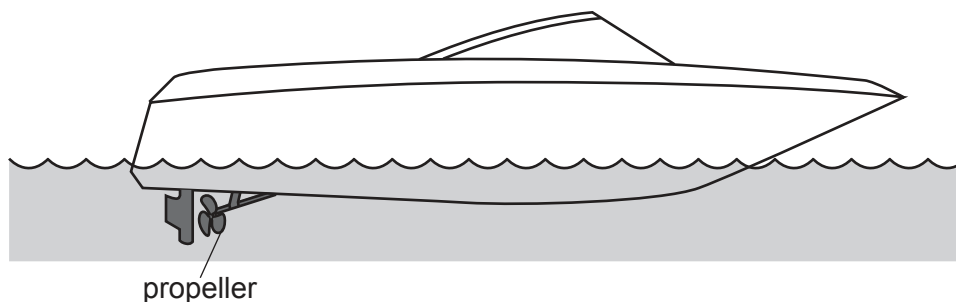


Fig. 9.1

(a) The boat is travelling at a constant speed across the surface of the sea. Fig. 9.2 shows four forces, **P**, **Q**, **R** and **S**, acting on the boat.

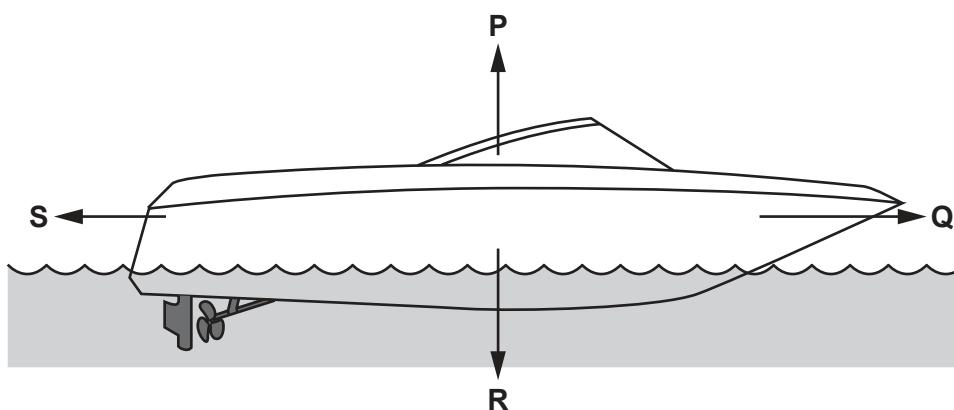


Fig. 9.2

(i) State the letter of the force driving the boat forward.

.....

[1]

(ii) Some of these forces are equal to each other. Place a tick in the box next to each pair of forces that must be equal in magnitude to each other.

- P and Q
- P and R
- P and S
- Q and R
- Q and S
- R and S

[2]

(b) The motor boat is driven by a gasoline (petrol) engine that turns the propeller.

(i) Complete the sequence of useful energy changes that take place from the gasoline to the motion of the boat.

- energy in the gasoline
- thermal energy in the engine
- energy of the propeller
- energy of the moving boat.

[3]

(ii) The boat takes 5.0 minutes to travel 960 metres.

Calculate the speed of the boat in metres per second.

speed = m/s [3]

(c) The boat makes water waves behind it. Fig. 9.3 shows a graph of the height of the water waves against distance.

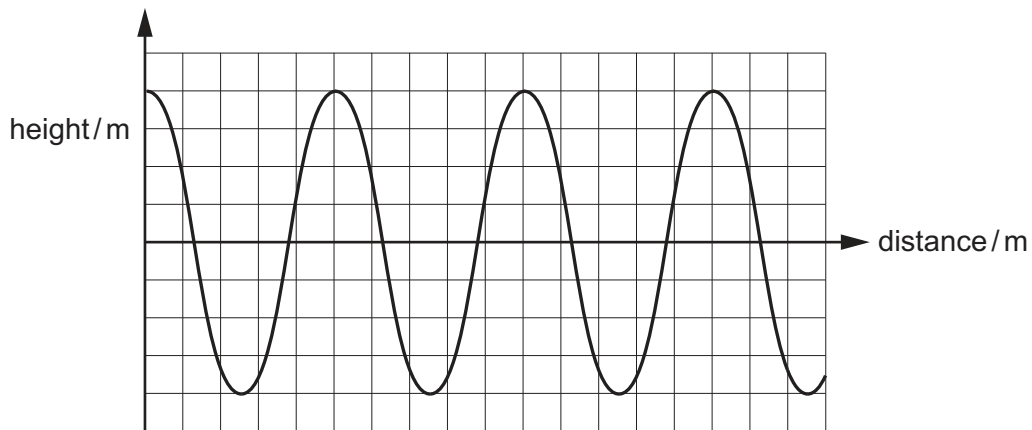


Fig. 9.3

The waves have a wavelength of 5 m and an amplitude of 0.8 m.

On Fig. 9.3 label the axes with the correct scales for these waves.

[2]

[Total: 11]

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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 —	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.).