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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.

2

- 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

excretion

nutrition

sensitivity

definition

responding to change

removing waste from the body

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]

3

(c) Organisms are made up of cells.

Fig. 1.1 is a photomicrograph of an animal cell.

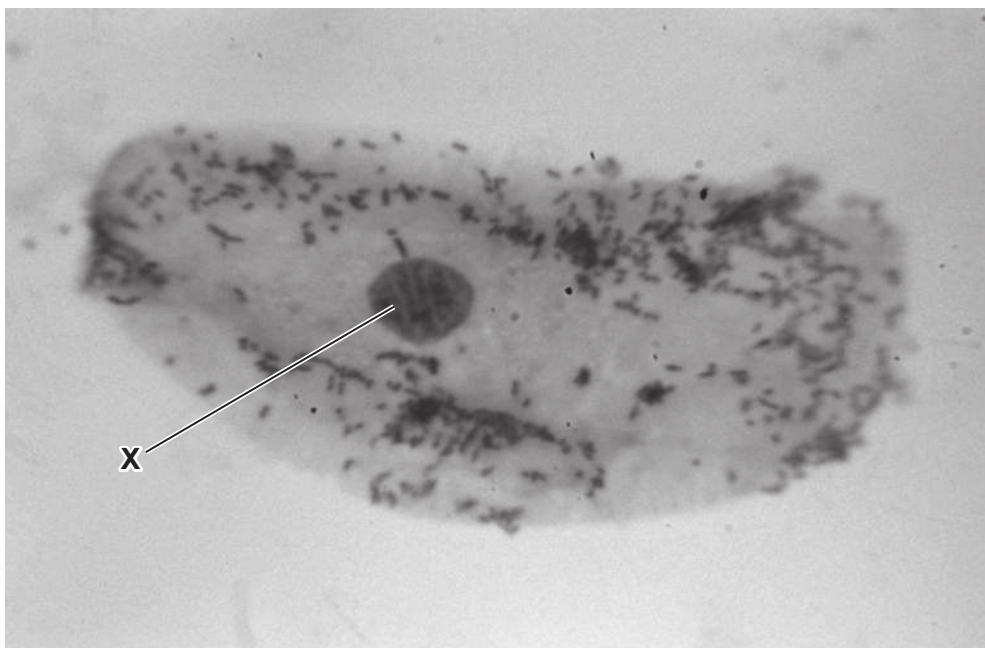


Fig. 1.1

(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]

4

- 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]

5

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

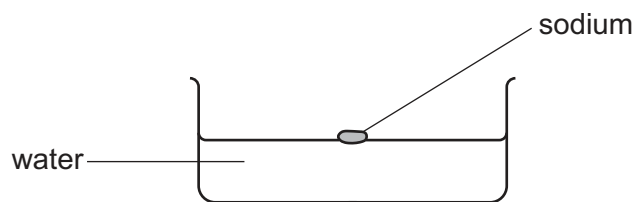


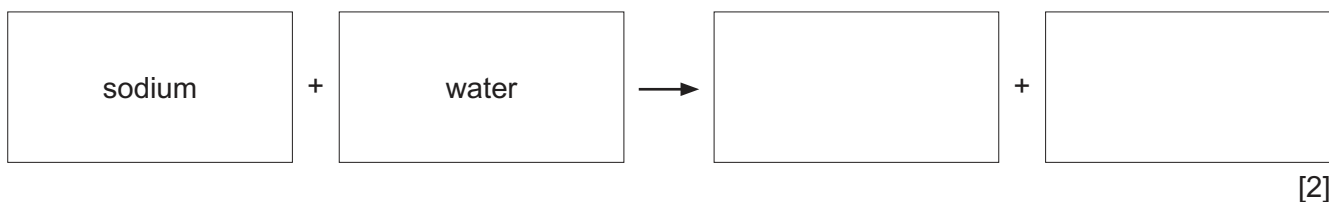
Fig. 2.2

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]

6

- 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.

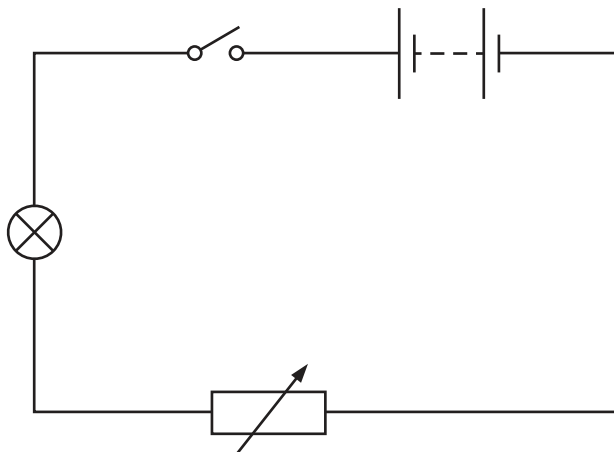


Fig. 3.1

[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]

7

- (iv)** A second lamp of resistance 20Ω is connected in parallel with the first lamp.

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

..... [1]

[Total: 9]

8

- 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.

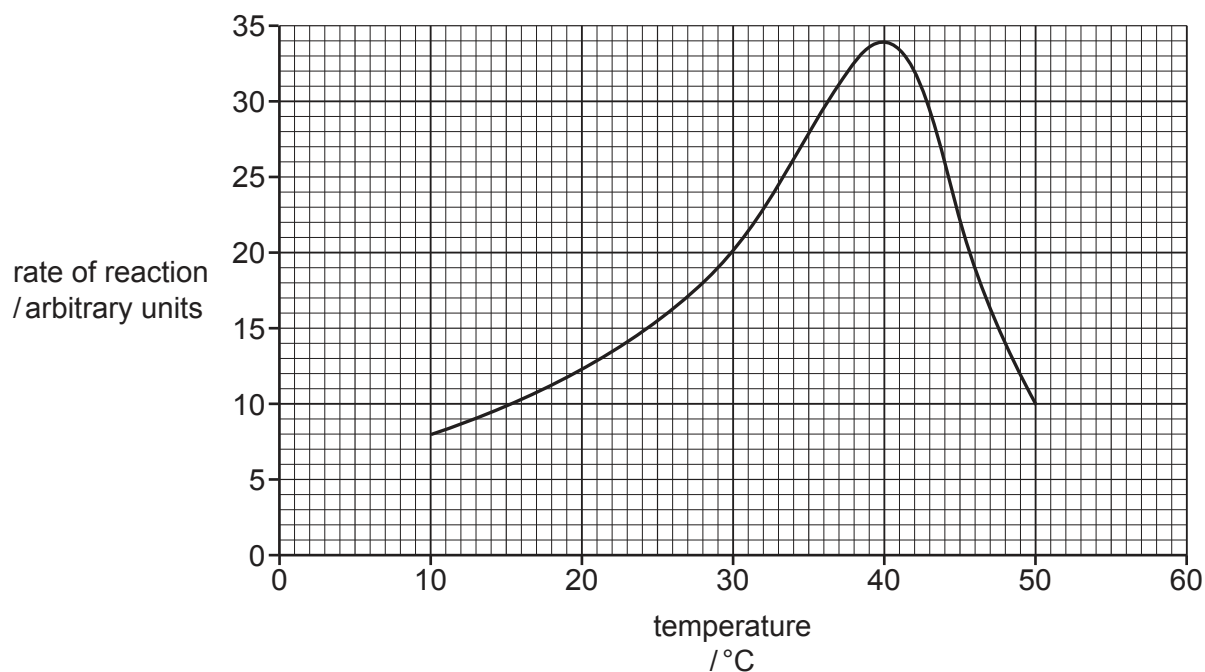


Fig. 4.1

- (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]

9

- (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.

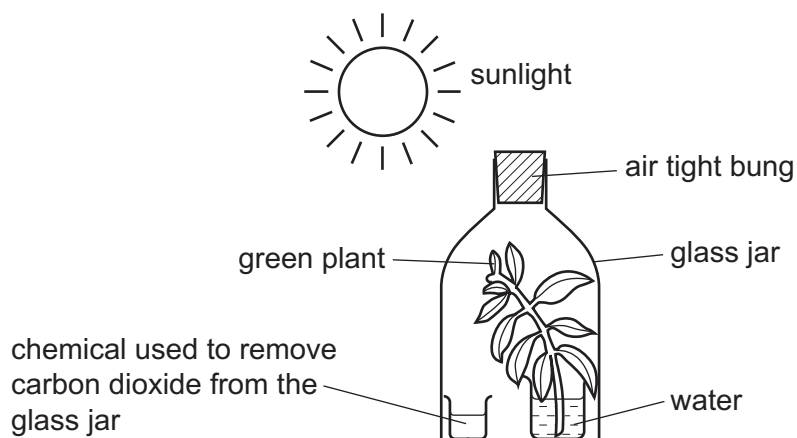


Fig. 4.2

- (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.

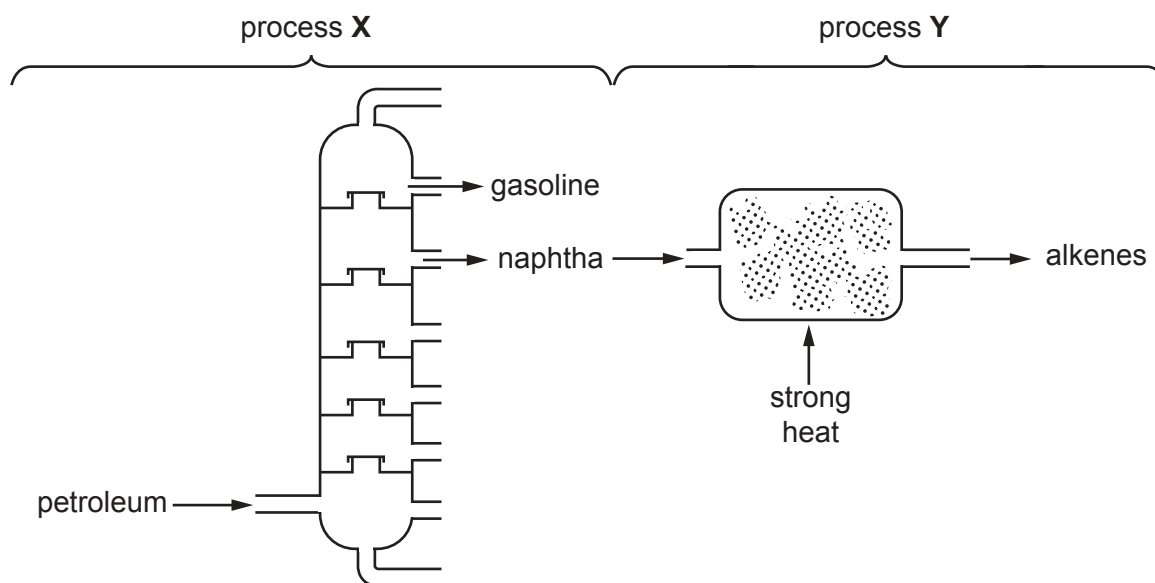


Fig. 5.1

- (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]

11

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

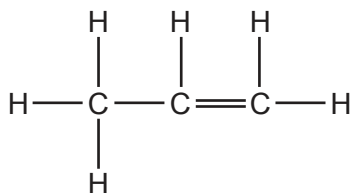


Fig. 5.2

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.

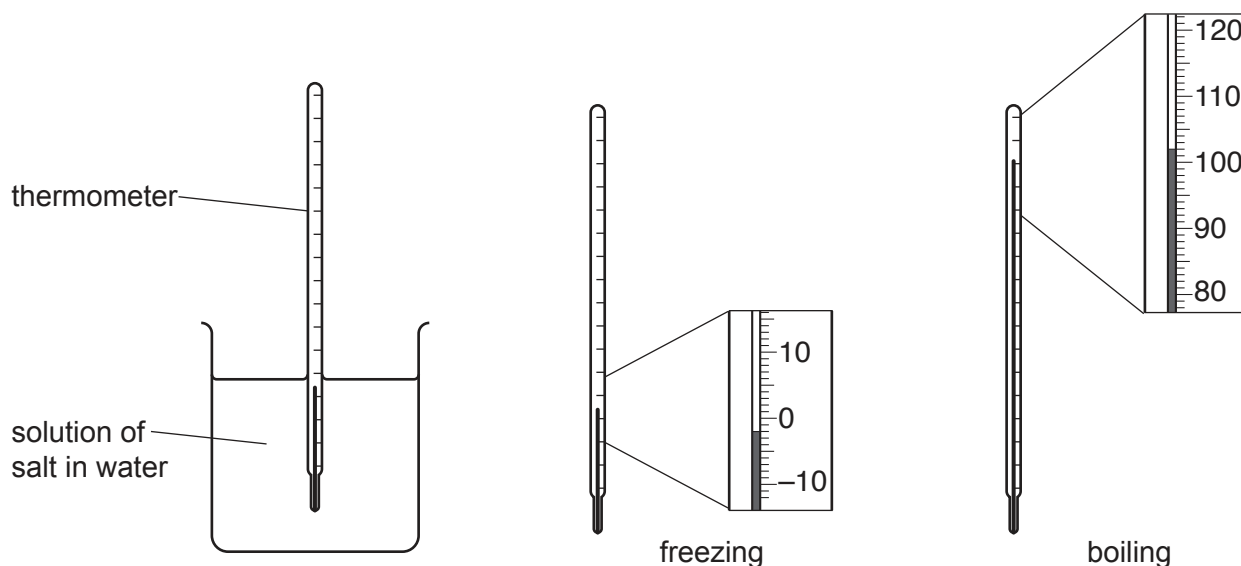


Fig. 6.1

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]

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

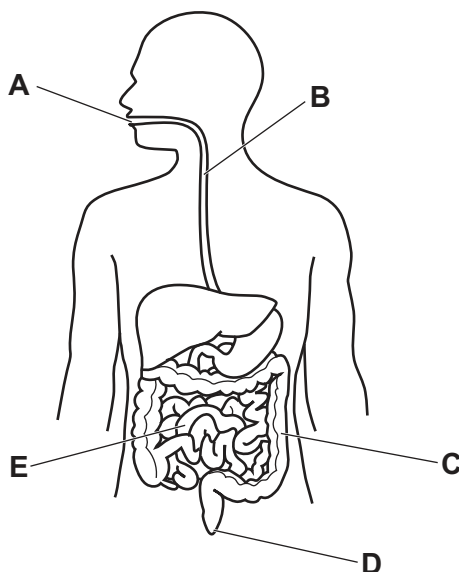


Fig. 7.1

- (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 100 g of food	carbohydrate /g per 100 g of food	fibre /g per 100 g 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]

15

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

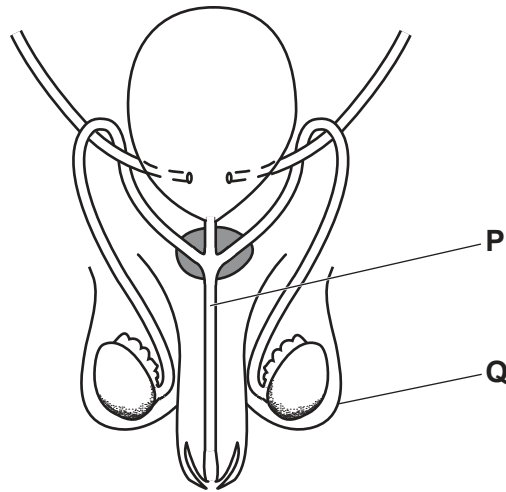


Fig. 7.2

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]

16

- 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.

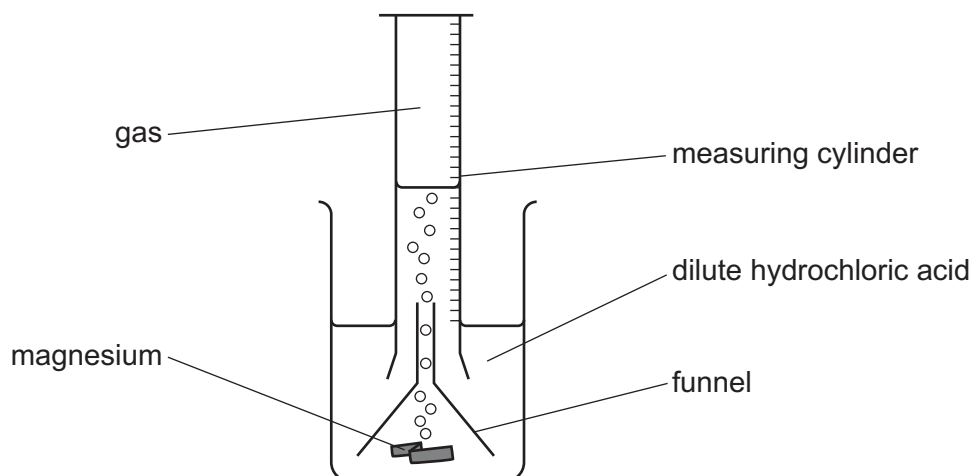


Fig. 8.1

- (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]

17

- (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]

18

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

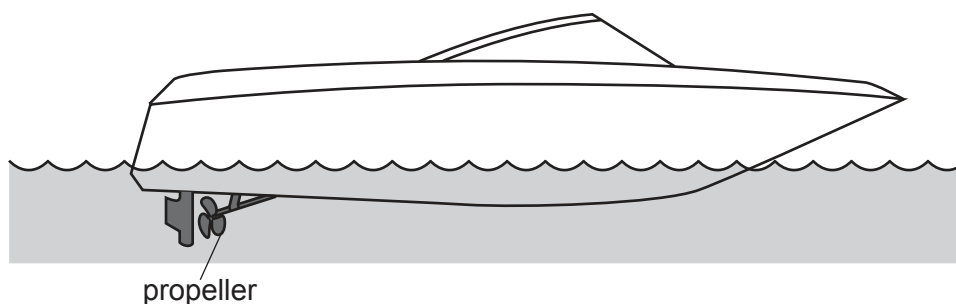


Fig. 9.1

- (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.

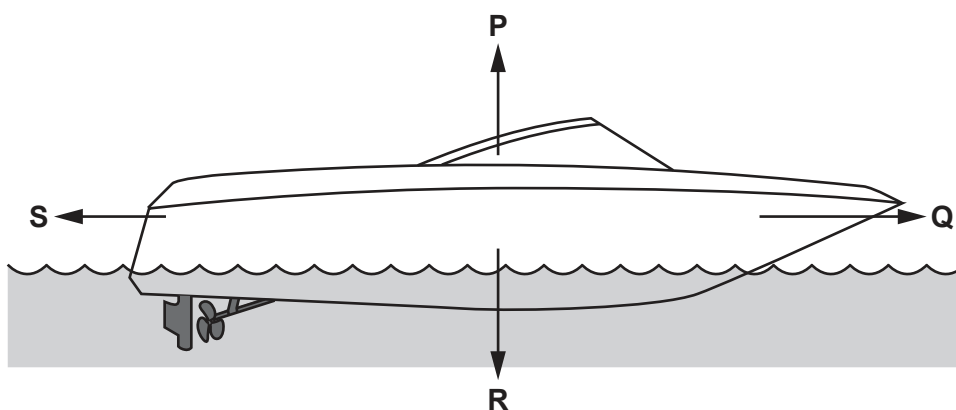


Fig. 9.2

- (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.

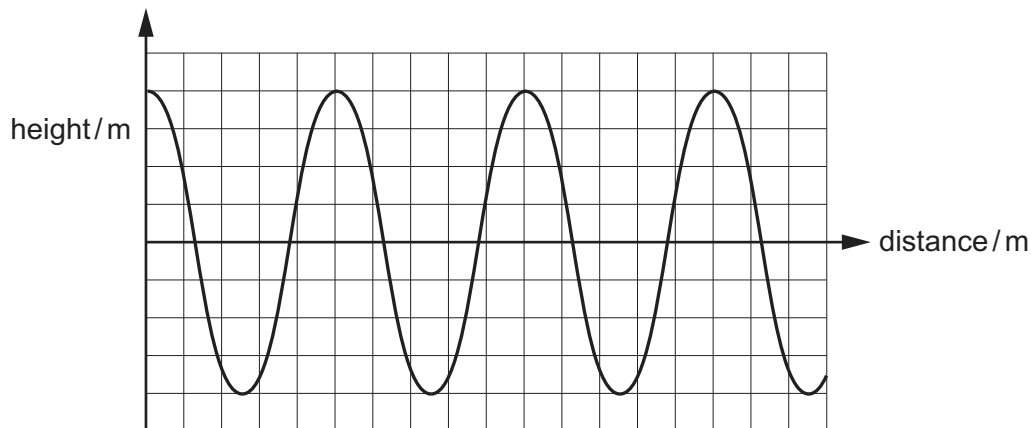


Fig. 9.3

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	1Hhydrogen1 Key atomic number atomic symbol name relative atomic mass										III	IV	V	VI	VII	VIII
3Li lithium 7	4Be beryllium 9											5B boron 11	6C carbon 12	7N nitrogen 14	8O oxygen 16	9F fluorine 19	10Ne neon 20
11Na sodium 23	12Mg magnesium 24											13Al aluminium 27	14Si silicon 28	15P phosphorus 31	16S sulfur 32	17Cl chlorine 35.5	18Ar argon 40
19K potassium 39	20Ca calcium 40	21Sc scandium 45	22Ti titanium 48	23V vanadium 51	24Cr chromium 52	25Mn manganese 55	26Fe iron 56	27Co cobalt 59	28Ni nickel 59	29Cu copper 64	30Zn zinc 65	31Ga gallium 70	32Ge germanium 73	33As arsenic 75	34Se selenium 79	35Br bromine 80	36Kr krypton 84
37Rb rubidium 85	38Sr strontium 88	39Y yttrium 89	40Zr zirconium 91	41Nb niobium 93	42Mo molybdenum 96	43Tc technetium —	44Ru ruthenium 101	45Rh rhodium 103	46Pd palladium 106	47Ag silver 108	48Cd cadmium 112	49In indium 115	50Sn tin 119	51Sb antimony 122	52Te tellurium 128	53I iodine 127	54Xe xenon 131
55Cs caesium 133	56Ba barium 137	57–71 lanthanoids	72Hf hafnium 178	73Ta tantalum 181	74W tungsten 184	75Re rhenium 186	76Os osmium 190	77Ir iridium 192	78Pt platinum 195	79Au gold 197	80Hg mercury 201	81Tl thallium 204	82Pb lead 207	83Bi bismuth 209	84Po polonium —	85At astatine —	86Rn radon —
87Fr francium —	88Ra radium —	89–103 actinoids	104Rf rutherfordium —	105Db dubnium —	106Sg seaborgium —	107Bh bohrium —	108Hs hassium —	109Mt meitnerium —	110Ds darmstadtium —	111Rg roentgenium —	112Cn copernicium —		114Fl flerovium —		116Lv livermorium —		
lanthanoids		57La lanthanum 139	58Ce cerium 140	59Pr praseodymium 141	60Nd neodymium 144	61Pm promethium —	62Sm samarium 150	63Eu europium 152	64Gd gadolinium 157	65Tb terbium 159	66Dy dysprosium 163	67Ho holmium 165	68Er erbium 167	69Tm thulium 169	70Yb ytterbium 173	71Lu lutetium 175	
actinoids		89Ac actinium —	90Th thorium 232	91Pa protactinium 231	92U uranium 238	93Np neptunium —	94Pu plutonium —	95Am americium —	96Cm curium —	97Bk berkelium —	98Cf californium —	99Es einsteinium —	100Fm fermium —	101Md mendelevium —	102No nobelium —	103Lr lawrencium —	

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).