Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

0123456789

COMBINED SCIENCE **0653/04**

Paper 4 Theory (Extended) **For examination from 2025**

SPECIMEN PAPER **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.
- Take the weight of 1.0 kg to be 9.8 N (acceleration of free fall = 9.8 m / s^2).

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 **22** pages. Any blank pages are indicated.

1 **(a)** Fig. 1.1 shows a sign from a restaurant kitchen.

Fig. 1.1

Explain why the message in the sign is important for controlling the spread of disease.

.....

.....

..... [2]

(b) A person is is given an initial vaccination for a disease. A few weeks later the person is given a booster vaccination. A booster vaccination is an additional vaccination for the same disease.

Fig. 1.2 shows how the number of antibodies in the body of the person changes after each vaccination.

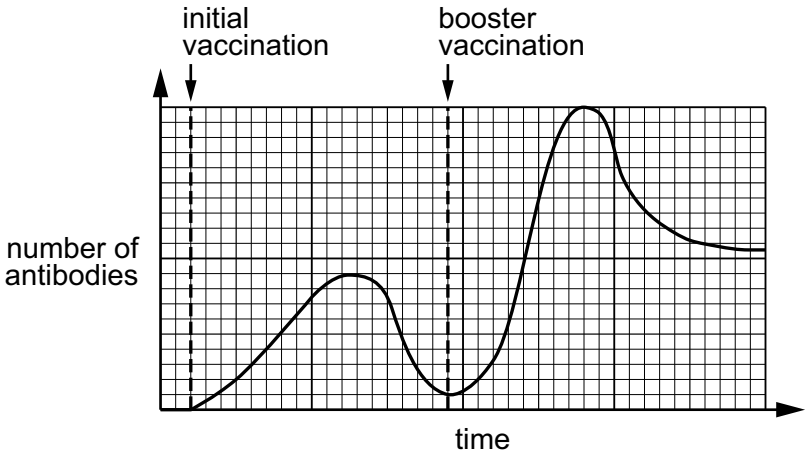

Fig. 1.2

(i) Describe **two** differences between the response to the initial vaccination and the response to the booster vaccination shown in Fig. 1.2.

1 .....

.....

2 .....

.....

[2]

(ii) Place a tick (✓) in the box that describes the response shown in Fig. 1.2.

phagocytosis	☐
assimilation	☐
active immunity	☐
transmissible disease	☐

[1]

(c) Explain how platelets in the blood help defend the body against disease.

.....

.....

..... [2]

(d) Heart disease is caused by the blockage of arteries in the heart. Less oxygen is transported to the heart muscle, which causes damage to the heart.

(i) State the name of these blocked arteries.

..... [1]

(ii) State the name of the component of blood that transports oxygen.

..... [1]

[Total: 9]

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2 **(a)** Fig. 2.1 shows a section of a plant stem.

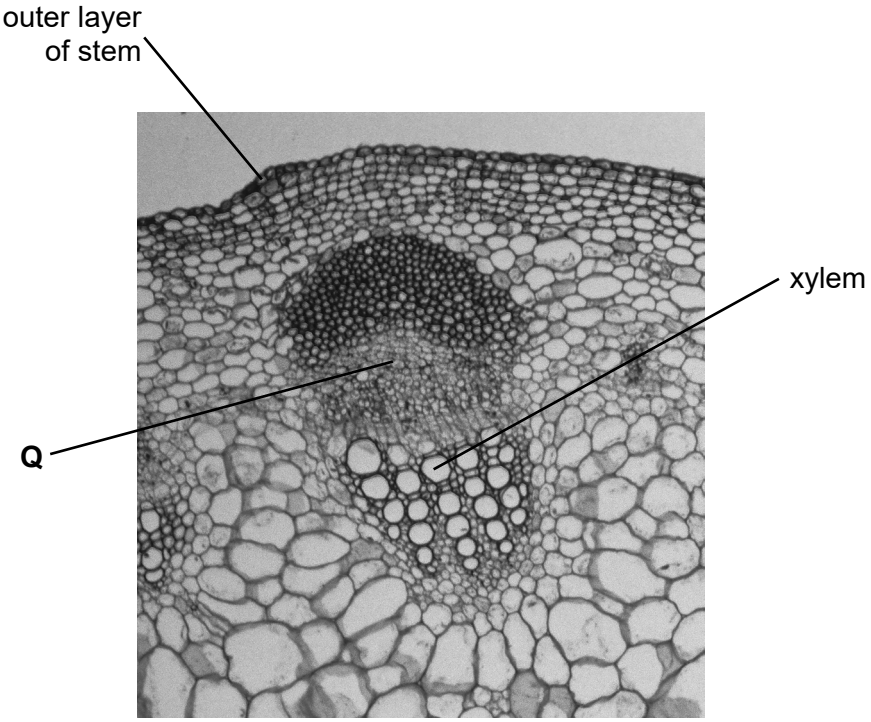


Fig. 2.1

(i) Circle the substances transported by the cells labelled **Q** on Fig. 2.1.

amino acids **fatty acids** **glycerol** **glucose**

nitrate ions **starch** **sucrose**

[1]

(ii) One function of xylem is transport.

State **one** other function of xylem.

..... [1]

(b) Plants photosynthesise.

State the balanced symbol equation for photosynthesis.

..... [2]

(c) A student uses hydrogencarbonate indicator solution to investigate the effect of light and dark conditions on gas exchange in aquatic plants.

Hydrogencarbonate indicator is a red solution that turns yellow in high concentrations of carbon dioxide and turns purple in low concentrations of carbon dioxide.

The student prepares the three test-tubes shown in Fig. 2.2.

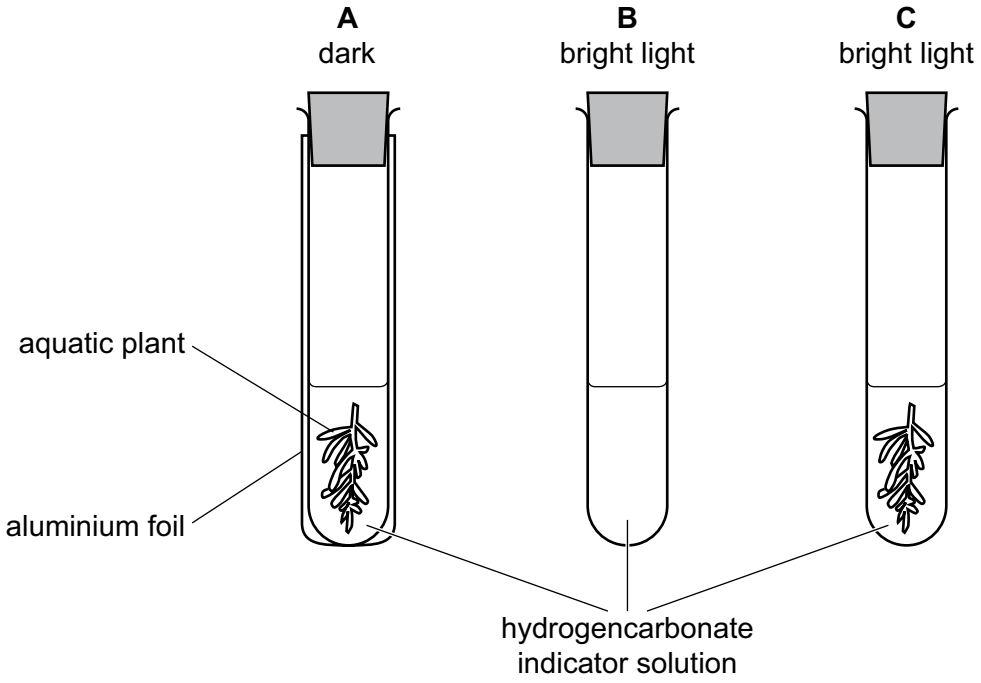


Fig. 2.2

After one hour, the student records the colour of the hydrogencarbonate indicator solution in each test-tube.

Table 2.1 shows the results.

Table 2.1

test-tube	conditions	colour of hydrogencarbonate indicator solution	
		at start	after one hour
A	dark	red	yellow
B	light	red	red
C	light	red	purple

Explain the results for test-tube **A** and test-tube **C**.

Use the words respiration and photosynthesis in your answer.

test-tube **A** .....

.....

.....

test-tube **C** .....

.....

.....

[4]

(d) Plants are an important part of the biodiversity of an ecosystem.

Explain the effect of deforestation on biodiversity.

.....

.....

..... [2]

[Total: 10]

3 **(a)** Fig. 3.1 shows part of the human digestive system.

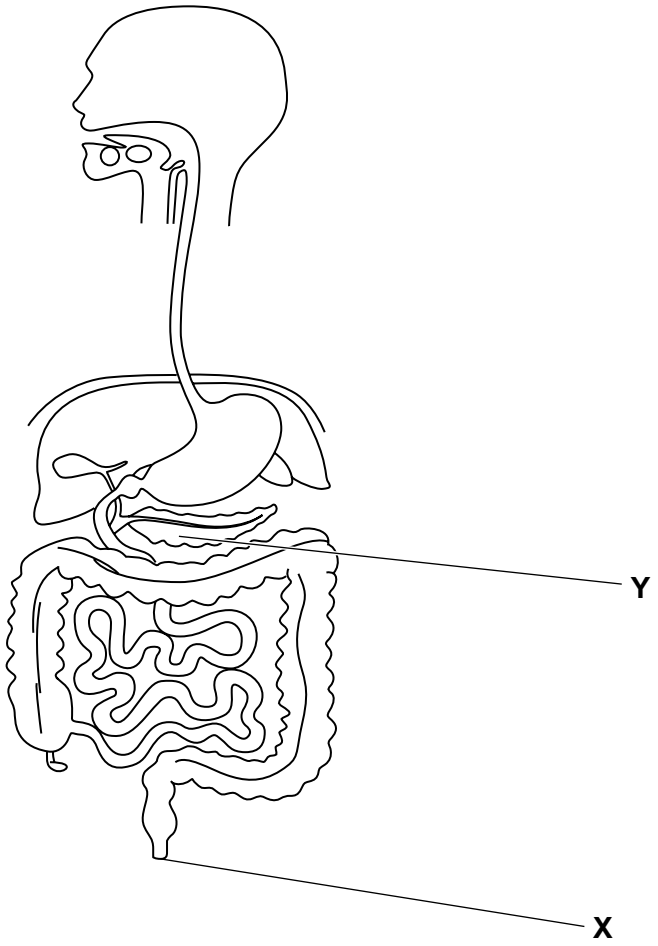


Fig. 3.1

(i) State the function of the part labelled **X** on Fig. 3.1.

..... [1]

(ii) Complete these sentences about the part labelled **Y** on Fig. 3.1.

The part labelled **Y** is the ..... .

Part **Y** releases an enzyme to break down fats and oils. This enzyme is called

..... .

Fats and oils are broken down into smaller molecules called

..... and ..... .

[3]

(b) Fig. 3.2 shows the effect of pH on enzyme activity.

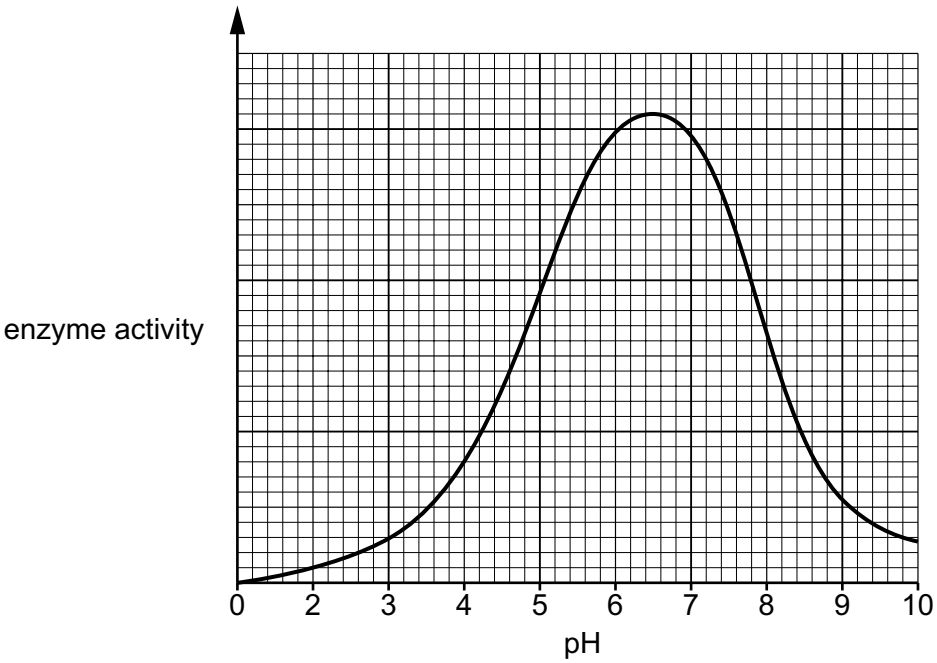


Fig. 3.2

(i) The enzyme in Fig. 3.2 is active in the mouth.

When the enzyme reaches the stomach, the enzyme activity changes.

Explain why the enzyme activity changes.

.....

.....

.....

..... [3]

(ii) Draw a curve on Fig. 3.2 to show the activity of a protease enzyme found in the stomach. [1]

[Total: 8]

4 Fig. 4.1 shows the reaction pathway diagrams for two reactions.

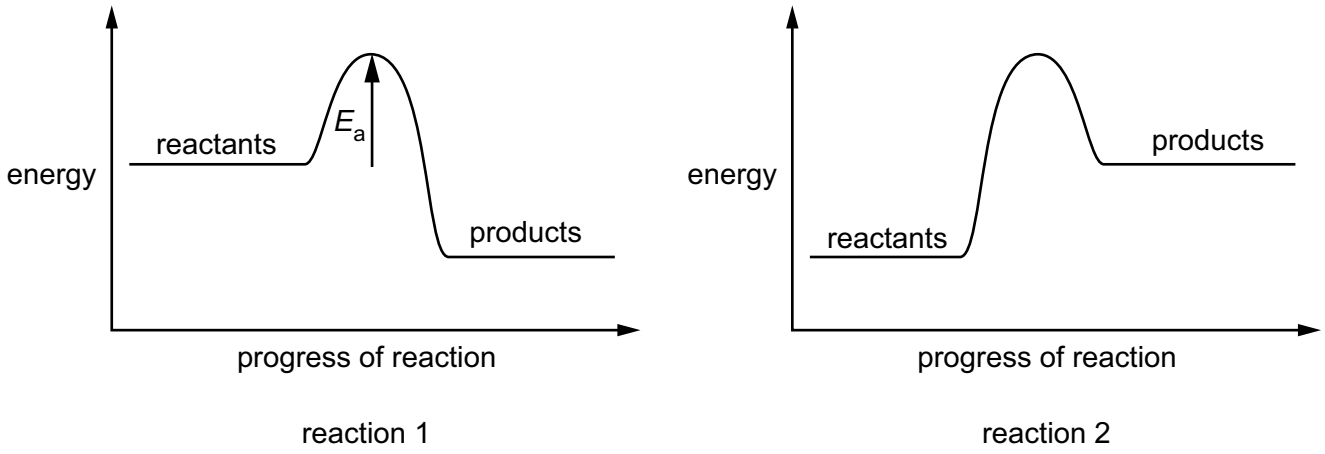


Fig. 4.1

(a) The activation energy for reaction 1 is represented by the arrow E_a.

(i) Define activation energy.

.....

.....

..... [1]

(ii) On Fig. 4.1, draw and label an arrow to show the activation energy for reaction 2. [1]

(b) During reaction 2, the temperature of the reaction mixture changes.

State how the temperature changes.

Give a reason for your answer.

temperature change .....

reason .....

.....

[1]

(c) Calcium carbonate reacts with dilute hydrochloric acid to produce calcium chloride.

(i) State the names of the other **two** products in this reaction.

1 .....

2 .....
[2]

(ii) The rate of this reaction can be increased by increasing the temperature of the hydrochloric acid.

Explain why.

Use ideas about particle collisions and energy in your answer.

.....

.....

..... [2]

[Total: 7]

5 Table 5.1 shows some information about aluminium and copper.

Table 5.1

	aluminium	copper
density in g / cm^3	2.7	8.9
melting point / °C	660	1084
electrical conductivity	high	high
other information	forms a layer of aluminium oxide which prevents corrosion	some copper compounds are toxic

(a) Use information from Table 5.1 to answer the following questions.

(i) State why aluminium and copper are used in electrical cables.

.....

..... [1]

(ii) State why aluminium is used in overhead electrical cables.

.....

..... [1]

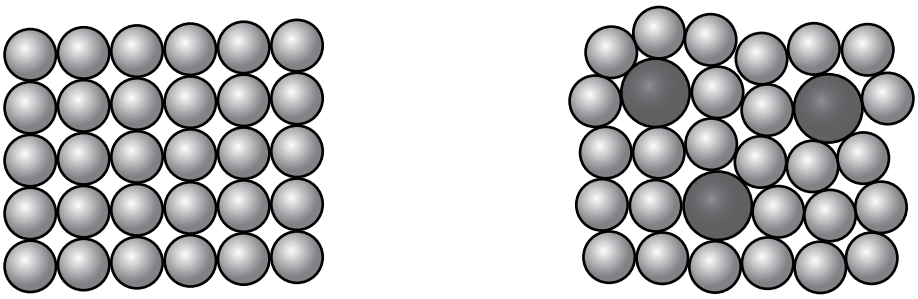
(iii) State why copper is **not** used to make food containers.

.....

..... [1]

(b) Steel is an alloy of iron. There are different types of steel.

Fig. 5.1 shows the arrangement of particles in pure iron and in one type of steel.



pure iron steel

Fig. 5.1

(i) Describe what is meant by an alloy.

.....

..... [1]

(ii) Explain why steel is stronger than pure iron.

.....

.....

..... [2]

(iii) Stainless steel is an alloy of iron. Stainless steel is used to make cutlery because it is strong.

State **one** other reason why stainless steel is used to make cutlery.

..... [1]

(c) Aluminium, copper and iron are extracted from their ores. Metals are extracted from their ores by electrolysis or by heating with carbon.

Put **one** tick (✓) in each row of Table 5.2 to identify how each metal is extracted from its ore.

Table 5.2

metal	heating with carbon	electrolysis
aluminium		
copper		
iron		

[2]

[Total: 9]

6 Gasoline (petrol) is a carbon-containing fuel.

(a) Some cars use gasoline as a fuel. The exhaust emissions from these cars contain carbon dioxide, carbon monoxide and carbon particulates.

Describe how each of these three substances forms in a car engine.

.....

.....

.....

..... [2]

(b) Gasoline contains octane, C_8H_{18}. Octane is a liquid at room temperature.

Complete the state symbols to show the states of octane, carbon dioxide, carbon monoxide and carbon particulates at room temperature.

C_8H_{18}(.....) CO_2(.....) CO(.....) C(.....) [2]

(c) **(i)** Fig. 6.1 represents a molecule of carbon dioxide.

O═C═O

Fig. 6.1

Carbon dioxide contains two double bonds.

Explain why carbon dioxide is **not** an unsaturated molecule.

.....

..... [1]

(ii) Increased carbon dioxide in the atmosphere contributes to climate change.

Describe **two** ways to reduce the rate at which carbon dioxide is released into the atmosphere.

1 .....

.....

2 .....

.....

[2]

(d) Carbon monoxide is toxic to living organisms in the environment. A catalytic converter is a device that is used in cars to reduce carbon monoxide emissions.

The symbol equation for one of the reactions in a catalytic converter is shown.

$$.....CO + ...NO \rightarrow .....CO_2 + N_2$$

(i) Complete the balanced symbol equation. [1]

(ii) State **one** other environmental problem that this reaction helps to reduce.

Explain your answer.

environmental problem .....

explanation .....

.....

[2]

[Total: 10]

7 **(a)** Fig. 7.1 shows a speed–time graph for a student walking to school.

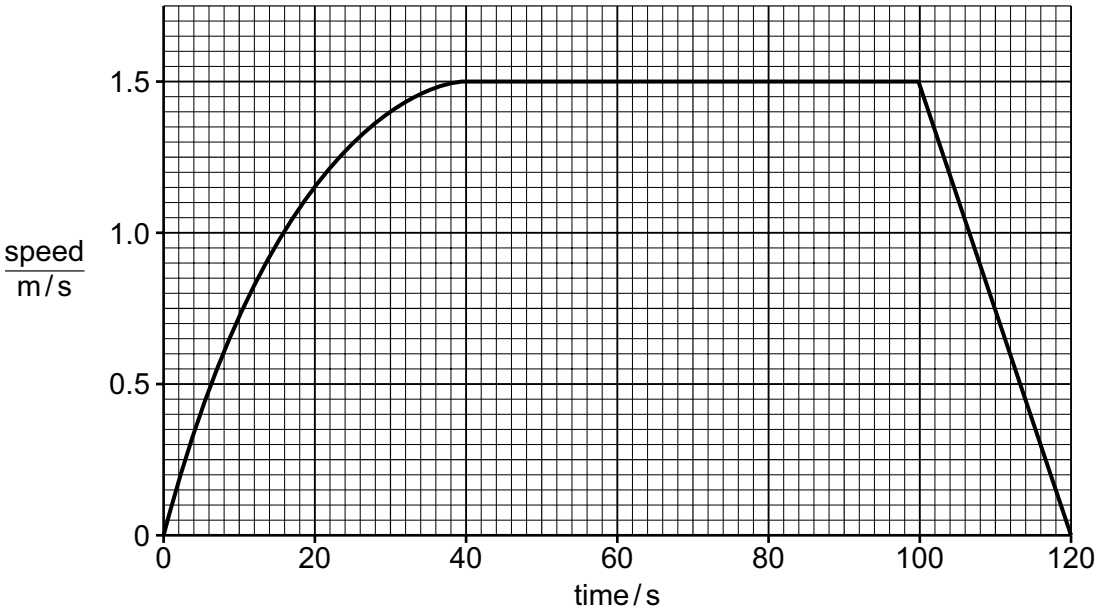


Fig. 7.1

(i) Determine the time taken by the student to reach maximum speed.

time = ... s [1]

(ii) On Fig. 7.1, write an **X** at a point on the graph when the student is decelerating. [1]

(iii) Determine the distance the student walks at constant speed.

distance = ... m [3]

(b) The student climbs a step into the school.

The student has a mass of 55 kg. The step is 0.15 m high.

Calculate the increase in the gravitational potential energy ΔE_p of the student climbing the step.

Include the unit in your answer.

ΔE_p = ... unit ..... [3]

[Total: 8]

8 **(a)** **(i)** Thermal energy transfer from the Sun to the Earth is mainly due to radiation in one region of the electromagnetic spectrum.

State the name of this region.

..... [1]

(ii) Electromagnetic radiation from the Sun heats the Earth.

Circle the correct words or phrases to complete the paragraph.

The temperature of the Earth is increasing. This is because the amount of radiation **absorbed / emitted** by the Earth from the Sun is **greater than / less than** the amount of radiation **absorbed / emitted** by the Earth into space.

[1]

(b) Earthquakes produce seismic P-waves (primary) and seismic S-waves (secondary). P-waves are longitudinal and S-waves are transverse.

(i) State **one** other type of longitudinal wave.

..... [1]

(ii) Describe the difference between transverse waves and longitudinal waves.

.....

.....

..... [2]

(c) The Earth orbits the Sun at an average distance of 1.51×10^8 km and takes 365.25 days for one orbit.

Calculate the orbital speed of the Earth around the Sun in km / h.

orbital speed = ... km / h [3]

(d) Billions of years in the future, the Sun will enter the next stage of its life cycle.

(i) State the next stage in the life cycle of the Sun.

..... [1]

(ii) Explain why the Sun will **not** become a black hole at the end of its life cycle.

.....

..... [1]

[Total: 10]

9 Fig. 9.1 shows a circuit used in a toy car.

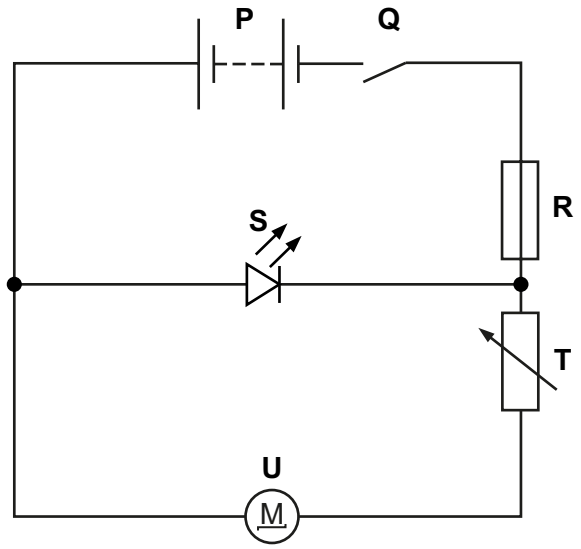


Fig. 9.1

(a) (i) The resistance of component **T** is 5.4 Ω. The resistance of component **U** is 3.5 Ω.

Calculate the combined resistance of components **T** and **U**.

resistance = ... Ω [1]

(ii) The current in component **R** is 2.7 A. The current in component **T** is 2.5 A.

Determine the current in component **S** and component **U**.

current in component **S** = ... A

current in component **U** = ... A
[2]

(iii) State the name of component **S**.

..... [1]

(b) Component **U** is an electric motor. When the motor is switched on, the toy car moves.

(i) Complete Fig. 9.2 to show one energy transfer that occurs.

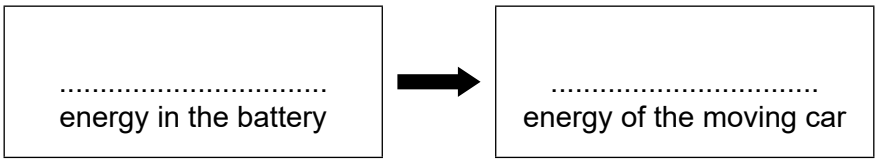


Fig. 9.2

[2]

(ii) The toy car moves for 10 s.

The power input to the motor is 3.6 W.

The useful energy output by the motor is 32 J.

Show that the efficiency of the motor is 89%.

[3]

[Total: 9]

The Periodic Table of Elements

Key

atomic number atomic symbol name relative atomic mass

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 –

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.).

