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COMBINED SCIENCE

0653/31

Paper 3 Theory (Core)

May/June 2025

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

1 (a) Fig. 1.1 is a diagram of a plant root hair cell.

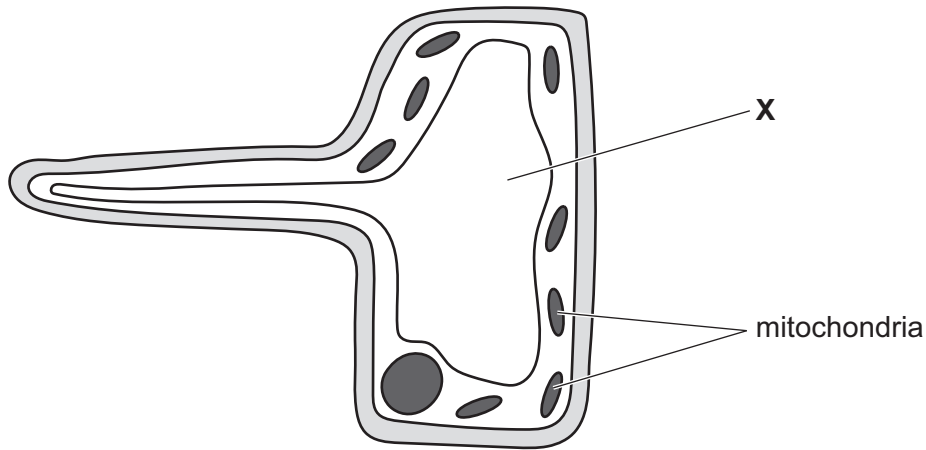


Fig. 1.1

(i) Name the part labelled **X** on Fig. 1.1.

..... [1]

(ii) State the function of mitochondria.

..... [1]

(iii) Suggest why the cell in Fig. 1.1 does **not** have chloroplasts.

.....

 [2]

(b) Water enters the root hair cell from the soil.

(i) Complete the sentence to describe the movement of water into the cell.

Water diffuses through a permeable membrane by

..... [2]

(ii) Water passes through the root to the xylem.

Circle the name of the root cells that water passes through to reach the xylem.

cortex

guard

mesophyll

palisade

[1]



(c) Fig. 1.2 shows part of the carbon cycle.

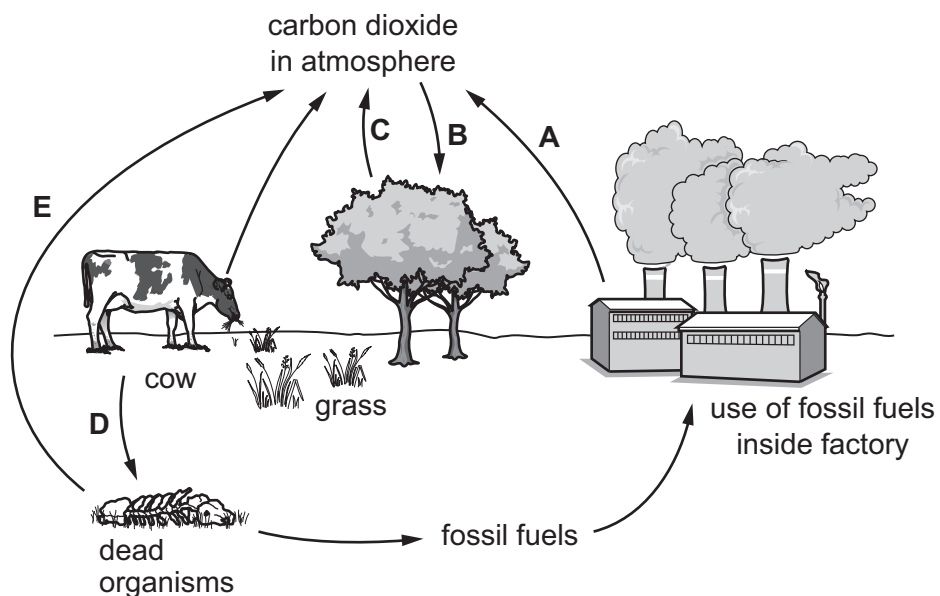


Fig. 1.2

(i) State the letter on Fig. 1.2 that represents:

combustion

decomposition.

[2]

(ii) Use Fig. 1.2 to explain why the cow is described as a herbivore.

.....

..... [1]

[Total: 10]



2 Fig. 2.1 shows the structure of a human heart.

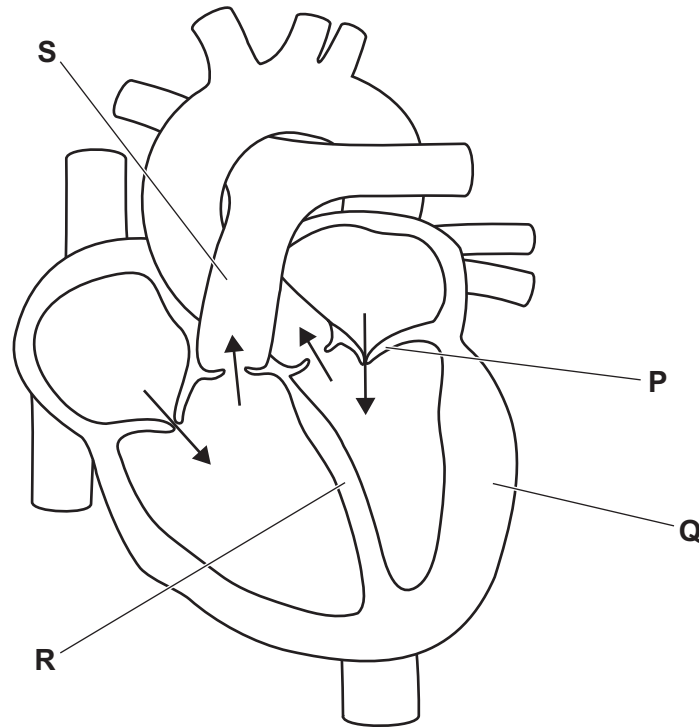


Fig. 2.1

The arrows in Fig. 2.1 show the direction of blood flow through the heart.

(a) Use letters **P–S** to complete the sentences about the heart in Fig. 2.1.

The part labelled is the muscular wall of the left ventricle.

Blood is transported away from the right side of the heart in the part labelled

The part labelled ensures one-way flow of blood.

[3]

(b) The activity of the heart may be monitored by ECG (electrocardiogram).

State **one other** way to monitor the activity of the heart.

..... [1]



(c) Blood contains four main components.

Name the component of blood that:

transports hormones

produces antibodies

contains haemoglobin

[3]

(d) Blood is pumped away from the heart in arteries and returns to the heart in veins.

Describe **two** differences in the structure of arteries compared to veins.

1

.....

2

.....

[2]

[Total: 9]



- 3 (a) Nutrition is one of the characteristics of living organisms.

Define nutrition.

.....
 [1]

- (b) Table 3.1 shows some information about nutrients in bananas.

Table 3.1

nutrient	mass of nutrient per 100 g of banana / g
carbohydrate	12.2
protein	1.1
fat	0.3
fibre (roughage)	2.6
vitamin C	0.0087

- (i) Identify the nutrient in Table 3.1 that helps to keep food moving through the large intestine.

..... [1]

- (ii) A health authority recommends that adults should eat 0.040 g of vitamin C per day.

A person eats 100 g of bananas.

Use Table 3.1 to calculate the percentage of the recommended mass of vitamin C the person eats.

percentage = [2]



(c) Banana trees that grow in the wild need to be pollinated before they can produce fruit.

Complete the sentences about pollination.

Use words from the list.

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

anther

fertilisation

filament

germination

ovary

ovule

reproduction

stigma

Pollination is the transfer of pollen grains from the to

the

The pollen nucleus then fuses with the nucleus of the

The fusion of nuclei is called

[4]

[Total: 8]



4 (a) Iron is a metal.

Fig. 4.1 shows the three physical states of iron.

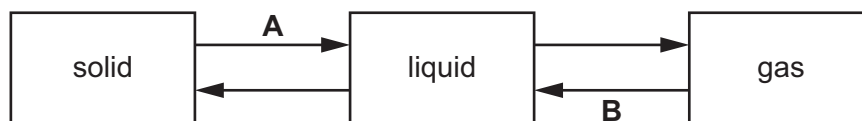


Fig. 4.1

Name the changes of state shown by arrows **A** and **B**.

A

B

[2]

(b) Complete the sentences about the particles in a liquid.

Use words or phrases from the list.

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

at the same speed as

more quickly than

stable

more slowly than

regular

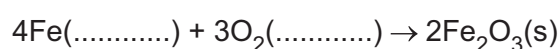
random

The particles in a liquid move in a solid.

Particles in a liquid have a arrangement.

[2]

(c) The symbol equation for the reaction of solid iron with oxygen is shown.



(i) Complete the symbol equation by adding the state symbols.

[1]

(ii) Explain how the equation shows that oxidation takes place.

.....

..... [1]

(d) Iron is used as a catalyst in a reaction to make ammonia.

Describe the effect of a catalyst on the rate of reaction.

..... [1]

[Total: 7]





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5 Potassium and magnesium are metals.

(a) A solid compound contains potassium ions.

Describe the use of a flame test to identify potassium ions.

.....

.....

.....

..... [2]

(b) A small piece of potassium is added to cold water. An exothermic reaction happens.

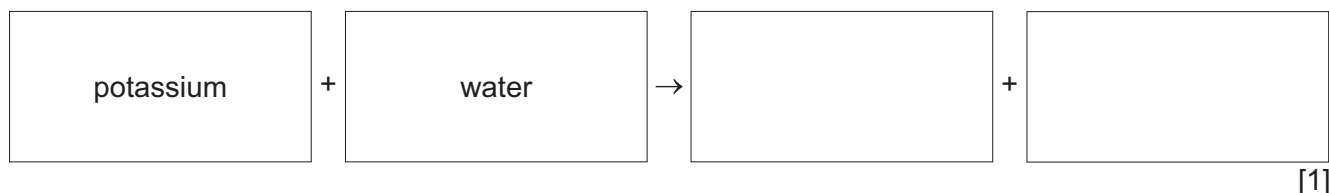
(i) Complete the sentence about an exothermic reaction.

An exothermic reaction transfers energy to the surroundings. [1]

(ii) State **one** observation that shows this reaction is exothermic.

..... [1]

(iii) Complete the word equation for this reaction.



(c) Magnox is an alloy of magnesium.

Describe what is meant by an alloy.

.....

..... [1]

(d) The proton number of magnesium is 12.

Determine the electronic configuration of magnesium.

..... [1]



(e) Fig. 5.1 shows the structure of a compound of magnesium.

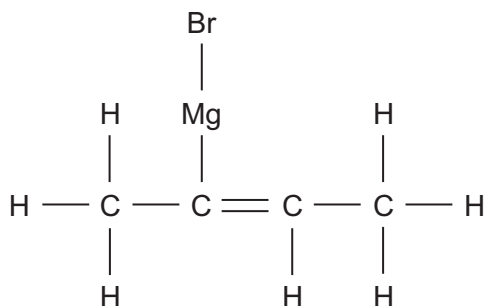


Fig. 5.1

Deduce the molecular formula of this compound.

..... [1]

[Total: 8]



6 (a) The formulas of some compounds of carbon are shown.



Use the formulas of these compounds to answer the following questions.

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

State which compound:

(i) decolourises aqueous bromine

..... [1]

(ii) is the main constituent of natural gas

..... [1]

(iii) forms poly(ethene) in an addition polymerisation reaction

..... [1]

(iv) is a product of the complete combustion of alkanes **and** leads to global warming

..... [1]

(v) is a toxic gas formed by incomplete combustion

..... [1]

(vi) is a waste gas produced from digestion in animals

..... [1]

(vii) is an acidic oxide.

..... [1]

(b) State what is meant by a hydrocarbon.

.....

..... [1]



(c) Bitumen and refinery gas are obtained from petroleum.

Name **one** use of:

bitumen

refinery gas.

[2]

(d) Coal is a fossil fuel.

During the combustion of coal, a compound that contains sulfur is made.

Name this compound.

..... [1]

[Total: 11]



7 Fig. 7.1 shows an electric motorcycle.

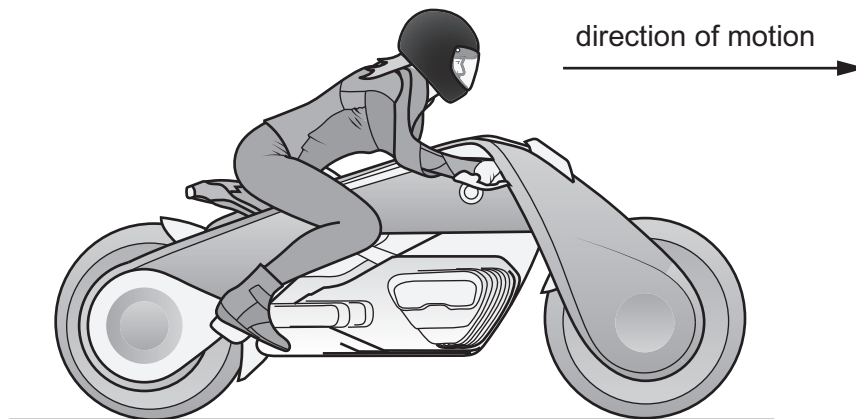


Fig. 7.1

- (a) (i) On Fig. 7.1, draw an arrow to show the direction of the air resistance acting on the motorcycle.

Label the arrow with the letter **R**.

[1]

- (ii) Complete the sentences about the motorcycle.

The motorcycle is moving at constant speed along a level road.

The total resistance force is 250 N.

The driving force must also be 250 N because the force is zero.

[1]

- (iii) Name the unit represented by N.

..... [1]



(b) The motorcycle is powered by a battery.

(i) The motorcycle travels a distance of 24 km at an average speed of 16 m/s.

Show that the time taken to travel this distance is 1500 s.

[2]

(ii) The battery supplies a constant current of 45 A at a voltage of 72 V.

Calculate the power supplied by the battery.

power = W [2]

(iii) Use your answer to (b)(ii) to calculate the total energy supplied by the battery in 1500 s.

energy = J [2]

[Total: 9]



8 Some cars are powered by petrol (gasoline) engines made of iron.

(a) Petrol burns inside the engine at a temperature of 1800°C .

(i) Iron melts at a temperature of 1538°C .

Suggest why the car engine must be cooled by a flow of cold water.

.....
..... [1]

(ii) The mass of iron used in the car engine is 150 kg.

The density of iron is 7900 kg/m^3 .

Calculate the volume of iron used in the car engine.

volume = m^3 [2]



(b) A car driver listens to the radio.

(i) Fig. 8.1 shows a wave.

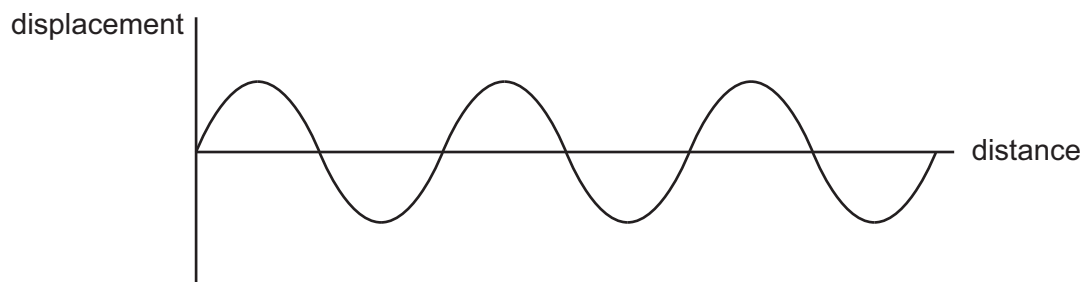


Fig. 8.1

On Fig. 8.1, draw a double-headed arrow ($\leftrightarrow$ or $\updownarrow$) to show **one** wavelength. [1]

(ii) The radio waves have a wavelength of 1200 m.

The speed of the radio waves is 3.0×10^8 m/s.

Calculate the frequency of the radio waves.

Include the unit in your answer.

frequency = unit [3]

(iii) Radio waves are used for radio transmissions.

State **one other** application of radio waves.

..... [1]

[Total: 8]



- 9 A spacecraft is on a journey to the planet Saturn.

(a) Fig. 9.1 shows a circuit for an electric motor used in the spacecraft.

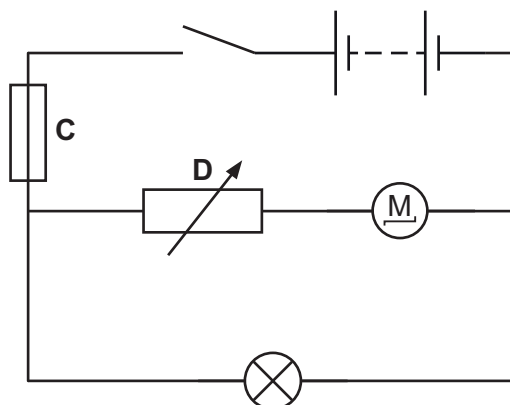


Fig. 9.1

- (i) State the name and purpose of component **C**.

name

purpose

[2]

- (ii) Describe how component **D** is used to control the current in the motor.

.....

.....

..... [2]

- (iii) The voltage across the lamp is 6.3 V.

The current in the lamp is 0.45 A.

Calculate the resistance of the lamp.

resistance = Ω [2]





(b) Complete the sentences about the journey of the spacecraft.

The spacecraft travels directly from the Earth to the planet Saturn.

On the way to Saturn, the spacecraft first crosses the orbit of the

planet and then crosses the orbit of

the planet

[2]

(c) Explain why the planets orbit around the Sun.

.....

.....

.....

..... [2]

[Total: 10]

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The Periodic Table of Elements

Group																			
I	II													III	IV	V	VI	VII	VIII
</																			

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
	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.).