



Cambridge Assessment International Education
Cambridge International General Certificate of Secondary Education

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COMBINED SCIENCE

0653/42

Paper 4 (Extended)

February/March 2019

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use an HB pencil for any diagrams or graphs.

Do not use staples, paper clips, glue or correction fluid.

DO NOT WRITE IN ANY BARCODES.

Answer **all** questions.

Electronic calculators may be used.

You may lose marks if you do not show your working or if you do not use appropriate units.

A copy of the Periodic Table is printed on page 24.

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [] at the end of each question or part question.

This document consists of **21** printed pages and **3** blank pages.

- 1 (a) (i) Fig. 1.1 shows a food chain of some organisms in a garden.

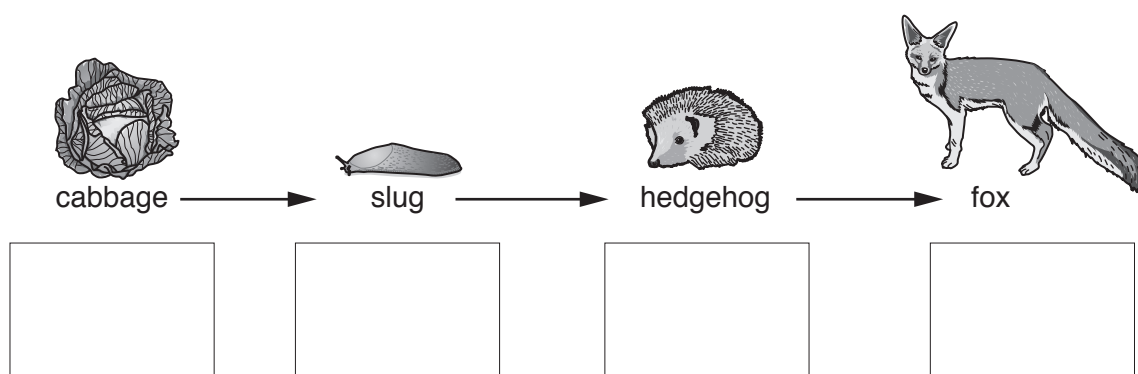


Fig. 1.1

The list shows the trophic levels of the organisms.

primary consumer

producer

secondary consumer

tertiary consumer

In Fig. 1.1 write the correct trophic level in the box below each organism.

[1]

- (ii) Fig. 1.2 shows a second food chain in the same garden.



Fig. 1.2

Complete the food web below by combining the organisms in the two food chains shown in Fig. 1.1 and Fig. 1.2. You do **not** need to include the pictures.

cabbage

sunflower

[2]

(iii) State **two** ways in which energy is wasted during transfer between trophic levels.

1.

.....

2.

.....

[2]

(b) Humans must eat a variety of foods for a balanced diet.

(i) Use words from the list to complete the essential components of a human's diet.

bile

carbohydrates

chlorophyll

enzymes

haemoglobin

hormones

proteins

A balanced diet contains mineral salts, fibre, , fats,

water, and vitamins.

[1]

(ii) Describe the importance of fibre in the diet.

.....

..... [1]

(iii) The list shows some foods. One of them is rich in fibre.

apple

cheese

fish

meat

milk

State the food rich in fibre.

[1]

(c) If a person's diet does not contain all the nutrients needed they can develop deficiency diseases. Scurvy is an example of a deficiency disease.

State the cause of the disease scurvy.

..... [1]

- (d) The amount of each nutrient in a balanced diet varies according to a person's need.
The list describes four people **A**, **B**, **C** and **D**.

person **A** is an adult male office worker

person **B** is an adult male gardener

person **C** is a teenage boy

person **D** is a teenage girl

- (i) Suggest which person, **A** or **B**, needs more energy supplied by their diet.
Give a reason for your answer.

person

reason

..... [1]

- (ii) Suggest which person, **C** or **D**, needs more energy supplied by their diet.
Give a reason for your answer.

person

reason

..... [1]

[Total: 11]

- 2 (a) Fig. 2.1 shows the processes of fractional distillation and cracking.

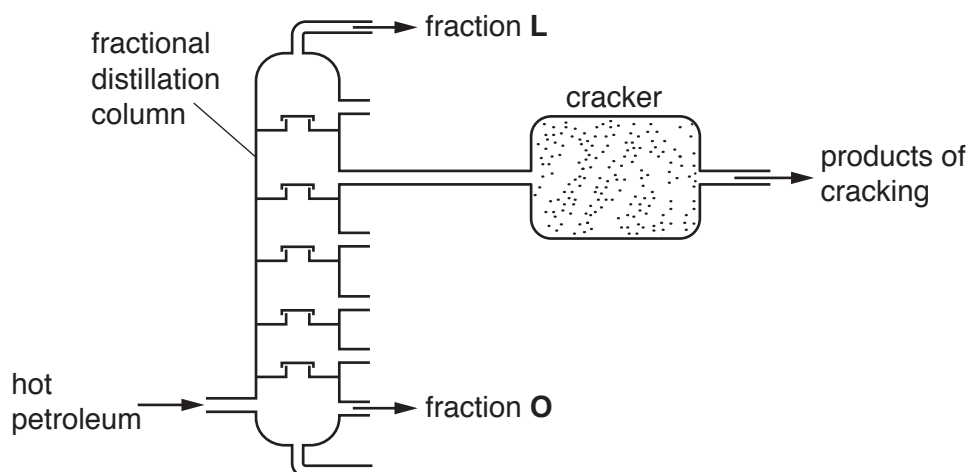


Fig. 2.1

- (i) State **two** ways in which fraction **O** differs from fraction **L**.

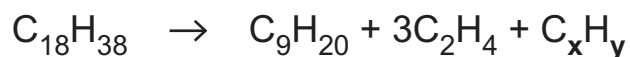
1.
.....
2.
..... [2]

- (ii) State **one** condition needed for the cracking process.

-
..... [1]

- (b) Cracking breaks down large saturated hydrocarbon molecules into smaller hydrocarbon molecules.

The equation below shows a chemical reaction that occurs during cracking.



Determine the values of **x** and **y**.

x =

y =

[2]

- (c) Ethene, an alkene, has the formula C_2H_4 .

Complete the dot-and-cross diagram to show the bonding electrons in a molecule of ethene.



[3]

- (d) The hydrocarbon $\text{C}_{18}\text{H}_{38}$ is an alkane. The alkanes are a homologous series.

Explain what is meant by the term *homologous series*.

.....
.....
..... [2]

[Total: 10]

- 3 Fig. 3.1 shows a girl throwing a beach ball up in the air.



Fig. 3.1

The ball moves vertically upwards, then falls down and the girl catches it.

Fig. 3.2 shows a graph of the ball's motion from when it leaves the girl's hand until she catches it.

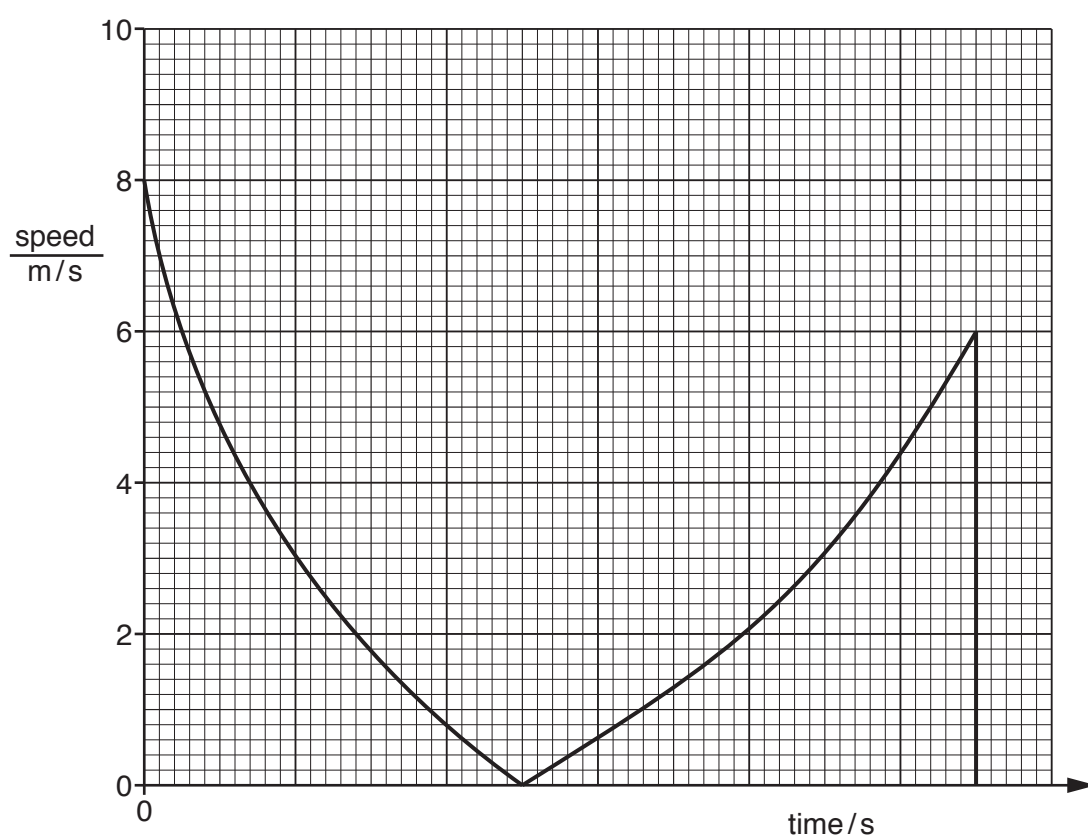


Fig. 3.2

- (a) On Fig. 3.2, label with an **X** the point when the ball reaches its maximum height.

[1]

- (b) The girl applies an upward force of 8.4 N to the ball.

The ball has a mass of 0.12 kg.

- (i) Calculate the resultant force on the ball.

gravitational field strength, $g = 10 \text{ N/kg}$

Show your working.

force = N [2]

- (ii) The ball left the girl's hand when it was 1.4 m above the ground.

Calculate the increase in gravitational potential energy of the ball when it reaches a height of 4.1 m above the ground.

Show your working.

gravitational potential energy = J [3]

- (c) (i) State the formula for calculating the kinetic energy of a moving object.

..... [1]

- (ii) The mass of the ball is 0.12 kg.

Use this information and Fig. 3.2 to calculate the kinetic energy of the ball as it left the girl's hand.

Show your working.

kinetic energy = J [2]

- 4 Fig. 4.1 shows a diagram of the internal structure of the heart and the blood vessels entering and leaving the heart.

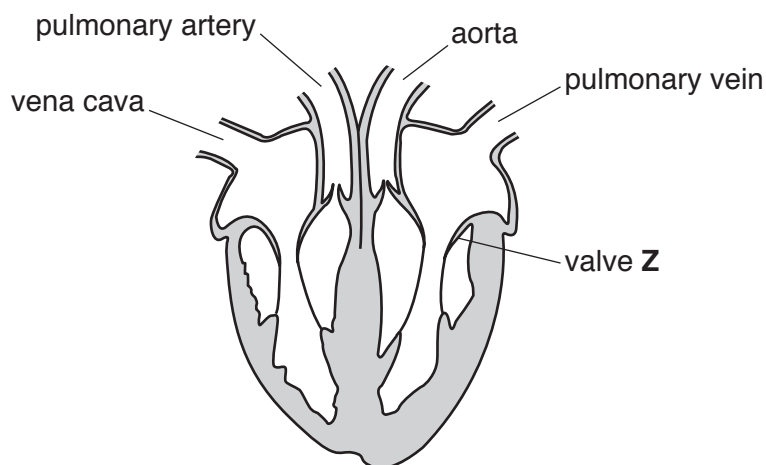


Fig. 4.1

- (a) Describe the function of valve **Z** in the heart shown in Fig. 4.1.

.....

.....

..... [2]

- (b) The concentrations of oxygen gas and of carbon dioxide gas in the blood in each side of the heart are measured.
The results are shown on Fig. 4.2.

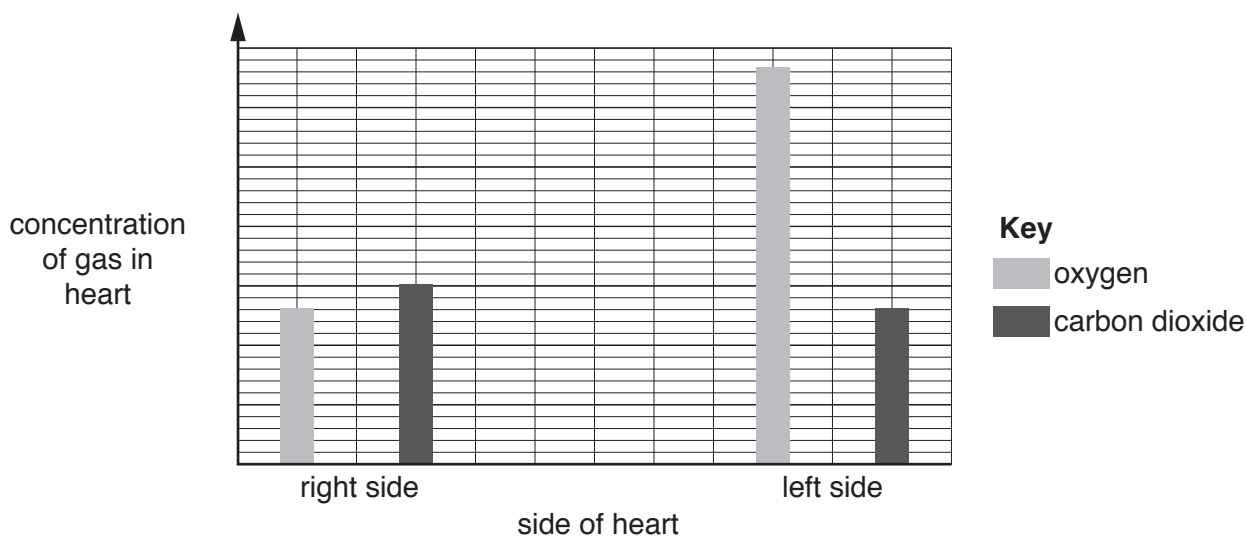


Fig. 4.2

(i) Explain why the concentration of carbon dioxide in the blood in the right side of the heart is higher than in the left side.

.....

.....

..... [2]

(ii) Describe what causes the oxygen concentration in the blood to be higher in the left side of the heart compared with the right side.

.....

..... [1]

(c) (i) State what is meant by *coronary heart disease*.

.....

.....

..... [2]

(ii) Describe **one** lifestyle choice a person can make to reduce the chance of developing coronary heart disease.

.....

..... [1]

[Total: 8]

5 (a) Iron is an element in Period 4 of the Periodic Table shown on page 24.

(i) Name the collection of metals in Period 4 that contains iron.

..... [1]

(ii) Deduce the number of electrons in an atom of iron.

electrons [1]

(b) Suggest why iron is used in the form of alloys, rather than as pure iron, for making cars.

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

(c) Iron is extracted from iron(III) oxide in a blast furnace.

(i) State the fuel used in a blast furnace.

..... [1]

(ii) Deduce the formula of the oxide of iron containing iron(III) ions, Fe^{3+} , and oxide ions, O^{2-} .

formula [1]

(iii) The word equation for one of the reactions occurring in the blast furnace is shown below.

iron(III) oxide + carbon monoxide $\rightarrow$ iron + carbon dioxide

Explain why this is a redox reaction.

.....
.....
..... [2]

(iv) Explain why aluminium cannot be extracted from aluminium oxide in a blast furnace.

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

- (v) The carbon dioxide produced in a blast furnace escapes into the atmosphere.

Carbon dioxide is a greenhouse gas.

State **one** possible effect of an increase in the concentration of carbon dioxide gas in the atmosphere.

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

- (d) Iron (III) sulfate, $\text{Fe}_2(\text{SO}_4)_3$, is a soluble salt.

Name **two** substances that react together to form iron (III) sulfate.

1.
2. [1]

[Total: 10]

- 6 The bathroom in a house has electric heating under the floor.

(a) Fig. 6.1 shows part of the heating circuit, with two identical heaters, heater 1 and heater 2.

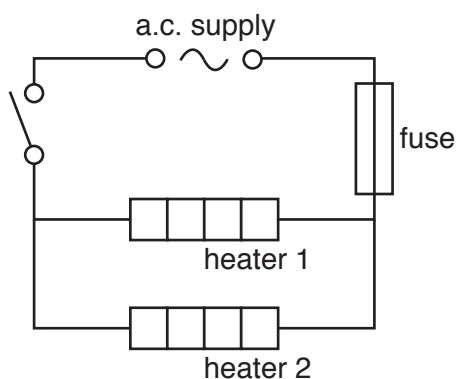


Fig. 6.1

When the circuit is switched on, the current in heater 1 is 4 A.

State the current in the fuse.

current = A

Explain your answer.

.....

[2]

- (b) The heaters are placed underneath a wooden floor.

The heating circuit is switched on, and the temperature of the heaters quickly reaches 70 °C.

Thermal energy conducted through the wood causes the temperature of the upper surface of the floor to increase slowly from 20 °C to 25 °C.

Air in contact with the floor is heated and warms the bathroom by convection.

Describe in terms of molecules:

- (i) how thermal energy passes through the wood by conduction

.....

 [2]

- (ii) how thermal energy is transferred from the surface of the floor to the ceiling of the bathroom.

.....

.....

.....

..... [3]

- (c) When the heaters are switched on, a small gap between the edge of the wooden floor and the walls of the bathroom slowly disappears.

Predict what will happen when the heaters are switched off again.

Explain your answer.

prediction

explanation

..... [2]

[Total: 9]

- 7 (a) Fig. 7.1 shows a diagram of a wind-pollinated flower.

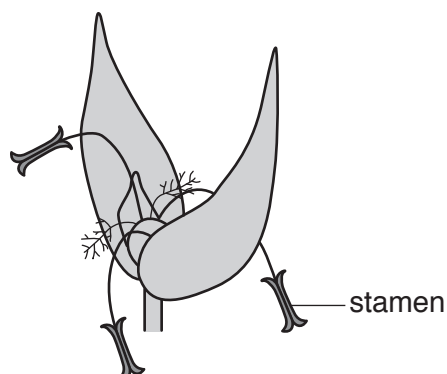


Fig. 7.1

Describe how the stamen in Fig. 7.1 is adapted for wind-pollination.

.....
 [2]

- (b) Fig. 7.2 shows two pollen grains. One is from a wind-pollinated flower and the other is from an insect-pollinated flower. They are not drawn to scale.

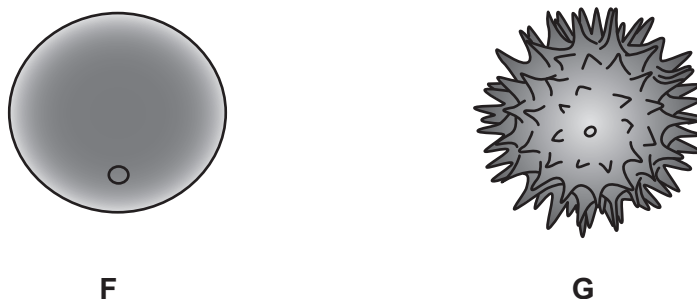


Fig. 7.2

Suggest which pollen grain, **F** or **G**, comes from a wind-pollinated flower.

Give a reason for your answer.

pollen grain

reason
 [1]

- (c) After pollination, fertilisation must take place before seeds can be produced.

Describe the difference between pollination and fertilisation.

.....

.....

..... [2]

- (d) Pollen grains in the flower need energy from photosynthesis in the leaves.

- (i) Name the cells in the leaf where most photosynthesis takes place.

..... [1]

- (ii) Describe how the cells you named in (i) are adapted for photosynthesis.

.....

..... [1]

- (iii) Name the part of the plant that transports sugars.

..... [1]

[Total: 8]

- 8 (a) Fig. 8.1 shows the apparatus a student uses to investigate the reaction between magnesium powder and excess dilute hydrochloric acid. The reaction produces a salt and hydrogen gas.

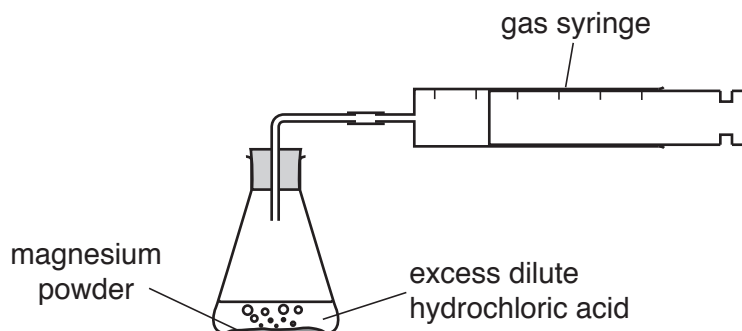


Fig. 8.1

The student measures the volume of gas in the gas syringe at regular intervals.

Fig. 8.2 shows a graph of her results.

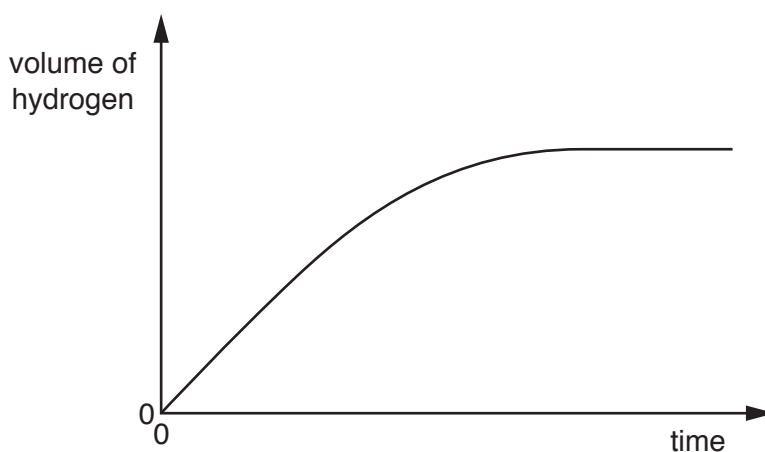


Fig. 8.2

- (i) On Fig. 8.2 mark with an **X** a time at which the reaction has already finished. [1]
- (ii) The student repeats the investigation at a higher temperature.
On Fig. 8.2 sketch a line to suggest the results of this experiment. [1]
- (iii) Explain the line you sketched in (a)(ii).

.....

.....

.....

..... [2]

- (b) Table 8.1 shows the composition of an alloy.

Table 8.1

element	% by mass
aluminium	8.0
magnesium	91.2
manganese	0.2
zinc	0.6

Calculate the mass of magnesium in 500 g of the alloy.

mass of magnesium = g [1]

- (c) Magnesium is produced by the electrolysis of molten magnesium chloride.

Name the substance produced at the anode.

..... [1]

[Total: 6]

- 9 In many cities, sodium street lamps are used at night. These lamps produce an intense yellow light.

- (a) A street is lit by eight identical sodium lamps using mains voltage of 240V. The current in each lamp is 0.50A.

The street is lit for 12 hours during the night.

Calculate the electrical energy used.

Show your working.

energy = J [3]

- (b) A sodium street lamp emits electromagnetic radiation as yellow light with a wavelength of $589 \times 10^{-9}\text{m}$.

- (i) State the speed at which electromagnetic waves travel.

speed = m/s [1]

- (ii) Use your answer to (b)(i) to calculate the frequency of the yellow light emitted by a sodium lamp.

Show your working.

frequency = Hz [2]

- (c) Electromagnetic radiation and water waves are examples of transverse wave motion.

Sound is an example of longitudinal wave motion.

Describe **one** way in which a longitudinal wave differs from a transverse wave.

.....
 [1]

(d) Table 9.1 shows some of the wavelengths of electromagnetic radiation emitted by another type of street lamp called a mercury-vapour lamp.

Table 9.1

wavelength / 10^{-9} m	colour
184	not visible
404	violet
436	blue
546	green
578	yellow-orange

(i) Use information in Table 9.1 to suggest the part of the electromagnetic spectrum where a wavelength of $184 \times 10^{-9}\text{ m}$ is likely to be found.

Give a reason for your answer.

part of spectrum

reason

..... [1]

(ii) Describe a danger to human health if this wavelength is **not** removed when mercury-vapour lamps are used near people.

.....

..... [1]

[Total: 9]