OCR
Oxford Cambridge and RSA

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Friday 26 November 2021 – Morning

GCSE (9–1) Combined Science B (Twenty First Century Science)

J260/04 Combined Science (Foundation Tier)

Time allowed: 1 hour 45 minutes

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You must have:
- a ruler (cm/mm)
- the Data Sheet for GCSE (9-1) Combined Science B (inside this document)

You can use:
- an HB pencil
- a scientific or graphical calculator

J260004

Please write clearly in black ink. **Do not write in the barcodes.**

Centre number | | | | | | Candidate number | | | | |

First name(s) _____

Last name _____

INSTRUCTIONS
- Use black ink. You can use an HB pencil, but only for graphs and diagrams.
- Write your answer to each question in the space provided. If you need extra space use the lined pages at the end of this booklet. The question numbers must be clearly shown.
- Answer **all** the questions.
- Where appropriate, your answer should be supported with working. Marks might be given for using a correct method, even if your answer is wrong.

INFORMATION
- The total mark for this paper is **75**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended response will be assessed in questions marked with an asterisk (*****).
- This document has **24** pages.

ADVICE
- Read each question carefully before you start your answer.

Answer **all** the questions.

1 **(a)** **(i)** Which statements about waves are **true** and which are **false**?

Tick (✓) **one** box in each row.

	True	False
All electromagnetic waves are transverse.	☐	☐
Light is an electromagnetic wave.	☐	☐
Sound is a transverse wave.	☐	☐

[2]

(ii) **Fig. 1.1** shows a transverse wave.

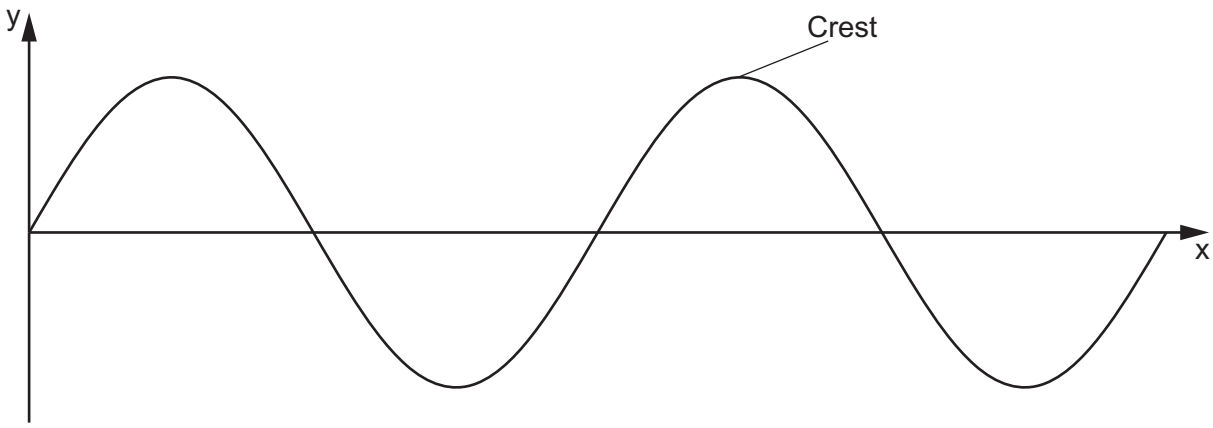

Fig. 1.1

Complete each sentence about the transverse wave in **Fig. 1.1**.

Use the words.

You can use each word once, more than once or not at all.

amplitude **frequency** **period** **speed** **wavelength**

The maximum height of the wave above the x-axis is called the .....

The distance from one crest to another is called the .....

The number of waves passing a point each second is called the .....

[2]

(b) Sundip is investigating the reflection of light off a plane mirror.

(i) Sundip writes a series of steps for her investigation.

They are **not** in the correct order.

A Measure the angle of the incident ray.

B Measure the angle of the reflected ray.

C Repeat the measurements for different angles.

D Use a ray box to shine a light at the plane mirror.

Write the **letters** in the boxes to show the correct order of the steps.

[3]

(ii) The table shows Sundip's results.

Angle of incidence (°)	Angle of reflection (°)
20	21
30	29
40	40
50	51
60	55
70	69

Sundip thinks one of her results is an outlier.

Put a (ring) around the **outlier** in the table**.** **[1]**

(iii) Complete the sentence to make Sundip's conclusion correct.

Put a (ring) around the correct answer.

The angle of the incident ray is **approximately equal to / greater than / less than / unrelated to** the angle of the reflected ray. **[1]**

(c) **Fig. 1.2** shows a pencil in a glass of water.

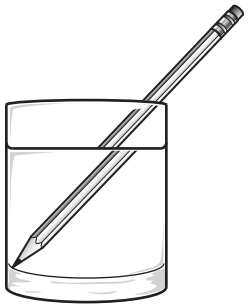

Fig. 1.2

Complete each sentence about why the pencil looks broken in **Fig. 1.2**.

Use the words.

You can use each word once, more than once or not at all.

colour **direction** **energy** **slows down** **speeds up**

The pencil appears broken because the light changes .....

when it moves from the air in the glass into the water.

The light ..... as it enters the water.

[2]

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2 Households in the UK are asked to separate recyclable materials such as metal cans, glass bottles and plastic containers from their waste.

Table 2.1 shows data about the recycling of these materials in the UK.

Packaging material	Packaging waste (thousand tonnes)	Total packaging recycled (thousand tonnes)	Percentage recycled (%)
Aluminium	177	94	53.1
Steel	559	431	77.1
Glass	2399	1623	67.7
Plastic	2260	1044	

Table 2.1

(a) (i) Which packaging material produces the highest amount of packaging waste?

Use data from **Table 2.1**.

Put a (ring) around the correct answer.

Aluminium **Glass** **Plastic** **Steel** **[1]**

(ii) Calculate the percentage of plastic recycled.

Use data from **Table 2.1**.

Use the equation: percentage recycled = $\frac{\text{total packaging recycled}}{\text{packaging waste}} \times 100$

Give your answer to **1** decimal place.

Percentage of plastic recycled = ... % **[3]**

(b) The UK government has recycling targets.

Table 2.2 shows the percentage of aluminium, steel and glass recycled in the UK in 2017.

Packaging material	Percentage recycled in the UK (%)	Recycling target (%)
Aluminium	53.1	50.0
Steel	77.1	50.0
Glass	67.7	60.0

Table 2.2

(i) Which packaging material has the UK been most successful in recycling?

Use data from **Table 2.2** to explain your answer.

.....

.....

.....

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

(ii) Household waste for recycling is sent to a sorting centre. Steel contains iron.

Suggest how the sorting centre could separate the steel cans from the aluminium cans.

.....

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

(iii) Producing glass from recycled materials uses less **energy** than producing glass from new resources.

Name **two** other factors that would be important when deciding that a product should be made from recycled materials instead of new resources.

Factor 1 .....

Factor 2 .....
[2]

3 **(a)** Jack is interested in the effect of different types of exercise on his pulse rate.

Describe how Jack could investigate the effect of different types of exercise on his pulse rate.

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..... **[3]**

(b) **Fig. 3.1** shows Jack's pulse rate before, during and after some exercise.

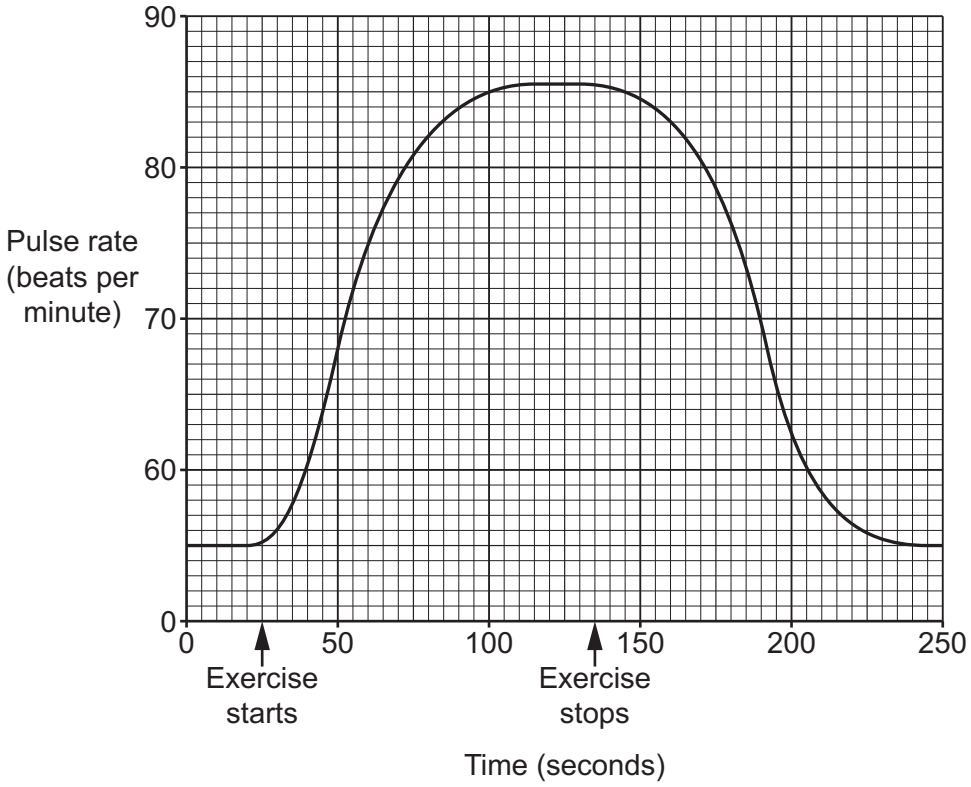

Fig. 3.1

Recovery rate is the time it takes for the pulse rate to return to the resting rate after exercise stops.

Calculate Jack's recovery rate using **Fig. 3.1**.

Give your answer in **minutes** and **seconds**.

Recovery rate = ... minutes ..... seconds **[3]**

(c) Jack measures the pulse rates of two people during and after exercise.

One person is fit and the other is unfit.

The results are shown in **Fig. 3.2**.

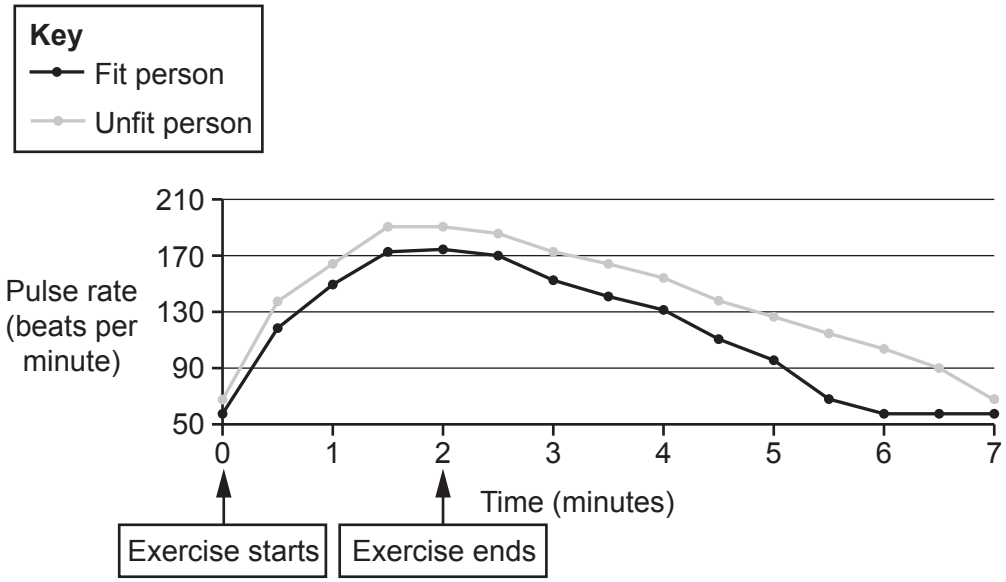

Fig. 3.2

(i) Jack concludes that the fitter a person is, the faster the recovery rate.

Do you agree with Jack's conclusion?

Yes ☐

No ☐

Use **Fig. 3.2** to explain your answer.

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

(ii) Suggest **one** way in which Jack could improve his investigation to increase confidence in his conclusion.

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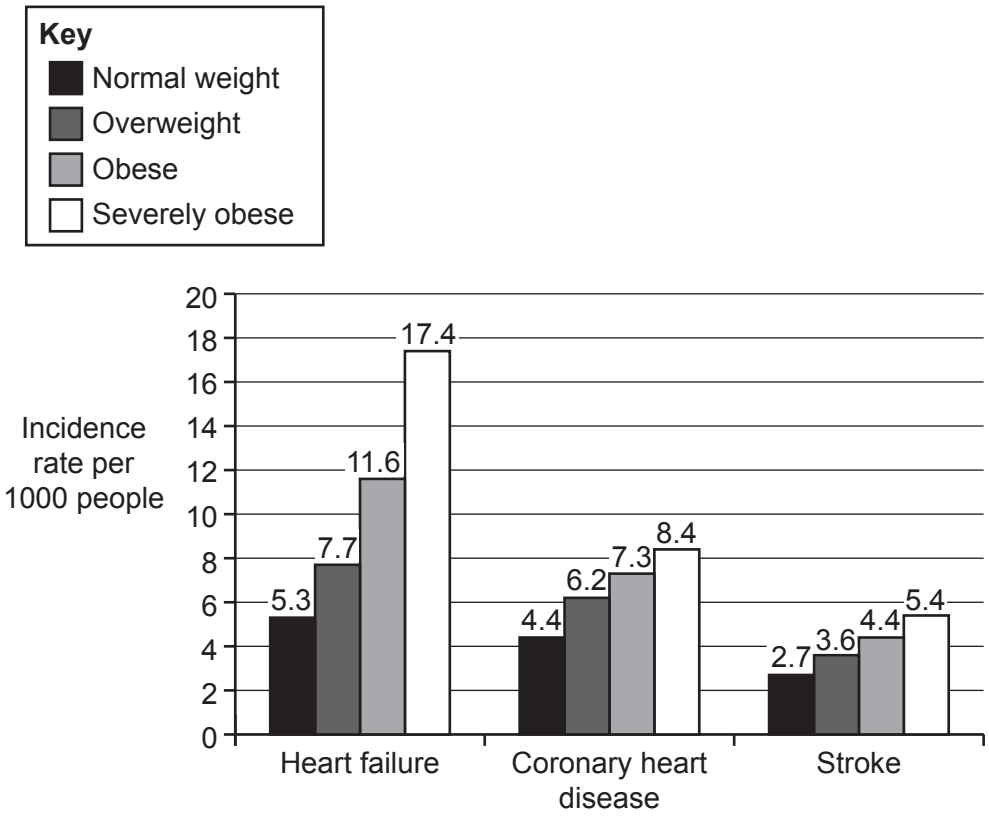
..... **[1]**

4 The graph shows the effect of weight on the incidence rate of heart failure, coronary heart disease and stroke per 1000 people.



(a) Identify **one** trend shown by the data in the graph.

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

(b) Health checks are carried out by the NHS when individuals turn 40. These health checks help health professionals to find out who is at greater risk of cardiovascular disease.

The table shows some of the questions asked at the health check and the answers provided by two patients.

Question	Patient 1	Patient 2
Do you smoke?	Yes	Yes
How many units of alcohol do you drink per week?	4	20
What word describes your weight?	Normal	Obese
Do you have a family history of heart disease?	No	Yes, my father has had a heart attack.

Suggest which patient is at a **higher** risk of cardiovascular disease.

Use the table to support your answer.

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..... **[3]**

(c) Write down **one** additional question that the health professional could ask the patients to help assess their risk of cardiovascular disease.

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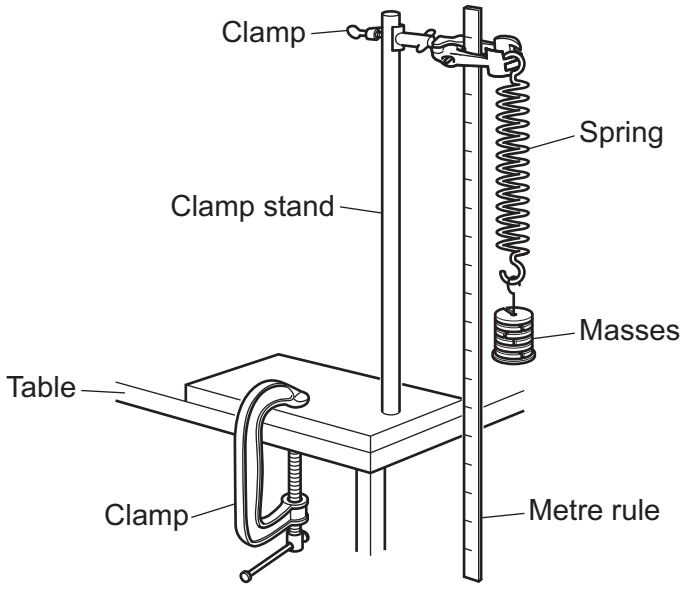
..... **[1]**

5 **(a)** Ling is investigating the extension of a spring, using the equipment shown in the diagram.



(i) Describe how Ling can use this equipment to observe the effect of forces on the extension of the spring.

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..... **[3]**

(ii) Ling suggests five ways of improving the accuracy of her results.

Which **two** suggestions will increase the accuracy of her results?

Tick (✓) **two** boxes.

Attach a pointer to the bottom of the spring to help read the measurement on the metre rule. ☐

Ask another student to complete the same experiment. ☐

Take the reading as soon as the mass is placed on the spring. ☐

Use a balance to check the exact mass applied to the spring. ☐

Repeat the experiment three times. ☐

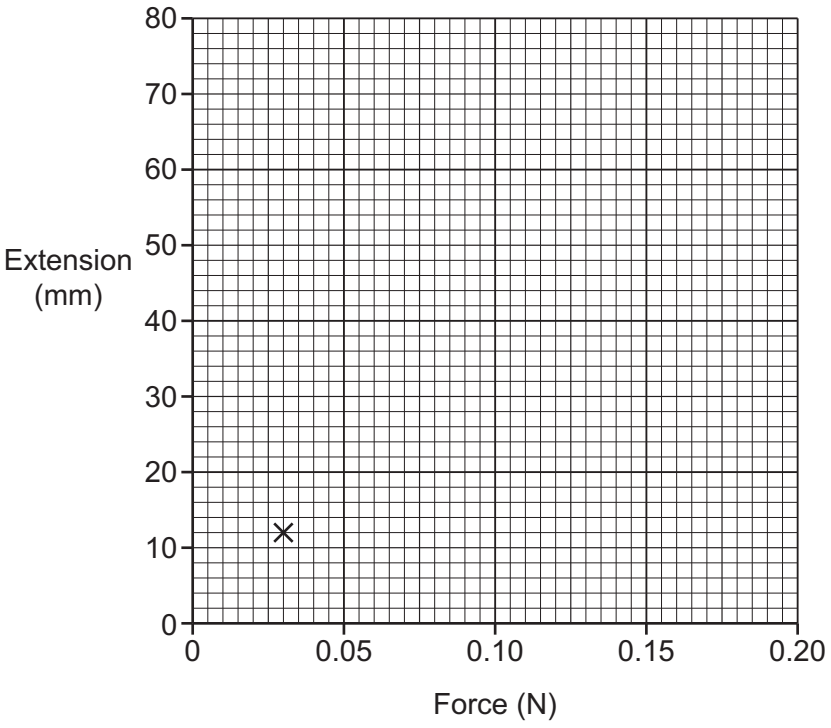
[2]

(b) The table shows Ling's results.

Force (N)	Extension (mm)
0.03	12
0.06	24
0.09	38
0.12	52
0.15	64
0.18	76

(i) Plot a graph, using the data in the table. One point has been done for you.

Draw a line of best fit. **[2]**



(ii) Which statement describes the relationship between the force on the spring and the extension of the spring?

Tick (✓) **one** box.

As the force increases, the extension decreases. ☐

As the force increases, the extension increases. ☐

There is no relationship between extension and force. ☐

[1]

6 The Amazon rainforest is an area of very high biodiversity.

The table shows data on **four** species groups found in the Amazon rainforest.

	Number of different species in different areas	
Species groups	**Rainforest with no human activity**	**Rainforest that has been deforested**
Mammals	667	12
Birds	1604	30
Reptiles	749	8
Plants	30 000	20

(a)* Explain the effect of human activity on species found in the Amazon rainforest.

Use data in the table to support your answer.

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..... **[6]**

(b) Which **two** statements are benefits of maintaining biodiversity in the Amazon rainforest?

Tick (✓) **two** boxes.

It prevents rainforest species from becoming extinct. ☐

More wood can be cut down and sold to other countries. ☐

The rainforest ecosystem is less resistant to change. ☐

More of the rainforest is available for farming. ☐

Rainforest plants could be a source of new medicines. ☐

[2]

7 **(a)** Krypton is a Group 0 element.

Which **two** statements are properties of krypton?

Tick (✓) **two** boxes.

It forms positive ions when reacting. ☐

It is a gas at room temperature. ☐

It is a liquid at room temperature. ☐

It has a low melting point. ☐

It reacts with Group 1 elements. ☐

It reacts with water. ☐

[2]

(b) The table shows some properties of the Group 1 elements.

Complete the table by predicting the reaction of caesium with water, and the melting point of rubidium.

Group 1 element	Reaction with water	Melting point (°C)
Lithium	slow fizzing	181
Sodium	melts, rapid fizzing	98
Potassium	melts, burns and pops	64
Rubidium	explosive	.....
Caesium	.....	29

[2]

(c) Potassium reacts with oxygen to form potassium oxide, K_2O.

Calculate the relative formula mass of potassium oxide.

Use the Data Sheet.

Relative formula mass of potassium oxide = ... **[3]**

(d) Sodium has an atomic number of 11 and a relative atomic mass of 23.

Complete the table to show the number of protons, neutrons and electrons in a sodium **ion**, Na^+.

Number of protons	.....
Number of neutrons	.....
Number of electrons	.....

[2]

(e) Which scientist developed the Periodic Table?

Tick (✓) **one** box.

Dalton ☐

Thomson ☐

Mendeleev ☐

Rutherford ☐

[1]

8 Beth plans an investigation to help her estimate the population of buttercup plants in her garden.

(a) This is part of Beth's method:

1. Divide the garden into four equal sections.
2. Count the number of buttercup plants in the section that has the most buttercup plants.
3. Multiply the number of buttercup plants counted by four.

Describe how Beth could improve her method.

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[4]

(b) Beth thinks three factors are having an effect on the growth of buttercup plants in her garden.

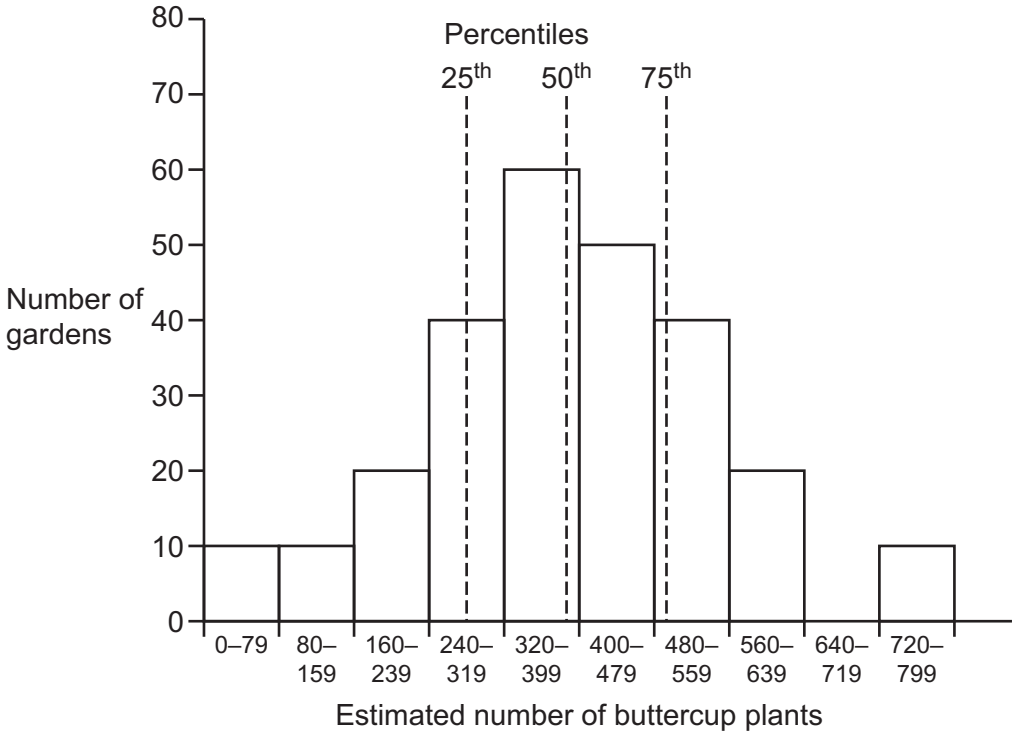
Draw lines to connect each factor with the correct explanation of its effect on buttercup plants.

Factor	**Explanation of its effect on buttercup plants**
Shade from trees	Less sunlight is available for photosynthesis
Waterlogged soil	Fewer leaves to absorb light
More slugs to eat plants	Less oxygen is available for respiration in root cells

[2]

(c) A group of students plot the estimated number of buttercup plants in their gardens.

The graph shows the students' results.



(i) How many gardens are sampled to produce the graph?

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

(ii) Kai estimates that he has 450 buttercup plants in his garden.

Which percentile of the students' data does Kai's estimation lie below?

Put a (ring) around the correct answer.

25th **50th** **75th** **[1]**

9 **(a)** Sea water is a solution of salts in water.

James has three sets of equipment. They are shown in **Fig. 9.1**.

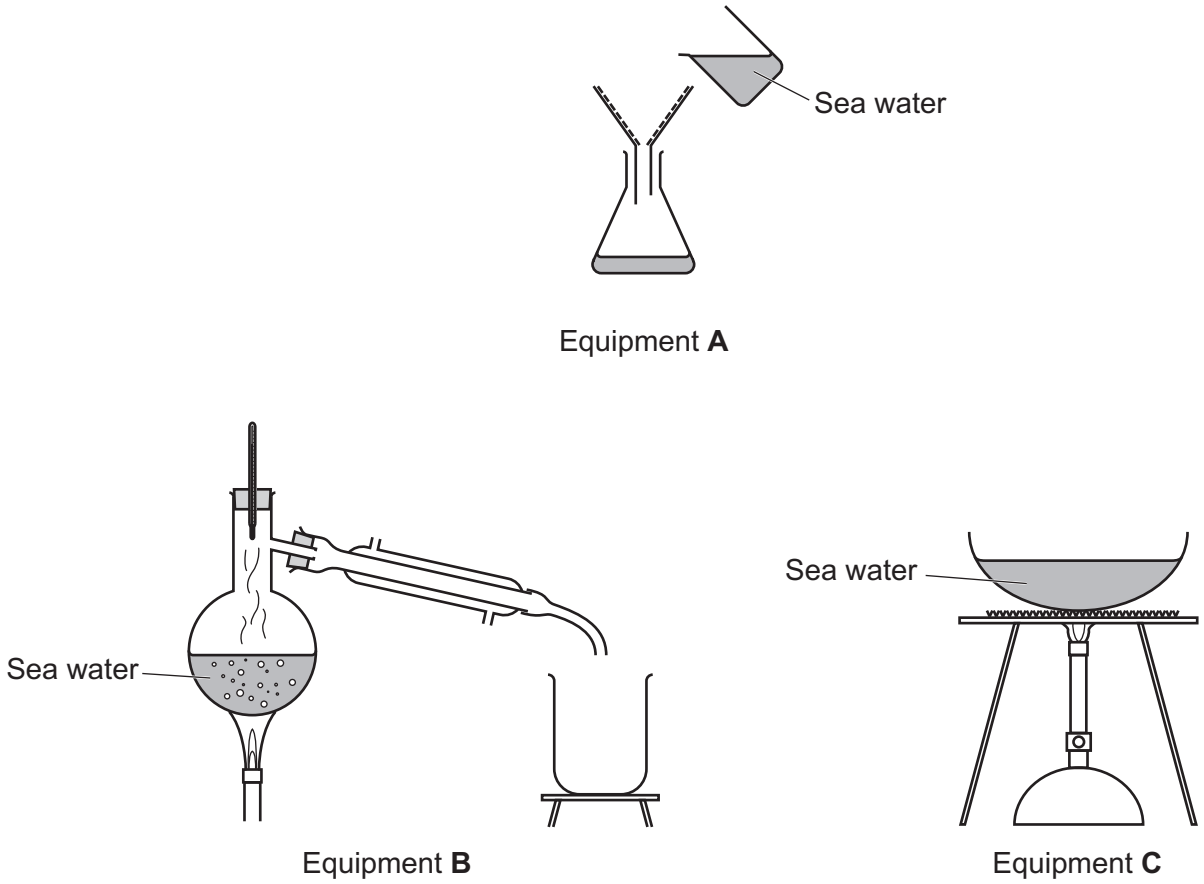


Fig. 9.1

Explain which set of equipment James should use to separate and collect **water** from sea water.

Include in your answer why the other sets of equipment are unsuitable.

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..... **[3]**

(b) Crude oil is a mixture of hydrocarbons. The mixture can be separated into fractions.

The table shows the number of carbon atoms in the hydrocarbon chains of three fractions of crude oil.

Fraction	Number of carbon atoms in hydrocarbon chains
Diesel oil	16–20
Kerosene	10–16
Petrol	5–8

Fractional distillation is used to separate the different fractions of crude oil.

(i) Complete **Fig. 9.2** to show where the three fractions **diesel oil**, **kerosene** and **petrol** would be collected in the fractionating tower.

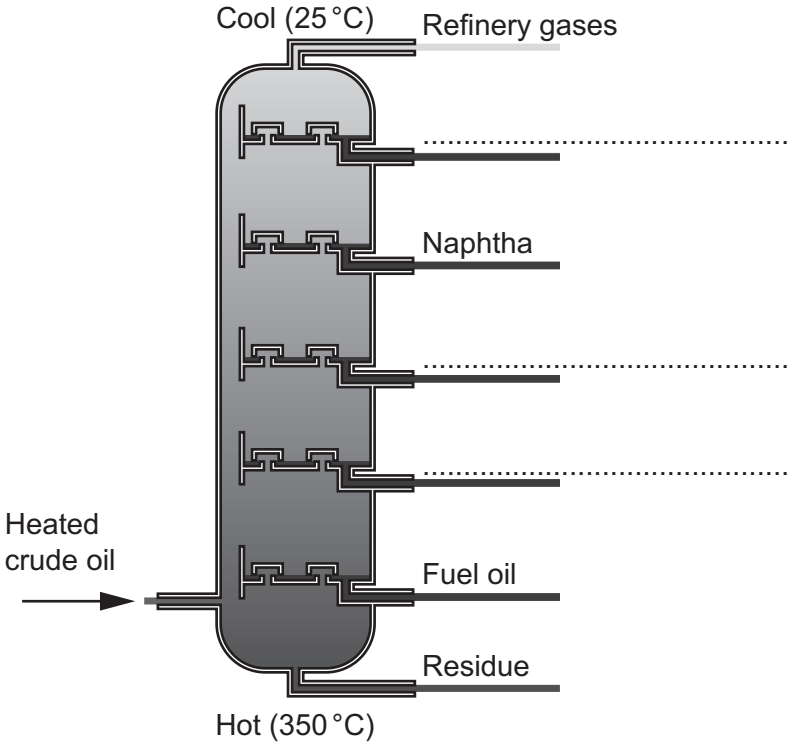

Fig. 9.2 **[2]**

(ii) Explain why naphtha is collected above fuel oil in the fractionating tower.

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

END OF QUESTION PAPER

ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).