Name	Date started	Target end date

REVISE
.wales

3.25 — Histograms with unequal class widths

Spec 4.2.20 — Unit 3 (calculator allowed)

When class widths differ, bar height should reflect frequency density, not frequency. Build histograms with unequal class widths, read frequencies as areas, and compare distributions on the same scale. Sourced from legacy WJEC GCSE Mathematics and Mathematics-Numeracy papers, organised for revision under the 2025 spec.

2025 SPECIFICATION

Estimated time for entire question pack: ~1 hours 28 minutes

*Derived from the GCSE Higher pace of **~1.5 min/mark** (59 marks across 10 questions).*

*You are advised to **not** attempt to complete all of this in one sitting.*

ABOUT THIS QUESTION PACK

This is a **focused single-topic practice pack**, not a single mock paper. Questions are organised against the 2025 specification. Questions are ordered chronologically by sitting, with custom-written and SAM questions at the end.

INSTRUCTIONS

Use black ink or black ball-point pen. Show all working — method marks are awarded for clear setup.

A calculator is allowed on every question in this pack (Unit 3 is the calculator-allowed paper).

Histograms with unequal class widths — what the new spec asks

WJEC GCSE Mathematics (first teaching 2025) · Unit 3: calculator-allowed.

Histograms with unequal class widths 4.2.20

- Calculate frequency density as $\text{frequency} \div \text{class width}$.
- Plot a histogram with frequency density on the y-axis and no gaps between bars.
- Read frequencies as areas: $\text{frequency} = \text{frequency density} \times \text{class width}$.
- Estimate proportions, totals and the mean from a histogram, assuming a uniform spread within each class.

Crib sheet »

Histograms with unequal class widths in one page

Quick-reference notes — revisit before each question. Don't use during the questions.

Frequency density

$$\text{frequency density} = \frac{\text{frequency}}{\text{class width}}$$

This is the height of each bar.

The y-axis is *frequency density*, never frequency.

Area = frequency

For each bar:

$$\text{frequency} = \text{frequency density} \times \text{class width}$$

i.e. the *area* of the bar equals the frequency in that class.

The total area of the histogram = total frequency n.

Why frequency density?

If class widths differ, plotting frequency directly makes wide classes look artificially 'tall' in count.

Frequency density rescales so equal areas mean equal frequencies — comparisons are fair.

Building a histogram

1. Compute the width of each class.
2. Divide frequency by width to get frequency density.
3. Draw bars of that height across each class interval — *no gaps* between bars.

Reading frequencies from a histogram

To find the frequency of a class:

frequency = bar height $\times$ bar width.

To find the frequency in a partial range (e.g. the lower half of a bar), use proportions of area — assume the data is spread uniformly within the class.

Estimating totals

Total number of values = sum of all bar areas.

This is the histogram's equivalent of $\sum f$ from a frequency table.

Often used to find an unknown frequency given the total.

Estimating proportions

Proportion in a range = (area of bars in that range) $\div$ (total area).

Useful for 'what percentage of values lie above v?' type questions.

Assume uniform spread within a class when cutting a bar.

Estimating the mean from a histogram

Read frequencies as areas, take midpoints of each class as x, then:

$$\bar{x} = \frac{\sum fx}{\sum f}$$

Same formula as for a grouped frequency table.

Common traps

- Plotting frequency on the y-axis instead of frequency density.
- Forgetting to divide by the class width when widths are unequal.
- Treating bar *height* as the frequency — it's the area that counts.
- Reading a partial bar without scaling by width.

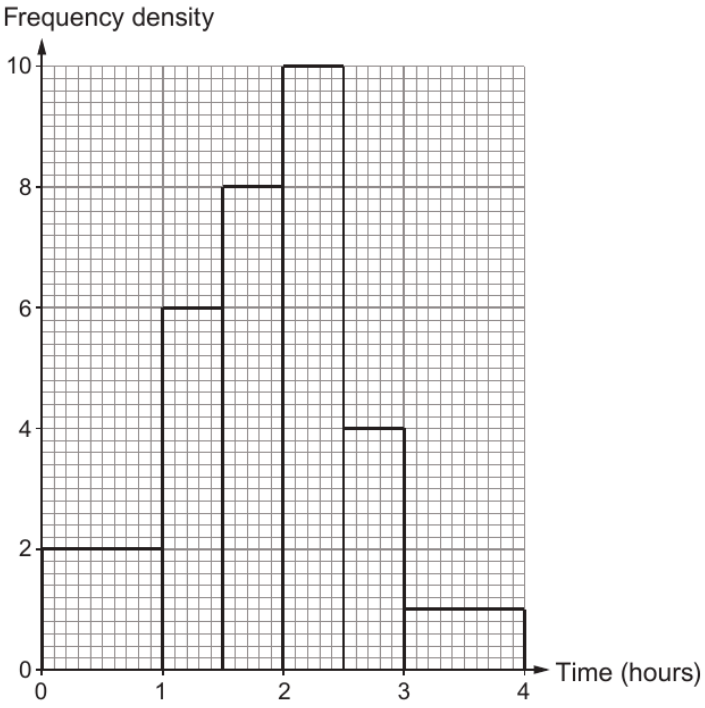
Examiner only

8. The *Big Fish Cymru* annual fishing competition is held on the west coast of Wales.

Information about **last year's** competition is displayed in the *Big Fish Cymru* booklet. A section of this booklet is shown below.

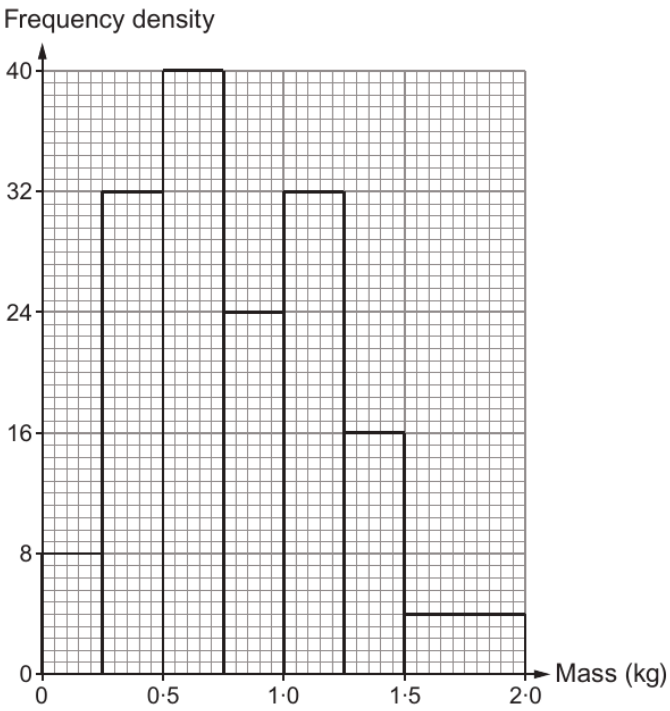
The competition organisers recorded the time taken for **each** angler to catch their **first** fish.

This is shown in the histogram on the right.



The competition organisers also recorded the mass of every fish caught.

This is shown in the histogram on the right.



Examiner only

(a) Last year, how many of the fish caught had a mass of less than 250 g? [1]

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(b) Last year, the final angler to catch their first fish did so after $3\frac{1}{2}$ hours.

How many **other** anglers took more than 3 hours to catch their first fish? [1]

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(c) The number of anglers taking part this year was three times as many as took part last year.
How many anglers took part in the competition this year? [4]

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Number of anglers this year was .....

(d) The median mass of the fish caught this year was 0·9 kg.

What is the difference, in kg, between the median mass of the fish caught this year and the median mass of the fish caught last year? [5]

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Difference in mass is ..... kg

Examiner only

(e) Approximately 10% of the anglers this year caught their first fish within 1 hour.

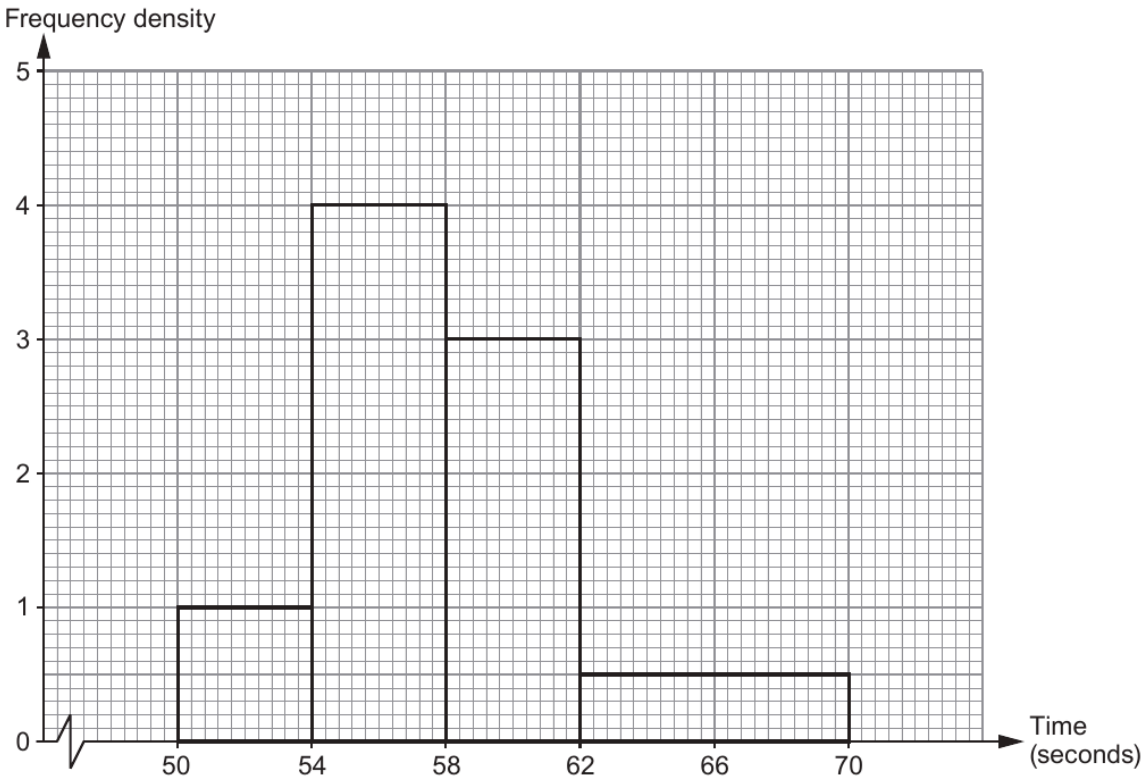
(i) How does this percentage compare with last year's percentage?
You must show all your working. [3]

(ii) Do you think it is fair to compare last year's competition results with this year's competition results?
You must give a reason for your answer. [1]

Examiner only

9. The time taken to run 400 m was recorded for each member of a running club.

(a) A histogram of the results for the members who are under 30 years of age is shown below.



(i) Calculate how many members of the running club are under 30 years of age. [2]

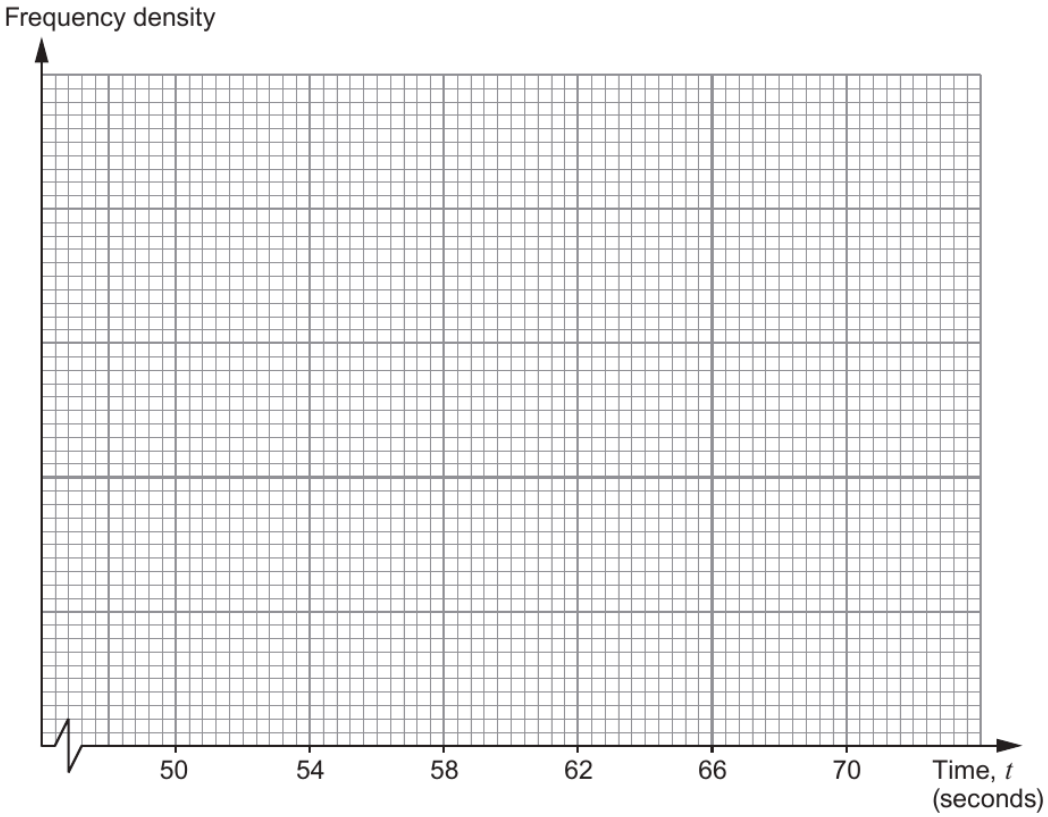
(ii) Calculate an estimate of the median time taken by the under-30s to run 400 m. [4]

Examiner only

(b) The frequency table below shows the results for the members who are 30 years of age or over.

Time, t (seconds)	$50 < t \leqslant 54$	$54 < t \leqslant 58$	$58 < t \leqslant 60$	$60 < t \leqslant 62$	$62 < t \leqslant 70$
Number of people	4	10	16	18	12
Frequency density					

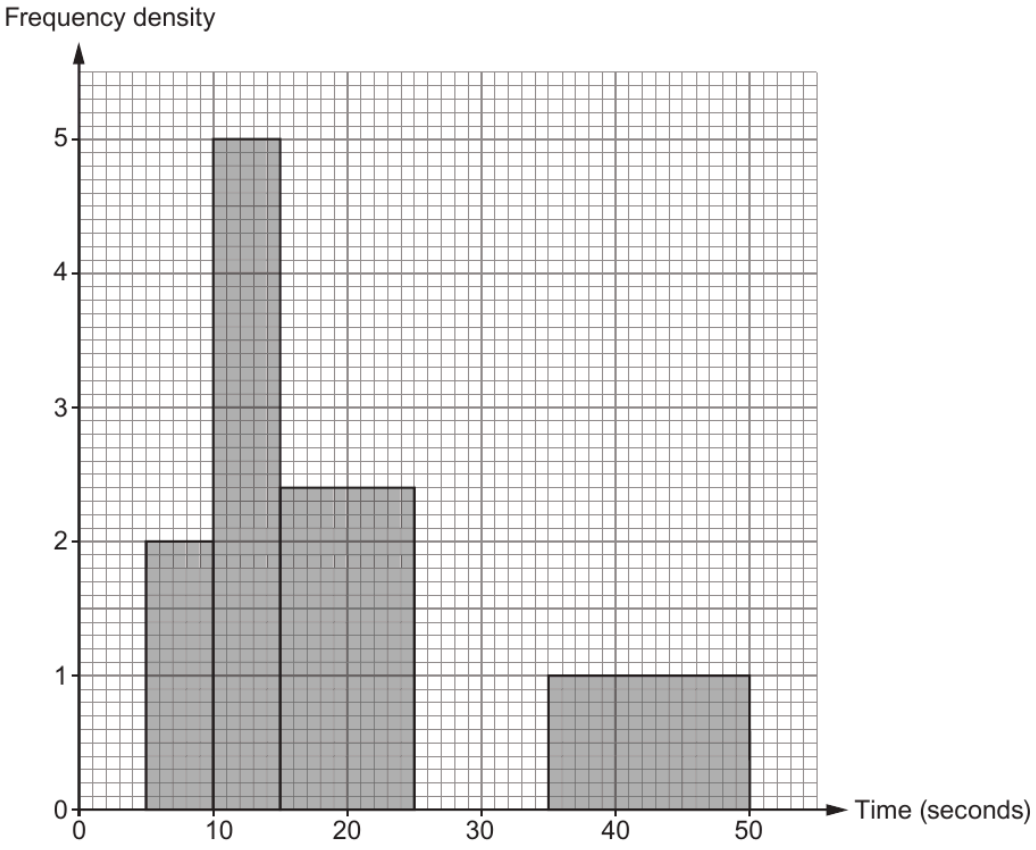
Complete the table, and draw a histogram to illustrate this data on the graph paper below. [4]



(c) On average, which of the two groups was faster at running 400 m?
Give a reason for your answer.
Your reason must be based on your interpretation of the histograms. [1]

Examiner only

7. The times taken by a group of pupils to answer a numeracy question were recorded. The histogram below shows some of the results.



(a) The remaining 16 pupils took between 25 and 35 seconds to answer the question. Complete the histogram. [1]

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(b) What is the greatest possible range of times taken by the pupils to answer the question? Circle your answer. [1]

50 seconds 4 seconds 40 seconds 45 seconds 35 seconds

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Examiner only

(c) Calculate the total number of pupils that were in the group. [2]

(d) Gareth was one of the pupils in the group.
He says,

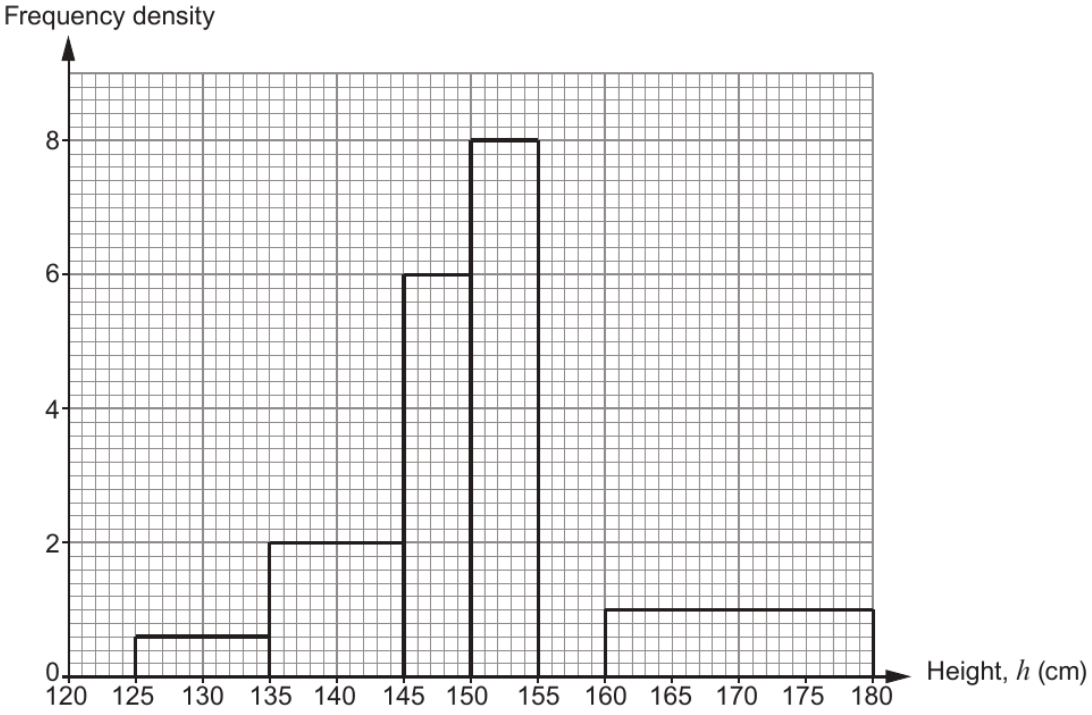
"The time I took to answer the question was 18 seconds. This means I was in the fastest 50% of the pupils."

(i) Explain how Gareth's statement could be true.
You must use calculations to justify your answer. [3]

(ii) Explain how Gareth's statement could be false. [1]

Examiner only

13. The heights of all the Year 11 girls at a school were measured.
Nia has started to draw a histogram of the results.



(a) There were 24 girls in Year 11 whose heights were in the group $155 < h \leqslant 160$ cm.
Use this information to complete Nia's histogram. [2]

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Examiner only

(b) Nia has started to do some data analysis on the heights of the Year 11 girls.
She has estimated the median and the upper quartile, as shown in the table below.

Lower quartile	Median	Upper quartile
.....	151·75 cm	156·875 cm

Use the histogram to calculate an estimate of the lower quartile of the heights of the Year 11 girls. [6]

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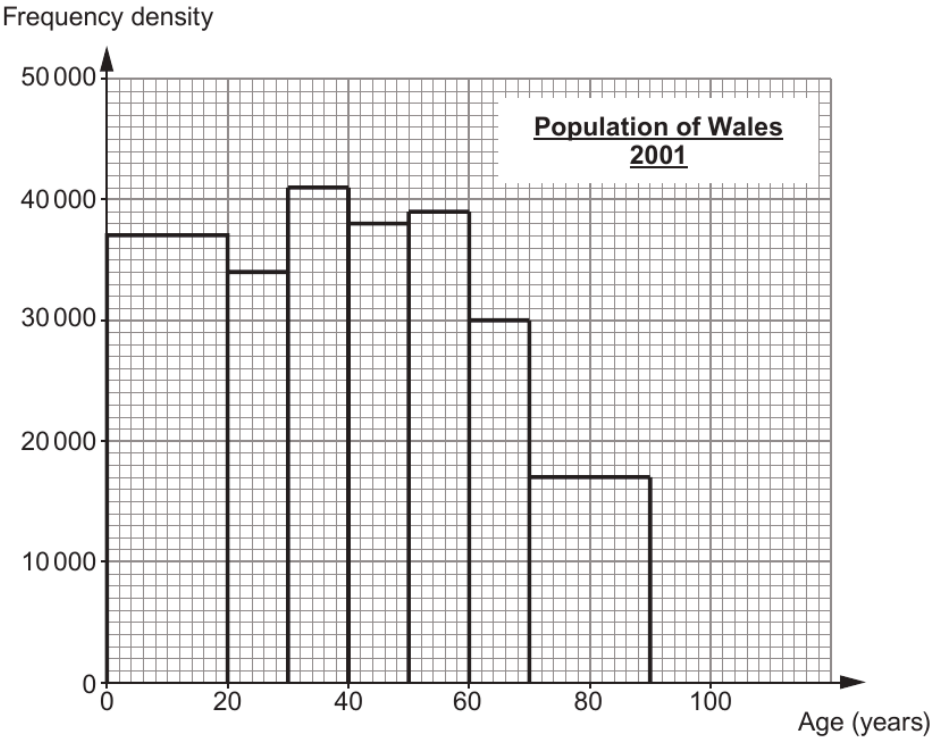
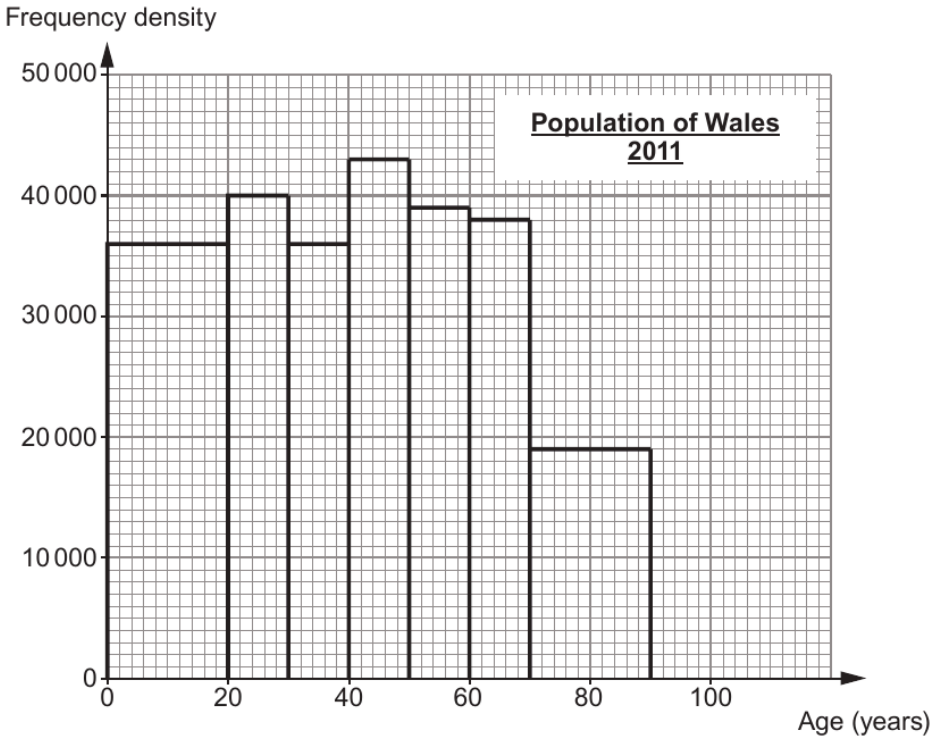
Examiner only

7. Danielle is studying the growth of the population of Wales.
She used the 2001 and 2011 Census data to draw these histograms.





Examiner only

(a) Use Danielle's histograms to answer the following questions:

(i) Circle the earliest decade in which anyone included in the histograms could have been born. [1]

1890–1899 1900–1909 1910–1919 1920–1929 1930–1939

(ii) From Danielle's histogram, the population of under-50s in Wales was 1 870 000 in 2001.
Calculate the **increase** in the population of under-50s in Wales from 2001 to 2011. [3]

(iii) The 60 to 69-year-olds saw the biggest increase in population from 2001 to 2011.
Calculate the **percentage** increase in the number of 60 to 69-year-olds from 2001 to 2011.
Give your answer to the nearest whole number. [3]

Examiner only

(b)

Age group	Population in 2001	Population in 2011
90 and over	19300	25200

The data in this table was also available to Danielle.
Explain why Danielle did not include this data in her histograms. [1]

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(c) The number of 40 to 49-year-olds in 2011 was different to the number of 30 to 39-year-olds in 2001.
Give a full explanation for what could have caused this. [1]

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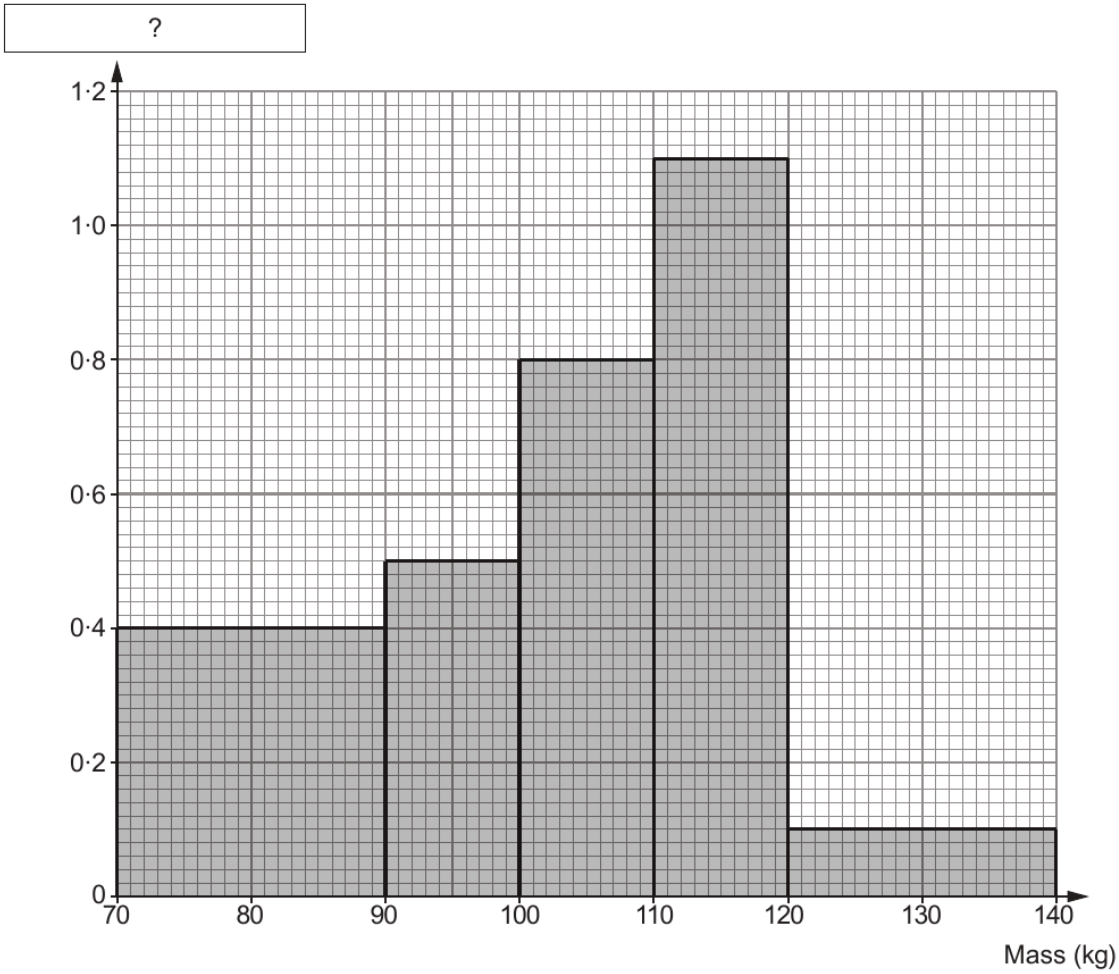
Examiner only

7. The masses of the players in the men's 2017-2018 Wales rugby squad are shown in the histogram below.
The squad consisted of 34 players.



(a) The label is missing on the vertical axis. What should the label be?
Circle your answer. [1]

Frequency Number of players Density

Cumulative frequency Frequency density

Examiner only

(b) Ben says,

"The histogram shows that the mass of the heaviest member of the squad was double the mass of the lightest member of the squad."

Is Ben correct?

Yes ☐ No ☐ You cannot tell ☐

You must give a reason for your choice. [1]

Reason: .....

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(c) The *Forwards* were the heaviest players in the squad.
The lightest *Forward* had a mass of 104 kg.
Calculate the **maximum** possible number of *Forwards* there could have been in the squad.
You must show all your working. [3]

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(d) To make a comparison with other teams, the coach wanted to know the mean mass of all the players in the squad.
Use the histogram to calculate an estimate of the mean mass of all the players in the squad. [5]

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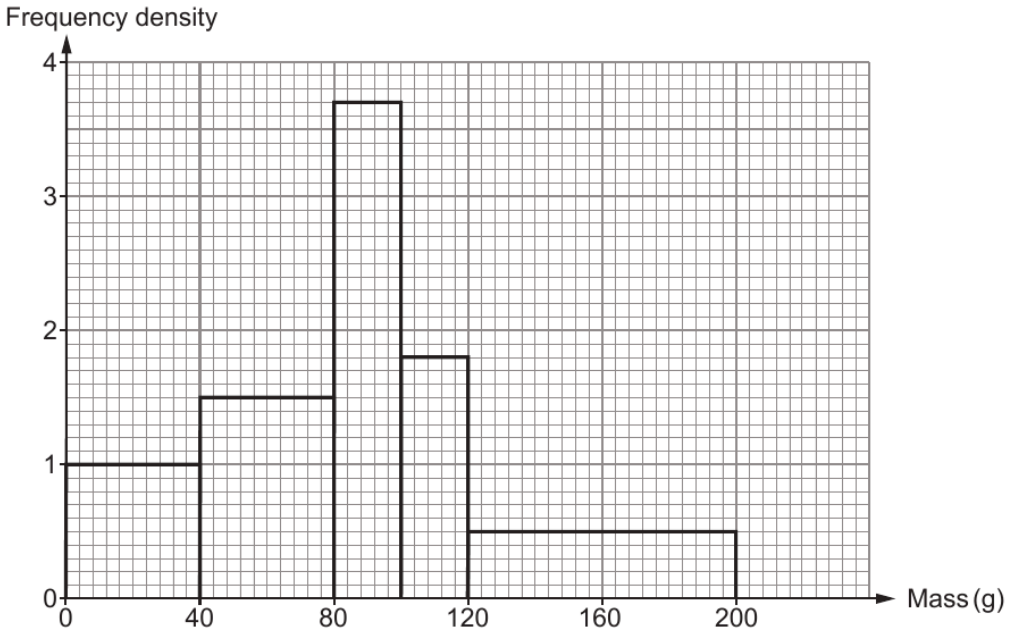
Examiner only

5. Madeleine is researching the effects of waves. She does this at two different beaches, Llanddawel and Abertig.
She measures the masses of pebbles in a sample taken from each beach.

(a) Look at the histogram below. It shows the masses of the pebbles in the sample taken from Llanddawel beach.

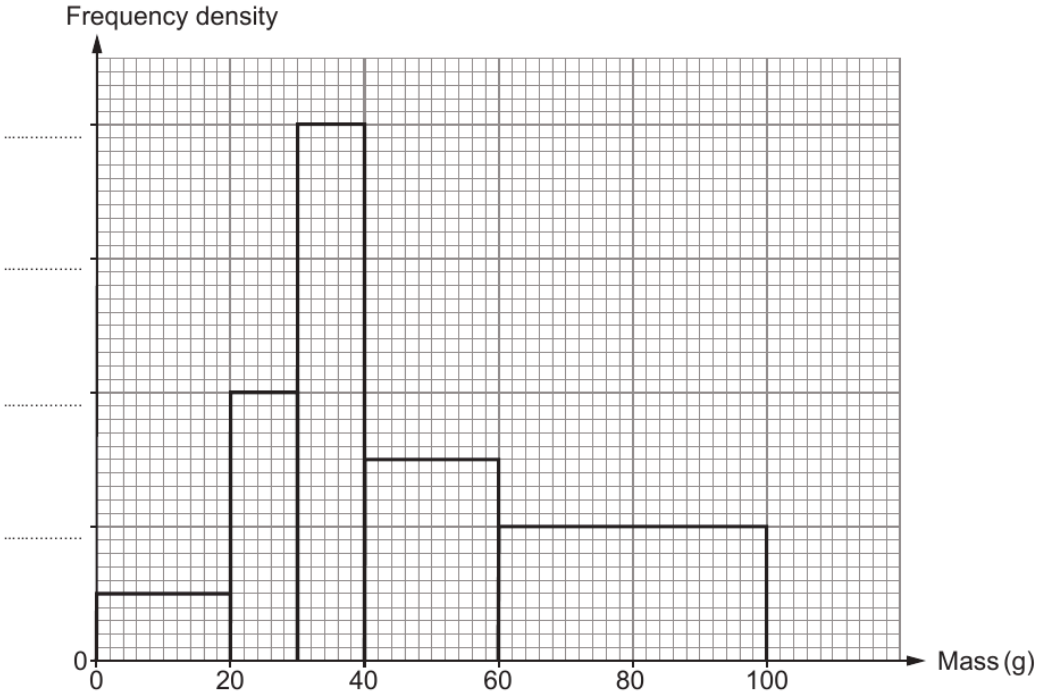


Calculate an estimate for the percentage of pebbles in Madeleine's sample that had a mass of less than 70 g. [5]

Examiner only

(b) Look at the histogram below. It shows the masses of the pebbles in the sample taken from Abertig beach.

The scale on the vertical axis is missing.



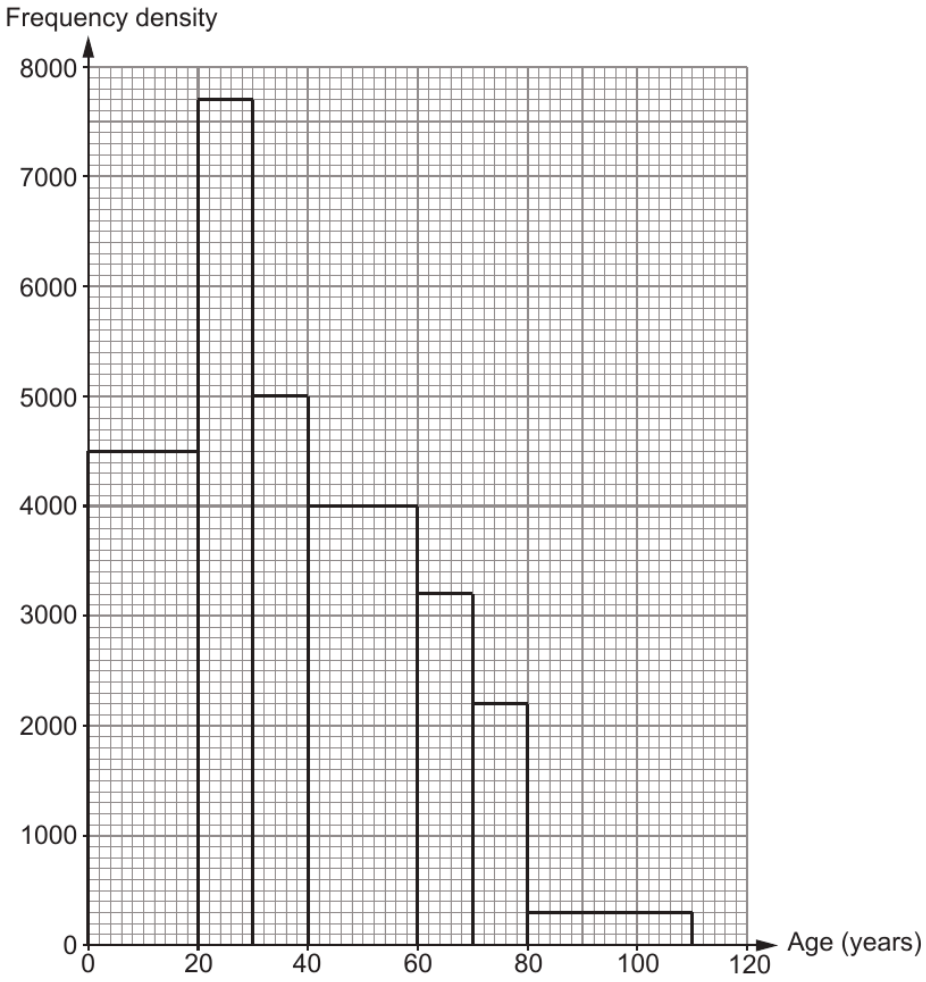
(i) 120 pebbles each had a mass of less than 30 g.
Use this fact to complete the frequency density axis above. [2]

(ii) What was the median mass of the pebbles in the sample taken from Abertig beach?
Circle your answer. [1]

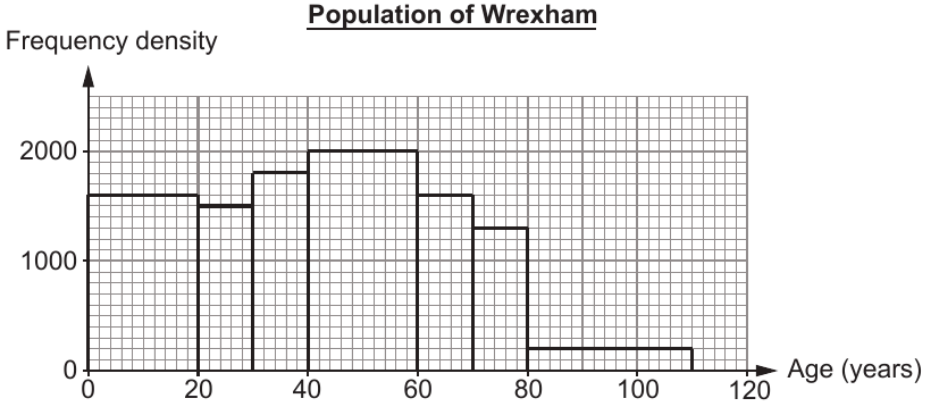
30 g 40 g 45 g 50 g 50·5 g

10. Anisa is comparing the ages of the populations of Cardiff and Wrexham in July 2019. She has used published data to draw these two histograms.

Population of Cardiff



Population of Wrexham



Examiner only

(a) In July 2019, the biggest difference between the populations of Cardiff and Wrexham was in the number of 20- to 30-year-olds.
Calculate how many more 20- to 30-year-olds there were in Cardiff than there were in Wrexham. [2]

(b) Anisa has used her histograms to carry out data analysis.
Some of her results are shown in the table below.

	Cardiff	Wrexham
Total population (people)	360 000	140 000
Estimate of the median age (years)		42·5

Use Anisa's histogram to calculate an estimate of the median age of the population of Cardiff in July 2019. [4]

Examiner only

7. The headteacher of Ynysgorwen School wants to know how long it takes pupils to travel to school.
The results for a sample of 120 pupils are shown in the table below.

Time taken, t (minutes)	Frequency	Frequency density
$0 < t \leqslant 10$	34	3·4
$10 < t \leqslant 20$	40	.....
$20 < t \leqslant 35$	24	.....
$35 < t \leqslant 50$	18	.....
$50 < t \leqslant 70$	4	.....

(a) (i) Complete the frequency density column. [3]

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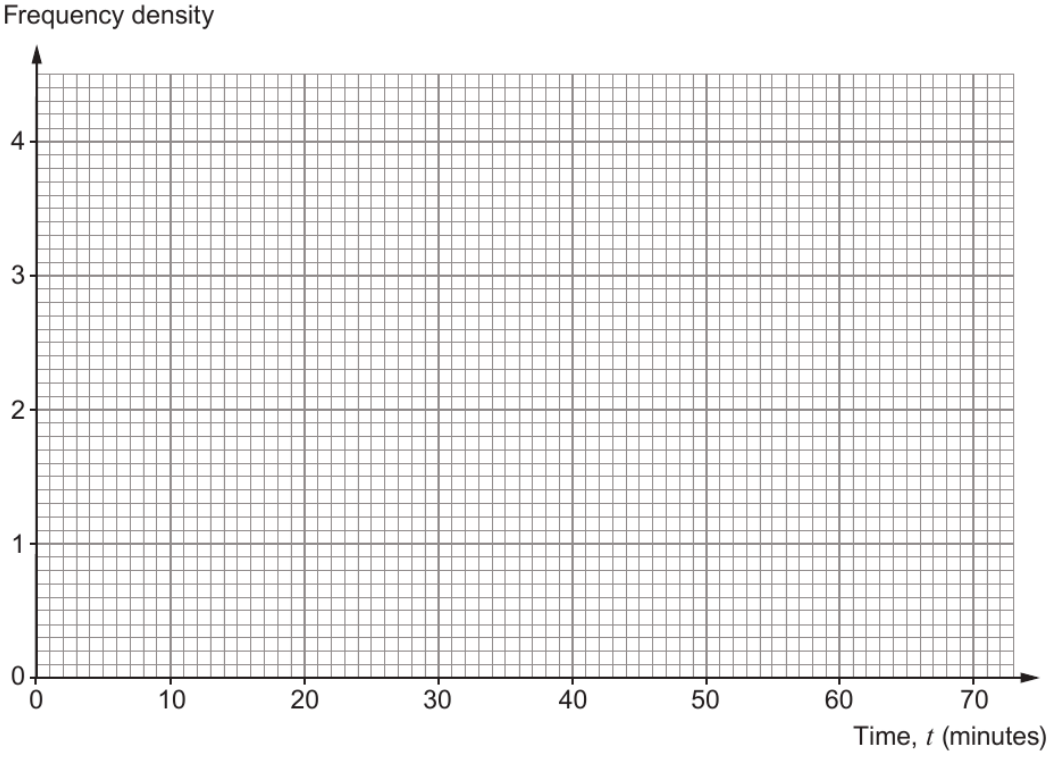
Examiner only

(ii) Draw a histogram to display this data. [2]

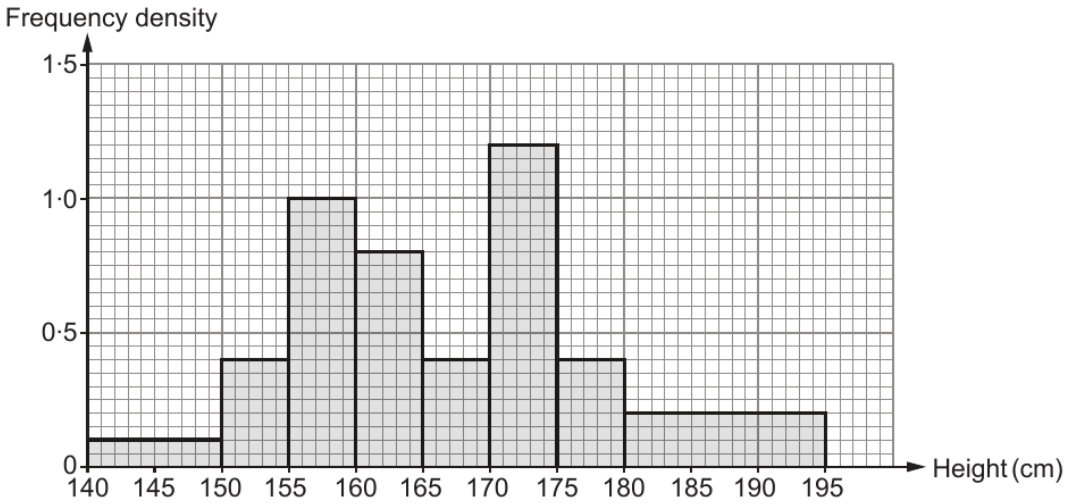


(b) (i) Calculate an estimate of the median travel time for the sample of pupils. [4]

(ii) What is the greatest possible median travel time for the sample of pupils? [1]

Examiner only

8. Nerys is a member of a junior athletics club.
She measured the heights, in centimetres, of all the 16-year-old girl athletes in the club.
Nerys drew the following histogram of the results.



(a) (i) Show that the number of 16-year-old girls in the athletics club is 25. [3]

(ii) The average height of a 16-year-old girl in the UK is 162·5 cm.
Calculate an estimate of the percentage of 16-year-old girls in the athletics club who are taller than 162·5 cm.
You must show all your working. [3]

Examiner only

(b) Grace is a member of the same junior athletics club.
She uses Nerys's histogram to draw a different histogram.
Grace uses the groups shown in the table below.

Height (cm)	Frequency	Frequency density
$140 \leqslant \text{height} < 155$	.....	.....
$155 \leqslant \text{height} < 165$	.....	.....
$165 \leqslant \text{height} < 175$	.....	.....
$175 \leqslant \text{height} < 195$	.....	.....

(i) Complete Grace's table. [2]

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(ii) Use the graph paper below to draw Grace's histogram. [2]