

Drawing Histograms

Solutions

For AQA GCSE Mathematics (8300) • Higher tier

Each question is shown in grey, followed by the working, one step per line. The final answer is in a box. *Marks* shows how the marks are usually given in the exam, and **Tip** points out a common mistake.

1 (2 marks)

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

- (a) A class $20 < t \leq 35$ has a frequency of 45
Work out the frequency density for this class.

$$\text{Class width} = 35 - 20 = 15$$

$$\text{Frequency density} = 45 \div 15 = 3$$

Answer: 3

- (b) A class $10 < x \leq 30$ has a frequency density of 2.5
Work out the frequency of this class.

Rearrange the formula: frequency = frequency density $\times$ class width

$$\text{Class width} = 30 - 10 = 20$$

$$\text{Frequency} = 2.5 \times 20 = 50$$

Answer: 50

2 (1 mark)

Explain why a histogram is used instead of a bar chart when the class widths are unequal.

In a histogram, the **area** of each bar represents the frequency.

So a wide class with a small frequency is not made to look bigger than it is.

In a bar chart, only the height shows the frequency, so wide classes would be misleading.

Answer: Area represents frequency

3 (5 marks)

The table shows the heights of 76 plants.

(a) Complete the frequency density column.

Frequency density = frequency $\div$ class width

$12 \div 10 = 1.2$, $18 \div 5 = 3.6$, $22 \div 5 = 4.4$, $16 \div 10 = 1.6$, $8 \div 20 = 0.4$

Height (h cm)	Frequency	Frequency density
$140 < h \leq 150$	12	1.2
$150 < h \leq 155$	18	3.6
$155 < h \leq 160$	22	4.4
$160 < h \leq 170$	16	1.6
$170 < h \leq 190$	8	0.4

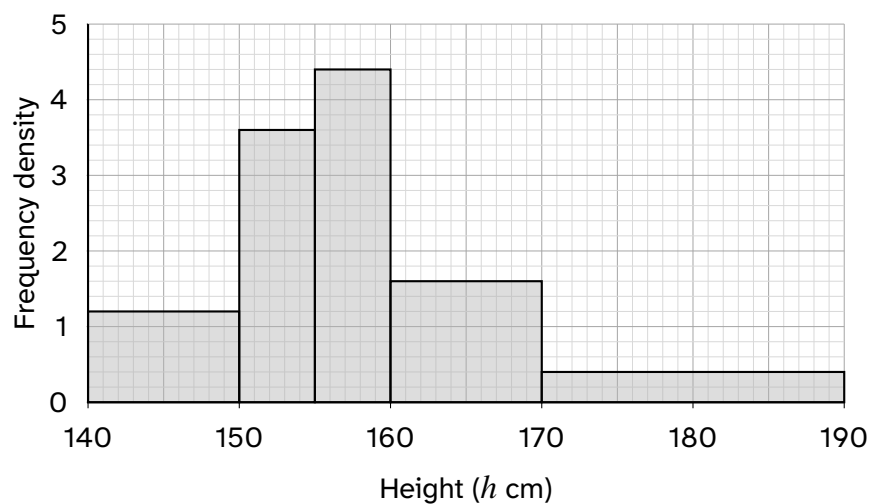
Answer: 1.2, 3.6, 4.4, 1.6, 0.4

Marks: 2 marks for all five correct. 1 mark for three correct.

(b) Draw a histogram to show this information.

Each bar goes across its whole class, with no gaps between bars.

The height of each bar is its frequency density from part (a).



Answer: See histogram

Tip: Plot frequency density, not frequency, on the vertical axis. Each small square is 0.2.

Marks: 3 marks for all five bars correct. 2 marks for four correct bars. 1 mark for two correct bars.

4 (7 marks)

The table shows information about the lengths of 120 fish caught in a lake.

Length, L (cm)	Frequency
$10 \leq L < 20$	12
$20 \leq L < 25$	18
$25 \leq L < 30$	26
$30 \leq L < 40$	36
$40 \leq L < 60$	28

(a) Work out an estimate of the mean length.

Midpoints: 15, 22.5, 27.5, 35, 50

Multiply each midpoint by its frequency:

$$15 \times 12 = 180, \quad 22.5 \times 18 = 405, \quad 27.5 \times 26 = 715$$

$$35 \times 36 = 1260, \quad 50 \times 28 = 1400$$

$$\text{Total} = 3960$$

$$\text{Mean} \approx 3960 \div 120 = 33$$

Answer: 33 cm

Tip: The classes have different widths, so find each midpoint carefully: $20 \leq L < 25$ has midpoint 22.5, and $40 \leq L < 60$ has midpoint 50.

Marks: 1 mark for at least three midpoint $\times$ frequency values. 1 mark for dividing the total by 120. 1 mark for 33.

(b) Draw a histogram to represent this information.

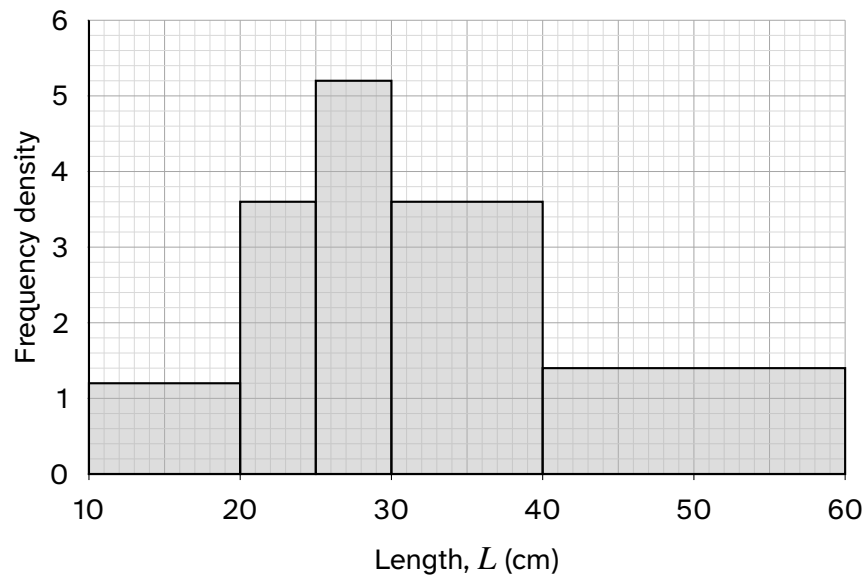
Class widths: 10, 5, 5, 10, 20

Frequency density = frequency $\div$ class width:

$$12 \div 10 = 1.2, \quad 18 \div 5 = 3.6, \quad 26 \div 5 = 5.2$$

$$36 \div 10 = 3.6, \quad 28 \div 20 = 1.4$$

The biggest frequency density is 5.2, so label the axis 0 to 6 (each small square is 0.2).



Answer: See histogram

Tip: Do not draw a bar chart of the frequencies. The $20 \leq L < 25$ and $25 \leq L < 30$ bars are only 5 cm wide, so they are taller than their frequencies suggest.

Marks: 1 mark for the class widths or two correct frequency densities. 1 mark for a correct scale on the frequency density axis. 2 marks for all five bars correct (1 mark for three).

5 (4 marks)

The histogram shows information about the time, t minutes, some commuters took to travel to work. The bar for $30 \leq t < 50$ is missing. No commuter took 50 minutes or more.

The number of commuters who took from 30 to 50 minutes is $\frac{2}{3}$ of the number who took from 15 to 30 minutes.

Complete the histogram.

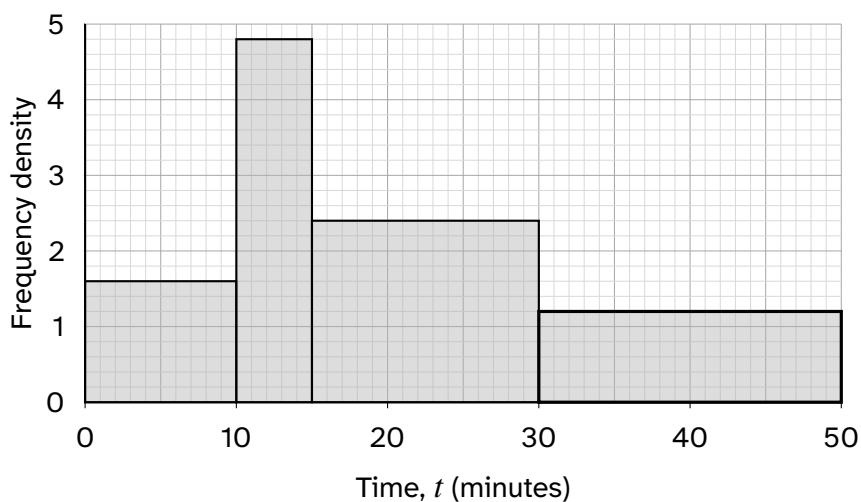
Frequency = class width $\times$ frequency density

$$15 \leq t < 30: 15 \times 2.4 = 36 \text{ commuters}$$

$$\frac{2}{3} \text{ of } 36 = 24 \text{ commuters took from 30 to 50 minutes.}$$

The class $30 \leq t < 50$ is 20 minutes wide.

$$\text{Frequency density} = 24 \div 20 = 1.2$$



Answer: Bar from 30 to 50 with frequency density 1.2 (24 commuters)

Tip: The bar heights are frequency densities, not frequencies. Multiply by the class width first, then divide by the new class width (20) at the end.

Marks: 1 mark for $15 \times 2.4 = 36$. 1 mark for 24. 1 mark for $24 \div 20$. 1 mark for the correct bar.

6 (5 marks)

The incomplete table and histogram show information about the masses, m kg, of the pumpkins sold at a farm shop one day.

- (a) Use the histogram to complete the table.
Use the table to complete the histogram.

Frequency = class width $\times$ frequency density

$$1 < m \leq 2: 1 \times 22 = 22$$

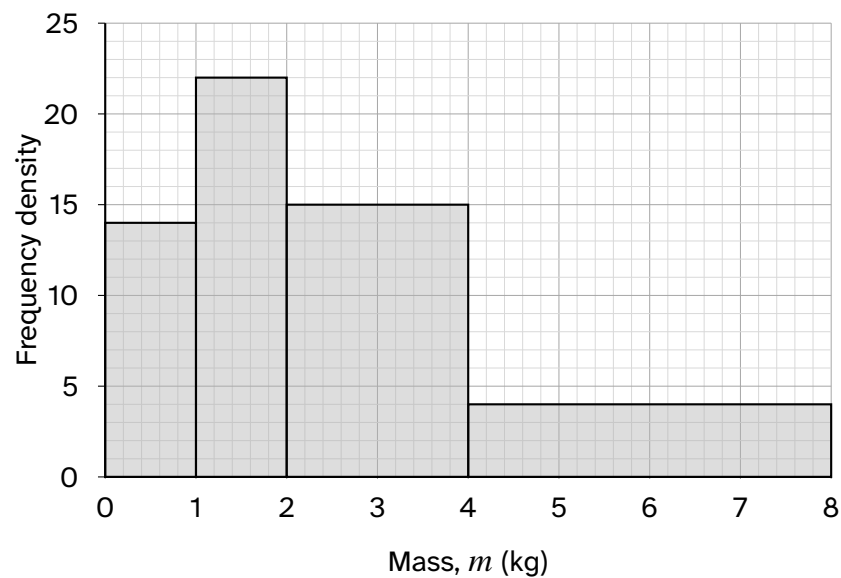
$$4 < m \leq 8: 4 \times 4 = 16$$

Frequency density = frequency $\div$ class width

$$0 < m \leq 1: 14 \div 1 = 14$$

$$2 < m \leq 4: 30 \div 2 = 15$$

Mass, m (kg)	Frequency
$0 < m \leq 1$	14
$1 < m \leq 2$	22
$2 < m \leq 4$	30
$4 < m \leq 8$	16



Answer: Table: 22 and 16. Bars of height 14 (0 to 1) and 15 (2 to 4)

Marks: 1 mark for 22 and 16 in the table. 1 mark for one correct bar. 1 mark for both bars correct.

- (b) Work out an estimate for the number of pumpkins with a mass greater than 3 kg.

$3 < m \leq 4$ is half of the class $2 < m \leq 4$, so estimate $30 \div 2 = 15$ pumpkins.

All 16 pumpkins in $4 < m \leq 8$ are heavier than 3 kg.

$$\text{Estimate} = 15 + 16 = 31$$

Answer: 31

Tip: Assume the pumpkins are spread evenly through a class, so half of the $2 < m \leq 4$ class is above 3 kg.

Marks: 1 mark for 15 (half of 30). 1 mark for 31.
