

Interpreting Histograms

Solutions

For Pearson Edexcel GCSE Mathematics (1MA1) • 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 (4 marks)

The histogram shows information about the times, in seconds, that some children took to swim one length of a pool. 12 children took between 40 seconds and 45 seconds.

(a) Work out the total number of children.

The axis has no scale, so use areas. Count small squares (each is 1 second wide).

40 to 45 seconds: $5 \times 24 = 120$ squares for 12 children.

So $120 \div 12 = 10$ squares represent 1 child.

Areas of all the bars: $10 \times 4 = 40$, $10 \times 12 = 120$, $5 \times 24 = 120$, $5 \times 16 = 80$,
 $20 \times 2 = 40$

Total area = 400 squares

$400 \div 10 = 40$ children

Answer: 40

Tip: Use the bar you know the frequency of to find what one square is worth. Compare areas, not heights.

Marks: 1 mark for the scale (e.g. 10 squares per child) or the total area 400. 1 mark for 40.

(b) Children who took less than 35 seconds get a badge.

Work out an estimate for the number of children who get a badge.

Less than 35 seconds: the first bar and half of the second bar.

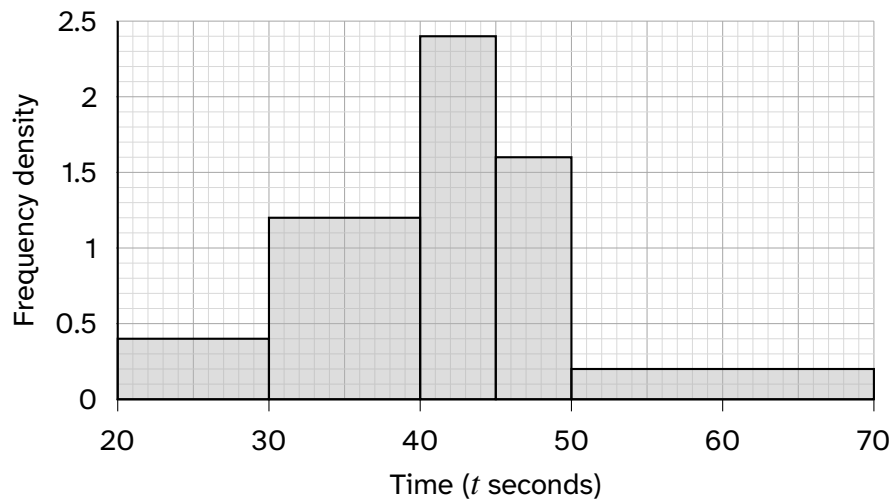
20 to 30 seconds: 40 squares

30 to 35 seconds: $5 \times 12 = 60$ squares

$40 + 60 = 100$ squares

$$100 \div 10 = 10 \text{ children}$$

For reference, here is the histogram with its scale. The 40 to 45 second bar has frequency density $12 \div 5 = 2.4$.



Answer: 10

Tip: Only use the part of the second bar from 30 to 35 seconds (width 5), not the whole bar.

Marks: 1 mark for $40 + 60$ squares (or $4 + 6$ children). 1 mark for 10.

2 (4 marks)

The histogram shows information about the masses, in grams, of some strawberries.

(a) Complete the frequency table for this information.

Frequency = frequency density $\times$ class width

Check with the first class: $0.3 \times 20 = 6$ ✓

$1.4 \times 10 = 14$, $2.4 \times 5 = 12$, $2.0 \times 5 = 10$, $0.3 \times 20 = 6$

Mass (m grams)	Frequency
$0 < m \leq 20$	6
$20 < m \leq 30$	14
$30 < m \leq 35$	12
$35 < m \leq 40$	10
$40 < m \leq 60$	6

Answer: 14, 12, 10, 6

Tip: The bar heights are frequency densities, not frequencies. Each small square on the vertical axis is 0.1.

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

- (b) Find an estimate for the upper quartile of the masses of the strawberries.

$$\text{Total} = 6 + 14 + 12 + 10 + 6 = 48$$

The upper quartile is $\frac{3}{4}$ of the way through: $\frac{3}{4} \times 48 = 36$, the 36th value.

Up to 35 g there are $6 + 14 + 12 = 32$ strawberries, so we need 4 more.

These come from the 10 strawberries in $35 < m \leq 40$ (width 5 g).

$$\text{Go } \frac{4}{10} \text{ of the way through the class: } 35 + \frac{4}{10} \times 5 = 37$$

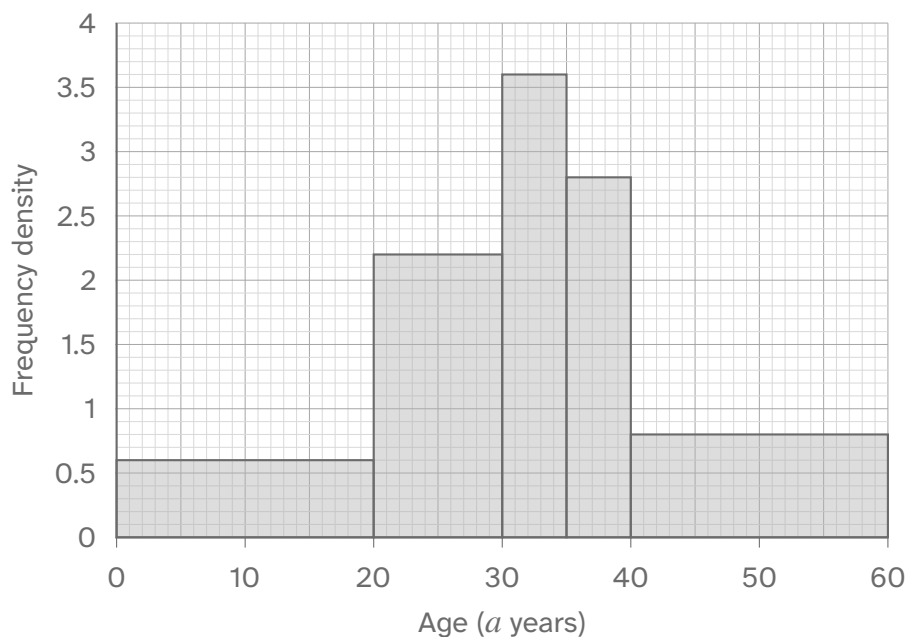
Answer: 37 grams

Tip: The upper quartile is $\frac{3}{4}$ of the way through the data, not $\frac{1}{4}$.

Marks: 1 mark for finding that the 36th value is in $35 < m \leq 40$. 1 mark for 37.

3 (9 marks)

The histogram gives information about the ages of people at a concert.



- (a) Work out the number of people aged between 30 and 40 years.

Frequency = frequency density × class width

$$30 < a \leq 35: 5 \times 3.6 = 18$$

$$35 < a \leq 40: 5 \times 2.8 = 14$$

$$\text{Total} = 18 + 14 = 32$$

Answer: 32

Tip: Adding the bar heights ($3.6 + 2.8$) is a common mistake. Multiply each height by its class width.

Marks: 1 mark for 5×3.6 or 5×2.8 . 1 mark for 32.

- (b) Work out the total number of people.

Find the frequency of each of the other bars:

$$0 < a \leq 20: 20 \times 0.6 = 12$$

$$20 < a \leq 30: 10 \times 2.2 = 22$$

$$40 < a \leq 60: 20 \times 0.8 = 16$$

$$\text{Total} = 12 + 22 + 18 + 14 + 16 = 82$$

Answer: 82

Marks: 1 mark for the frequency of at least two of the other bars. 1 mark for 82.

- (c) Find an estimate for the median age.

There are 82 people, so the median is about the 41st value.

Up to 30 years there are $12 + 22 = 34$ people.

We need $41 - 34 = 7$ more people from the class $30 < a \leq 35$.

This class has 3.6 people per year (its frequency density).

$$7 \div 3.6 = 1.94 \dots \text{ years into the class}$$

$$\text{Median} \approx 30 + 1.94 = 31.9 \text{ years}$$

Answer: 31.9 years

Marks: 1 mark for finding the median is about the 41st value. 1 mark for $30 + \frac{7}{3.6}$ (or $30 + \frac{7}{18} \times 5$). 1 mark for 31.9.

- (d) Estimate the number of people aged over 50

Over 50 is the part of the last bar from 50 to 60.

Width = 10, frequency density = 0.8

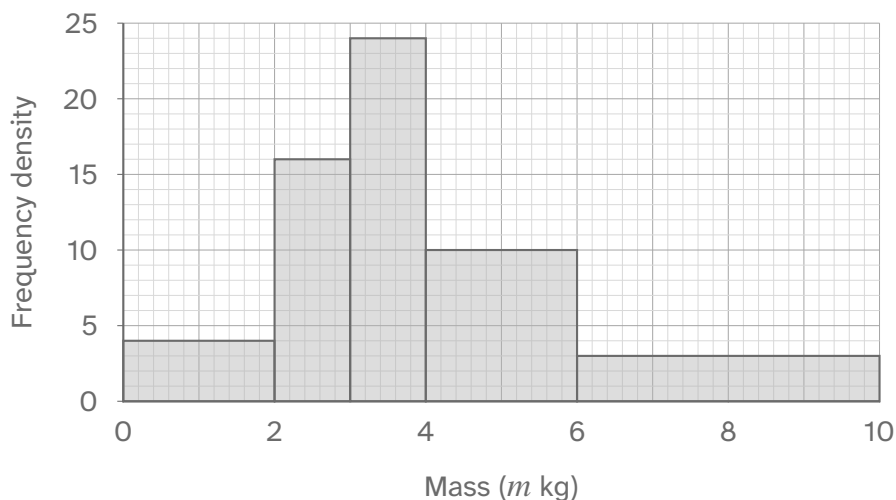
$$10 \times 0.8 = 8 \text{ people}$$

Answer: 8

Marks: 1 mark for 10×0.8 . 1 mark for 8.

4 (4 marks)

The histogram gives information about the masses, in kg, of the pumpkins grown on a farm.



The lightest 15% of the pumpkins are sold as mini pumpkins.
Work out an estimate for the greatest mass of a mini pumpkin.
You must show all your working.

Frequency = class width $\times$ frequency density:

$$2 \times 4 = 8, \quad 1 \times 16 = 16, \quad 1 \times 24 = 24, \quad 2 \times 10 = 20, \quad 4 \times 3 = 12$$

Total number of pumpkins = 80

15% of 80 = 12, so we need the lightest 12 pumpkins.

The first bar (0 to 2 kg) has 8, so we need 4 more from the bar 2 to 3 kg.

That bar has frequency density 16, so 4 pumpkins take up $4 \div 16 = 0.25$ kg of width.

Greatest mass $\approx 2 + 0.25 = 2.25$ kg

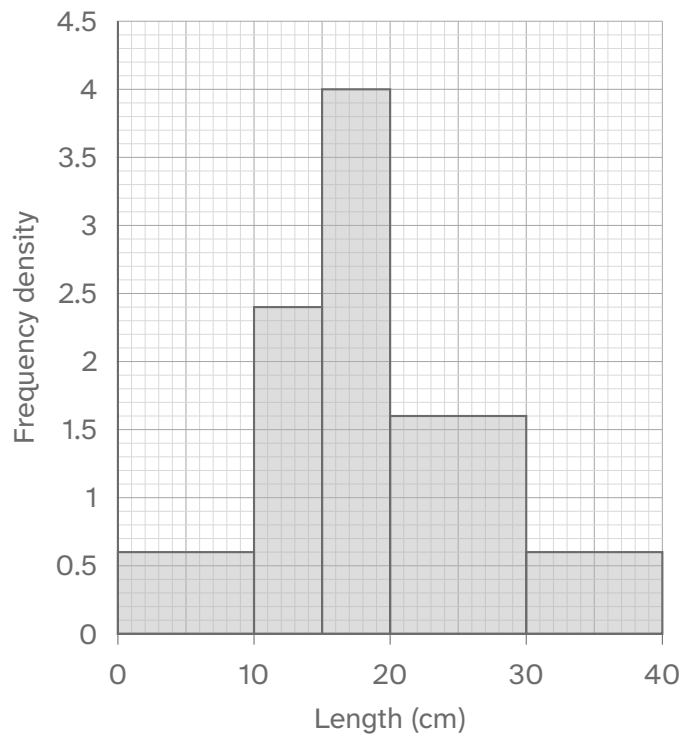
Answer: 2.25 kg

Tip: The lightest pumpkins are at the **left** of the histogram, so count up from 0 kg.

Marks: 1 mark for frequency density $\times$ class width. 1 mark for 15% of 80 = 12. 1 mark for $2 + \frac{4}{16}$ or equivalent. 1 mark for 2.25.

5 (4 marks)

The histogram gives information about the lengths, in cm, of the fish in a pond.



A fish is caught at random.

Work out an estimate for the probability that its length is more than 17 cm.

Frequency = class width $\times$ frequency density:

$$10 \times 0.6 = 6, \quad 5 \times 2.4 = 12, \quad 5 \times 4 = 20, \quad 10 \times 1.6 = 16, \quad 10 \times 0.6 = 6$$

Total number of fish = 60

17 to 20 cm: $3 \times 4 = 12$ fish

More than 17 cm: $12 + 16 + 6 = 34$

$$\text{Probability} = \frac{34}{60} = \frac{17}{30}$$

Answer: $\frac{34}{60} = \frac{17}{30}$

Tip: From 17 to 20 cm is only 3 cm of the 15 to 20 bar. Then divide by the total number of fish to get a probability.

Marks: 1 mark for frequency density $\times$ class width. 1 mark for the total 60. 1 mark for $12 + 16 + 6 = 34$. 1 mark for $\frac{34}{60}$ oe.
