Please check the examination details below before entering your candidate information

| Candidate surname | Other names |
|---|---|
| | |

Centre Number | Candidate Number

# Pearson Edexcel Level 3 GCE

## Thursday 23 May 2024

Afternoon

**Paper reference** **8MA0/21**

# Mathematics

## Advanced Subsidiary
## PAPER 21: Statistics

**You must have:**
Mathematical Formulae and Statistical Tables (Green), calculator

Total Marks

**Candidates may use any calculator allowed by Pearson regulations. Calculators must not have the facility for symbolic algebra manipulation, differentiation and integration, or have retrievable mathematical formulae stored in them.**

## Instructions

- Use **black** ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B).
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions and ensure that your answers to parts of questions are clearly labelled.
- Answer the questions in the spaces provided – *there may be more space than you need*.
- You should show sufficient working to make your methods clear. Answers without working may not gain full credit.
- Values from statistical tables should be quoted in full. If a calculator is used instead of tables the value should be given to an equivalent degree of accuracy.
- Inexact answers should be given to three significant figures unless otherwise stated.

## Information

- A booklet 'Mathematical Formulae and Statistical Tables' is provided.
- The total mark for this part of the examination is 30. There are 5 questions.
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*

## Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- If you change your mind about an answer, cross it out and put your new answer and any working underneath.
- Check your answers if you have time at the end.

*Turn over* ▶

**1.** A coach recorded the heights of some adult rugby players and found the following summary statistics.

Median = 1.85 m

Range = 0.28 m

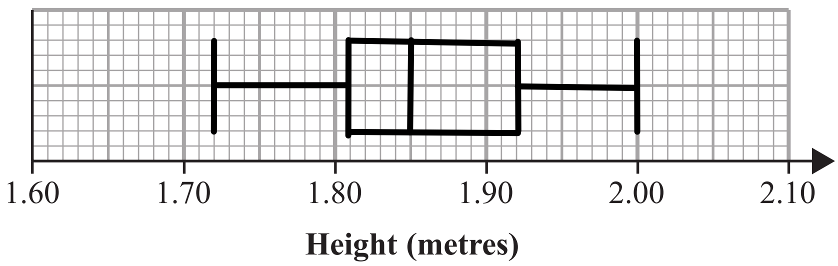
Interquartile range = 0.11 m

The coach also noticed that

- the height of the shortest player is 1.72 m    $1.72 + 0.28 = 2$ (tallest)
- 25% of the players' heights are below the height of a player whose height is 1.81 m (LQ)    $1.81 + 0.11 = 1.92$ (UQ)

Draw a box and whisker plot to represent this information on the grid below.

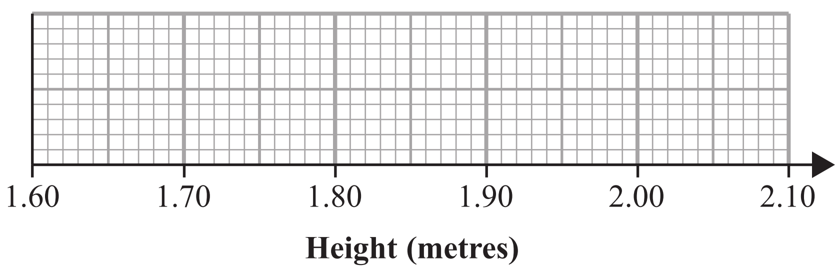
**(4)**




**Use the spare grid on page 3 if you need to redraw your box and whisker plot.**

**Question 1 continued**

**Only use this grid if you need to redraw your box and whisker plot.**




**(Total for Question 1 is 4 marks)**

**2.** Keith is studying the variable Daily Mean Wind Direction, in degrees, from the large data set.

Keith summarised the data for Camborne from 1987 into 4 directions $A$, $B$, $C$ and $D$ representing North, South, East and West in some order.

| **Direction** | $A$ | $B$ | $C$ | $D$ |
|---|---|---|---|---|
| **Frequency** | 22 | 48 | 56 | 58 |

(a) Using your knowledge of the large data set state, giving a reason, which direction $A$ represents.

**(1)**

The entry for Hurn on 27th September 1987 was 999

(b) State, giving a reason, what Keith should do with this value.

**(2)**

a/ East - east has the lowest frequency.

b/ It should be removed. The wind direction should be 0 to 360.

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P 7 5 6 8 0 A 0 4 1 6

Question 2 continued

(Total for Question 2 is 3 marks)

**3.** Customers in a shop have to queue to pay.

The partially completed table below and partially completed histogram opposite, give information about the time, $x$ minutes, spent in the queue by each of 112 customers one day.

| Time in queue ($x$ minutes) | width | Frequency | F . d |
|---|---|---|---|
| 1–2 | 1 | 64 | 64 |
| 2–3 | 1 | 25 | 25 |
| 3–4 | 1 | 13 | 13 |
| 4–6 | 2 | 7 | 3.5 |
| 6–8 | 2 | 3 | 1.5 |

No customer spent less than 1 minute or longer than 8 minutes in the queue.

(a) Complete the table. $112 - 64 - 25 - 13 - 3 = 7$

**(2)**

(b) Complete the histogram.

**(2)**

Ting decides to model the **frequency density** for these 112 customers by a curve with equation

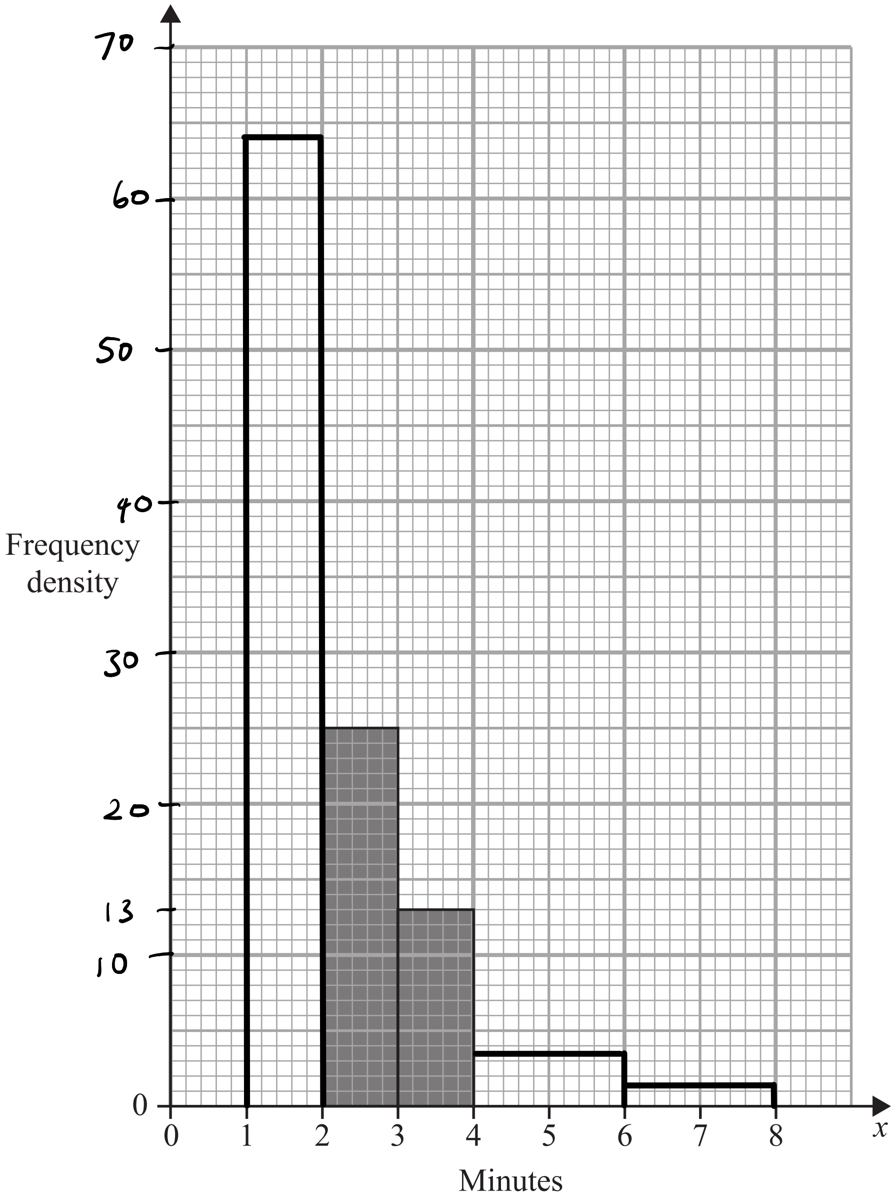
$$y = \frac{k}{x^2} \qquad 1 \leqslant x \leqslant 8$$

where $k$ is a constant.

(c) Find the value of $k$

**(3)**

**Question 3 continued**




c/ $\int_1^8 \frac{k}{x^2} \, dx = 112$

$\int_1^8 kx^{-2} \, dx = 112$

$\left[-kx^{-1}\right]_1^8 = 112$

$\frac{-k}{8} - - \frac{k}{1} = 112$

**Turn over for a spare grid if you need to redraw your histogram.**

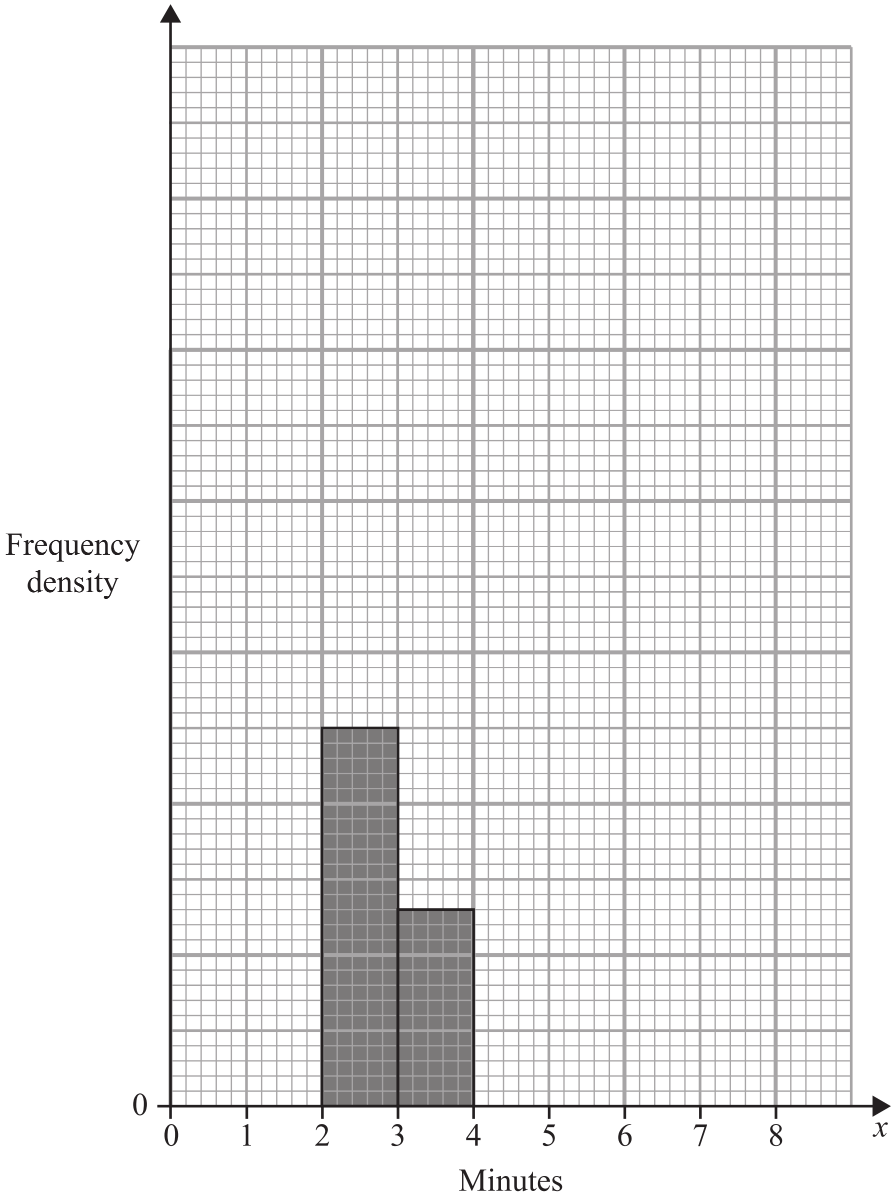
**Question 3 continued**

$\frac{7}{8}k = 112$

$k = 128$

**Question 3 continued**

**Only use this grid if you need to redraw your histogram.**




**(Total for Question 3 is 7 marks)**

4. The random variable $X \sim B(27, 0.35)$

(a) Find (i) $P(X = 10)$

(ii) $P(12 \leqslant X < 15)$

**(3)**

Historical records show that the proportion of defective items produced by a machine is 0.12

Following a maintenance service of the machine, a random sample of 60 items is taken and 3 defective items are found.

(b) Carry out a suitable test to determine whether the proportion of defective items produced by the machine has decreased following the maintenance service. You should state your hypotheses clearly and use a 5% level of significance.

**(4)**

(c) Write down the *p*-value for your test in part (b)

**(1)**

a/ i) Binomial PD $\quad P(X = 10) = \underline{0.154}$

ii) Binomial CD

$P(12 \leqslant X < 15) = P(X \leqslant 14) - P(X \leqslant 11)$

$= 0.977 - 0.798$

$= \underline{0.179}$

b/ $H_0: p = 0.12$

$H_1: p < 0.12$

$X \sim B(60, 0.12) \quad P(X \leqslant 3) = 0.0601$

$0.0601 > 0.05$

There is not enough evidence to suggest the proportion of defective items has decreased.

c/ 0.0601

**Question 4 continued**







Turn over

**Question 4 continued**

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**Question 4 continued**

**(Total for Question 4 is 8 marks)**

**5.** A biased 4-sided spinner has the numbers 6, 7, 8 and 10 on it.

The discrete random variable $X$ represents the score when the spinner is spun once and has the following probability distribution,

| $x$ | 6 | 7 | 8 | 10 |
|---|---|---|---|---|
| $P(X = x)$ | 0.5 | 0.2 | $q$ | $q$ |

where $q$ is a probability.  $1 - 0.7 = 0.3$

(a) Find the value of $q$  $\frac{0.3}{2} = 0.15$ **(1)**

Karen spins the spinner repeatedly until she **either** gets a 7 **or** she has taken 4 spins.

(b) Show that the probability that Karen stops after taking her 3rd spin is 0.128 **(2)**

The random variable $S$ represents the number of spins Karen takes.

(c) Find the probability distribution for $S$ **(4)**

The random variable $N$ represents the number of times Karen gets a 7

(d) Find $P(S > N)$ **(1)**

a/ 0.15

b/ P(Not 7, Not 7, 7) = $0.8 \times 0.8 \times 0.2$

= 0.128

c/

| s | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| P(S = s) | 0.2 | 0.16 | 0.128 | 0.512 |

$0.8 \times 0.2$  $1 - 0.2 - 0.16 - 0.128$

d/ Number of spins > Number of 7s

$1 - 0.2$

0.8

Question 5 continued

**Question 5 continued**

**(Total for Question 5 is 8 marks)**

**TOTAL FOR STATISTICS IS 30 MARKS**