Candidate surname | Other names

Pearson Edexcel
Level 3 Certificate

Centre Number | Candidate Number

Time 1 hour 40 minutes

Paper reference **7MC0/02**

Mathematics in Context
PAPER 2: Applications

You must have: Ruler graduated in centimetres and millimetres, pen, HB pencil, eraser, calculator.
Source booklet.

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need*.
- **Calculators may be used.**

Information

- The total mark for this paper is 80
- 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.
- Check your answers if you have time at the end.
- Good luck with your examination.

Turn over ▶

Pearson

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SECTION A

Answer ALL questions. Write your answers in the spaces provided.

FOOD

1 **Refer to the data source.**

(a) In which year was available weekly income almost 5% lower than in 2003?

(1)

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The average price paid for a loaf of bread in 2018 was £1.10

(b) Calculate an estimate for the average price paid for a loaf of bread in 2003.

(3)

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(Total for Question 1 is 4 marks)

2 Uzma is investigating how the quantities of different food and drink products consumers buy are affected by changes in price.

Uzma's theory is that when the price of a product decreases, a consumer buys a greater quantity of that product.

(a) (i) What type of correlation is expected for this theory?

(1)

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(ii) Is there likely to be a causal relationship between the price of a product and the quantity purchased?
Give a reason for your answer.

(1)

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(b) Which would be the response (dependent) variable, the price of a product or the quantity purchased?
Give a reason for your answer.

(1)

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Uzma will test her theory by calculating the product moment correlation coefficient between the change in price (x) and the change in quantity purchased (y).

Given that $S_{xx} = 15\,903.86$, $S_{yy} = 25\,732.1$ and $S_{xy} = -1631.21$

(c) (i) Calculate the product moment correlation coefficient.

(2)

(ii) Is Uzma's theory correct?
Justify your answer.

(1)

(Total for Question 2 is 6 marks)

3 Ben is going to make sandwiches to sell at a fair.
He will make two types of ham sandwich, deluxe and standard.

Let x be the number of deluxe sandwiches he will make.
Let y be the number of standard sandwiches he will make.
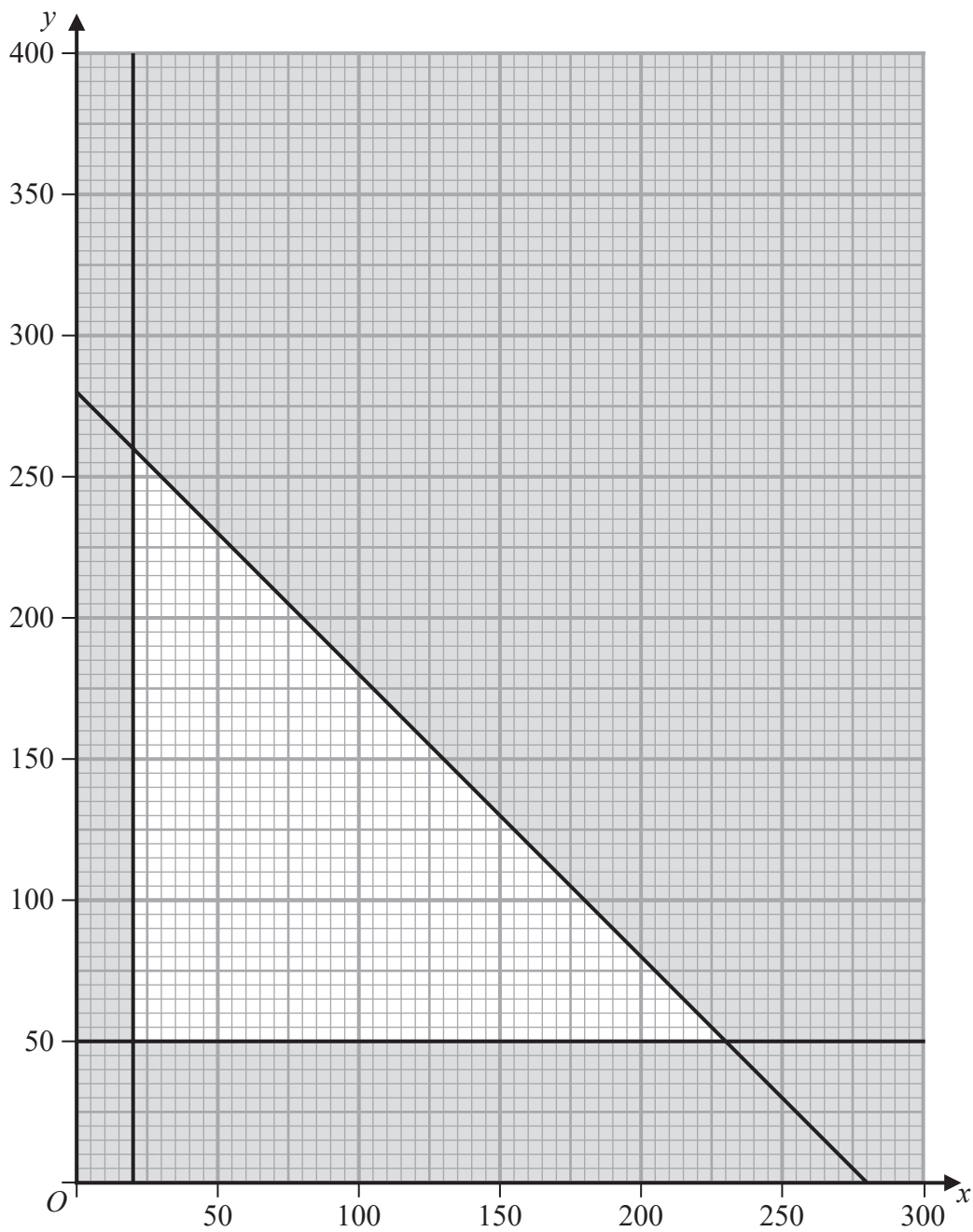
Three constraints are shown on the grid.
Two of these are $x \geqslant 20$ and $y \geqslant 50$

(a) Explain, in context, what the inequality $x \geqslant 20$ represents.

(1)

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The third constraint on the grid represents the total number of slices of bread available to make the sandwiches.

(b) Write, as an inequality, the third constraint shown on the grid.

(1)

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Each deluxe sandwich will have 3 slices of ham and 2 slices of cheese.
Each standard sandwich will have 2 slices of ham and 1 slice of cheese.

To make the sandwiches, Ben has a total of

24 packets of ham, each of which has 25 slices of ham
12 packets of cheese, each of which has 30 slices of cheese.

(c) Write down an inequality, in terms of x and y, that represents the constraint for ham.

(2)

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The constraint for cheese can be represented by the inequality $2x + y \leqslant 360$

(d) On the grid, show this constraint and the constraint you found in part (c).
Label the feasible region R.

(3)

Ben will donate the total sales amount to charity.
He wants to maximise the total sales amount.

Ben plans to sell each deluxe sandwich for £2.25 and each standard sandwich for £1.80

Assuming he sells all the sandwiches he makes,

(e) find the maximum total sales amount.
You should state the number of each type of sandwich he needs to make.

(3)

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(Total for Question 3 is 10 marks)

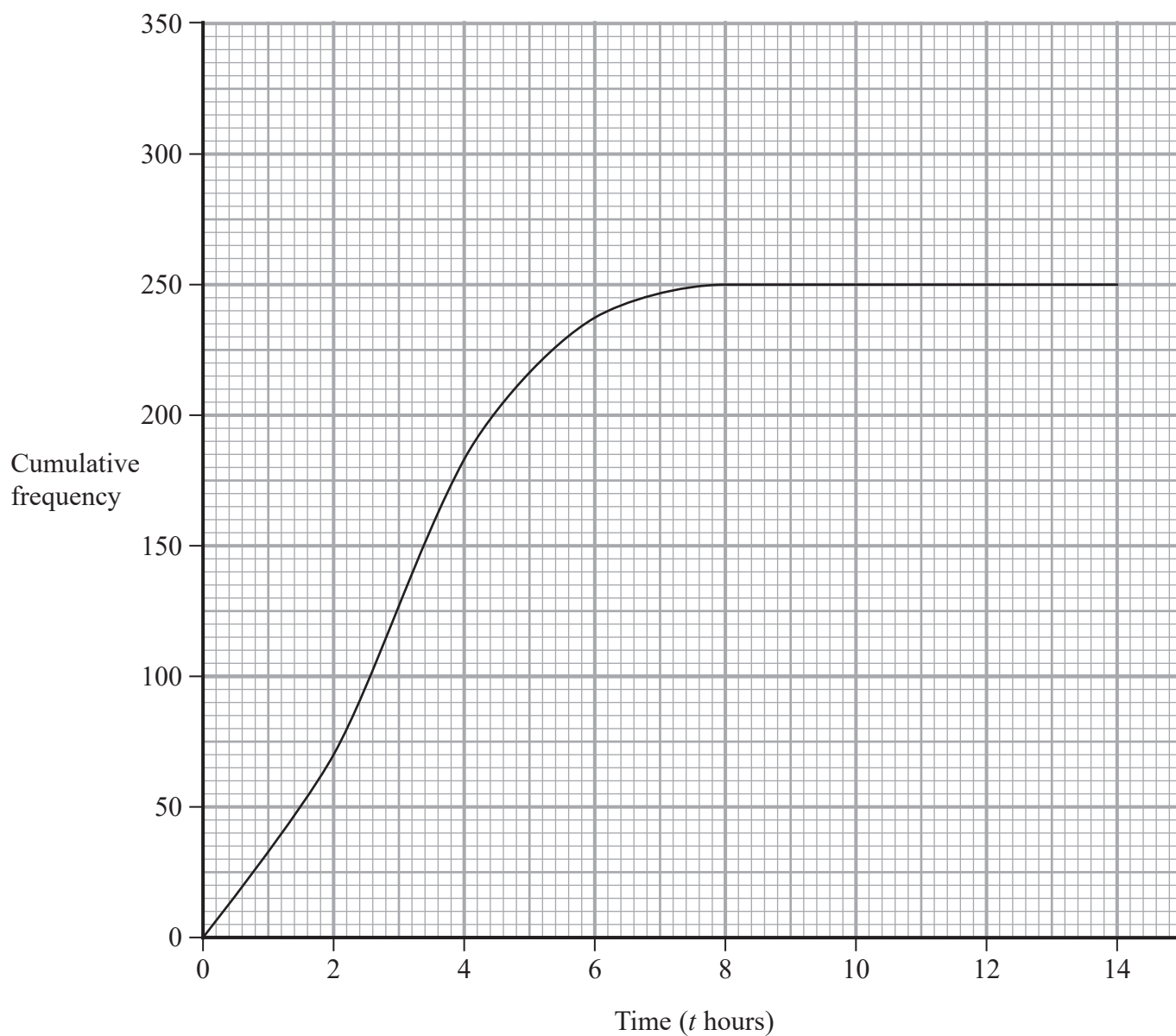**TOTAL FOR SECTION A IS 20 MARKS**

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Turn over for Question 4

SECTION B

Answer ALL questions. Write your answers in the spaces provided.

TASK 1: DOGS

4 The cumulative frequency graph shows information about the time spent walking per week by 250 people who do **not** own dogs.

Cumulative frequency (y-axis, 0 to 350)

Time (t hours) (x-axis, 0 to 14)

The table shows information about the time spent walking per week by 300 dog owners.

Time (*t* hours)	Frequency
$2 < t \leqslant 4$	18
$4 < t \leqslant 6$	36
$6 < t \leqslant 8$	75
$8 < t \leqslant 10$	109
$10 < t \leqslant 12$	48
$12 < t \leqslant 14$	14

(a) On the grid opposite, draw a cumulative frequency graph for this information.

(3)

An article in a magazine states that dog owners walk for at least 250 hours more per year on average than people who do **not** own dogs.

(b) Use estimates of the median time spent walking per week for dog owners and for people who do **not** own dogs to comment on the validity of this claim.

(4)

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(Total for Question 4 is 7 marks)

5 A pet shop buys dog food in 2 kg bags and in 15 kg sacks from a supplier.
The shop places two orders.

Order 1 is for 25 bags and 8 sacks.
The total supply cost is £299.50

Order 2 is for 15 bags and 3 sacks.
The total supply cost is £141

The supplier does not charge for delivery.

(a) Write down two equations that represent the information for these orders.
You do not have to solve the equations.

(2)

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The table shows information about the dog food.

	Supply cost (£)	Retail price (£)
2 kg bag	5.10	8.99
15 kg sack	21.50	37.99

$$\text{Percentage mark-up} = \frac{\text{retail price} - \text{supply cost}}{\text{supply cost}} \times 100$$

(b) Work out which has the greater percentage mark-up, a 2 kg bag or a 15 kg sack.
You must show how you get your answer.

(3)

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The pet shop buys dog collars and leads from a supplier.

x is the cost, in pounds (£), of one collar.
y is the cost, in pounds (£), of one lead.

The total supply cost, in pounds (£), on two invoices can be represented by the equations

$$20x + 35y = 214$$
$$12x - 5y = 3.60$$

(c) Work out the supply cost of one collar and the supply cost of one lead.

(3)

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(Total for Question 5 is 8 marks)

6 Andrew has a new puppy.

He looks at the cost options to cover vet bills for emergency treatments.

Andrew considers three options

- pay vet bills for emergency treatments as they arise
- buy standard pet insurance for £246 per year and pay £75 per emergency treatment
- buy premium pet insurance for £320 per year and pay no emergency treatment costs.

The table shows the probabilities and average costs of three common emergency treatments in the first year of owning a puppy.

Emergency treatment	Probability	Average cost of emergency treatment (£)
Out of hours appointment	0.93	250
Toxic ingestion	0.42	590
Leg injury	0.07	1800

Use the information in the table to determine which of the three options that Andrew is considering will give the lowest expected cost.
Justify your answer.

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(Total for Question 6 is 5 marks)

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Turn over for Question 7

TASK 2: HEPTATHLON

7 The heptathlon is a combination of seven athletic events performed across two days of competition. Points are scored in each event based on performance.

The number of points awarded for each event is calculated using a formula.

For the javelin throw the number of points, J, is given by the formula

$$J = 15.98 (D - 3.8)^{1.04}$$

where D is the length of the javelin throw in metres.

(a) Calculate the number of points awarded for a javelin throw of length 53.15 metres.

(2)

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For the 800 metre race, the number of points, P, is given by the formula

$$P = 0.11 \, (254 - T)^{1.88}$$

where T seconds is the time taken to run the race.

Louise's highest total for the heptathlon is 6981 points.

At the end of six events, she has a total of 5963 points.

The final event is the 800 metre race.

(b) (i) Write down an inequality that could be used to work out the time Louise will need to run the 800 metre race in order to get a total of more than 6981 points.

(2)

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(ii) Hence, or otherwise, work out an estimate for the maximum time Louise will need to run the 800 metre race in order to get a total of more than 6981 points.

(4)

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(Total for Question 7 is 8 marks)

8 The table gives information about the distances jumped by 11 competitors in the long jump event in a heptathlon competition.

Competitor	Distance (metres)
A	5.72
B	5.84
C	5.93
D	6.04
E	6.09
F	6.13
G	6.15
H	6.18
J	6.20
K	6.21
L	6.25

An outlier is defined as any value that is

greater than the upper quartile + (1.5 × interquartile range)

or

lower than the lower quartile – (1.5 × interquartile range)

(a) Show that there are no outliers.

(4)

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(b) Draw a box plot to represent all the information.

(2)

5.6	5.7	5.8	5.9	6.0	6.1	6.2	6.3

Distance (metres)
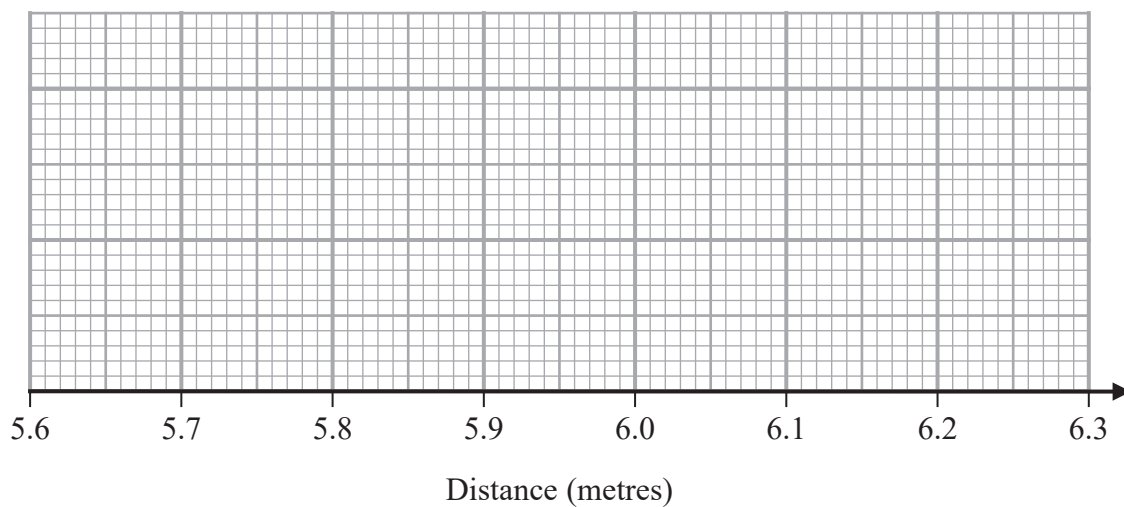
(Total for Question 8 is 6 marks)

9 Sarah is a heptathlete returning to training after an injury.

Her coach gives Sarah this training schedule which she hopes will help Sarah return to full fitness.

Week (n)	1	2	3	4	5	6
Total number of minutes of training per week	300	425	550	675	800	925

The total number of minutes of training per week can be modelled by a sequence.

(a) Write down the mathematical name of this type of sequence.

(1)

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The total number of minutes that Sarah will train each week, for the first six weeks, using the schedule from her coach is shown in the table.

Week (n)	1	2	3	4	5	6
Total number of minutes of training per week	300	425	550	675	800	925

The total number of minutes, u_n, that Sarah will train in week n using this schedule can be written in the form

$$u_n = pn + q, \text{ where } p \text{ and } q \text{ are constants.}$$

(b) (i) Find the value of p and the value of q.

(2)

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Before this injury, Sarah trained for 7 hours each day for 5 days a week.
Sarah decides to use her coach's training schedule. She continues to increase her training time each week according to the model found in (b)(i)

(ii) How many weeks will it be before Sarah is training for at least the same number of hours each week as she was before the injury?

(3)

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(Total for Question 9 is 6 marks)

TASK 3: HEALTH CENTRE

10 The table shows some information from a survey of 500 people about the waiting time, in days, between making an appointment to see a doctor at a health centre and the date of the appointment.

Waiting time (t days)	Frequency
$0 \leqslant t < 1$	124
$1 \leqslant t < 7$	192
$7 \leqslant t < 14$	112
$14 \leqslant t < 28$	56
$28 \leqslant t$	16

An additional 80 people make an appointment to see a doctor at the health centre.

(a) Using the information in the table, work out an estimate for the number of the additional 80 people who will have a waiting time of less than one day.

(3)

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16 of the 500 people who completed the survey waited at least 28 days between making an appointment and the date of the appointment.

(b) Explain why the interval $28 \leqslant t$ used to represent these people **cannot** be shown on the histogram.

(1)

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(c) On the grid opposite, draw a histogram to represent the information for all the people who have a waiting time of less than 28 days.

(3)

Frequency
density

0   5   10   15   20   25   30
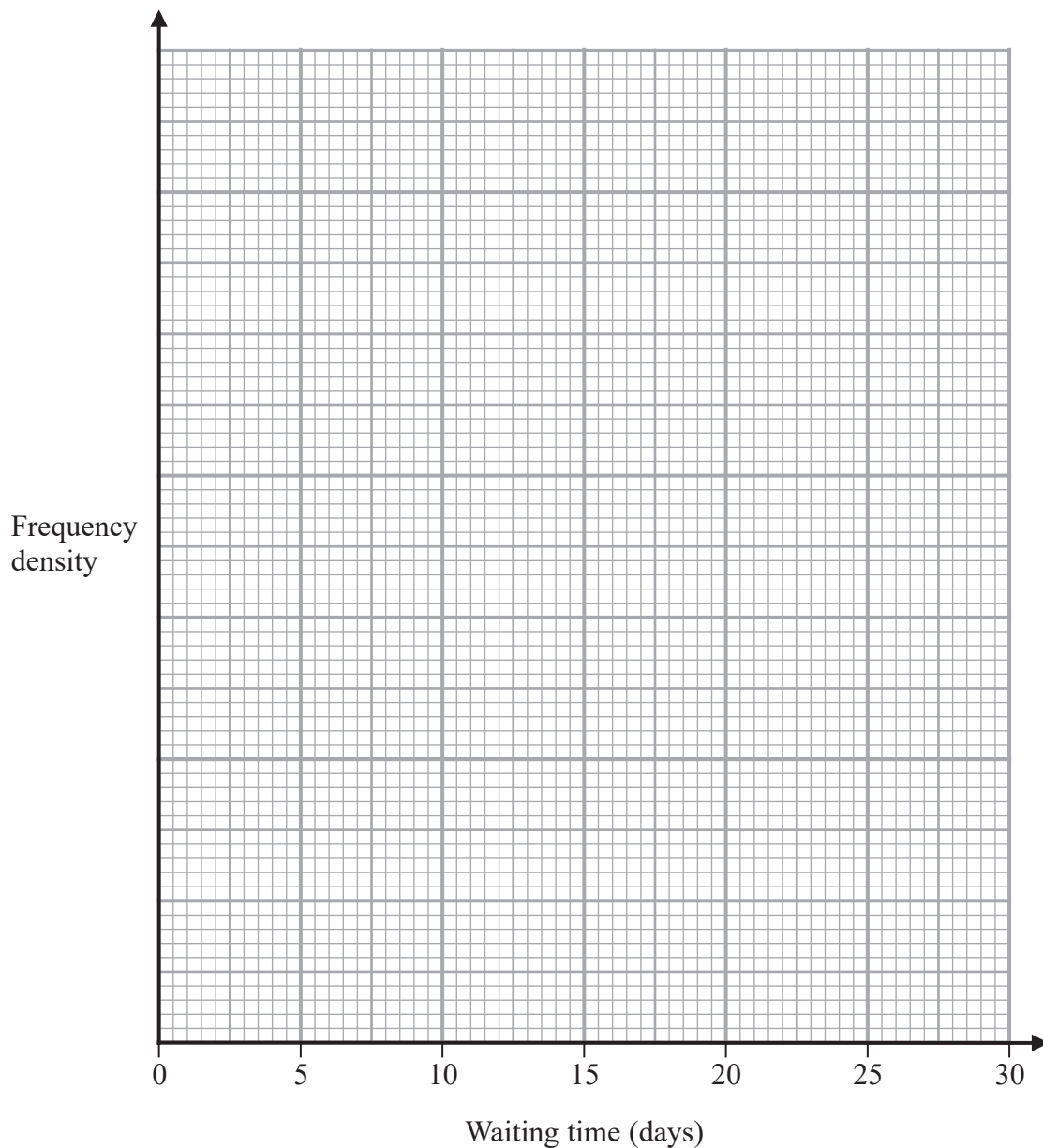
Waiting time (days)

A newspaper reports that the average waiting time in the UK between making an appointment to see a doctor and the date of the appointment has recently exceeded 2 weeks for the first time.

(d) By finding an estimate for the median, compare the waiting time at the health centre with the average waiting time in the UK.

(3)

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The health centre aims to provide people with an appointment with a waiting time of less than 10 days.

(e) Work out an estimate for the number of people, from the 500 people surveyed, who had a waiting time of less than 10 days.

(2)

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(Total for Question 10 is 12 marks)

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Turn over for Question 11

11 The health centre also surveyed 500 people about the type of appointment they required for their most recent medical need.

Some of these people required more than one type of appointment.

The Venn diagram shows some information about the types of appointment required.
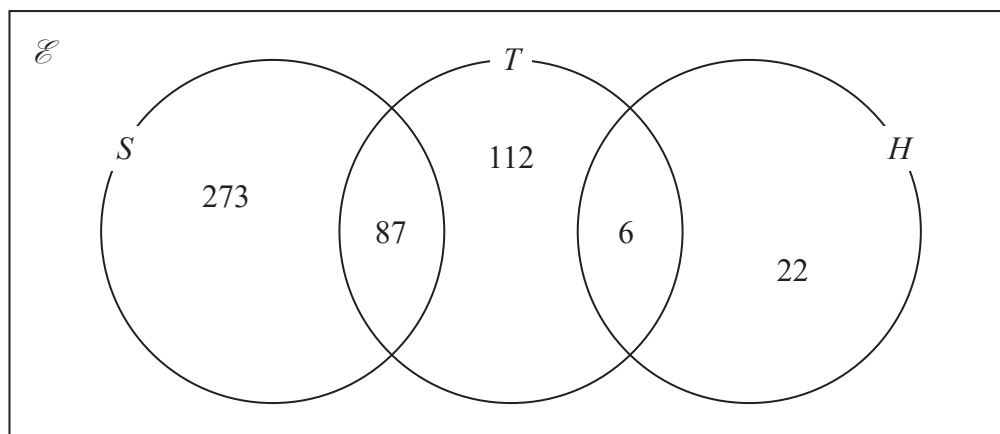
$\mathscr{E}$ = {people in the survey}
S = {people who required an appointment at the surgery}
T = {people who required a telephone appointment}
H = {people who required a home visit appointment}

One of these 500 people is chosen at random.

(a) Find the probability that

   (i)   this person required a home visit appointment,

   (1)

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   (ii) this person required only one type of appointment.

   (1)

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(b) (i) Write down the two events that are mutually exclusive.
Give a reason for your answer.

(2)

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(ii) Describe, in context, $S \cap T$

(1)

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(iii) Shade the region that represents $S' \cap T \cap H'$

(1)

(iv) Find P $(H \mid T)$

(2)

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(Total for Question 11 is 8 marks)

TOTAL FOR SECTION B IS 60 MARKS
TOTAL FOR PAPER IS 80 MARKS

Pearson Edexcel Level 3 Certificate

Time 1 hour 40 minutes

Mathematics in Context
PAPER 2: Applications

Source Booklet
Do not return this Booklet with the question paper.

P 6 7 6 8 2 R A

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Formulae sheet

There will be no credit for anything you write on this formulae sheet.

Mean of a frequency distribution
$$= \frac{\sum fx}{\sum f}$$

Mean of a grouped frequency distribution
$$= \frac{\sum fx}{\sum f}, \text{ where } x \text{ is the mid-interval value}$$

Variance
$$= \frac{\sum (x - \bar{x})^2}{n}$$

Standard deviation (set of numbers)
$$\sqrt{\left[\frac{\sum x^2}{n} - \left(\frac{\sum x}{n} \right)^2 \right]}$$

or
$$\sqrt{\left[\frac{\sum (x - \bar{x})^2}{n} \right]}$$

where $\bar{x}$ is the mean of the set of values

Standard deviation

(discrete frequency distribution)
$$\sqrt{\left[\frac{\sum fx^2}{\sum f} - \left(\frac{\sum fx}{\sum f} \right)^2 \right]}$$

or
$$\sqrt{\left[\frac{\sum f(x - \bar{x})^2}{\sum f} \right]}$$

Spearman's rank correlation coefficient
$$1 - \frac{6 \sum d^2}{n(n^2 - 1)}$$

The product moment correlation coefficient is

$$r = \frac{S_{xy}}{\sqrt{S_{xx}S_{yy}}} = \frac{\sum x_i y_i - \dfrac{\left(\sum x_i\right)\left(\sum y_i\right)}{n}}{\sqrt{\left(\sum x_i^2 - \dfrac{\left(\sum x_i\right)^2}{n}\right)\left(\sum y_i^2 - \dfrac{\left(\sum y_i\right)^2}{n}\right)}}$$

The regression coefficient of y on x is $b = \dfrac{S_{xy}}{S_{xx}}$

Least squares regression line of y on x is $y = a + bx$ where $a = \bar{y} - b\bar{x}$

Arithmetic series

$$u_n = a + (n-1)d$$

$$S_n = \frac{1}{2}n(a + l) = \frac{1}{2}n[2a + (n-1)d]$$

Geometric series

$$u_n = ar^{n-1}$$

$$S_n = \frac{a(1 - r^n)}{1 - r}$$

$$S_\infty = \frac{a}{1 - r} \quad \text{for } |r| < 1$$

SECTION A: FOOD

Data source A

Around 5,000 households in the UK are surveyed annually to provide information for the Living Costs and Food Survey, covering household shopping and eating habits.

Available weekly income is defined as the amount of income left after costs for housing have been paid.

Table 1: Percentage changes in available weekly income for low income households and food and non-alcoholic drink prices in real terms (UK) since 2003

Year	% change in available weekly income since 2003	% change in food and non-alcoholic drink prices in real terms since 2003
2004	−2.1	−0.2
2005	−0.3	−0.9
2006	−2.2	−1.4
2007	−8.8	−1.2
2008	−8.6	0.8
2009	−15.3	6.1
2010	−8.9	9.5
2011	−7.2	9.7
2012	−4.9	10.7
2013	−7.3	11.0
2014	−8.1	12.5
2015	−5.6	10.6
2016	−7.1	7.7
2017	−10.7	4.3
2018	−13.4	3.9

Source information

Data source A adapted from:
https://www.gov.uk/government/publications/food-statistics-pocketbook/foodstatistics-in-your-pocket-prices-and-expenditure#trend-in-share-of-spend-going-on-food-andnon alcoholic-beverages-in-low-income-and-all-uk-households-2005-06-to-2017