

**Pearson Edexcel Level 3 Certificate**

**Wednesday 22 May 2019**

Morning (Time: 1 hour 40 minutes)

Paper Reference **7MC0/02**

**Mathematics in Context**

**Paper 2: Applications**

**Source booklet**

**Do not return this source booklet with the question paper**

*Turn over* ►

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## Formulae sheet

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

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

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

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

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

or

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

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

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

or

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

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

The product moment correlation coefficient is

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

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

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

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

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

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

**There will be no credit for anything you write in this source booklet.**

**SECTION A: AIR TRAVEL**

The following tables show information about flight delays, to the nearest minute, at Heathrow airport in 2005 and 2015

<b>2005</b>	
<b>Delay (minutes)</b>	<b>Number of flights</b>
0–15	319 099
16–30	74 708
31–60	48 687
61–180	23 679
181–360	1 983
<b>Total</b>	<b>468 156</b>

<b>2015</b>	
<b>Delay (minutes)</b>	<b>Number of flights</b>
0–15	354 461
16–30	57 334
31–60	36 564
61–180	18 810
181–360	1 838
<b>Total</b>	<b>469 007</b>

Adapted from <https://www.caa.co.uk/Data-and-analysis/UK-aviation-market/Flight-reliability/Datasets/UK-flight-punctuality-data/>

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Candidate surname

Other names

**Pearson Edexcel**  
**Level 3 Certificate**

Centre Number

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Candidate Number

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**Wednesday 22 May 2019**

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**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.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

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**SECTION A**

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

**AIR TRAVEL**

- 1** The data below and the graph opposite show the total number of passengers per quarter using UK airports between 2013 and 2015

<b>Quarter</b>	<b>Number of passengers (millions)</b>	<b>4-point moving average (millions)</b>
2013 Q1	41.1	52.7
2013 Q2	56.3	
2013 Q3	65.7	
2013 Q4	47.7	
2014 Q1	42.3	53.0
2014 Q2	59.3	53.8
2014 Q3	68.4	54.4
2014 Q4	50.2	55.1
2015 Q1	45.5	55.9
2015 Q2	61.7	56.5
2015 Q3	72.2	57.4
2015 Q4	53.2	.....

Eurostat (<http://ec.europa.eu/eurostat/web/transport/data/database>)

- (a) (i) Explain why it is appropriate to use a 4-point moving average for this data.

(1)

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- (ii) Calculate the missing 4-point moving average.

(2)

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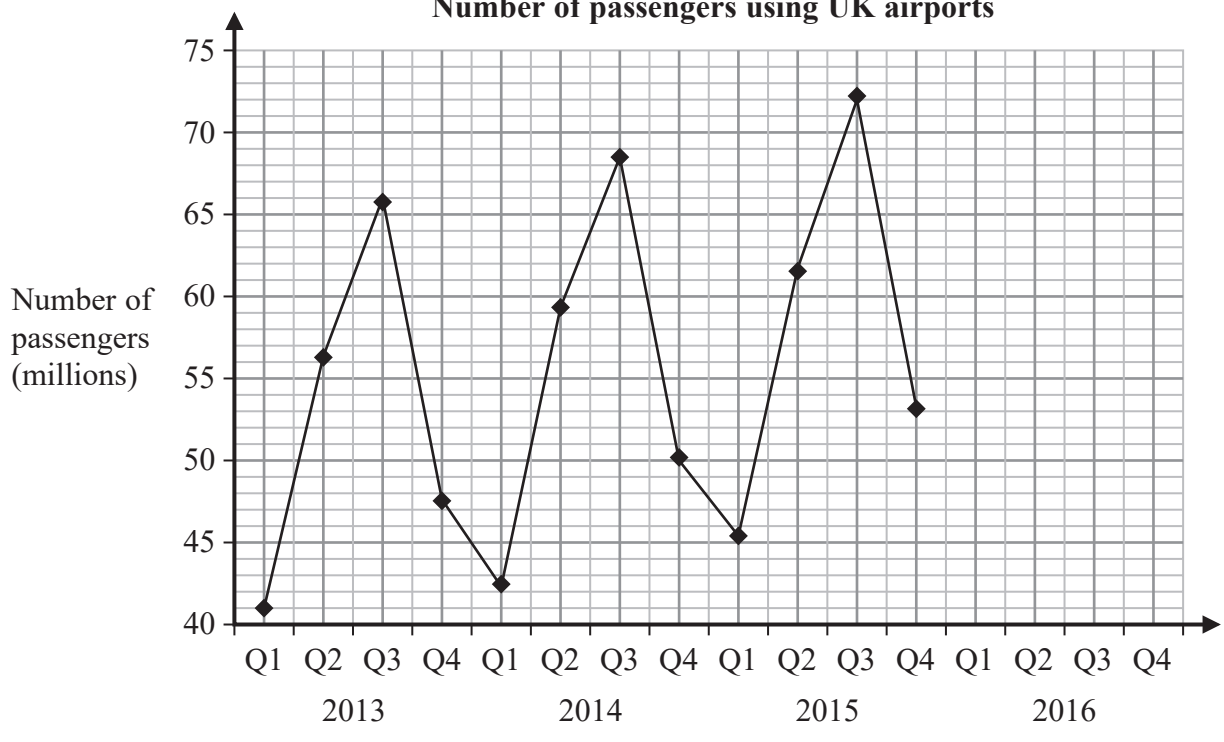


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Number of passengers using UK airports



- (b) On the grid above, plot all the moving averages. (2)
- (c) Use your graph to predict the total number of passengers using UK airports for the year 2016. Make your method clear. (3)

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(Total for Question 1 is 8 marks)



**2 Refer to the data source.**

- (a) State the class interval that contains the median delay for the flights at Heathrow airport in 2005

(1)

The table gives information about flight delays, to the nearest minute, at Heathrow airport in 2015

Delay (minutes)	Number of flights				
0–15	354461				
16–30	57334				
31–60	36564				
61–180	18810				
181–360	1838				
<b>Total</b>	<b>469 007</b>				

- (b) (i) Calculate an estimate for the mean delay.

(4)

- (ii) Calculate an estimate for the standard deviation.

(3)





For flights at Heathrow airport it is claimed that since 2005

- punctuality has improved
- there is less variability in the length of flight delays.

Estimates for the mean delay and standard deviation for 2005 are given below.

Mean	20.8 minutes
Standard deviation	30.8 minutes

(c) To what extent does the data support these claims?

(2)

In 2015 the mean delay for flights delayed between 0 minutes and 15 minutes was found to be 5 minutes.

(d) Without doing any further calculation describe what effect, if any, using this information would have on the estimate of the mean delay in part (b)(i).  
You must justify your answer.

(2)

(Total for Question 2 is 12 marks)

**TOTAL FOR SECTION A IS 20 MARKS**



## SECTION B

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

### TASK 1: FINANCE

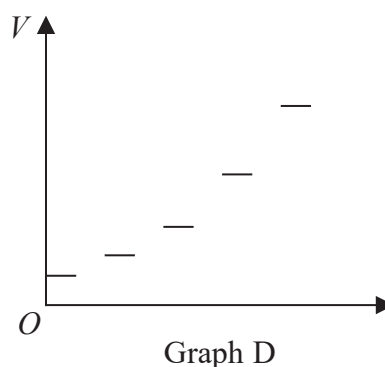
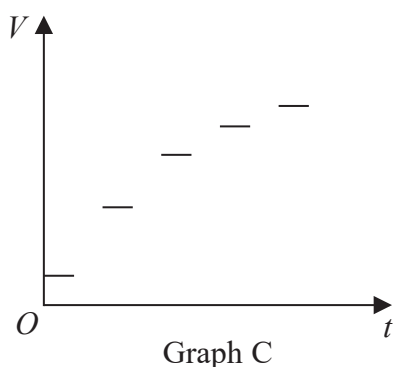
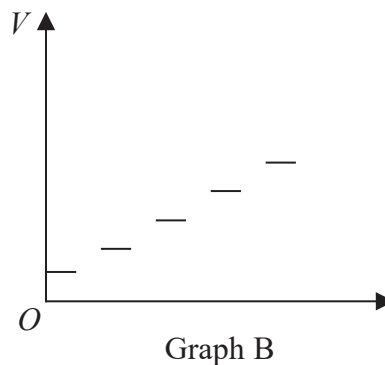
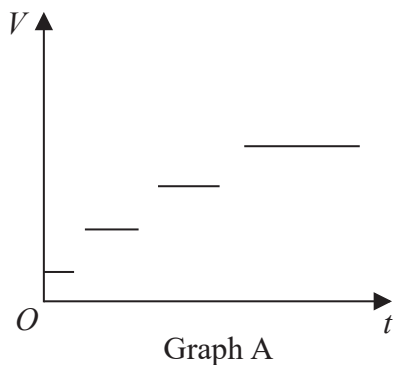
- 3 Hannah invests  $\pounds x$  in a fixed rate bond for  $n$  years.  
The fixed rate bond pays 1.5% compound interest per annum.

$V$  is the value, in pounds, of the bond after  $n$  years.

- (a) Write a formula for  $V$ , in terms of  $x$  and  $n$ .

(2)

Here are four graphs.



- (b) Write down the letter of the graph that best represents the value of the bond,  $\pounds V$ , after  $n$  years.

(1)

(Total for Question 3 is 3 marks)

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4 Sarah is going to study for 3 years for an accountancy qualification. She has to pay a tuition fee of £1500 at the start of each year of study.

Sarah will borrow £1500 from her bank at the start of each year of study. The bank charges 6.1% compound interest per annum.

Sarah will pay nothing back to the bank until the end of her studies.

(a) Work out the total amount Sarah will owe the bank at the end of the 3 years.

(4)

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At the end of the three years, Sarah decides to study for one extra year. She needs to borrow £1500 for this extra year.

Sarah will now pay nothing back to the bank until the end of the 4 years. She thinks she will owe £1591.50 more than she owes at the end of 3 years.

(b) Is Sarah correct?  
You must justify your answer.

(2)

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**(Total for Question 4 is 6 marks)**



5 Indrani invests £3000 in a savings account at the end of January. She invests a further £250 at the end of each subsequent month.

(a) (i) Work out the total amount of money she has invested by the beginning of July. (2)

(ii) Find an expression for the total amount of money she has invested by the beginning of the  $n$ th month, where  $n$  is the number of months after the end of January. (2)

Ben invests £ $x$  in a savings account.

He invests a further £ $y$  in the savings account at the end of each year.

This savings account pays compound interest of 0.5% per annum.

Ben models the total amount, £ $P_n$ , in the savings account after  $n$  years

$$P_n = 1.005^n x + y(1 + 1.005 + 1.005^2 + \dots + 1.005^{n-1})$$

for  $n > 3$

(b) (i) Write down any assumptions Ben has made in this model. (1)

Here are the first five terms of a sequence.

$$1 \quad 1.005 \quad 1.005^2 \quad 1.005^3 \quad 1.005^4$$

(ii) Write down the mathematical name for this type of sequence. (1)





6 Hazel is paying back her student finance.

She knows she must pay 9% of any amount she earns over the threshold of £25 000

This spreadsheet will show how much people pay back each year for different annual salaries.

1	A	B	C
2	Annual salary (£)	Threshold (£)	Amount to pay back (£)
3	27 000	25 000	
4	30 000	25 000	
5	33 000	25 000	
6	36 000	25 000	
7			

Write down a suitable formula for cell C3

(1)

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(Total for Question 6 is 1 mark)



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**TASK 2: TELECOMMUNICATIONS**

7 In 2012 the population of the UK was 61 064 454

In 2012 in the UK

- 57 889 102 people had access to the internet
- for every 100 people there were 52 landlines
- for every 100 people there were 122 mobile phones.

A person is picked at random from the population of the UK in 2012

(a) Write down an estimate for the probability that this person has access to the internet. (1)

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Jay says,

“An estimate for the probability that this person has a mobile phone is 1.22”

This estimate cannot be correct.

(b) Explain why. (1)

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(c) Work out an estimate for the number of landlines in the UK in 2012 (2)

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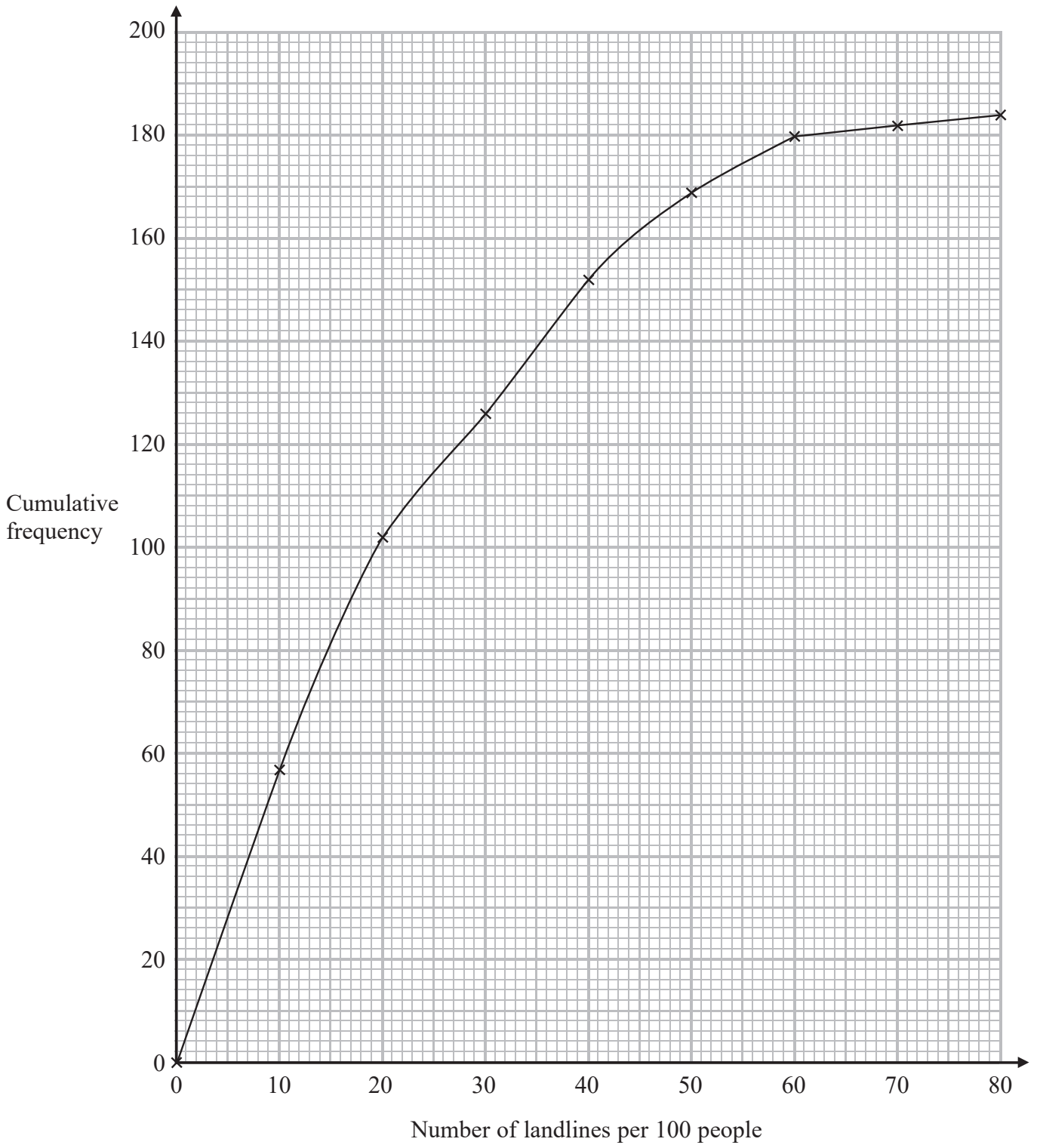
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**(Total for Question 7 is 4 marks)**



8 The cumulative frequency graph shows some information about the number of landlines per 100 people for some countries in 2016



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An outlier is defined as any value that is

greater than the upper quartile +  $(1.5 \times \text{interquartile range})$

or

less than the lower quartile -  $(1.5 \times \text{interquartile range})$

The minimum number of landlines per 100 people is 0

The maximum number of landlines per 100 people is 72

(a) Show that there are no outliers.

(4)

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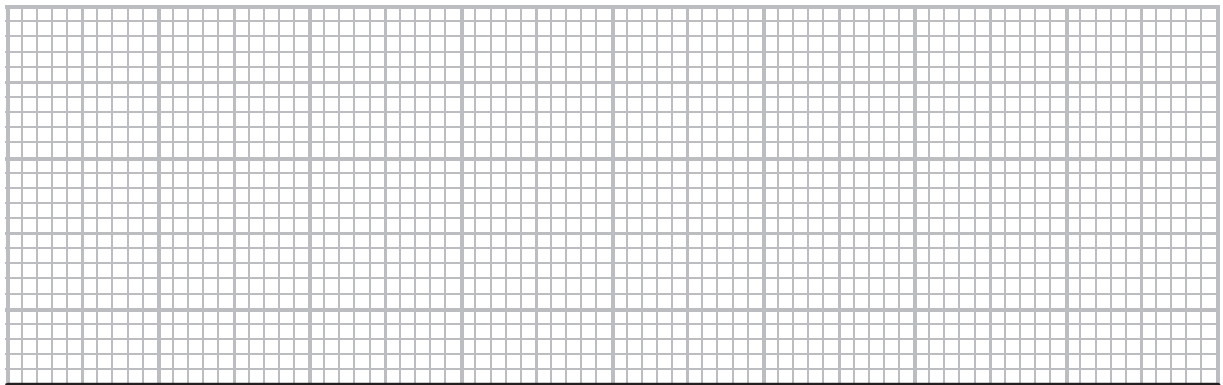
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(b) Draw a box plot to represent all the information.

(3)



(Total for Question 8 is 7 marks)



9 A recent article stated that

“Countries with fewer landlines have more mobile phones.”

(i) Calculate Spearman’s rank correlation coefficient for the data in the table.

(6)

Country	Number of mobile phones per 100 people	Number of landlines per 100 people		
South Africa	24	7		
Mexico	91	16		
Bolivia	93	8		
Ireland	100	38		
France	101	58		
Cook Islands	105	75		
Norway	109	6		
Guernsey	113	60		
Peru	120	10		
Serbia	127	28		
USA	129	38		
New Zealand	130	41		
Latvia	135	19		
Russia	163	23		
Thailand	171	7		

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(ii) Is the statement in the article correct?  
Justify your answer.

(1)

**(Total for Question 9 is 7 marks)**



P 6 0 6 9 0 A 0 1 5 2 4

10 A new telephone company wants to set up telephone and internet packages in the UK.

It wants to know what services would be popular in the UK.

The company decides to take a sample of 400 people.

It will ask

300 people in London  
and 100 people in Manchester.

Give two different reasons why this sample is **not** representative of the UK population.

(2)

Reason 1 .....

Reason 2 .....

(Total for Question 10 is 2 marks)



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**Turn over for Question 11**



P 6 0 6 9 0 A 0 1 7 2 4



The company also sells bags to shops.

Each bag costs £15

There is a charge of £20 for each delivery.

A shop orders  $x$  bags.

Let  $y$  be the total cost for the order of  $x$  bags and delivery.

(b) Write down a formula for  $y$  in terms of  $x$ .

(1)

The manager of a shop is going to order some bags.

He wants the delivery charge to be less than 10% of the total cost.

(c) Work out the minimum number of bags he needs to order.

(4)

(Total for Question 11 is 11 marks)



**12** PrintL prints logos on t-shirts and mugs.

Only one logo is printed on each t-shirt and on each mug.

It takes 15 seconds and 10 g of ink to print a logo on one t-shirt.

It takes 25 seconds and 8 g of ink to print a logo on one mug.

There are 10 hours of production time available each day for printing.

There are 19 kg of ink available each day for printing.

Let  $x$  be the number of t-shirts printed with a logo each day.

Let  $y$  be the number of mugs printed with a logo each day.

(a) (i) Show that  $3x + 5y \leq 7200$  and  $5x + 4y \leq 9500$

(3)

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PrintL decide they will print logos on t-shirts and mugs each day such that the

$$\text{number of t-shirts} : \text{number of mugs} = n : 1$$

where  $n \geq 4$

(ii) Write down an inequality for this constraint.

(2)

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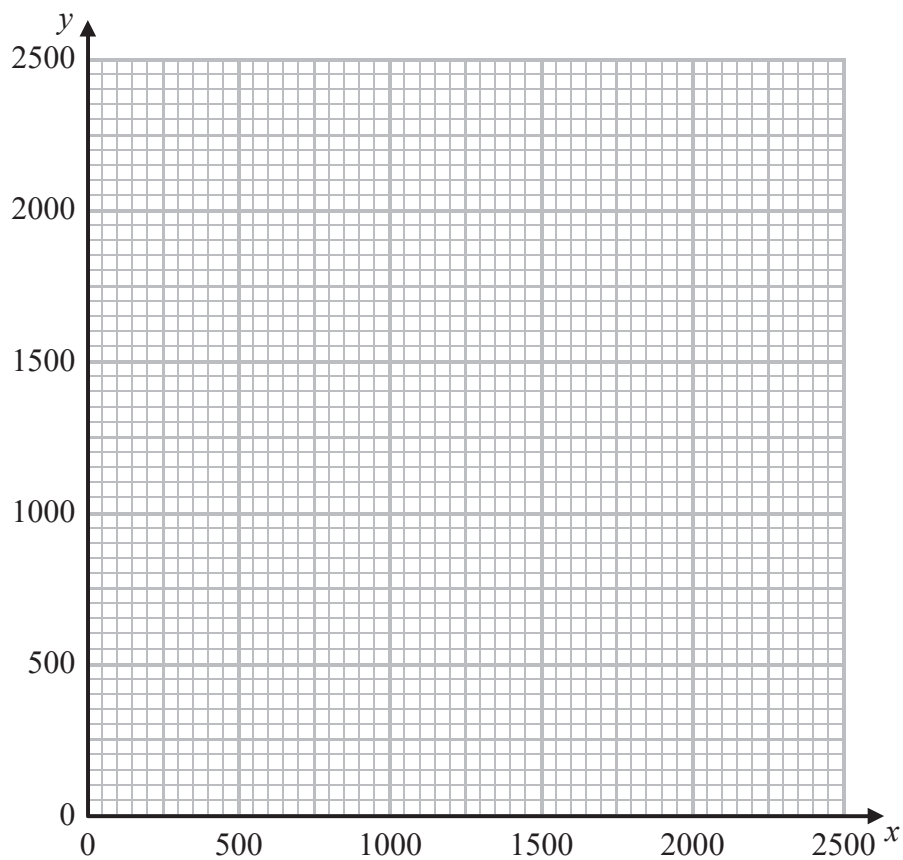
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(b) On the grid, show all the constraints.  
Label the feasible region R.

(4)



(Total for Question 12 is 9 marks)

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



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