



Cambridge International AS & A Level

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MATHEMATICS

9709/51

Paper 5 Probability & Statistics 1

May/June 2023

1 hour 15 minutes

You must answer on the question paper.

You will need: List of formulae (MF19)

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
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INFORMATION

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- The number of marks for each question or part question is shown in brackets [].

This document has **16** pages. Any blank pages are indicated.

1 A summary of 50 values of x gives

$$\Sigma(x - q) = 700, \quad \Sigma(x - q)^2 = 14\,235,$$

where q is a constant.

(a) Find the standard deviation of these values of x . [2]

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(b) Given that $\Sigma x = 2865$, find the value of q . [2]

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- 2 (a) Find the number of ways in which a committee of 6 people can be chosen from 6 men and 8 women if it must include 3 men and 3 women. [2]

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A different committee of 6 people is to be chosen from 6 men and 8 women. Three of the 6 men are brothers.

- (b) Find the number of ways in which this committee can be chosen if there are no restrictions on the numbers of men and women, but it must include no more than two of the brothers. [3]

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3 (a) Find the number of different arrangements of the 8 letters in the word COCOONED. [1]

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(b) Find the number of different arrangements of the 8 letters in the word COCOONED in which the first letter is O and the last letter is N. [2]

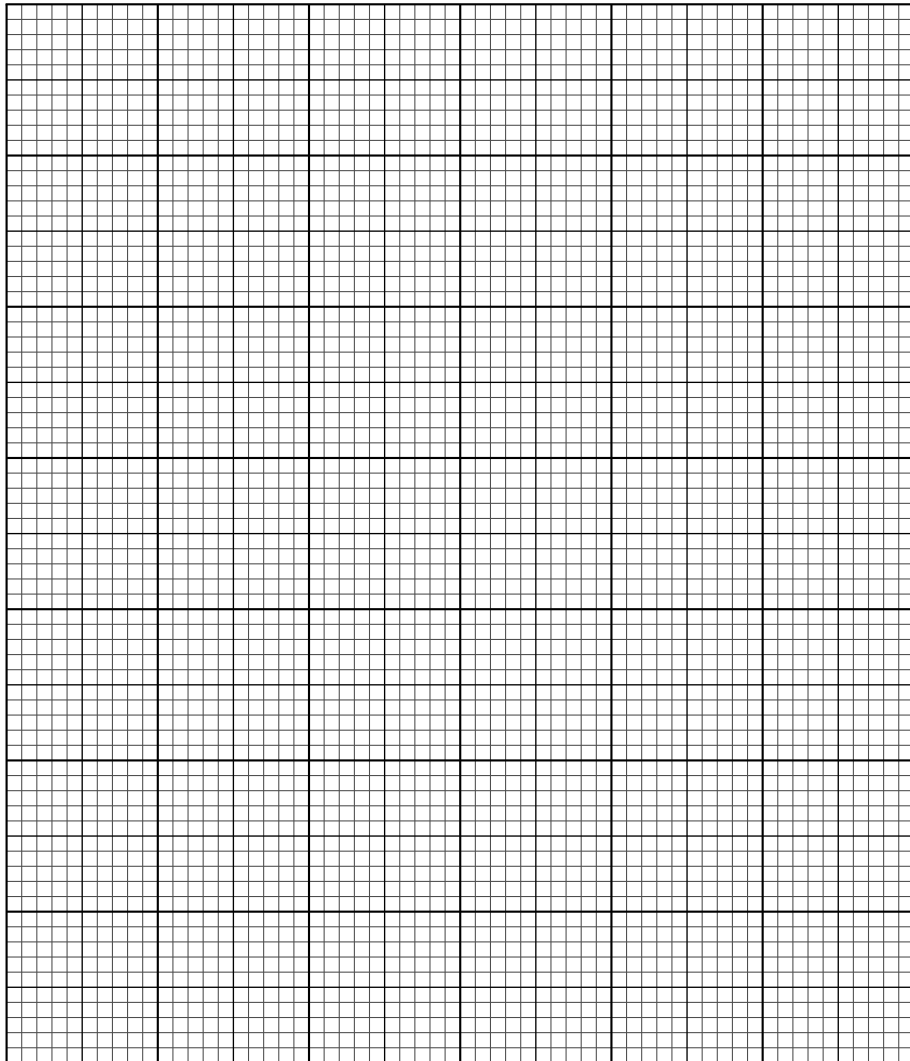
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- 5 The populations of 150 villages in the UK, to the nearest hundred, are summarised in the table.

Population	100 – 800	900 – 1200	1300 – 2000	2100 – 3200	3300 – 4800
Number of villages	8	12	50	48	32

- (a) Draw a histogram to represent this information.

[4]



7 A children’s wildlife magazine is published every Monday. For the next 12 weeks it will include a model animal as a free gift. There are five different models: tiger, leopard, rhinoceros, elephant and buffalo, each with the same probability of being included in the magazine.

Sahim buys one copy of the magazine every Monday.

(a) Find the probability that the first time that the free gift is an elephant is before the 6th Monday. [2]

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(b) Find the probability that Sahim will get more than two leopards in the 12 magazines. [3]

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MATHEMATICS

9709/52

Paper 5 Probability & Statistics 1

May/June 2023

1 hour 15 minutes

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1 The random variable X takes the values $-2, 2$ and 3 . It is given that

$$P(X = x) = k(x^2 - 1),$$

where k is a constant.

(a) Draw up the probability distribution table for X , giving the probabilities as numerical fractions. [3]

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(b) Find $E(X)$ and $\text{Var}(X)$. [3]

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2 A sports event is taking place for 4 days, beginning on Sunday. The probability that it will rain on Sunday is 0.4. On any subsequent day, the probability that it will rain is 0.7 if it rained on the previous day and 0.2 if it did not rain on the previous day.

(a) Find the probability that it does **not** rain on any of the 4 days of the event. [1]

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(b) Find the probability that the first day on which it rains during the event is Tuesday. [2]

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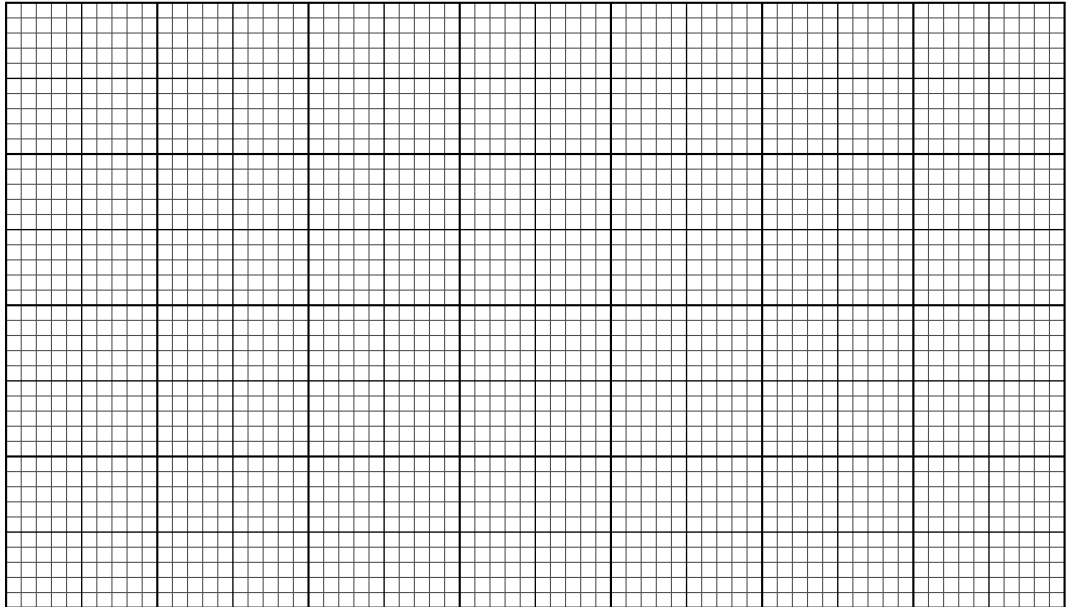
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The lower quartile, median and upper quartile for company *B* are \$2600, \$2690 and \$2780 respectively.

- (b) Draw two box-and-whisker plots in a single diagram to represent the information for the salaries of employees at companies *A* and *B*. [3]



- (c) Comment on whether the mean would be a more appropriate measure than the median for comparing the given information for the two companies. [1]

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- 4 A fair 5-sided spinner has sides labelled 1, 2, 3, 4, 5. The spinner is spun repeatedly until a 2 is obtained on the side on which the spinner lands. The random variable X denotes the number of spins required.

(a) Find $P(X = 4)$. [1]

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(b) Find $P(X < 6)$. [2]

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Two fair 5-sided spinners, each with sides labelled 1, 2, 3, 4, 5, are spun at the same time. If the numbers obtained are equal, the score is 0. Otherwise, the score is the higher number minus the lower number.

(c) Find the probability that the score is greater than 0 given that the score is **not** equal to 2. [3]

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The two spinners are spun at the same time repeatedly .

- (d) For 9 randomly chosen spins of the two spinners, find the probability that the score is greater than 2 on at least 3 occasions. [3]

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5 The lengths of Western bluebirds are normally distributed with mean 16.5 cm and standard deviation 0.6 cm.

A random sample of 150 of these birds is selected.

(a) How many of these 150 birds would you expect to have length between 15.4 cm and 16.8 cm? [4]

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The lengths of Eastern bluebirds are normally distributed with mean 18.4 cm and standard deviation σ cm. It is known that 72% of Eastern bluebirds have length greater than 17.1 cm.

(b) Find the value of σ . [3]

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6 In a group of 25 people there are 6 swimmers, 8 cyclists and 11 runners. Each person competes in only one of these sports. A team of 7 people is selected from these 25 people to take part in a competition.

(a) Find the number of different ways in which the team of 7 can be selected if it consists of exactly 1 swimmer, at least 4 cyclists and at most 2 runners. [4]

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For another competition, a team of 9 people consists of 2 swimmers, 3 cyclists and 4 runners. The team members stand in a line for a photograph.

(b) How many different arrangements are there of the 9 people if the swimmers stand together, the cyclists stand together and the runners stand together? [2]

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MATHEMATICS

9709/53

Paper 5 Probability & Statistics 1

May/June 2023

1 hour 15 minutes

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1 Two fair coins are thrown at the same time repeatedly until a pair of heads is obtained. The number of throws taken is denoted by the random variable X .

(a) State the value of $E(X)$. [1]

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(b) Find the probability that exactly 5 throws are required to obtain a pair of heads. [1]

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(c) Find the probability that fewer than 7 throws are required to obtain a pair of heads. [2]

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(b) Draw up the probability distribution table for X , giving the probabilities as numerical fractions. [1]

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(c) Given that $E(X) = 3.2$, find $\text{Var}(X)$. [2]

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- 4 The times taken, in minutes, to complete a cycle race by 19 cyclists from each of two clubs, the Cheetahs and the Panthers, are represented in the following back-to-back stem-and-leaf diagram.

Cheetahs		Panthers
9 8	7	4
8 7 3 2 0	8	6 8
9 8 7	9	1 7 8 9 9
6 5 3 3 1	10	2 3 4 4 5 6
9 8 2	11	1 2 8
4	12	0 6

Key: 7 | 9 | 1 means 97 minutes for Cheetahs and 91 minutes for Panthers

- (a) Find the median and the interquartile range of the times of the Cheetahs. [3]

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The median and interquartile range for the Panthers are 103 minutes and 14 minutes respectively.

- (b) Make two comparisons between the times taken by the Cheetahs and the times taken by the Panthers. [2]

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Another cyclist, Kenny, from the Cheetahs also took part in the race. The mean time taken by the 20 cyclists from the Cheetahs was 99 minutes.

- (c) Find the time taken by Kenny to complete the race. [3]

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5 Jasmine throws two ordinary fair 6-sided dice at the same time and notes the numbers on the uppermost faces. The events A and B are defined as follows.

A : The sum of the two numbers is less than 6.

B : The difference between the two numbers is at most 2.

(a) Determine whether or not the events A and B are independent. [4]

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(b) Find $P(B | A')$. [3]

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- 7 (a) Find the number of different arrangements of the 10 letters in the word CASABLANCA in which the two Cs are **not** together. [3]

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- (b) Find the number of different arrangements of the 10 letters in the word CASABLANCA which have an A at the beginning, an A at the end and exactly 3 letters between the 2 Cs. [3]

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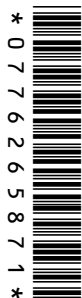
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MATHEMATICS

9709/52

Paper 5 Probability & Statistics 1

February/March 2023

1 hour 15 minutes

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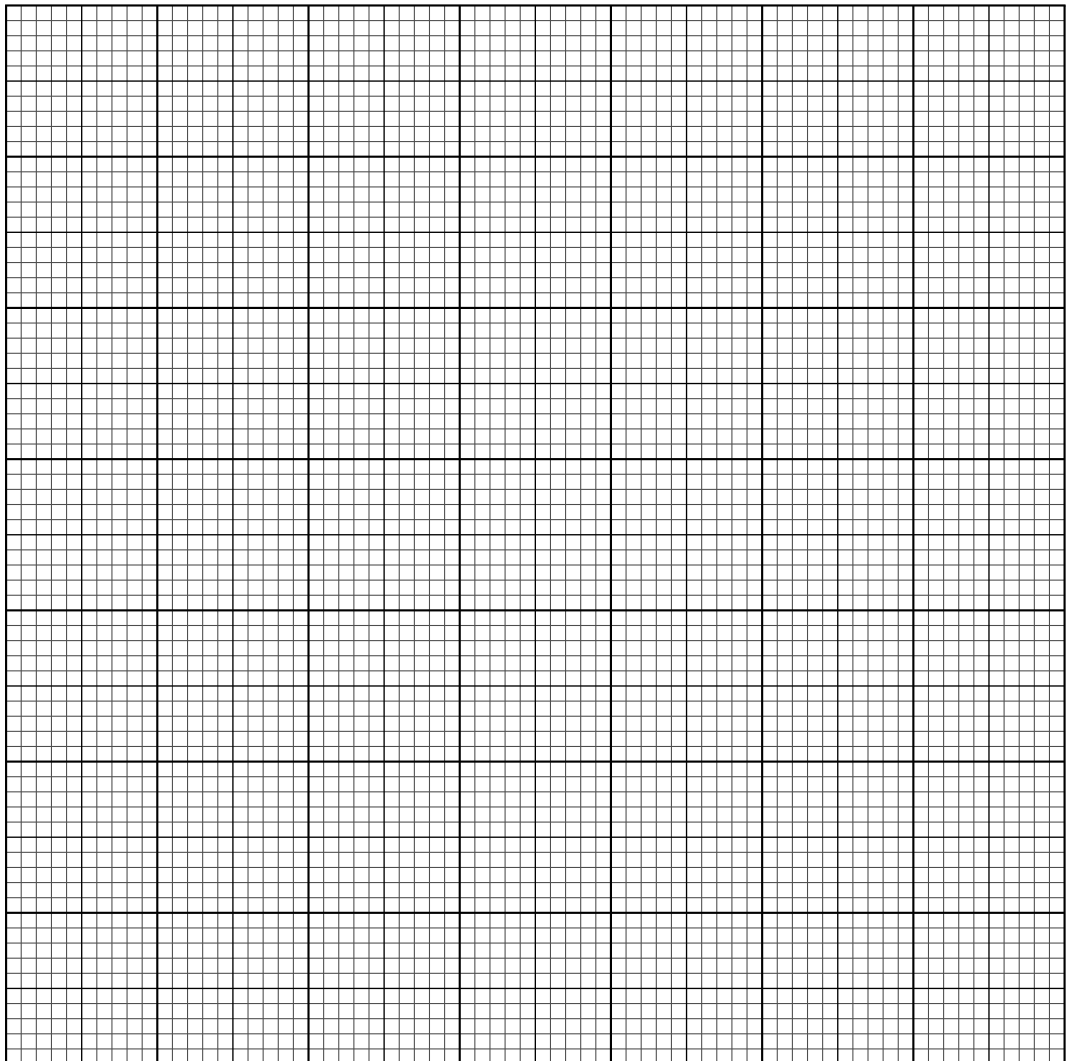
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- 1 Each year the total number of hours, x , of sunshine in Kintoo is recorded during the month of June. The results for the last 60 years are summarised in the table.

x	$30 \leq x < 60$	$60 \leq x < 90$	$90 \leq x < 110$	$110 \leq x < 140$	$140 \leq x < 180$	$180 \leq x \leq 240$
Number of years	4	8	14	25	7	2

- (a) Draw a cumulative frequency graph to illustrate the data.

[3]



(b) Use your graph to estimate the 70th percentile of the data. [2]

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(c) Calculate an estimate for the mean number of hours of sunshine in Kintoo during June over the last 60 years. [3]

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- (b) Find the probability that the 5th person asked is the first person who is **not** in favour of the leisure centre. [1]

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- (c) Find the probability that the 7th person asked is the second person who is **not** in favour of the leisure centre. [2]

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6 In a cycling event the times taken to complete a course are modelled by a normal distribution with mean 62.3 minutes and standard deviation 8.4 minutes.

(a) Find the probability that a randomly chosen cyclist has a time less than 74 minutes. [2]

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(b) Find the probability that 4 randomly chosen cyclists all have times between 50 and 74 minutes. [4]

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- 7 (a) Find the number of different arrangements of the 9 letters in the word DELIVERED in which the three Es are together and the two Ds are **not** next to each other. [4]

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- (b) Find the probability that a randomly chosen arrangement of the 9 letters in the word DELIVERED has exactly 4 letters between the two Ds. [5]

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Five letters are selected from the 9 letters in the word DELIVERED.

- (c) Find the number of different selections if the 5 letters include at least one D and at least one E. [3]

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- 1 (a) Find the number of different arrangements of the 8 letters in the word DECEIVED in which all three Es are together and the two Ds are together. [2]

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- (b) Find the number of different arrangements of the 8 letters in the word DECEIVED in which the three Es are not all together. [4]

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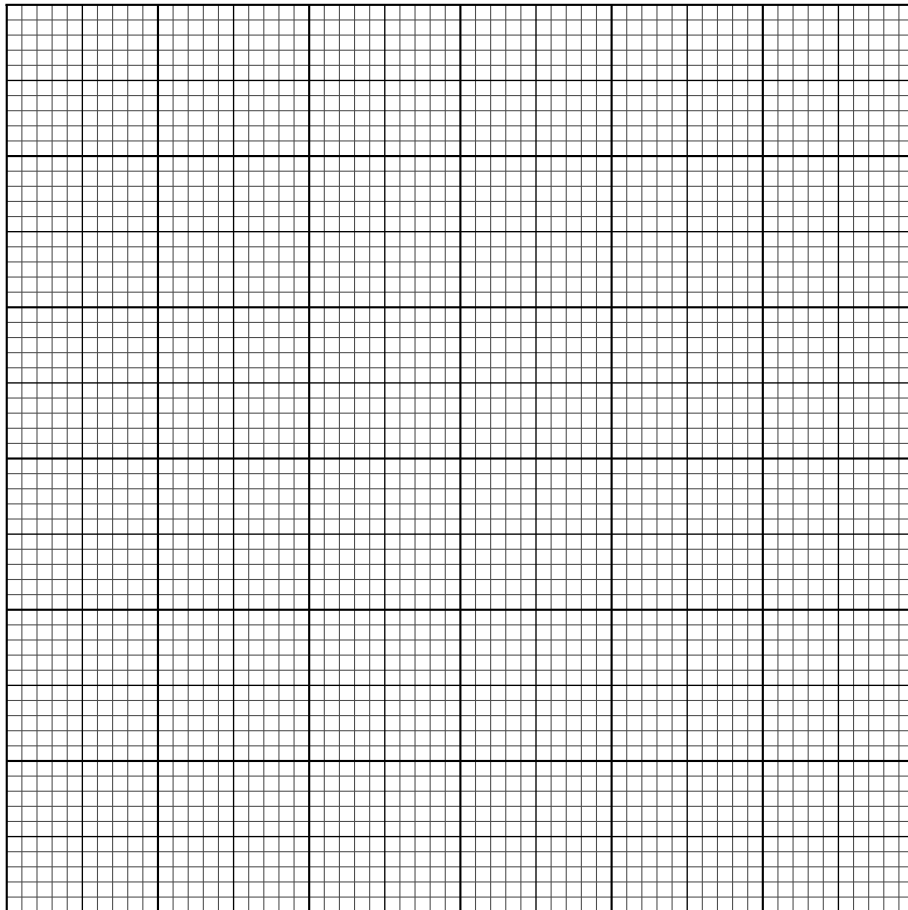
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3 The times taken to travel to college by 2500 students are summarised in the table.

Time taken (t minutes)	$0 \leq t < 20$	$20 \leq t < 30$	$30 \leq t < 40$	$40 \leq t < 60$	$60 \leq t < 90$
Frequency	440	720	920	300	120

(a) Draw a histogram to represent this information.

[4]



From the data, the estimate of the mean value of t is 31.44.

- (b) Calculate an estimate of the standard deviation of the times taken to travel to college. [3]

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- (c) In which class interval does the upper quartile lie? [1]

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It was later discovered that the times taken to travel to college by two students were incorrectly recorded. One student's time was recorded as 15 instead of 5 and the other's time was recorded as 65 instead of 75.

- (d) Without doing any further calculations, state with a reason whether the estimate of the standard deviation in part (b) would be increased, decreased or stay the same. [1]

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Jacob throws all four coins together 10 times.

- (c) Find the probability that he obtains exactly one head on fewer than 3 occasions. [3]

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- (d) Find the probability that Jacob obtains exactly one head for the first time on the 7th or 8th time that he throws the 4 coins. [2]

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5 The lengths, in cm, of the leaves of a particular type are modelled by the distribution $N(5.2, 1.5^2)$.

(a) Find the probability that a randomly chosen leaf of this type has length less than 6 cm. [2]

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The lengths of the leaves of another type are also modelled by a normal distribution. A scientist measures the lengths of a random sample of 500 leaves of this type and finds that 46 are less than 3 cm long and 95 are more than 8 cm long.

(b) Find estimates for the mean and standard deviation of the lengths of leaves of this type. [5]

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(c) In a random sample of 2000 leaves of this second type, how many would the scientist expect to find with lengths more than 1 standard deviation from the mean? [4]

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6 Janice is playing a computer game. She has to complete level 1 and level 2 to finish the game. She is allowed at most two attempts at any level.

- For level 1, the probability that Janice completes it at the first attempt is 0.6. If she fails at her first attempt, the probability that she completes it at the second attempt is 0.3.
- If Janice completes level 1, she immediately moves on to level 2.
- For level 2, the probability that Janice completes it at the first attempt is 0.4. If she fails at her first attempt, the probability that she completes it at the second attempt is 0.2.

(a) Show that the probability that Janice moves on to level 2 is 0.72. [1]

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(b) Find the probability that Janice finishes the game. [3]

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Cambridge International AS & A Level

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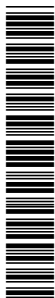
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* 8 2 8 0 4 3 3 9 6 1 *



MATHEMATICS

9709/52

Paper 5 Probability & Statistics 1

May/June 2022

1 hour 15 minutes

You must answer on the question paper.

You will need: List of formulae (MF19)

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- If additional space is needed, you should use the lined page at the end of this booklet; the question number or numbers must be clearly shown.
- You should use a calculator where appropriate.
- You must show all necessary working clearly; no marks will be given for unsupported answers from a calculator.
- Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place for angles in degrees, unless a different level of accuracy is specified in the question.

INFORMATION

- The total mark for this paper is 50.
- The number of marks for each question or part question is shown in brackets [].

This document has **16** pages. Any blank pages are indicated.

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2 A fair 6-sided die has the numbers 1, 2, 2, 3, 3, 3 on its faces. The die is rolled twice. The random variable X denotes the sum of the two numbers obtained.

(a) Draw up the probability distribution table for X . [3]

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(b) Find $E(X)$ and $\text{Var}(X)$. [3]

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- 3 The back-to-back stem-and-leaf diagram shows the diameters, in cm, of 19 cylindrical pipes produced by each of two companies, *A* and *B*.

Company <i>A</i>							Company <i>B</i>				
					4	33	1	2	8		
	9	8	3	2	0	34	1	6	8	9	9
8	7	5	4	1	1	35	1	2	2	3	
		9	6	5	2	36	5	6			
			4	3	1	37	0	3	4		
						38	2	8			

Key: 1 | 35 | 3 means the pipe diameter from company *A* is 0.351 cm and from company *B* is 0.353 cm.

- (a) Find the median and interquartile range of the pipes produced by company *A*. [3]

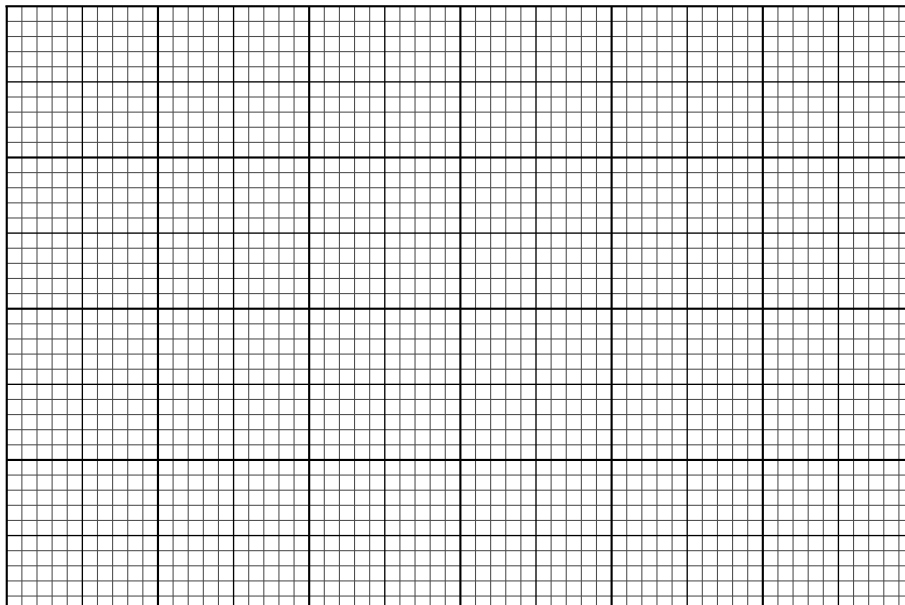
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It is given that for the pipes produced by company *B* the lower quartile, median and upper quartile are 0.346 cm, 0.352 cm and 0.370 cm respectively.

- (b) Draw box-and-whisker plots for companies *A* and *B* on the grid below. [3]



- (c) Make one comparison between the diameters of the pipes produced by companies *A* and *B*. [1]

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6 (a) Find the number of different arrangements of the 9 letters in the word CROCODILE. [1]

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(b) Find the number of different arrangements of the 9 letters in the word CROCODILE in which there is a C at each end and the two Os are not together. [3]

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- (c) Four letters are selected from the 9 letters in the word CROCODILE.

Find the number of selections in which the number of Cs is not the same as the number of Os.

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- (d) Find the number of ways in which the 9 letters in the word CROCODILE can be divided into three groups, each containing three letters, if the two Cs must be in different groups. [3]

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- (b) Find the probability that all 3 eggs chosen contain a yellow sweet, given that all three children have the same colour sweet. [2]

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- (c) Find the probability that at least one of Hanna’s three children chooses an egg that contains an orange sweet. [3]

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MATHEMATICS

9709/53

Paper 5 Probability & Statistics 1

May/June 2022

1 hour 15 minutes

You must answer on the question paper.

You will need: List of formulae (MF19)

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
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- You should use a calculator where appropriate.
- You must show all necessary working clearly; no marks will be given for unsupported answers from a calculator.
- Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place for angles in degrees, unless a different level of accuracy is specified in the question.

INFORMATION

- The total mark for this paper is 50.
- The number of marks for each question or part question is shown in brackets [].

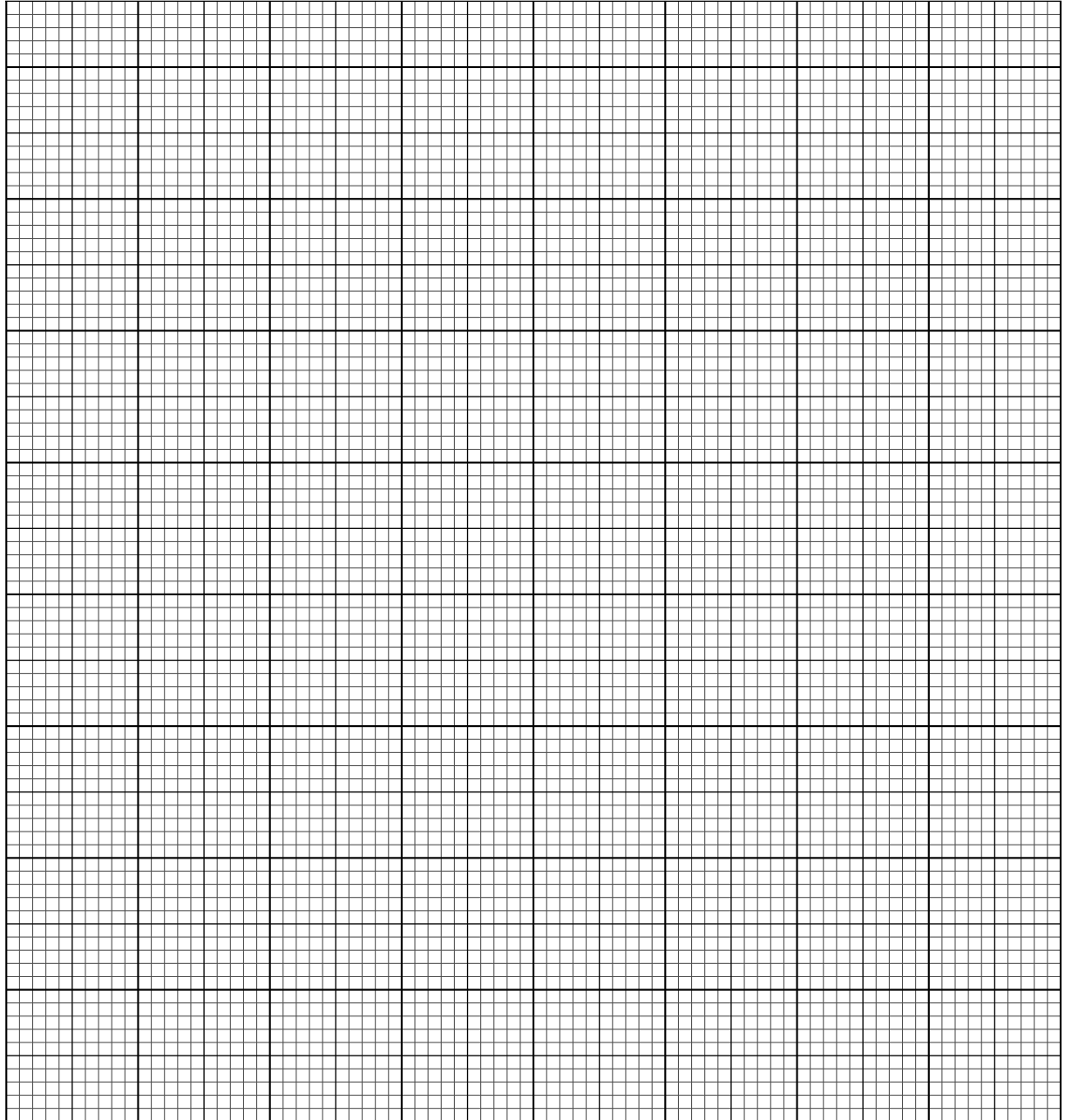
This document has **12** pages.

- 1 The time taken, t minutes, to complete a puzzle was recorded for each of 150 students. These times are summarised in the table.

Time taken (t minutes)	$t \leq 25$	$t \leq 50$	$t \leq 75$	$t \leq 100$	$t \leq 150$	$t \leq 200$
Cumulative frequency	16	44	86	104	132	150

- (a) Draw a cumulative frequency graph to illustrate the data.

[2]



- (b) Use your graph to estimate the 20th percentile of the data.

[1]

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2 Twenty children were asked to estimate the height of a particular tree. Their estimates, in metres, were as follows.

4.1	4.2	4.4	4.5	4.6	4.8	5.0	5.2	5.3	5.4
5.5	5.8	6.0	6.2	6.3	6.4	6.6	6.8	6.9	19.4

(a) Find the mean of the estimated heights. [1]

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(b) Find the median of the estimated heights. [1]

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(c) Give a reason why the median is likely to be more suitable than the mean as a measure of the central tendency for this information. [1]

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3 The random variable X takes the values $-2, 1, 2, 3$. It is given that $P(X = x) = kx^2$, where k is a constant.

(a) Draw up the probability distribution table for X , giving the probabilities as numerical fractions. [3]

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(b) Find $E(X)$ and $\text{Var}(X)$. [3]

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Farmer Jones sells the apples to the supermarket at \$0.24 each. He sells apples that weigh more than 205 grams to a local shop at \$0.30 each. He does not sell apples that weigh less than 142 grams.

The total number of apples grown by Farmer Jones this year is 20 000.

- (b) Calculate an estimate for his total income from this year's apples. [3]

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Farmer Tan also grows apples. The weights, in grams, of the apples grown this year follow the distribution $N(182, 20^2)$. 72% of these apples have a weight more than w grams.

- (c) Find the value of w . [3]

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- 6 Sajid is practising for a long jump competition. He counts any jump that is longer than 6 m as a success. On any day, the probability that he has a success with his first jump is 0.2. For any subsequent jump, the probability of a success is 0.3 if the previous jump was a success and 0.1 otherwise. Sajid makes three jumps.
- (a) Draw a tree diagram to illustrate this information, showing all the probabilities. [2]

(b) Find the probability that Sajid has exactly one success given that he has at least one success. [5]

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On another day, Sajid makes six jumps.

(c) Find the probability that only his first three jumps are successes or only his last three jumps are successes. [3]

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7 A group of 15 friends visit an adventure park. The group consists of four families.

- Mr and Mrs Kenny and their four children
- Mr and Mrs Lizo and their three children
- Mrs Martin and her child
- Mr and Mrs Nantes

The group travel to the park in three cars, one containing 6 people, one containing 5 people and one containing 4 people. The cars are driven by Mr Lizo, Mrs Martin and Mr Nantes respectively.

(a) In how many different ways can the remaining 12 members of the group be divided between the three cars? [3]

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The group enter the park by walking through a gate one at a time.

(b) In how many different orders can the 15 friends go through the gate if Mr Lizo goes first and each family stays together? [3]

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In the park, the group enter a competition which requires a team of 4 adults and 3 children.

- (c) In how many ways can the team be chosen from the group of 15 so that the 3 children are all from different families? [2]

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- (d) In how many ways can the team be chosen so that at least one of Mr Kenny or Mr Lizo is included? [3]

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MATHEMATICS

9709/52

Paper 5 Probability & Statistics 1

February/March 2022

1 hour 15 minutes

You must answer on the question paper.

You will need: List of formulae (MF19)

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
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- You must show all necessary working clearly; no marks will be given for unsupported answers from a calculator.
- Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place for angles in degrees, unless a different level of accuracy is specified in the question.

INFORMATION

- The total mark for this paper is 50.
- The number of marks for each question or part question is shown in brackets [].

This document has **12** pages. Any blank pages are indicated.

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1 A fair red spinner has edges numbered 1, 2, 2, 3. A fair blue spinner has edges numbered $-3, -2, -1, -1$. Each spinner is spun once and the number on the edge on which each spinner lands is noted. The random variable X denotes the sum of the resulting two numbers.

(a) Draw up the probability distribution table for X . [3]

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(b) Given that $E(X) = 0.25$, find the value of $\text{Var}(X)$. [2]

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2 In a certain country, the probability of more than 10cm of rain on any particular day is 0.18, independently of the weather on any other day.

(a) Find the probability that in any randomly chosen 7-day period, more than 2 days have more than 10cm of rain. [3]

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(b) For 3 randomly chosen 7-day periods, find the probability that exactly two of these periods have at least one day with more than 10cm of rain. [3]

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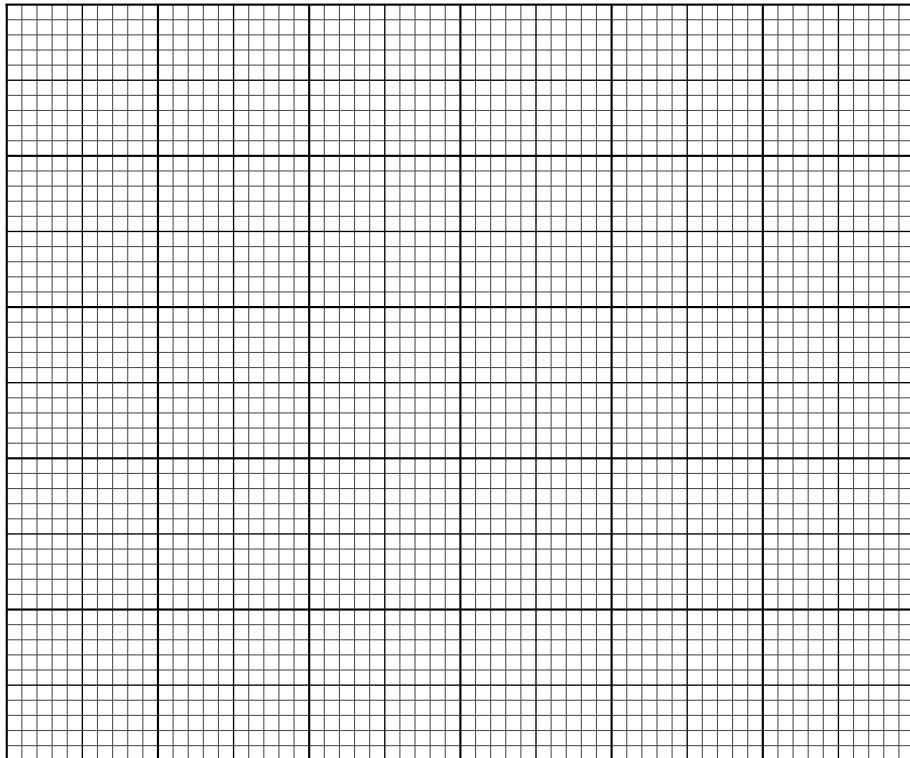
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- 3 At a summer camp an arithmetic test is taken by 250 children. The times taken, to the nearest minute, to complete the test were recorded. The results are summarised in the table.

Time taken, in minutes	1 – 30	31 – 45	46 – 65	66 – 75	76 – 100
Frequency	21	30	68	86	45

- (a) Draw a histogram to represent this information. [4]



- (b) State which class interval contains the median. [1]

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- (c) Given that an estimate of the mean time is 61.05 minutes, state what feature of the distribution accounts for the median and the mean being different. [1]

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4 The weights of male leopards in a particular region are normally distributed with mean 55 kg and standard deviation 6 kg.

(a) Find the probability that a randomly chosen male leopard from this region weighs between 46 and 62 kg. [4]

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The weights of female leopards in this region are normally distributed with mean 42 kg and standard deviation σ kg. It is known that 25% of female leopards in the region weigh less than 36 kg.

(b) Find the value of σ . [3]

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6 A factory produces chocolates in three flavours: lemon, orange and strawberry in the ratio 3 : 5 : 7 respectively. Nell checks the chocolates on the production line by choosing chocolates randomly one at a time.

(a) Find the probability that the first chocolate with lemon flavour that Nell chooses is the 7th chocolate that she checks. [1]

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(b) Find the probability that the first chocolate with lemon flavour that Nell chooses is after she has checked at least 6 chocolates. [2]

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‘Surprise’ boxes of chocolates each contain 15 chocolates: 3 are lemon, 5 are orange and 7 are strawberry.

Petra has a box of Surprise chocolates. She chooses 3 chocolates at random from the box. She eats each chocolate before choosing the next one.

(c) Find the probability that none of Petra’s 3 chocolates has orange flavour. [2]

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- (d) Find the probability that each of Petra's 3 chocolates has a different flavour. [3]

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- (e) Find the probability that at least 2 of Petra's 3 chocolates have strawberry flavour given that none of them has orange flavour. [4]

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MATHEMATICS

9709/51

Paper 5 Probability & Statistics 1

October/November 2021

1 hour 15 minutes

You must answer on the question paper.

You will need: List of formulae (MF19)

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
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- You must show all necessary working clearly; no marks will be given for unsupported answers from a calculator.
- Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place for angles in degrees, unless a different level of accuracy is specified in the question.

INFORMATION

- The total mark for this paper is 50.
- The number of marks for each question or part question is shown in brackets [].

This document has **12** pages.

1 Two fair coins are thrown at the same time. The random variable X is the number of throws of the two coins required to obtain two tails at the same time.

(a) Find the probability that two tails are obtained for the first time on the 7th throw. [2]

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(b) Find the probability that it takes more than 9 throws to obtain two tails for the first time. [2]

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2 A summary of 40 values of x gives the following information:

$$\Sigma(x - k) = 520, \quad \Sigma(x - k)^2 = 9640,$$

where k is a constant.

(a) Given that the mean of these 40 values of x is 34, find the value of k . [2]

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(b) Find the variance of these 40 values of x . [2]

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- 4 A fair spinner has edges numbered 0, 1, 2, 2. Another fair spinner has edges numbered $-1, 0, 1$. Each spinner is spun. The number on the edge on which a spinner comes to rest is noted. The random variable X is the sum of the numbers for the two spinners.

(a) Draw up the probability distribution table for X . [3]

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(b) Find $\text{Var}(X)$. [3]

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For the second photograph, the members will stand in two rows, with 5 in the back row and 4 in the front row.

- (c) In how many different ways can the 9 members be divided into a group of 5 and a group of 4? [2]

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- (d) For a random division into a group of 5 and a group of 4, find the probability that Raman and Sanjay are in the same group as each other. [4]

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- 6 The weights, in kg, of 15 rugby players in the Rebels club and 15 soccer players in the Sharks club are shown below.

Rebels	75	78	79	80	82	82	83	84	85	86	89	93	95	99	102
Sharks	66	68	71	72	74	75	75	76	78	83	83	84	85	86	92

- (a) Represent the data by drawing a back-to-back stem-and-leaf diagram with Rebels on the left-hand side of the diagram. [4]

- (b) Find the median and the interquartile range for the Rebels. [3]

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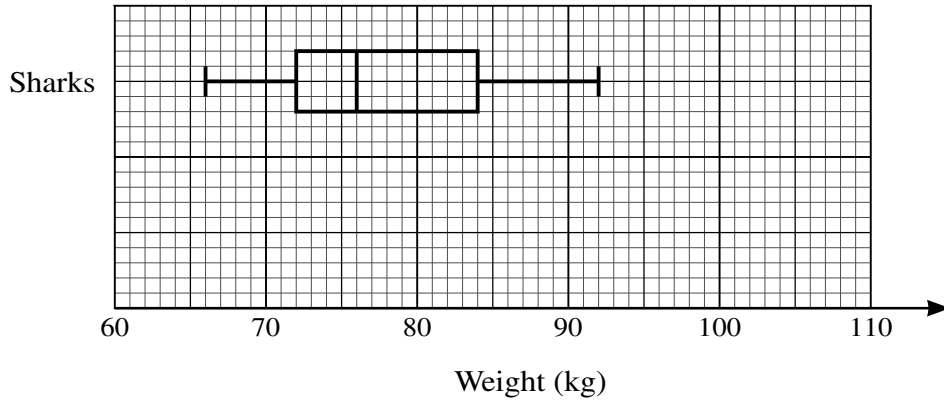
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A box-and-whisker plot for the Sharks is shown below.



(c) On the same diagram, draw a box-and-whisker plot for the Rebels. [2]

(d) Make one comparison between the weights of the players in the Rebels club and the weights of the players in the Sharks club. [1]

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(b) On 90% of days, Karli spends more than t minutes on social media.

Find the value of t .

[3]

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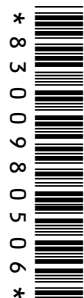
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MATHEMATICS

9709/52

Paper 5 Probability & Statistics 1

October/November 2021

1 hour 15 minutes

You must answer on the question paper.

You will need: List of formulae (MF19)

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
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- Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place for angles in degrees, unless a different level of accuracy is specified in the question.

INFORMATION

- The total mark for this paper is 50.
- The number of marks for each question or part question is shown in brackets [].

This document has **12** pages.

2 A group of 6 people is to be chosen from 4 men and 11 women.

(a) In how many different ways can a group of 6 be chosen if it must contain exactly 1 man? [2]

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Two of the 11 women are sisters Jane and Kate.

(b) In how many different ways can a group of 6 be chosen if Jane and Kate cannot both be in the group? [3]

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- 3** A bag contains 5 yellow and 4 green marbles. Three marbles are selected at random from the bag, without replacement.

(a) Show that the probability that exactly one of the marbles is yellow is $\frac{5}{14}$. [3]

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The random variable X is the number of yellow marbles selected.

(b) Draw up the probability distribution table for X . [3]

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5 In a certain region, the probability that any given day in October is wet is 0.16, independently of other days.

(a) Find the probability that, in a 10-day period in October, fewer than 3 days will be wet. [3]

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(b) Find the probability that the first wet day in October is 8 October. [2]

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(c) For 4 randomly chosen years, find the probability that in exactly 1 of these years the first wet day in October is 8 October. [2]

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6 The times taken, in minutes, to complete a particular task by employees at a large company are normally distributed with mean 32.2 and standard deviation 9.6.

(a) Find the probability that a randomly chosen employee takes more than 28.6 minutes to complete the task. [3]

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(b) 20% of employees take longer than t minutes to complete the task.
Find the value of t . [3]

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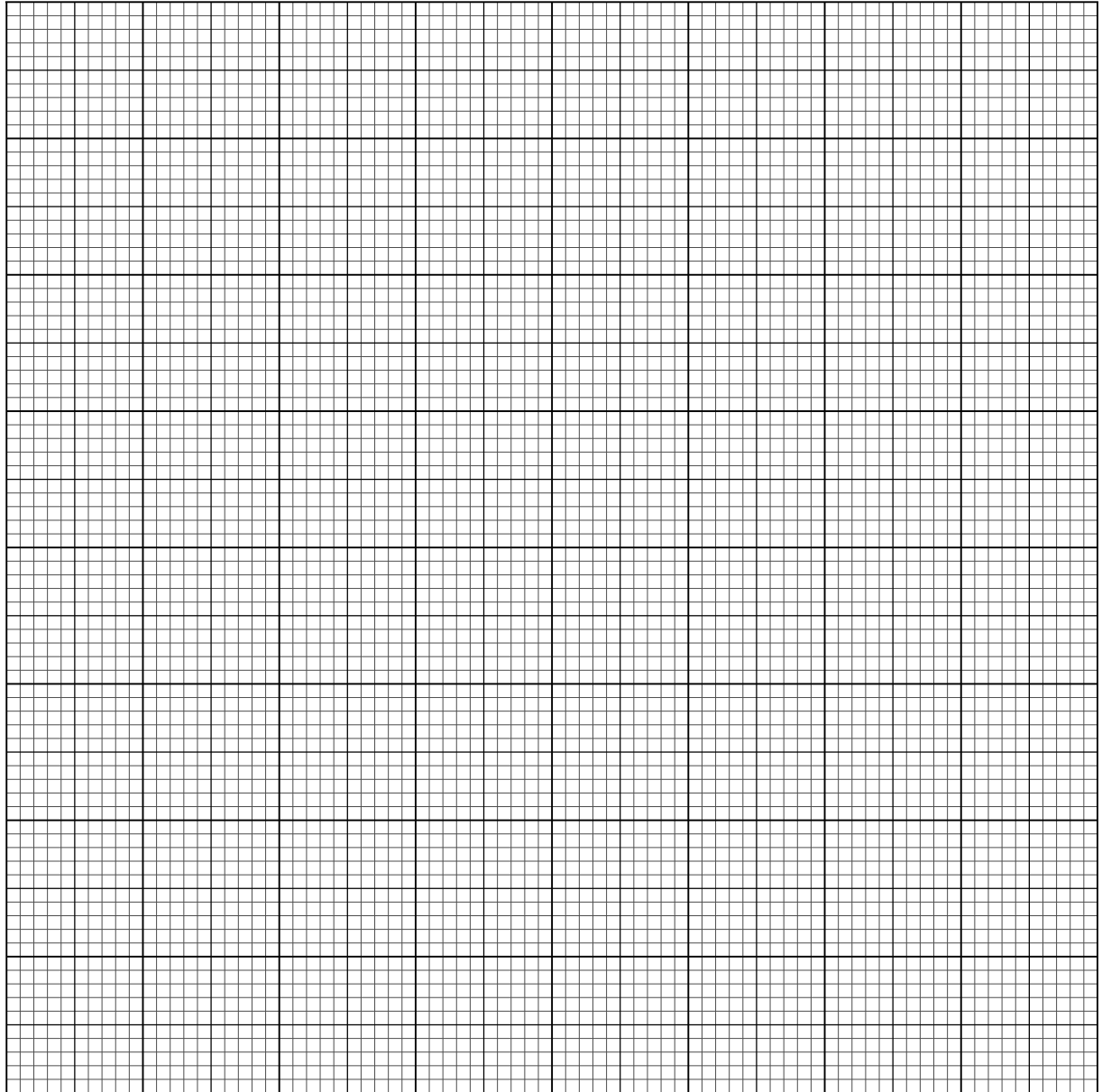
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7 The distances, x m, travelled to school by 140 children were recorded. The results are summarised in the table below.

Distance, x m	$x \leq 200$	$x \leq 300$	$x \leq 500$	$x \leq 900$	$x \leq 1200$	$x \leq 1600$
Cumulative frequency	16	46	88	122	134	140

(a) On the grid, draw a cumulative frequency graph to represent these results. [2]





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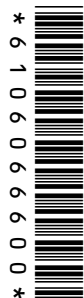
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MATHEMATICS

9709/53

Paper 5 Probability & Statistics 1

October/November 2021

1 hour 15 minutes

You must answer on the question paper.

You will need: List of formulae (MF19)

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
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- You should use a calculator where appropriate.
- You must show all necessary working clearly; no marks will be given for unsupported answers from a calculator.
- Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place for angles in degrees, unless a different level of accuracy is specified in the question.

INFORMATION

- The total mark for this paper is 50.
- The number of marks for each question or part question is shown in brackets [].

This document has **16** pages. Any blank pages are indicated.

- 2 Lakeview and Riverside are two schools. The pupils at both schools took part in a competition to see how far they could throw a ball. The distances thrown, to the nearest metre, by 11 pupils from each school are shown in the following table.

Lakeview	10	14	19	22	26	27	28	30	32	33	41
Riverside	23	36	21	18	37	25	18	20	24	30	25

- (a) Draw a back-to-back stem-and-leaf diagram to represent this information, with Lakeview on the left-hand side. [4]

- (b) Find the interquartile range of the distances thrown by the 11 pupils at Lakeview school. [2]

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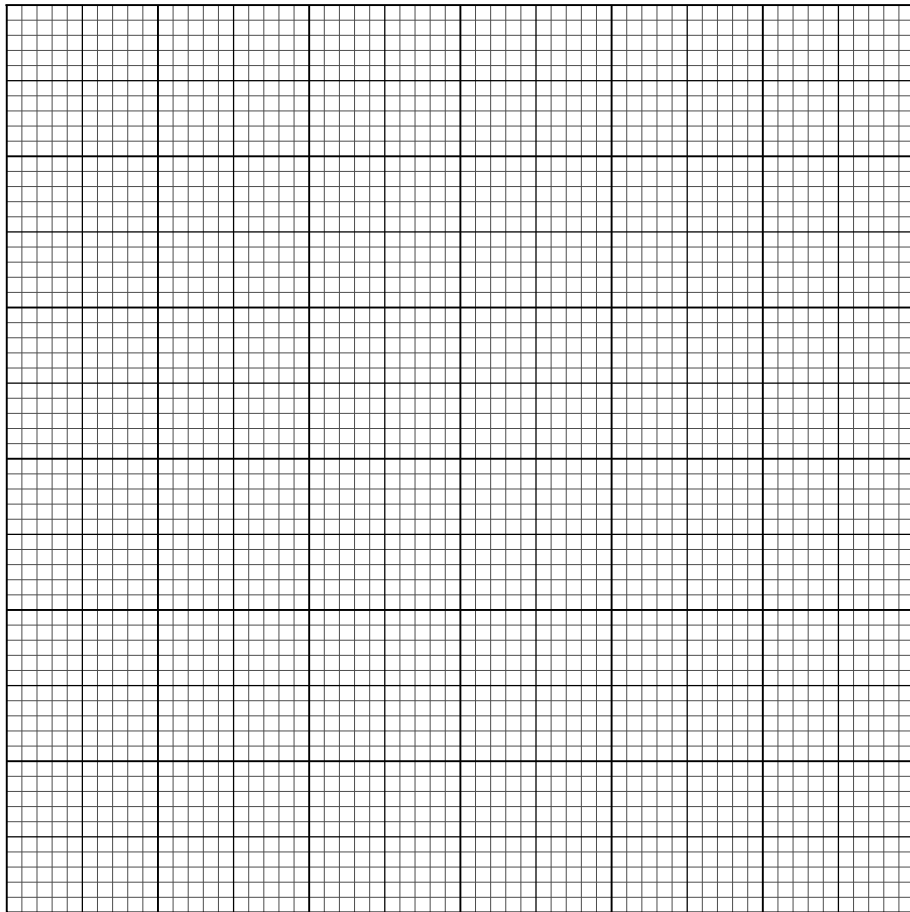
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- 3 The times taken, in minutes, by 360 employees at a large company to travel from home to work are summarised in the following table.

Time, t minutes	$0 \leq t < 5$	$5 \leq t < 10$	$10 \leq t < 20$	$20 \leq t < 30$	$30 \leq t < 50$
Frequency	23	102	135	76	24

- (a) Draw a histogram to represent this information.

[4]



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4 Raj wants to improve his fitness, so every day he goes for a run. The times, in minutes, of his runs have a normal distribution with mean 41.2 and standard deviation 3.6.

(a) Find the probability that on a randomly chosen day Raj runs for more than 43.2 minutes. [3]

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(b) Find an estimate for the number of days in a year (365 days) on which Raj runs for less than 43.2 minutes. [2]

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5 A security code consists of 2 letters followed by a 4-digit number. The letters are chosen from {A, B, C, D, E} and the digits are chosen from {1, 2, 3, 4, 5, 6, 7}. No letter or digit may appear more than once. An example of a code is BE3216.

(a) How many different codes can be formed? [2]

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(b) Find the number of different codes that include the letter A or the digit 5 or both. [3]

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- 6 In a game, Jim throws three darts at a board. This is called a ‘turn’. The centre of the board is called the bull’s-eye.

The random variable X is the number of darts in a turn that hit the bull’s-eye. The probability distribution of X is given in the following table.

x	0	1	2	3
$P(X = x)$	0.6	p	q	0.05

It is given that $E(X) = 0.55$.

- (a) Find the values of p and q . [4]

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- (b) Find $\text{Var}(X)$. [2]

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Jim is practising for a competition and he repeatedly throws three darts at the board.

- (c) Find the probability that $X = 1$ in at least 3 of 12 randomly chosen turns. [3]

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- (d) Find the probability that Jim first succeeds in hitting the bull’s-eye with all three darts on his 9th turn. [1]

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MATHEMATICS

9709/51

Paper 5 Probability & Statistics 1

May/June 2021

1 hour 15 minutes

You must answer on the question paper.

You will need: List of formulae (MF19)

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
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- Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place for angles in degrees, unless a different level of accuracy is specified in the question.

INFORMATION

- The total mark for this paper is 50.
- The number of marks for each question or part question is shown in brackets [].

This document has **16** pages. Any blank pages are indicated.

4 To gain a place at a science college, students first have to pass a written test and then a practical test.

Each student is allowed a maximum of two attempts at the written test. A student is only allowed a second attempt if they fail the first attempt. No student is allowed more than one attempt at the practical test. If a student fails both attempts at the written test, then they cannot attempt the practical test.

The probability that a student will pass the written test at the first attempt is 0.8. If a student fails the first attempt at the written test, the probability that they will pass at the second attempt is 0.6. The probability that a student will pass the practical test is always 0.3.

(a) Draw a tree diagram to represent this information, showing the probabilities on the branches. [3]

(b) Find the probability that a randomly chosen student will succeed in gaining a place at the college. [2]

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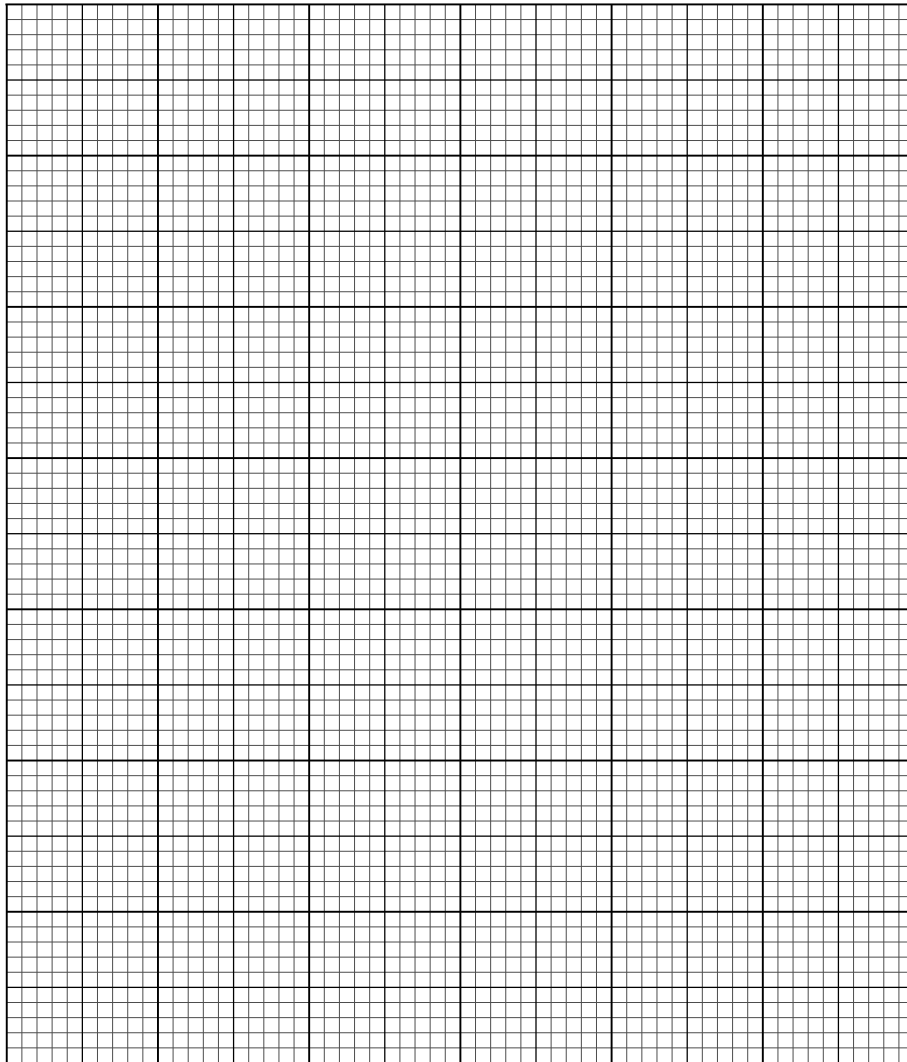
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5 The times taken by 200 players to solve a computer puzzle are summarised in the following table.

Time (t seconds)	$0 \leq t < 10$	$10 \leq t < 20$	$20 \leq t < 40$	$40 \leq t < 60$	$60 \leq t < 100$
Number of players	16	54	78	32	20

(a) Draw a histogram to represent this information.

[4]



7 Sharma knows that she has 3 tins of carrots, 2 tins of peas and 2 tins of sweetcorn in her cupboard. All the tins are the same shape and size, but the labels have all been removed, so Sharma does not know what each tin contains.

Sharma wants carrots for her meal, and she starts opening the tins one at a time, chosen randomly, until she opens a tin of carrots. The random variable X is the number of tins that she needs to open.

(a) Show that $P(X = 3) = \frac{6}{35}$. [2]

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(b) Draw up the probability distribution table for X . [4]

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MATHEMATICS

9709/52

Paper 5 Probability & Statistics 1

May/June 2021

1 hour 15 minutes

You must answer on the question paper.

You will need: List of formulae (MF19)

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
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This document has **12** pages.

1 An ordinary fair die is thrown repeatedly until a 5 is obtained. The number of throws taken is denoted by the random variable X .

(a) Write down the mean of X . [1]

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(b) Find the probability that a 5 is first obtained after the 3rd throw but before the 8th throw. [2]

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(c) Find the probability that a 5 is first obtained in fewer than 10 throws. [2]

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- 3 On each day that Alexa goes to work, the probabilities that she travels by bus, by train or by car are 0.4, 0.35 and 0.25 respectively. When she travels by bus, the probability that she arrives late is 0.55. When she travels by train, the probability that she arrives late is 0.7. When she travels by car, the probability that she arrives late is x .

On a randomly chosen day when Alexa goes to work, the probability that she does not arrive late is 0.48.

- (a) Find the value of x . [3]

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- (b) Find the probability that Alexa travels to work by train given that she arrives late. [3]

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- 4 A fair spinner has sides numbered 1, 2, 2. Another fair spinner has sides numbered -2 , 0, 1. Each spinner is spun. The number on the side on which a spinner comes to rest is noted. The random variable X is the sum of the numbers for the two spinners.

(a) Draw up the probability distribution table for X . [3]

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(b) Find $E(X)$ and $\text{Var}(X)$. [3]

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6 (a) Find the total number of different arrangements of the 8 letters in the word TOMORROW. [2]

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(b) Find the total number of different arrangements of the 8 letters in the word TOMORROW that have an R at the beginning and an R at the end, and in which the three Os are not all together.

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7 The heights, in cm, of the 11 basketball players in each of two clubs, the Amazons and the Giants, are shown below.

Amazons	205	198	181	182	190	215	201	178	202	196	184
Giants	175	182	184	187	189	192	193	195	195	195	204

(a) State an advantage of using a stem-and-leaf diagram compared to a box-and-whisker plot to illustrate this information. [1]

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(b) Represent the data by drawing a back-to-back stem-and-leaf diagram with Amazons on the left-hand side of the diagram. [4]

(c) Find the interquartile range of the heights of the players in the Amazons. [2]

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Four new players join the Amazons. The mean height of the 15 players in the Amazons is now 191.2 cm. The heights of three of the new players are 180 cm, 185 cm and 190 cm.

(d) Find the height of the fourth new player. [3]

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MATHEMATICS

9709/53

Paper 5 Probability & Statistics 1

May/June 2021

1 hour 15 minutes

You must answer on the question paper.

You will need: List of formulae (MF19)

INSTRUCTIONS

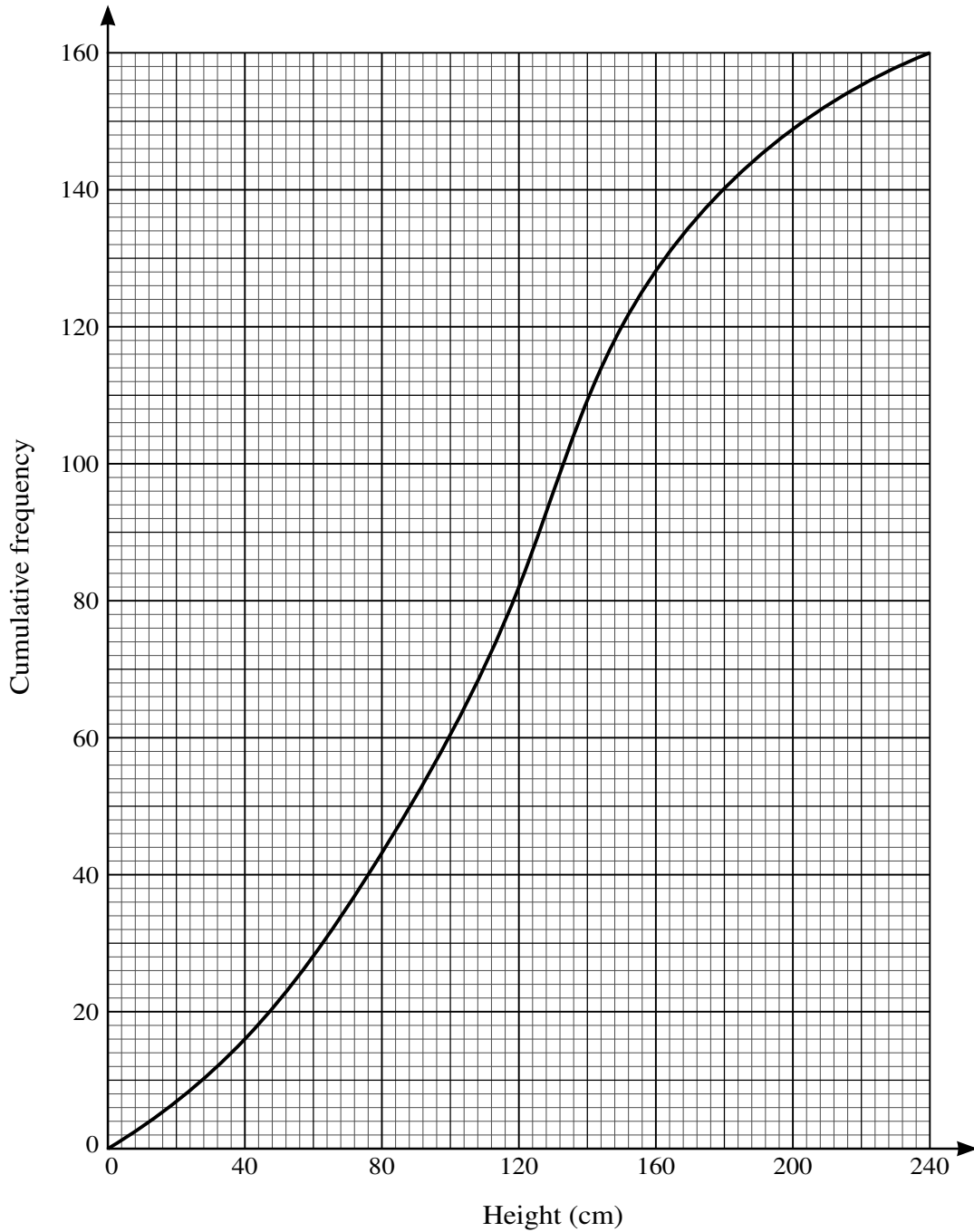
- Answer **all** questions.
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INFORMATION

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- The number of marks for each question or part question is shown in brackets [].

This document has **16** pages. Any blank pages are indicated.

- 1 The heights in cm of 160 sunflower plants were measured. The results are summarised on the following cumulative frequency curve.



- (a) Use the graph to estimate the number of plants with heights less than 100 cm. [1]

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(b) Use the graph to estimate the 65th percentile of the distribution. [2]

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(c) Use the graph to estimate the interquartile range of the heights of these plants. [2]

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3 A sports club has a volleyball team and a hockey team. The heights of the 6 members of the volleyball team are summarised by $\Sigma x = 1050$ and $\Sigma x^2 = 193\,700$, where x is the height of a member in cm. The heights of the 11 members of the hockey team are summarised by $\Sigma y = 1991$ and $\Sigma y^2 = 366\,400$, where y is the height of a member in cm.

(a) Find the mean height of all 17 members of the club. [2]

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(b) Find the standard deviation of the heights of all 17 members of the club. [3]

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6 (a) How many different arrangements are there of the 11 letters in the word REQUIREMENT? [2]

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(b) How many different arrangements are there of the 11 letters in the word REQUIREMENT in which the two Rs are together and the three Es are together? [1]

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(c) How many different arrangements are there of the 11 letters in the word REQUIREMENT in which there are exactly three letters between the two Rs? [3]

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7 In the region of Arka, the total number of households in the three villages Reeta, Shan and Teber is 800. Each of the households was asked about the quality of their broadband service. Their responses are summarised in the following table.

		Quality of broadband service		
		Excellent	Good	Poor
Village	Reeta	75	118	32
	Shan	223	177	40
	Teber	12	60	63

(a) (i) Find the probability that a randomly chosen household is in Shan and has poor broadband service. [1]

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(ii) Find the probability that a randomly chosen household has good broadband service given that the household is in Shan. [2]

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In the whole of Arka there are a large number of households. A survey showed that 35% of households in Arka have no broadband service.

(b) (i) 10 households in Arka are chosen at random.

Find the probability that fewer than 3 of these households have no broadband service. [3]

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MATHEMATICS

9709/52

Paper 5 Probability & Statistics 1

February/March 2021

1 hour 15 minutes

You must answer on the question paper.

You will need: List of formulae (MF19)

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
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INFORMATION

- The total mark for this paper is 50.
- The number of marks for each question or part question is shown in brackets [].

This document has **12** pages.

2 Georgie has a red scarf, a blue scarf and a yellow scarf. Each day she wears exactly one of these scarves. The probabilities for the three colours are 0.2, 0.45 and 0.35 respectively. When she wears a red scarf, she always wears a hat. When she wears a blue scarf, she wears a hat with probability 0.4. When she wears a yellow scarf, she wears a hat with probability 0.3.

(a) Find the probability that on a randomly chosen day Georgie wears a hat. [2]

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(b) Find the probability that on a randomly chosen day Georgie wears a yellow scarf given that she does not wear a hat. [3]

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3 The time spent by shoppers in a large shopping centre has a normal distribution with mean 96 minutes and standard deviation 18 minutes.

(a) Find the probability that a shopper chosen at random spends between 85 and 100 minutes in the shopping centre. [3]

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88% of shoppers spend more than t minutes in the shopping centre.

(b) Find the value of t . [3]

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4 The random variable X takes the values 1, 2, 3, 4 only. The probability that X takes the value x is $kx(5 - x)$, where k is a constant.

(a) Draw up the probability distribution table for X , in terms of k . [2]

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(b) Show that $\text{Var}(X) = 1.05$. [4]

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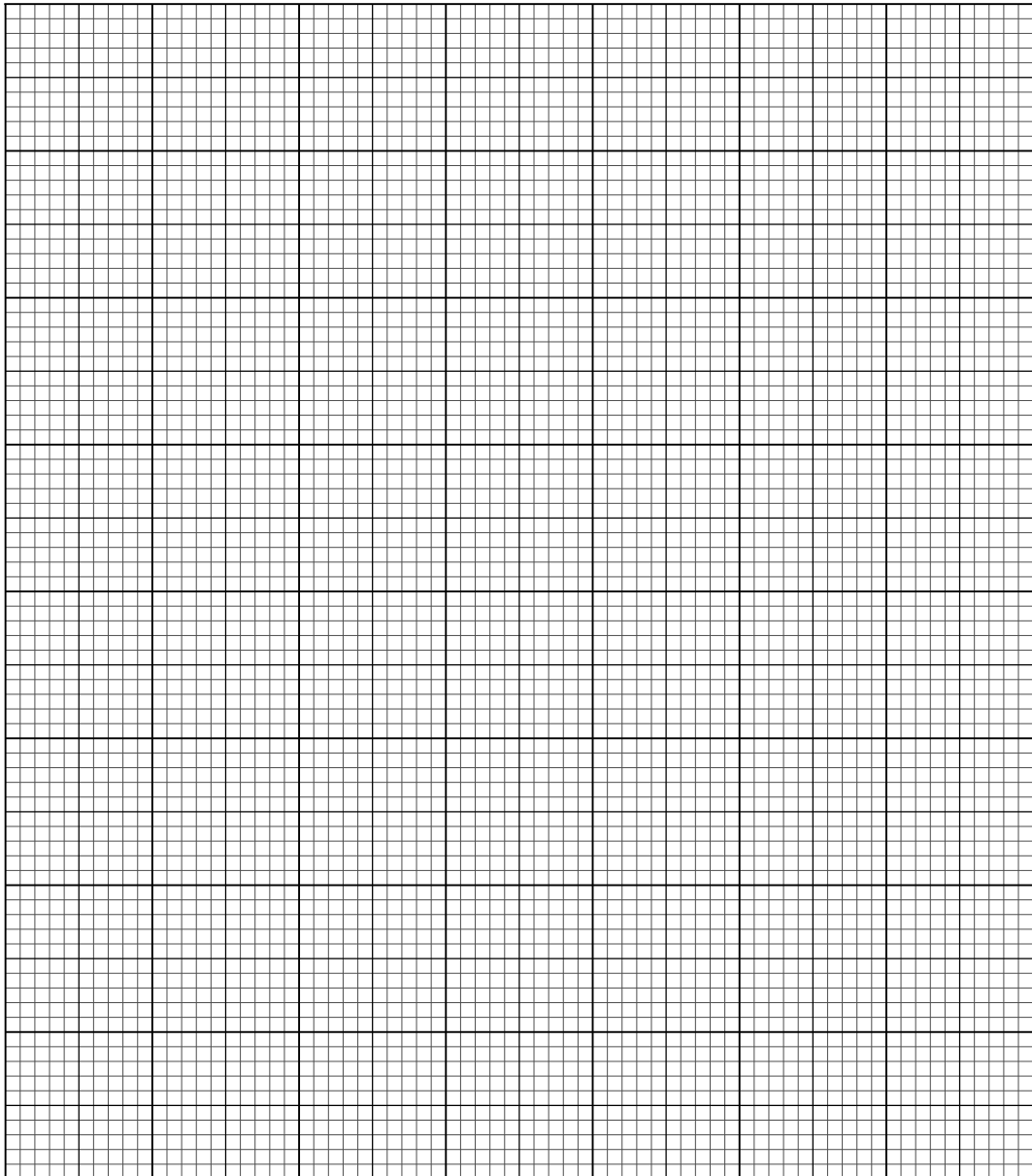
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- 5 A driver records the distance travelled in each of 150 journeys. These distances, correct to the nearest km, are summarised in the following table.

Distance (km)	0 – 4	5 – 10	11 – 20	21 – 30	31 – 40	41 – 60
Frequency	12	16	32	66	20	4

- (a) Draw a cumulative frequency graph to illustrate the data.

[4]



On average at all the schools in this country 30% of the students do not like any sports.

(b) (i) 10 of the students from this country are chosen at random.

Find the probability that at least 3 of these students do not like any sports. [3]

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(ii) 90 students from this country are now chosen at random.

Use an approximation to find the probability that fewer than 32 of them do not like any sports. [5]

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Cambridge International AS & A Level

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MATHEMATICS

9709/51

Paper 5 Probability & Statistics 1

October/November 2020

1 hour 15 minutes

You must answer on the question paper.

You will need: List of formulae (MF19)

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- If additional space is needed, you should use the lined page at the end of this booklet; the question number or numbers must be clearly shown.
- You should use a calculator where appropriate.
- You must show all necessary working clearly; no marks will be given for unsupported answers from a calculator.
- Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place for angles in degrees, unless a different level of accuracy is specified in the question.

INFORMATION

- The total mark for this paper is 50.
- The number of marks for each question or part question is shown in brackets [].

This document has **12** pages. Blank pages are indicated.

1 Two ordinary fair dice, one red and the other blue, are thrown.

Event A is 'the score on the red die is divisible by 3'.

Event B is 'the sum of the two scores is at least 9'.

(a) Find $P(A \cap B)$. [2]

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(b) Hence determine whether or not the events A and B are independent. [2]

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2 The probability that a student at a large music college plays in the band is 0.6. For a student who plays in the band, the probability that she also sings in the choir is 0.3. For a student who does not play in the band, the probability that she sings in the choir is x . The probability that a randomly chosen student from the college does not sing in the choir is 0.58.

(a) Find the value of x . [3]

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Two students from the college are chosen at random.

(b) Find the probability that both students play in the band and both sing in the choir. [2]

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3 Kayla is competing in a throwing event. A throw is counted as a success if the distance achieved is greater than 30 metres. The probability that Kayla will achieve a success on any throw is 0.25.

(a) Find the probability that Kayla takes more than 6 throws to achieve a success. [2]

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(b) Find the probability that, for a random sample of 10 throws, Kayla achieves at least 3 successes. [3]

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4 The random variable X takes each of the values 1, 2, 3, 4 with probability $\frac{1}{4}$. Two independent values of X are chosen at random. If the two values of X are the same, the random variable Y takes that value. Otherwise, the value of Y is the larger value of X minus the smaller value of X .

(a) Draw up the probability distribution table for Y . [4]

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(b) Find the probability that $Y = 2$ given that Y is even. [2]

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5 The time in hours that Davin plays on his games machine each day is normally distributed with mean 3.5 and standard deviation 0.9.

(a) Find the probability that on a randomly chosen day Davin plays on his games machine for more than 4.2 hours. [3]

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(b) On 90% of days Davin plays on his games machine for more than t hours. Find the value of t . [3]

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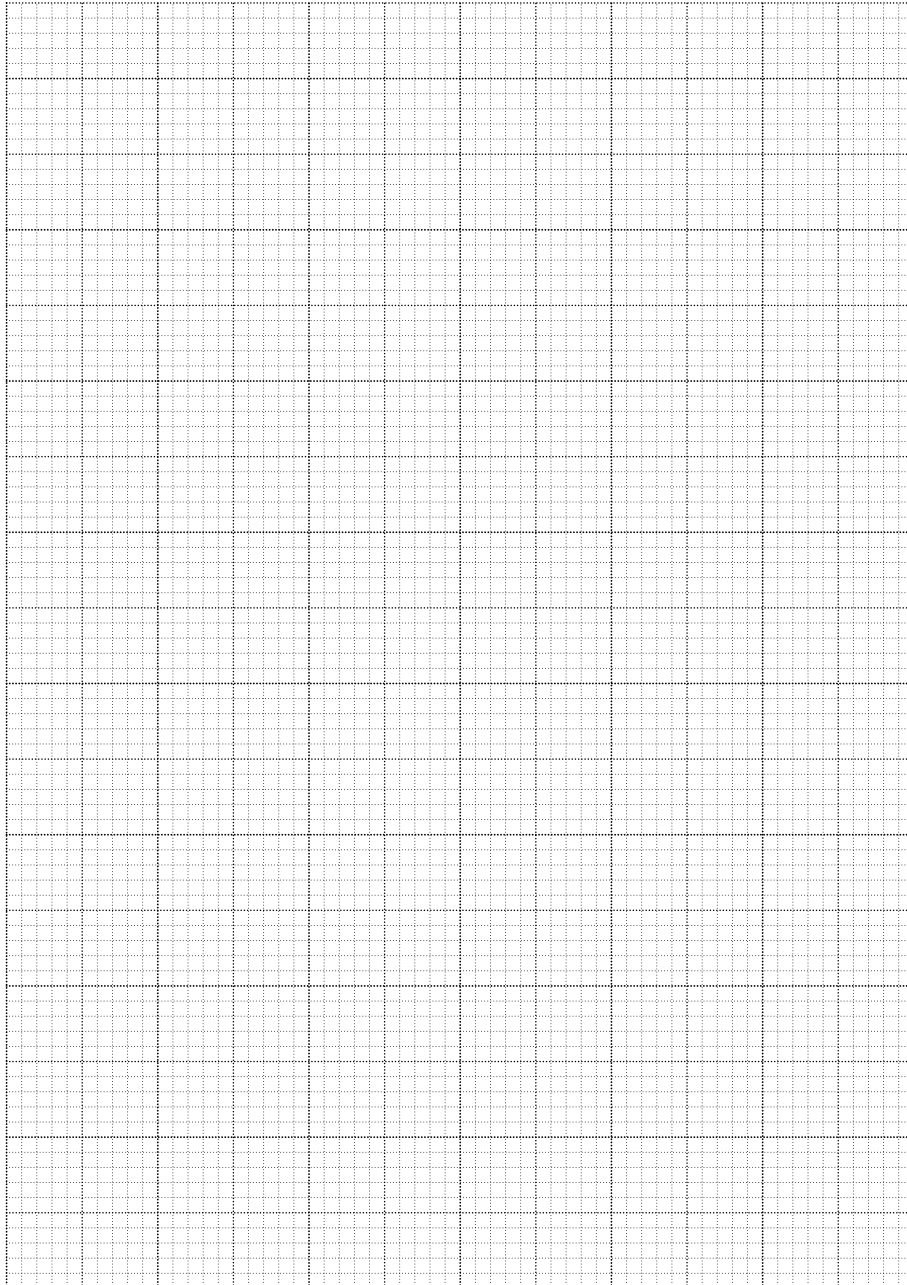
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- 6 The times, t minutes, taken by 150 students to complete a particular challenge are summarised in the following cumulative frequency table.

Time taken (t minutes)	$t \leq 20$	$t \leq 30$	$t \leq 40$	$t \leq 60$	$t \leq 100$
Cumulative frequency	12	48	106	134	150

- (a) Draw a cumulative frequency graph to illustrate the data.

[2]



- 7 (a) Find the number of different ways in which the 10 letters of the word SHOPKEEPER can be arranged so that all 3 Es are together. [2]

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- (b) Find the number of different ways in which the 10 letters of the word SHOPKEEPER can be arranged so that the Ps are not next to each other. [4]

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- (c) Find the probability that a randomly chosen arrangement of the 10 letters of the word SHOPKEEPER has an E at the beginning and an E at the end. [2]

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Four letters are selected from the 10 letters of the word SHOPKEEPER.

- (d) Find the number of different selections if the four letters include exactly one P. [3]

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MATHEMATICS

9709/52

Paper 5 Probability & Statistics 1

October/November 2020

1 hour 15 minutes

You must answer on the question paper.

You will need: List of formulae (MF19)

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- If additional space is needed, you should use the lined page at the end of this booklet; the question number or numbers must be clearly shown.
- You should use a calculator where appropriate.
- You must show all necessary working clearly; no marks will be given for unsupported answers from a calculator.
- Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place for angles in degrees, unless a different level of accuracy is specified in the question.

INFORMATION

- The total mark for this paper is 50.
- The number of marks for each question or part question is shown in brackets [].

This document has **16** pages. Blank pages are indicated.

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1 A fair six-sided die, with faces marked 1, 2, 3, 4, 5, 6, is thrown repeatedly until a 4 is obtained.

(a) Find the probability that obtaining a 4 requires fewer than 6 throws. [2]

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On another occasion, the die is thrown 10 times.

(b) Find the probability that a 4 is obtained at least 3 times. [3]

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2 A bag contains 5 red balls and 3 blue balls. Sadie takes 3 balls at random from the bag, without replacement. The random variable X represents the number of red balls that she takes.

(a) Show that the probability that Sadie takes exactly 1 red ball is $\frac{15}{56}$. [2]

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(b) Draw up the probability distribution table for X . [3]

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(c) Given that $E(X) = \frac{15}{8}$, find $\text{Var}(X)$. [2]

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3 Pia runs 2 km every day and her times in minutes are normally distributed with mean 10.1 and standard deviation 1.3.

(a) Find the probability that on a randomly chosen day Pia takes longer than 11.3 minutes to run 2 km. [3]

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(b) On 75% of days, Pia takes longer than t minutes to run 2 km. Find the value of t . [3]

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Let X be the event that 1 April is fine and Y be the event that 3 April is rainy.

(c) Find the value of $P(X \cap Y)$. [3]

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(d) Find the probability that 1 April is fine given that 3 April is rainy. [3]

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- 5 The following table gives the weekly snowfall, in centimetres, for 11 weeks in 2018 at two ski resorts, Dados and Linva.

Dados	6	8	12	15	10	36	42	28	10	22	16
Linva	2	11	15	16	0	32	36	40	10	12	9

- (a) Represent the information in a back-to-back stem-and-leaf diagram. [4]

(b) Find the median and the interquartile range for the weekly snowfall in Dados. [3]

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(c) The median, lower quartile and upper quartile of the weekly snowfall for Linva are 12, 9 and 32 cm respectively. Use this information and your answers to part (b) to compare the central tendency and the spread of the weekly snowfall in Dados and Linva. [2]

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6 Mr and Mrs Ahmed with their two children, and Mr and Mrs Baker with their three children, are visiting an activity centre together. They will divide into groups for some of the activities.

(a) In how many ways can the 9 people be divided into a group of 6 and a group of 3? [2]

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5 of the 9 people are selected at random for a particular activity.

(b) Find the probability that this group of 5 people contains all 3 of the Baker children. [3]

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All 9 people stand in a line.

- (c) Find the number of different arrangements in which Mr Ahmed is not standing next to Mr Baker. [3]

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- (d) Find the number of different arrangements in which there is exactly one person between Mr Ahmed and Mr Baker. [3]

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* 2 6 9 2 6 4 9 1 1 5 *

MATHEMATICS

9709/53

Paper 5 Probability & Statistics 1

October/November 2020

1 hour 15 minutes

You must answer on the question paper.

You will need: List of formulae (MF19)

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
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- You should use a calculator where appropriate.
- You must show all necessary working clearly; no marks will be given for unsupported answers from a calculator.
- Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place for angles in degrees, unless a different level of accuracy is specified in the question.

INFORMATION

- The total mark for this paper is 50.
- The number of marks for each question or part question is shown in brackets [].

This document has **12** pages. Blank pages are indicated.

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1 The times taken to swim 100 metres by members of a large swimming club have a normal distribution with mean 62 seconds and standard deviation 5 seconds.

(a) Find the probability that a randomly chosen member of the club takes between 56 and 66 seconds to swim 100 metres. [3]

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(b) 13% of the members of the club take more than t minutes to swim 100 metres. Find the value of t . [3]

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2 An ordinary fair die is thrown until a 6 is obtained.

(a) Find the probability that obtaining a 6 takes more than 8 throws. [2]

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Two ordinary fair dice are thrown together until a pair of 6s is obtained. The number of throws taken is denoted by the random variable X .

(b) Find the expected value of X . [1]

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(c) Find the probability that obtaining a pair of 6s takes either 10 or 11 throws. [2]

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3 A committee of 6 people is to be chosen from 9 women and 5 men.

- (a) Find the number of ways in which the 6 people can be chosen if there must be more women than men on the committee. [3]

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The 9 women and 5 men include a sister and brother.

- (b) Find the number of ways in which the committee can be chosen if the sister and brother cannot both be on the committee. [3]

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4 The 13 00 train from Jahor to Keman runs every day. The probability that the train arrives late in Keman is 0.35.

(a) For a random sample of 7 days, find the probability that the train arrives late on fewer than 3 days. [3]

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A random sample of 142 days is taken.

(b) Use an approximation to find the probability that the train arrives late on more than 40 days. [5]

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5 The 8 letters in the word RESERVED are arranged in a random order.

(a) Find the probability that the arrangement has V as the first letter and E as the last letter. [3]

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(b) Find the probability that the arrangement has both Rs together given that all three Es are together. [4]

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6 Three coins A , B and C are each thrown once.

- Coins A and B are each biased so that the probability of obtaining a head is $\frac{2}{3}$.
- Coin C is biased so that the probability of obtaining a head is $\frac{4}{5}$.

(a) Show that the probability of obtaining exactly 2 heads and 1 tail is $\frac{4}{9}$. [3]

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The random variable X is the number of heads obtained when the three coins are thrown.

(b) Draw up the probability distribution table for X . [3]

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(c) Given that $E(X) = \frac{32}{15}$, find $\text{Var}(X)$. [2]

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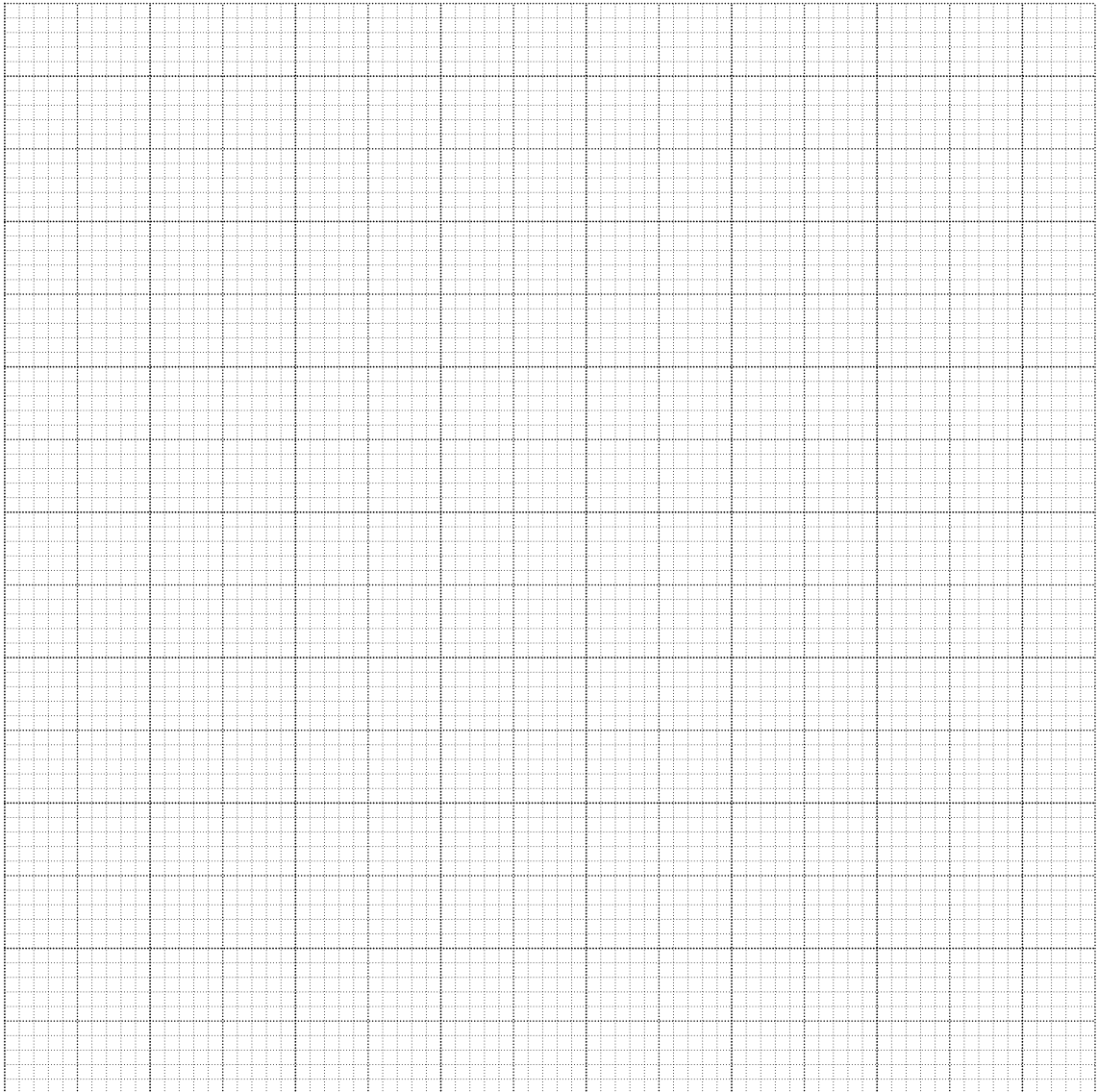
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- 7 A particular piece of music was played by 91 pianists and for each pianist, the number of incorrect notes was recorded. The results are summarised in the table.

Number of incorrect notes	1 – 5	6 – 10	11 – 20	21 – 40	41 – 70
Frequency	10	5	26	32	18

- (a) Draw a histogram to represent this information.

[5]



- (b) State which class interval contains the lower quartile and which class interval contains the upper quartile.

Hence find the greatest possible value of the interquartile range. [2]

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- (c) Calculate an estimate for the mean number of incorrect notes. [3]

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MATHEMATICS

9709/51

Paper 5 Probability & Statistics 1

May/June 2020

1 hour 15 minutes

You must answer on the question paper.

You will need: List of formulae (MF19)

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- If additional space is needed, you should use the lined page at the end of this booklet; the question number or numbers must be clearly shown.
- You should use a calculator where appropriate.
- You must show all necessary working clearly; no marks will be given for unsupported answers from a calculator.
- Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place for angles in degrees, unless a different level of accuracy is specified in the question.

INFORMATION

- The total mark for this paper is 50.
- The number of marks for each question or part question is shown in brackets [].

This document has **16** pages. Blank pages are indicated.

1 The score when two fair six-sided dice are thrown is the sum of the two numbers on the upper faces.

(a) Show that the probability that the score is 4 is $\frac{1}{12}$. [1]

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The two dice are thrown repeatedly until a score of 4 is obtained. The number of throws taken is denoted by the random variable X .

(b) Find the mean of X . [1]

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(c) Find the probability that a score of 4 is first obtained on the 6th throw. [1]

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(d) Find $P(X < 8)$. [2]

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- 2 (a) Find the number of different arrangements that can be made from the 9 letters of the word JEWELLERY in which the three Es are together and the two Ls are together. [2]

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- (b) Find the number of different arrangements that can be made from the 9 letters of the word JEWELLERY in which the two Ls are not next to each other. [4]

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- 5 On Mondays, Rani cooks her evening meal. She has a pizza, a burger or a curry with probabilities 0.35, 0.44, 0.21 respectively. When she cooks a pizza, Rani has some fruit with probability 0.3. When she cooks a burger, she has some fruit with probability 0.8. When she cooks a curry, she never has any fruit.

(a) Draw a fully labelled tree diagram to represent this information.

[2]

(b) Find the probability that Rani has some fruit. [2]

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(c) Find the probability that Rani does not have a burger given that she does not have any fruit. [4]

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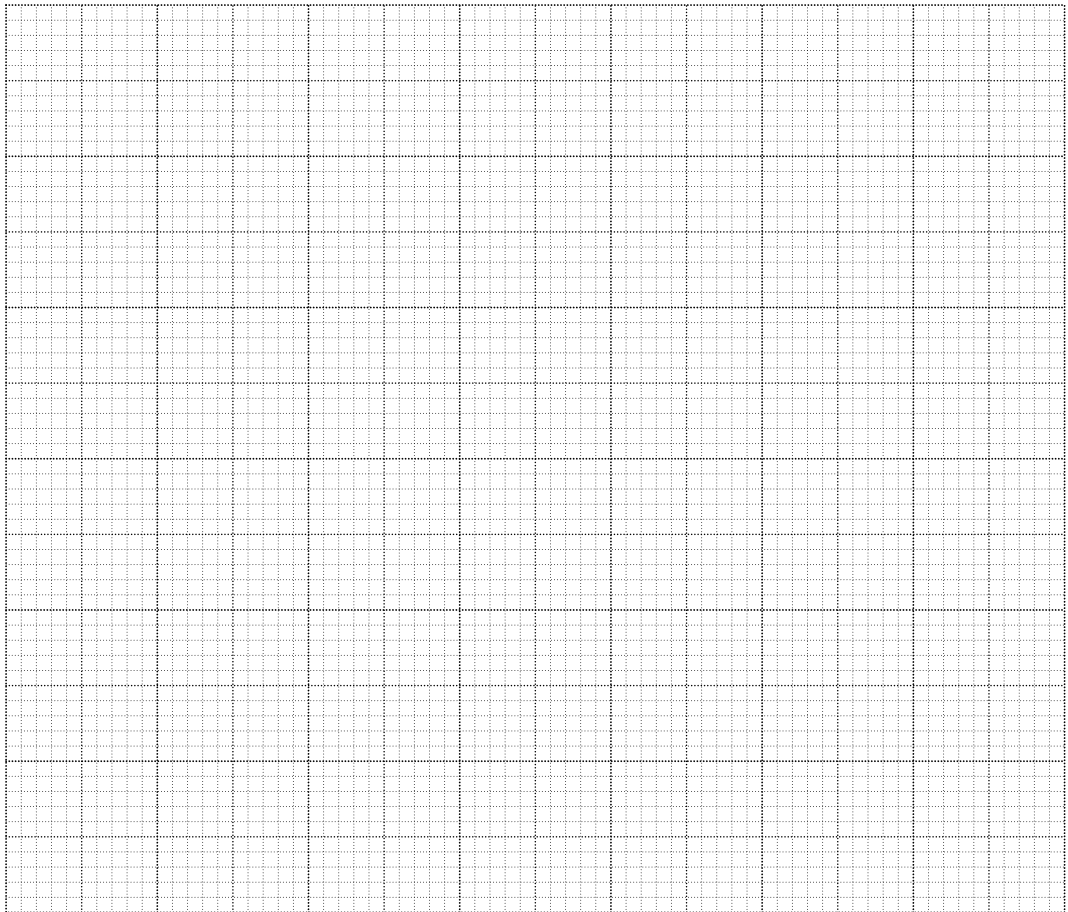
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- 7 The numbers of chocolate bars sold per day in a cinema over a period of 100 days are summarised in the following table.

Number of chocolate bars sold	1 – 10	11 – 15	16 – 30	31 – 50	51 – 60
Number of days	18	24	30	20	8

- (a) Draw a histogram to represent this information.

[5]



(b) What is the greatest possible value of the interquartile range for the data? [2]

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(c) Calculate estimates of the mean and standard deviation of the number of chocolate bars sold. [4]

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MATHEMATICS

9709/52

Paper 5 Probability & Statistics 1

May/June 2020

1 hour 15 minutes

You must answer on the question paper.

You will need: List of formulae (MF19)

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
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- You should use a calculator where appropriate.
- You must show all necessary working clearly; no marks will be given for unsupported answers from a calculator.
- Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place for angles in degrees, unless a different level of accuracy is specified in the question.

INFORMATION

- The total mark for this paper is 50.
- The number of marks for each question or part question is shown in brackets [].

This document has **16** pages. Blank pages are indicated.

- 2 A total of 500 students were asked which one of four colleges they attended and whether they preferred soccer or hockey. The numbers of students in each category are shown in the following table.

	Soccer	Hockey	Total
Amos	54	32	86
Benn	84	72	156
Canton	22	56	78
Devar	120	60	180
Total	280	220	500

- (a) Find the probability that a randomly chosen student is at Canton college and prefers hockey. [1]

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- (b) Find the probability that a randomly chosen student is at Devar college given that he prefers soccer. [2]

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- (c) One of the students is chosen at random. Determine whether the events ‘the student prefers hockey’ and ‘the student is at Amos college or Benn college’ are independent, justifying your answer. [2]

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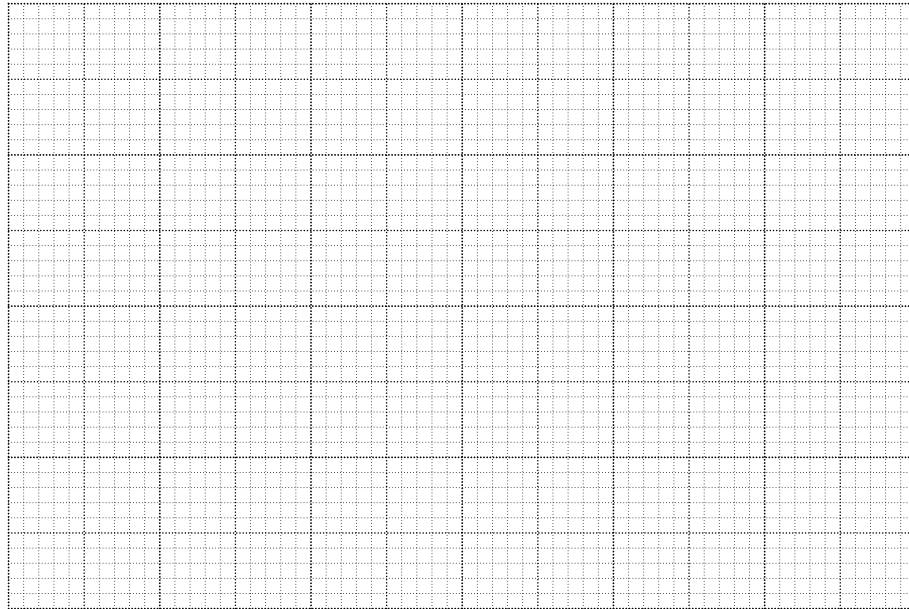
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It is given that for machine *B* the median is 0.232 m, the lower quartile is 0.224 m and the upper quartile is 0.243 m.

- (b) Draw box-and-whisker plots for *A* and *B*. [3]



- (c) Hence make two comparisons between the lengths of the rods produced by machine *A* and those produced by machine *B*. [2]

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4 Trees in the Redian forest are classified as tall, medium or short, according to their height. The heights can be modelled by a normal distribution with mean 40 m and standard deviation 12 m. Trees with a height of less than 25 m are classified as short.

(a) Find the probability that a randomly chosen tree is classified as short. [3]

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Of the trees that are classified as tall or medium, one third are tall and two thirds are medium.

(b) Show that the probability that a randomly chosen tree is classified as tall is 0.298, correct to 3 decimal places. [2]

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5 A fair three-sided spinner has sides numbered 1, 2, 3. A fair five-sided spinner has sides numbered 1, 1, 2, 2, 3. Both spinners are spun once. For each spinner, the number on the side on which it lands is noted. The random variable X is the larger of the two numbers if they are different, and their common value if they are the same.

(a) Show that $P(X = 3) = \frac{7}{15}$. [2]

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(b) Draw up the probability distribution table for X . [3]

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- 6 (a) Find the number of different ways in which the 10 letters of the word SUMMERTIME can be arranged so that there is an E at the beginning and an E at the end. [2]

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- (b) Find the number of different ways in which the 10 letters of the word SUMMERTIME can be arranged so that the Es are not together. [4]

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MATHEMATICS

9709/53

Paper 5 Probability & Statistics 1

May/June 2020

1 hour 15 minutes

You must answer on the question paper.

You will need: List of formulae (MF19)

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
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- You should use a calculator where appropriate.
- You must show all necessary working clearly; no marks will be given for unsupported answers from a calculator.
- Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place for angles in degrees, unless a different level of accuracy is specified in the question.

INFORMATION

- The total mark for this paper is 50.
- The number of marks for each question or part question is shown in brackets [].

This document has **12** pages. Blank pages are indicated.

1 Juan goes to college each day by any one of car or bus or walking. The probability that he goes by car is 0.2, the probability that he goes by bus is 0.45 and the probability that he walks is 0.35. When Juan goes by car, the probability that he arrives early is 0.6. When he goes by bus, the probability that he arrives early is 0.1. When he walks he always arrives early.

(a) Draw a fully labelled tree diagram to represent this information. [2]

(b) Find the probability that Juan goes to college by car given that he arrives early. [4]

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4 A fair four-sided spinner has edges numbered 1, 2, 2, 3. A fair three-sided spinner has edges numbered -2, -1, 1. Each spinner is spun and the number on the edge on which it comes to rest is noted. The random variable X is the sum of the two numbers that have been noted.

(a) Draw up the probability distribution table for X . [3]

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(b) Find $\text{Var}(X)$. [3]

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5 A pair of fair coins is thrown repeatedly until a pair of tails is obtained. The random variable X denotes the number of throws required to obtain a pair of tails.

(a) Find the expected value of X . [1]

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(b) Find the probability that exactly 3 throws are required to obtain a pair of tails. [1]

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(c) Find the probability that fewer than 6 throws are required to obtain a pair of tails. [2]

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- 6 The annual salaries, in thousands of dollars, for 11 employees at each of two companies *A* and *B* are shown below.

Company <i>A</i>	30	32	35	41	41	42	47	49	52	53	64
Company <i>B</i>	26	47	30	52	41	38	35	42	49	31	42

- (a) Represent the data by drawing a back-to-back stem-and-leaf diagram with company *A* on the left-hand side of the diagram. [4]

(b) Find the median and the interquartile range of the salaries of the employees in company *A*. [3]

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A new employee joins company *B*. The mean salary of the 12 employees is now \$38 500.

(c) Find the salary of the new employee. [3]

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- 7 (a) Find the number of different possible arrangements of the 9 letters in the word CELESTIAL. [1]

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- (b) Find the number of different arrangements of the 9 letters in the word CELESTIAL in which the first letter is C, the fifth letter is T and the last letter is E. [2]

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- (c) Find the probability that a randomly chosen arrangement of the 9 letters in the word CELESTIAL does not have the two Es together. [4]

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MATHEMATICS

9709/52

Paper 5 Probability & Statistics 1

February/March 2020

1 hour 15 minutes

You must answer on the question paper.

You will need: List of formulae (MF19)

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
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- You must show all necessary working clearly; no marks will be given for unsupported answers from a calculator.
- Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place for angles in degrees, unless a different level of accuracy is specified in the question.

INFORMATION

- The total mark for this paper is 50.
- The number of marks for each question or part question is shown in brackets [].

This document has **12** pages. Blank pages are indicated.

- 1 The 40 members of a club include Ranuf and Saed. All 40 members will travel to a concert. 35 members will travel in a coach and the other 5 will travel in a car. Ranuf will be in the coach and Saed will be in the car.

In how many ways can the members who will travel in the coach be chosen? [3]

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- 2 An ordinary fair die is thrown repeatedly until a 1 or a 6 is obtained.
- (a) Find the probability that it takes at least 3 throws but no more than 5 throws to obtain a 1 or a 6. [3]

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On another occasion, this die is thrown 3 times. The random variable X is the number of times that a 1 or a 6 is obtained.

(b) Draw up the probability distribution table for X . [3]

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(c) Find $E(X)$. [2]

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3 The weights of apples of a certain variety are normally distributed with mean 82 grams. 22% of these apples have a weight greater than 87 grams.

(a) Find the standard deviation of the weights of these apples. [3]

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(b) Find the probability that the weight of a randomly chosen apple of this variety differs from the mean weight by less than 4 grams. [4]

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4 Richard has 3 blue candles, 2 red candles and 6 green candles. The candles are identical apart from their colours. He arranges the 11 candles in a line.

(a) Find the number of different arrangements of the 11 candles if there is a red candle at each end. [2]

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(b) Find the number of different arrangements of the 11 candles if all the blue candles are together and the red candles are not together. [4]

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(b) Find the probability that the two balls chosen are not the same colour. [2]

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(c) Find the probability that the ball chosen from box *A* is blue given that the ball chosen from box *B* is blue. [4]

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- 7 Helen measures the lengths of 150 fish of a certain species in a large pond. These lengths, correct to the nearest centimetre, are summarised in the following table.

Length (cm)	0 – 9	10 – 14	15 – 19	20 – 30
Frequency	15	48	66	21

- (a) Draw a cumulative frequency graph to illustrate the data.

[4]



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MATHEMATICS

9709/61

Paper 6 Probability & Statistics 1 (**S1**)

October/November 2019

1 hour 15 minutes

Candidates answer on the Question Paper.

Additional Materials: List of Formulae (MF9)

READ THESE INSTRUCTIONS FIRST

Write your centre number, candidate number and name in the spaces at the top of this page.

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Answer **all** the questions in the space provided. If additional space is required, you should use the lined page at the end of this booklet. The question number(s) must be clearly shown.

Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place in the case of angles in degrees, unless a different level of accuracy is specified in the question.

The use of an electronic calculator is expected, where appropriate.

You are reminded of the need for clear presentation in your answers.

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [] at the end of each question or part question.

The total number of marks for this paper is 50.

This document consists of **14** printed pages and **2** blank pages.



2 Annan has designed a new logo for a sportswear company. A survey of a large number of customers found that 42% of customers rated the logo as good.

- (i) A random sample of 10 customers is chosen. Find the probability that fewer than 8 of them rate the logo as good. [3]

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- (ii) On another occasion, a random sample of n customers of the company is chosen. Find the smallest value of n for which the probability that at least one person rates the logo as good is greater than 0.995. [3]

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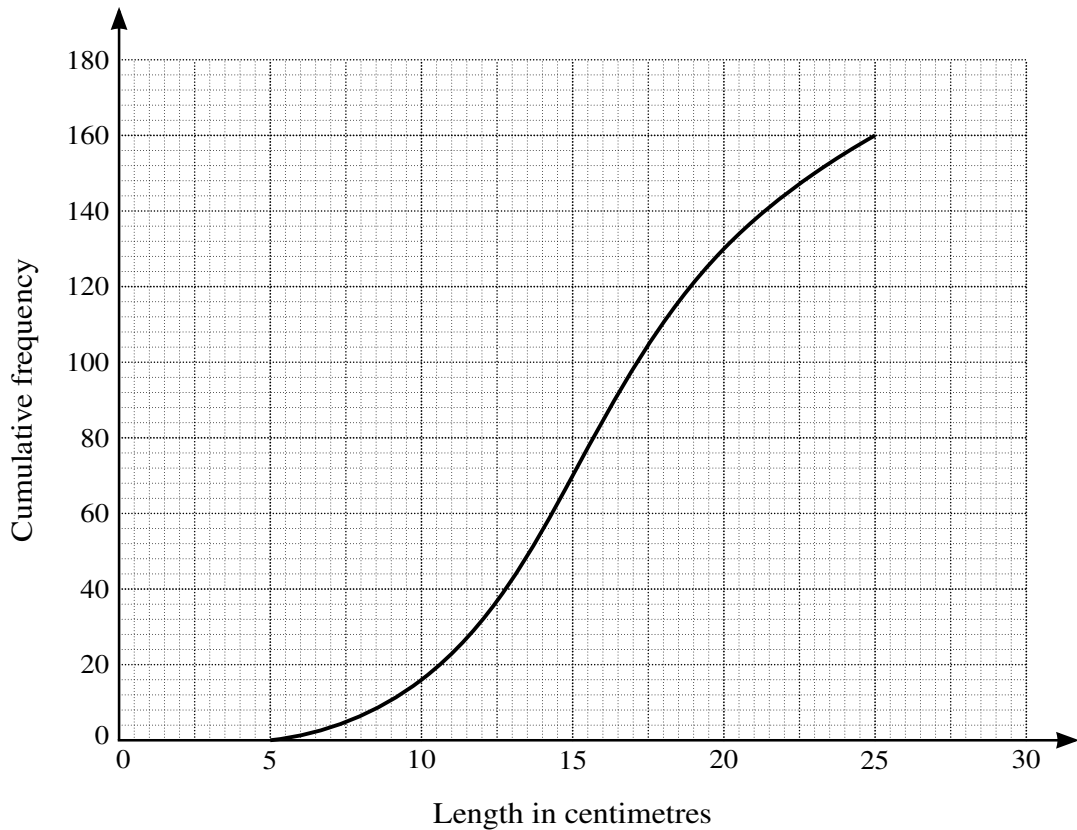
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- 5 Ransha measured the lengths, in centimetres, of 160 palm leaves. His results are illustrated in the cumulative frequency graph below.



- (i) Estimate how many leaves have a length between 14 and 24 centimetres. [1]

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- (ii) 10% of the leaves have a length of L centimetres or more. Estimate the value of L . [2]

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(iii) Estimate the median and the interquartile range of the lengths.

[3]

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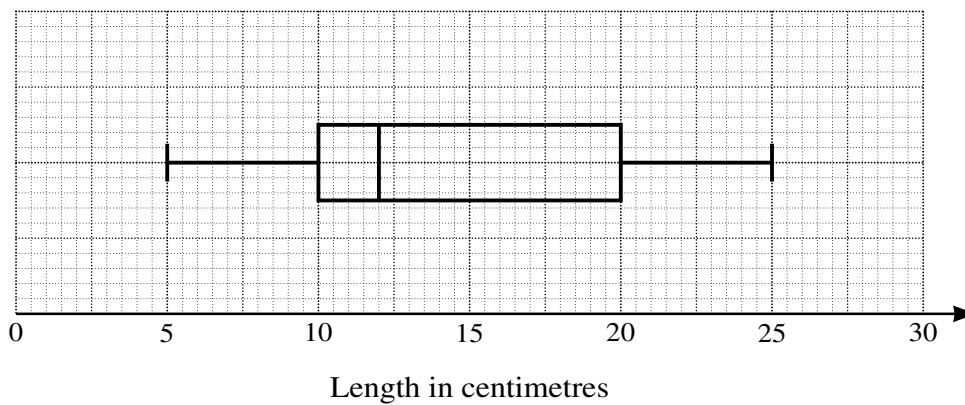
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Sharim measured the lengths, in centimetres, of 160 palm leaves of a different type. He drew a box-and-whisker plot for the data, as shown on the grid below.



(iv) Compare the central tendency and the spread of the two sets of data.

[2]

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Three athletes from the club are chosen at random.

(iii) Find the probability that exactly 2 have PBs of less than 46 seconds. [3]

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MATHEMATICS

9709/62

Paper 6 Probability & Statistics 1 (S1)

October/November 2019

1 hour 15 minutes

Candidates answer on the Question Paper.

Additional Materials: List of Formulae (MF9)

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You are reminded of the need for clear presentation in your answers.

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [] at the end of each question or part question.

The total number of marks for this paper is 50.

This document consists of **14** printed pages and **2** blank pages.



1 Twelve tourists were asked to estimate the height, in metres, of a new building. Their estimates were as follows.

50 45 62 30 40 55 110 38 52 60 55 40

(i) Find the median and the interquartile range for the data. [3]

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(ii) Give a disadvantage of using the mean as a measure of the central tendency in this case. [1]

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2 Benju cycles to work each morning and he has two possible routes. He chooses the hilly route with probability 0.4 and the busy route with probability 0.6. If he chooses the hilly route, the probability that he will be late for work is x and if he chooses the busy route the probability that he will be late for work is $2x$. The probability that Benju is late for work on any day is 0.36.

(i) Show that $x = 0.225$. [2]

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(ii) Given that Benju is not late for work, find the probability that he chooses the hilly route. [3]

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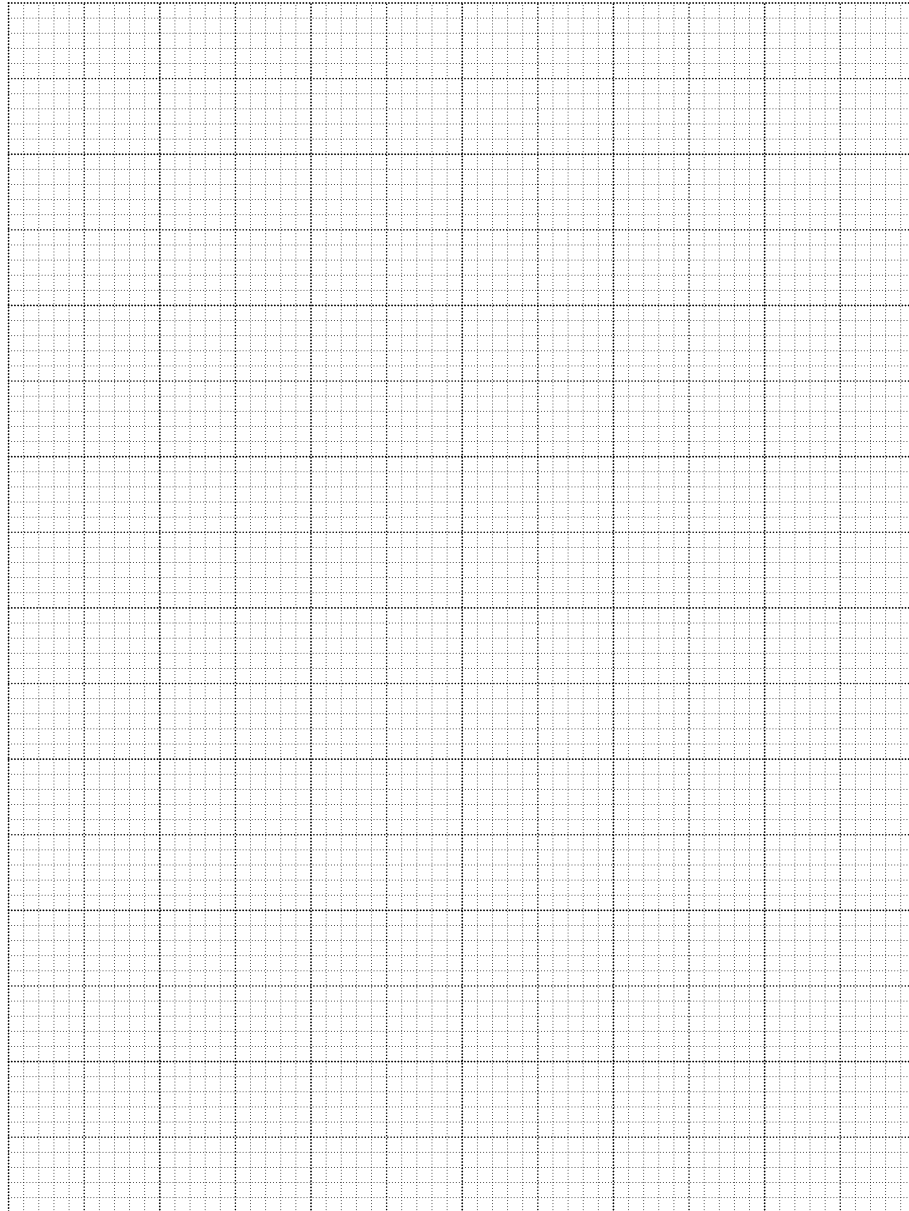
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- 3 The speeds, in km h^{-1} , of 90 cars as they passed a certain marker on a road were recorded, correct to the nearest km h^{-1} . The results are summarised in the following table.

Speed (km h^{-1})	10 – 29	30 – 39	40 – 49	50 – 59	60 – 89
Frequency	10	24	30	14	12

- (i) On the grid, draw a histogram to illustrate the data in the table.

[4]



6 The heights, in metres, of fir trees in a large forest have a normal distribution with mean 40 and standard deviation 8.

(i) Find the probability that a fir tree chosen at random in this forest has a height less than 45 metres. [2]

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(ii) Find the probability that a fir tree chosen at random in this forest has a height within 5 metres of the mean. [2]

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- (iii) Find the probability that a randomly chosen arrangement of the 9 letters of the word TOADSTOOL has a T at the beginning and a T at the end. [2]

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- (iv) Five letters are selected from the 9 letters of the word TOADSTOOL. Find the number of different selections if the five letters include at least 2 Os and at least 1 T. [4]

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MATHEMATICS

9709/63

Paper 6 Probability & Statistics 1 (S1)

October/November 2019

1 hour 15 minutes

Candidates answer on the Question Paper.

Additional Materials: List of Formulae (MF9)

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Answer **all** the questions in the space provided. If additional space is required, you should use the lined page at the end of this booklet. The question number(s) must be clearly shown.

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You are reminded of the need for clear presentation in your answers.

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [] at the end of each question or part question.

The total number of marks for this paper is 50.

This document consists of 13 printed pages and 3 blank pages.



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2 (i) How many different arrangements are there of the 9 letters in the word CORRIDORS? [2]

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(ii) How many different arrangements are there of the 9 letters in the word CORRIDORS in which the first letter is D and the last letter is R or O? [3]

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3 A sports team of 7 people is to be chosen from 6 attackers, 5 defenders and 4 midfielders. The team must include at least 3 attackers, at least 2 defenders and at least 1 midfielder.

(i) In how many different ways can the team of 7 people be chosen? [4]

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The team of 7 that is chosen travels to a match in two cars. A group of 4 travel in one car and a group of 3 travel in the other car.

(ii) In how many different ways can the team of 7 be divided into a group of 4 and a group of 3? [2]

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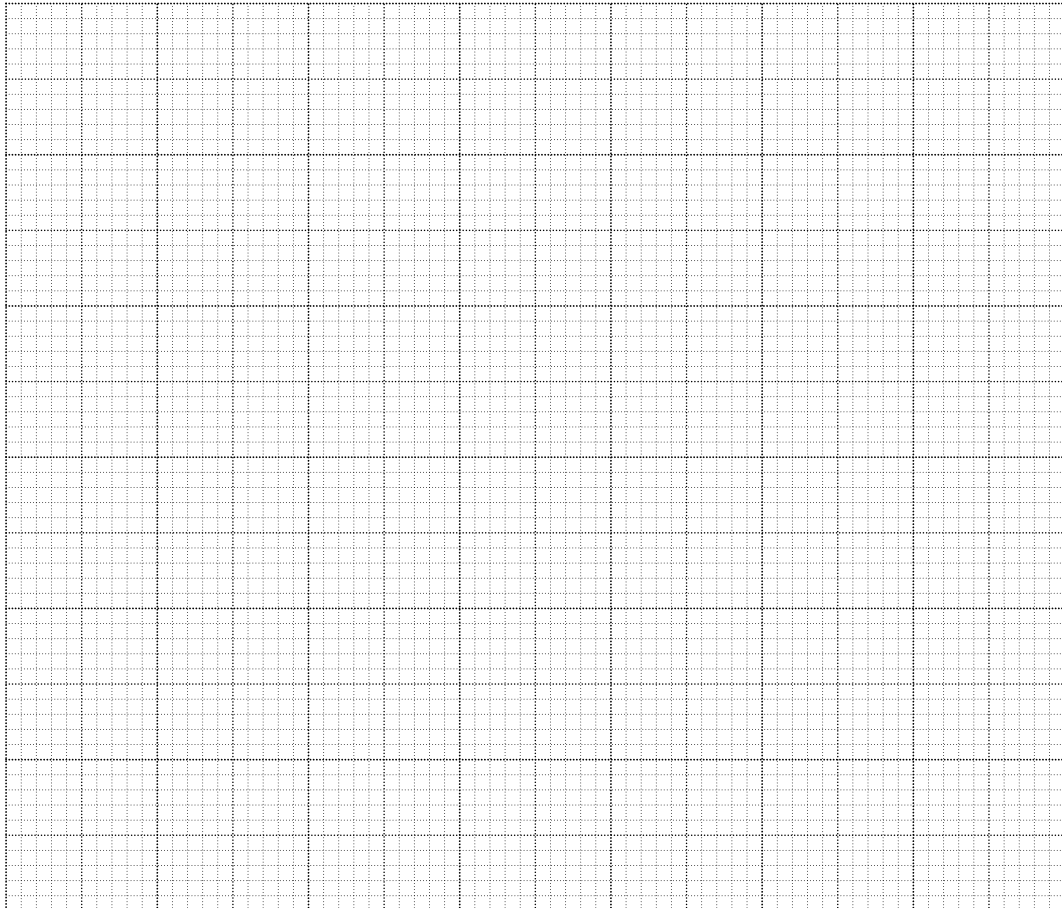
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- 5 Last Saturday, 200 drivers entering a car park were asked the time, in minutes, that it had taken them to travel from home to the car park. The results are summarised in the following cumulative frequency table.

Time (t minutes)	$t \leq 10$	$t \leq 20$	$t \leq 30$	$t \leq 50$	$t \leq 70$	$t \leq 90$
Cumulative frequency	16	50	106	146	176	200

- (i) On the grid, draw a cumulative frequency graph to illustrate the data.

[2]



- (ii) Use your graph to estimate the median of the data.

[1]

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6 A box contains 3 red balls and 5 white balls. One ball is chosen at random from the box and is not returned to the box. A second ball is now chosen at random from the box.

(i) Find the probability that both balls chosen are red. [1]

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(ii) Show that the probability that the balls chosen are of different colours is $\frac{15}{28}$. [2]

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(iii) Given that the second ball chosen is red, find the probability that the first ball chosen is red. [2]

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The random variable X denotes the number of red balls chosen.

(iv) Draw up the probability distribution table for X . [2]

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(v) Find $\text{Var}(X)$. [3]

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7 A competition is taking place between two choirs, the Notes and the Classics. There is a large audience for the competition.

- 30% of the audience are Notes supporters.
- 45% of the audience are Classics supporters.
- The rest of the audience are not supporters of either of these choirs.
- No one in the audience supports both of these choirs.

(i) A random sample of 6 people is chosen from the audience.

(a) Find the probability that no more than 2 of the 6 people are Notes supporters. [3]

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(b) Find the probability that none of the 6 people support either of these choirs. [2]

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MATHEMATICS

9709/61

Paper 6 Probability & Statistics 1 (S1)

May/June 2019

1 hour 15 minutes

Candidates answer on the Question Paper.

Additional Materials: List of Formulae (MF9)

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This document consists of **15** printed pages and **1** blank page.



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1 The times, t seconds, taken to swim 100 m were recorded for a group of 9 swimmers and were found to be as follows.

95 126 117 135 120 125 114 119 136

(i) Find the values of $\Sigma(t - 120)$ and $\Sigma(t - 120)^2$. [2]

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(ii) Using your values found in part (i), calculate the variance of t . [2]

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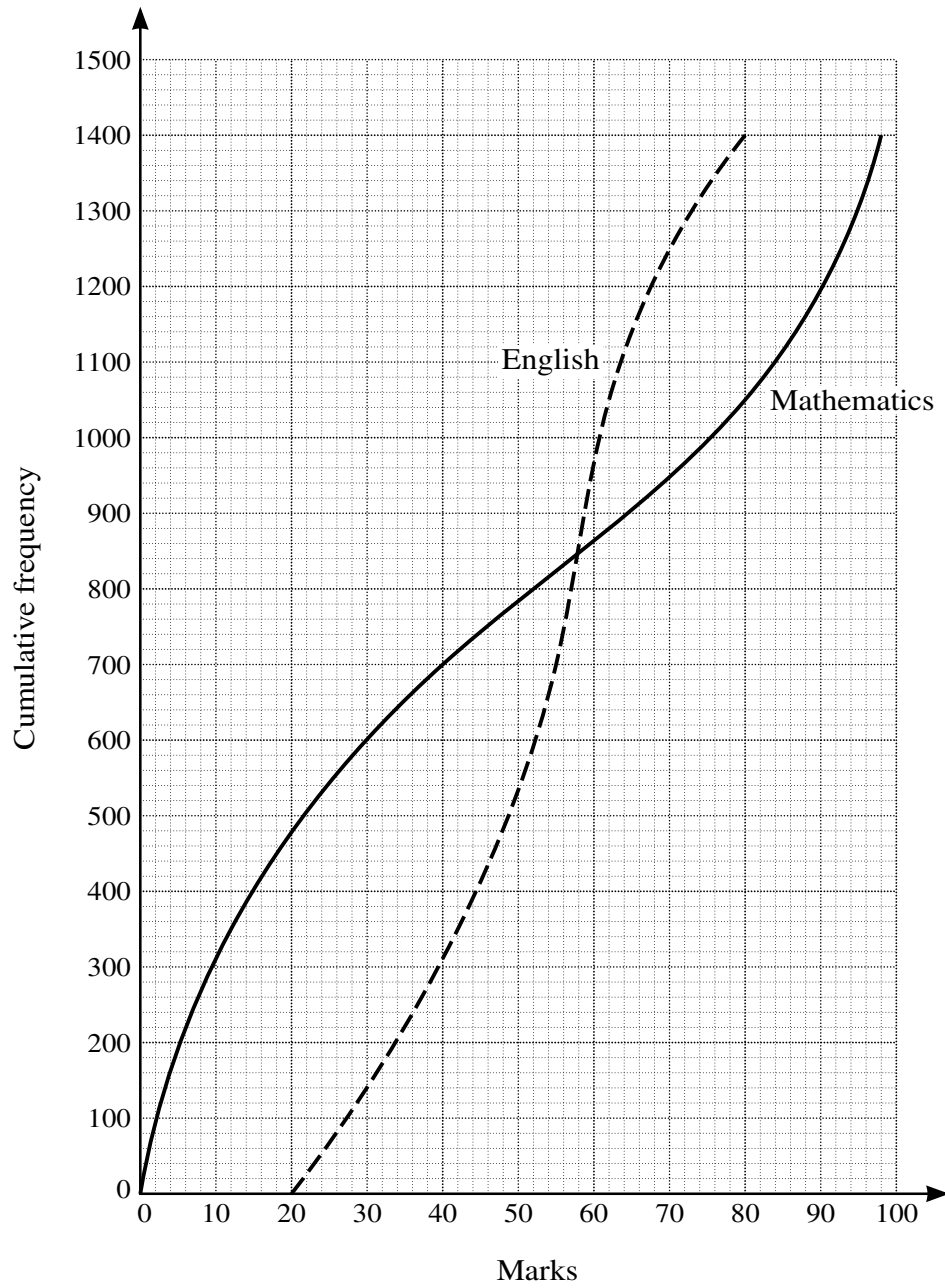
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- 4 The Mathematics and English A-level marks of 1400 pupils all taking the same examinations are shown in the cumulative frequency graphs below. Both examinations are marked out of 100.



7 The weight of adult female giraffes has a normal distribution with mean 830 kg and standard deviation 120 kg.

(i) There are 430 adult female giraffes in a particular game reserve. Find the number of these adult female giraffes which can be expected to weigh less than 700 kg. [4]

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(ii) Given that 90% of adult female giraffes weigh between $(830 - w)$ kg and $(830 + w)$ kg, find the value of w . [3]

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The weight of adult male giraffes has a normal distribution with mean 1190 kg and standard deviation σ kg.

(iii) Given that 83.4% of adult male giraffes weigh more than 950 kg, find the value of σ . [3]

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8 Freddie has 6 toy cars and 3 toy buses, all different. He chooses 4 toys to take on holiday with him.

(i) In how many different ways can Freddie choose 4 toys? [1]

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(ii) How many of these choices will include both his favourite car and his favourite bus? [2]

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Freddie arranges these 9 toys in a line.

(iii) Find the number of possible arrangements if the buses are all next to each other. [3]

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MATHEMATICS

9709/62

Paper 6 Probability & Statistics 1 (S1)

May/June 2019

1 hour 15 minutes

Candidates answer on the Question Paper.

Additional Materials: List of Formulae (MF9)

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3 The probability that Janice will buy an item online in any week is 0.35. Janice does not buy more than one item online in any week.

(i) Find the probability that, in a 10-week period, Janice buys at most 7 items online. [3]

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(ii) The probability that Janice buys at least one item online in a period of n weeks is greater than 0.99. Find the smallest possible value of n . [3]

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5 Maryam has 7 sweets in a tin; 6 are toffees and 1 is a chocolate. She chooses one sweet at random and takes it out. Her friend adds 3 chocolates to the tin. Then Maryam takes another sweet at random out of the tin.

(i) Draw a fully labelled tree diagram to illustrate this situation. [3]

(ii) Draw up the probability distribution table for the number of toffees taken. [3]

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- 6 (i) Give one advantage and one disadvantage of using a box-and-whisker plot to represent a set of data. [2]

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- (ii) The times in minutes taken to run a marathon were recorded for a group of 13 marathon runners and were found to be as follows.

180 275 235 242 311 194 246 229 238 768 332 227 228

State which of the mean, mode or median is most suitable as a measure of central tendency for these times. Explain why the other measures are less suitable. [3]

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(iii) Another group of 33 people ran the same marathon and their times in minutes were as follows.

190 203 215 246 249 253 255 254 258 260 261
 263 267 269 274 276 280 288 283 287 294 300
 307 318 327 331 336 345 351 353 360 368 375

(a) On the grid below, draw a box-and-whisker plot to illustrate the times for these 33 people. [4]

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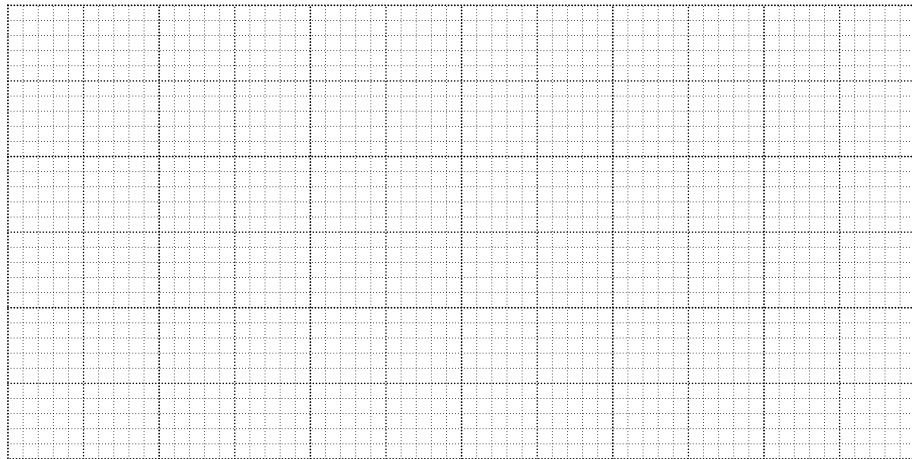
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(b) Find the interquartile range of these times. [1]

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- 7 (a) A group of 6 teenagers go boating. There are three boats available. One boat has room for 3 people, one has room for 2 people and one has room for 1 person. Find the number of different ways the group of 6 teenagers can be divided between the three boats. [3]

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- (b) Find the number of different 7-digit numbers which can be formed from the seven digits 2, 2, 3, 7, 7, 7, 8 in each of the following cases.

- (i) The odd digits are together and the even digits are together. [3]

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(ii) The 2s are not together. [4]

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MATHEMATICS

9709/63

Paper 6 Probability & Statistics 1 (S1)

May/June 2019

1 hour 15 minutes

Candidates answer on the Question Paper.

Additional Materials: List of Formulae (MF9)

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1 The time taken, in minutes, by a ferry to cross a lake has a normal distribution with mean 85 and standard deviation 6.8.

(i) Find the probability that, on a randomly chosen occasion, the time taken by the ferry to cross the lake is between 79 and 91 minutes. [3]

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(ii) Over a long period it is found that 96% of ferry crossings take longer than a certain time t minutes. Find the value of t . [3]

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2 Megan sends messages to her friends in one of 3 different ways: text, email or social media. For each message, the probability that she uses text is 0.3 and the probability that she uses email is 0.2. She receives an immediate reply from a text message with probability 0.4, from an email with probability 0.15 and from social media with probability 0.6.

(i) Draw a fully labelled tree diagram to represent this information. [2]

(ii) Given that Megan does not receive an immediate reply to a message, find the probability that the message was an email. [4]

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3 Mr and Mrs Keene and their 5 children all go to watch a football match, together with their friends Mr and Mrs Uzuma and their 2 children. Find the number of ways in which all 11 people can line up at the entrance in each of the following cases.

(i) Mr Keene stands at one end of the line and Mr Uzuma stands at the other end. [2]

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(ii) The 5 Keene children all stand together and the Uzuma children both stand together. [3]

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- 4 (i) Find the number of ways a committee of 6 people can be chosen from 8 men and 4 women if there must be at least twice as many men as there are women on the committee. [3]

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- (ii) Find the number of ways a committee of 6 people can be chosen from 8 men and 4 women if 2 particular men refuse to be on the committee together. [3]

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7 The times in minutes taken by 13 pupils at each of two schools in a cross-country race are recorded in the table below.

Thaters School	38	43	48	52	54	56	57	58	58	61	62	66	75
Whitefay Park School	45	47	53	56	56	61	64	66	69	73	75	78	83

(i) Draw a back-to-back stem-and-leaf diagram to illustrate these times with Thaters School on the left. [4]

(ii) Find the interquartile range of the times for pupils at Thaters School. [2]

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The times taken by pupils at Whitefay Park School are denoted by x minutes.

(iii) Find the value of $\Sigma(x - 60)^2$. [2]

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(iv) It is given that $\Sigma(x - 60) = 46$. Use this result, together with your answer to part **(iii)**, to find the variance of x . [2]

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MATHEMATICS

9709/62

Paper 6 Probability & Statistics 1 (S1)

February/March 2019

1 hour 15 minutes

Candidates answer on the Question Paper.

Additional Materials: List of Formulae (MF9)

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1 On each day that Tamar goes to work, he wears either a blue suit with probability 0.6 or a grey suit with probability 0.4. If he wears a blue suit then the probability that he wears red socks is 0.2. If he wears a grey suit then the probability that he wears red socks is 0.32.

(i) Find the probability that Tamar wears red socks on any particular day that he is at work. [2]

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(ii) Given that Tamar is not wearing red socks at work, find the probability that he is wearing a grey suit. [3]

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3 The times taken, in minutes, for trains to travel between Alphaton and Beeton are normally distributed with mean 140 and standard deviation 12.

- (i) Find the probability that a randomly chosen train will take less than 132 minutes to travel between Alphaton and Beeton. [3]

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- (ii) The probability that a randomly chosen train takes more than k minutes to travel between Alphaton and Beeton is 0.675. Find the value of k . [3]

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4 The random variable X takes the values $-1, 1, 2, 3$ only. The probability that X takes the value x is kx^2 , where k is a constant.

(i) Draw up the probability distribution table for X , in terms of k , and find the value of k . [3]

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(ii) Find $E(X)$ and $Var(X)$. [3]

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- 5 The weights, in kg, of the 11 members of the Dolphins swimming team and the 11 members of the Sharks swimming team are shown below.

Dolphins	62	75	69	82	63	80	65	65	73	82	72
Sharks	68	84	59	70	71	64	77	80	66	74	72

- (i) Draw a back-to-back stem-and-leaf diagram to represent this information, with Dolphins on the left-hand side of the diagram and Sharks on the right-hand side. [4]

6 The results of a survey by a large supermarket show that 35% of its customers shop online.

(i) Six customers are chosen at random. Find the probability that more than three of them shop online. [3]

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(ii) For a random sample of n customers, the probability that at least one of them shops online is greater than 0.95. Find the least possible value of n . [3]

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7 Find the number of different arrangements that can be made of all 9 letters in the word CAMERAMAN in each of the following cases.

(i) There are no restrictions. [2]

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(ii) The As occupy the 1st, 5th and 9th positions. [1]

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(iii) There is exactly one letter between the Ms. [4]

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MATHEMATICS

9709/61

Paper 6 Probability & Statistics 1 (S1)

October/November 2018

1 hour 15 minutes

Candidates answer on the Question Paper.

Additional Materials: List of Formulae (MF9)

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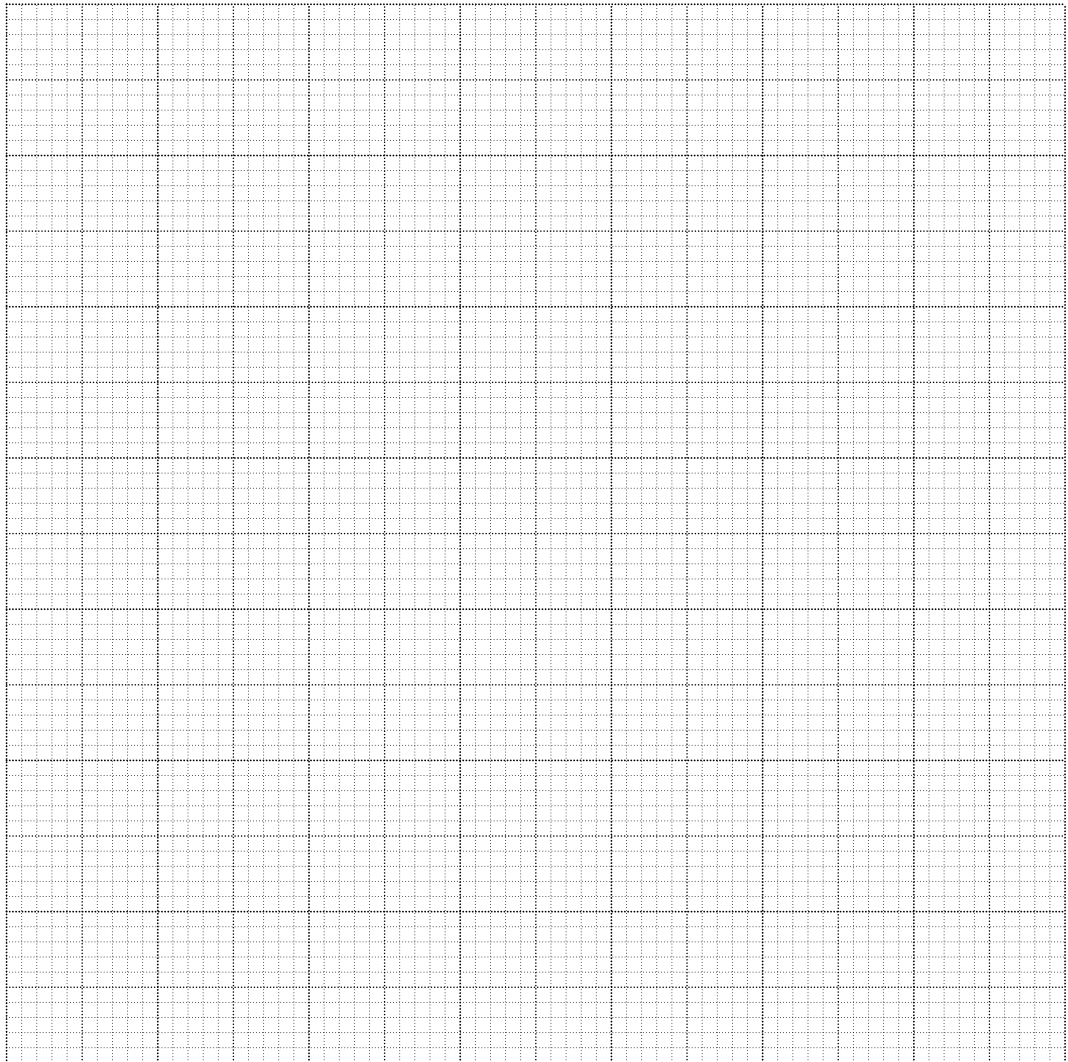
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- 6 The daily rainfall, x mm, in a certain village is recorded on 250 consecutive days. The results are summarised in the following cumulative frequency table.

Rainfall, x mm	$x \leq 20$	$x \leq 30$	$x \leq 40$	$x \leq 50$	$x \leq 70$	$x \leq 100$
Cumulative frequency	52	94	142	172	222	250

- (i) On the grid, draw a cumulative frequency graph to illustrate the data. [2]



- (ii) On 100 of the days, the rainfall was k mm or more. Use your graph to estimate the value of k . [2]

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7 In a group of students, the numbers of boys and girls studying Art, Music and Drama are given in the following table. Each of these 160 students is studying exactly one of these subjects.

	Art	Music	Drama
Boys	24	40	32
Girls	15	12	37

(i) Find the probability that a randomly chosen student is studying Music. [1]

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(ii) Determine whether the events ‘a randomly chosen student is a boy’ and ‘a randomly chosen student is studying Music’ are independent, justifying your answer. [2]

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(iii) Find the probability that a randomly chosen student is not studying Drama, given that the student is a girl. [2]

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MATHEMATICS

9709/62

Paper 6 Probability & Statistics 1 (S1)

October/November 2018

1 hour 15 minutes

Candidates answer on the Question Paper.

Additional Materials: List of Formulae (MF9)

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1 (i) How many different arrangements are there of the 11 letters in the word MISSISSIPPI? [2]

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(ii) Two letters are chosen at random from the 11 letters in the word MISSISSIPPI. Find the probability that these two letters are the same. [3]

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2 The following back-to-back stem-and-leaf diagram shows the reaction times in seconds in an experiment involving two groups of people, *A* and *B*.

	<i>A</i>		<i>B</i>	
(4)	4 2 0 0	20	5 6 7	(3)
(5)	9 8 5 0 0	21	1 2 2 3 7 7	(6)
(8)	9 8 7 5 3 2 2 2	22	1 3 5 6 6 8 9	(7)
(6)	8 7 6 5 2 1	23	4 5 7 8 8 9 9 9	(8)
(3)	8 6 3	24	2 4 5 6 7 8 8	(7)
(1)	0	25	0 2 7 8	(4)

Key: 5 | 22 | 6 means a reaction time of 0.225 seconds for *A* and 0.226 seconds for *B*

(i) Find the median and the interquartile range for group *A*. [3]

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The median value for group *B* is 0.235 seconds, the lower quartile is 0.217 seconds and the upper quartile is 0.245 seconds.

(ii) Draw box-and-whisker plots for groups *A* and *B* on the grid. [3]



7 (a) The time, X hours, for which students use a games machine in any given day has a normal distribution with mean 3.24 hours and standard deviation 0.96 hours.

(i) On how many days of the year (365 days) would you expect a randomly chosen student to use a games machine for less than 4 hours? [3]

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(ii) Find the value of k such that $P(X > k) = 0.2$. [3]

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(iii) Find the probability that the number of hours for which a randomly chosen student uses a games machine in a day is within 1.5 standard deviations of the mean. [3]

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(b) The variable Y is normally distributed with mean μ and standard deviation σ , where $4\sigma = 3\mu$ and $\mu \neq 0$. Find the probability that a randomly chosen value of Y is positive. [3]

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MATHEMATICS

9709/63

Paper 6 Probability & Statistics 1 (S1)

October/November 2018

1 hour 15 minutes

Candidates answer on the Question Paper.

Additional Materials: List of Formulae (MF9)

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2 A fair 6-sided die has the numbers $-1, -1, 0, 0, 1, 2$ on its faces. A fair 3-sided spinner has edges numbered $-1, 0, 1$. The die is thrown and the spinner is spun. The number on the uppermost face of the die and the number on the edge on which the spinner comes to rest are noted. The sum of these two numbers is denoted by X .

(i) Draw up a table showing the probability distribution of X . [3]

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(ii) Find $\text{Var}(X)$. [3]

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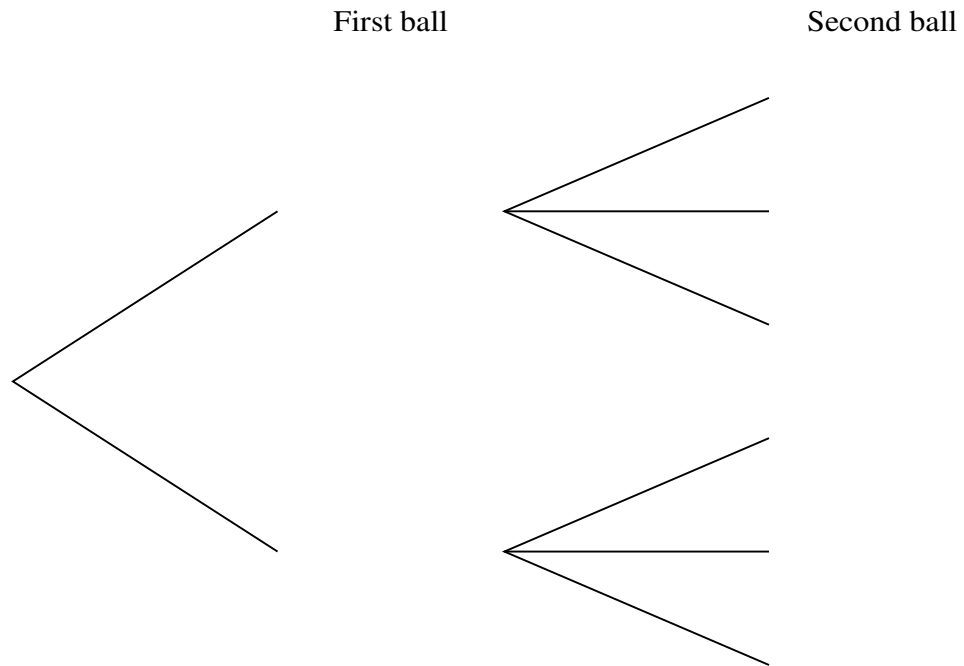
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3 A box contains 3 red balls and 5 blue balls. One ball is taken at random from the box and not replaced. A yellow ball is then put into the box. A second ball is now taken at random from the box.

(i) Complete the tree diagram to show all the outcomes and the probability for each branch. [2]



(ii) Find the probability that the two balls taken are the same colour. [2]

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7 The heights, in cm, of the 11 members of the Anvils athletics team and the 11 members of the Brecons swimming team are shown below.

Anvils	173	158	180	196	175	165	170	169	181	184	172
Brecons	166	170	171	172	172	178	181	182	183	183	192

(i) Draw a back-to-back stem-and-leaf diagram to represent this information, with Anvils on the left-hand side of the diagram and Brecons on the right-hand side. [4]

(ii) Find the median and the interquartile range for the heights of the Anvils. [3]

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MATHEMATICS

9709/61

Paper 6 Probability & Statistics 1 (**S1**)

May/June 2018

1 hour 15 minutes

Candidates answer on the Question Paper.

Additional Materials: List of Formulae (MF9)

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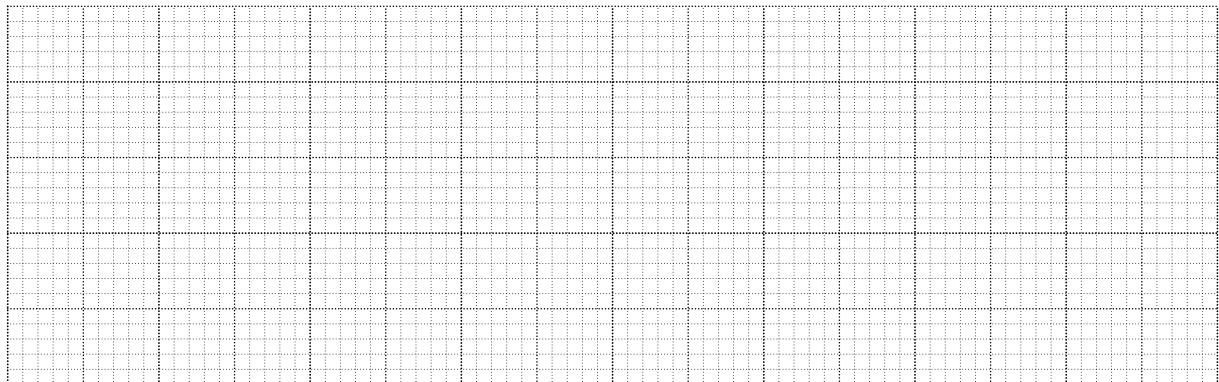


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2 In a survey 55 students were asked to record, to the nearest kilometre, the total number of kilometres they travelled to school in a particular week. The results are shown below.

5	5	9	10	13	13	13	15	15	15	15
16	18	18	18	19	19	20	20	20	20	21
21	21	21	23	25	25	27	27	29	30	33
35	38	39	40	42	45	48	50	50	51	51
52	55	57	57	60	61	64	65	66	69	70

(i) On the grid, draw a box-and-whisker plot to illustrate the data. [5]



An ‘outlier’ is defined as any data value which is more than 1.5 times the interquartile range above the upper quartile, or more than 1.5 times the interquartile range below the lower quartile.

(ii) Show that there are no outliers. [2]

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3 Andy has 4 red socks and 8 black socks in his drawer. He takes 2 socks at random from his drawer.

(i) Find the probability that the socks taken are of different colours. [2]

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The random variable X is the number of red socks taken.

(ii) Draw up the probability distribution table for X . [3]

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(iii) Find $E(X)$. [1]

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7 Find the number of different ways in which all 9 letters of the word MINCEMEAT can be arranged in each of the following cases.

(i) There are no restrictions. [1]

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(ii) No vowel (A, E, I are vowels) is next to another vowel. [4]

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1 Each of a group of 10 boys estimates the length of a piece of string. The estimates, in centimetres, are as follows.

37 40 45 38 36 38 42 38 40 39

(i) Find the mode. [1]

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(ii) Find the median and the interquartile range. [3]

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2 In a group of students, $\frac{3}{4}$ are male. The proportion of male students who like their curry hot is $\frac{3}{5}$ and the proportion of female students who like their curry hot is $\frac{4}{5}$. One student is chosen at random.

(i) Find the probability that the student chosen is either female, or likes their curry hot, or is both female and likes their curry hot. [4]

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(ii) Showing your working, determine whether the events ‘the student chosen is male’ and ‘the student chosen likes their curry hot’ are independent. [2]

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- 3 (i) The volume of soup in Super Soup cartons has a normal distribution with mean μ millilitres and standard deviation 9 millilitres. Tests have shown that 10% of cartons contain less than 440 millilitres of soup. Find the value of μ . [3]

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- (ii) A food retailer orders 150 Super Soup cartons. Calculate the number of these cartons for which you would expect the volume of soup to be more than 1.8 standard deviations above the mean. [3]

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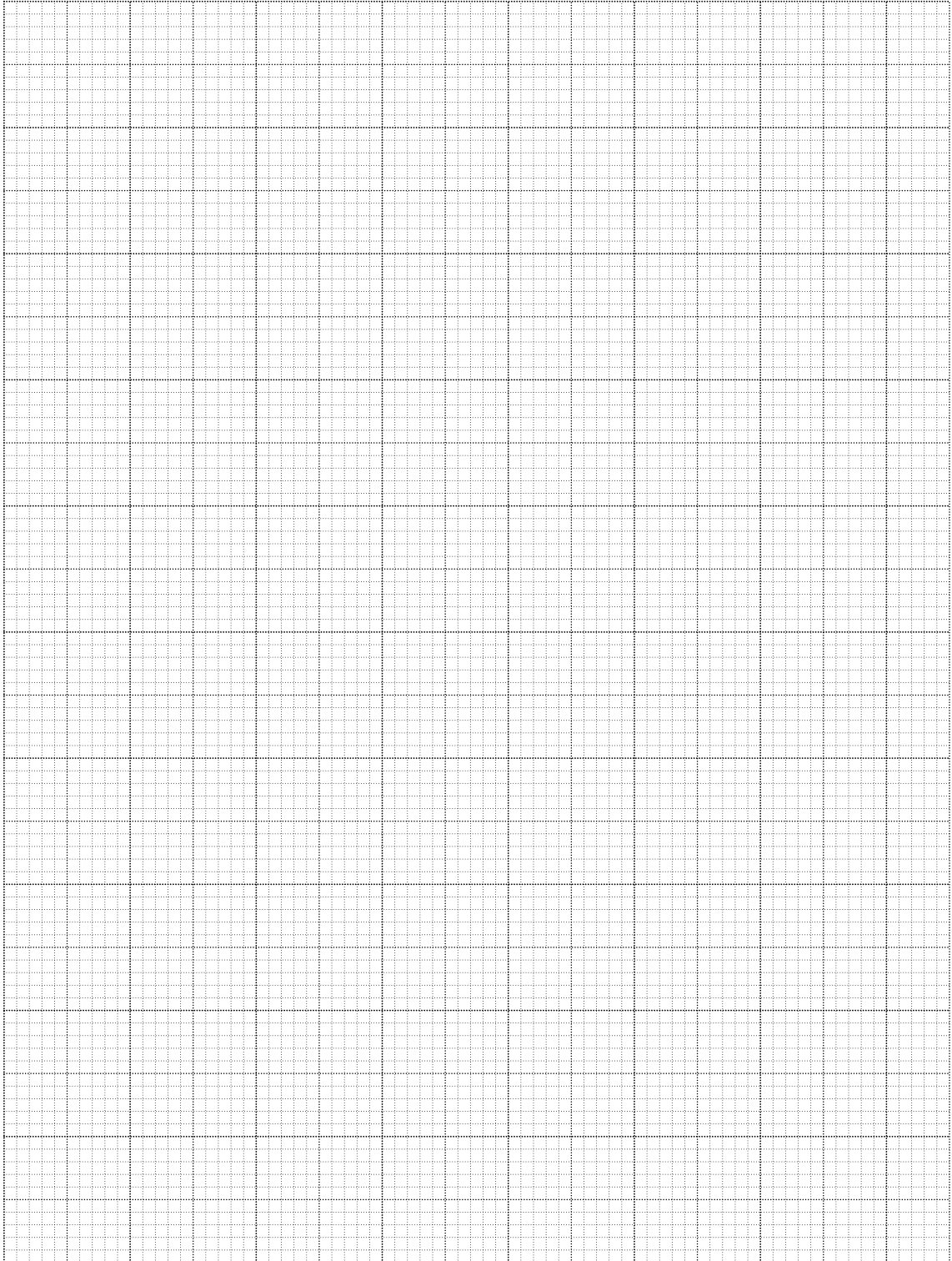
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(iii) On the grid, draw a histogram to illustrate the data in the table.

[4]



6 (a) Find the number of ways in which all 9 letters of the word AUSTRALIA can be arranged in each of the following cases.

(i) All the vowels (A, I, U are vowels) are together. [3]

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(ii) The letter T is in the central position and each end position is occupied by one of the other consonants (R, S, L). [3]

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7 In a certain country, 60% of mobile phones sold are made by Company A, 35% are made by Company B and 5% are made by other companies.

(i) Find the probability that, out of a random sample of 13 people who buy a mobile phone, fewer than 11 choose a mobile phone made by Company A. [3]

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(ii) Use a suitable approximation to find the probability that, out of a random sample of 130 people who buy a mobile phone, at least 50 choose a mobile phone made by Company B. [5]

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MATHEMATICS

9709/63

Paper 6 Probability & Statistics 1 (**S1**)

May/June 2018

1 hour 15 minutes

Candidates answer on the Question Paper.

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- 1 The masses in kilograms of 50 children having a medical check-up were recorded correct to the nearest kilogram. The results are shown in the table.

Mass (kg)	10 – 14	15 – 19	20 – 24	25 – 34	35 – 59
Frequency	6	12	14	10	8

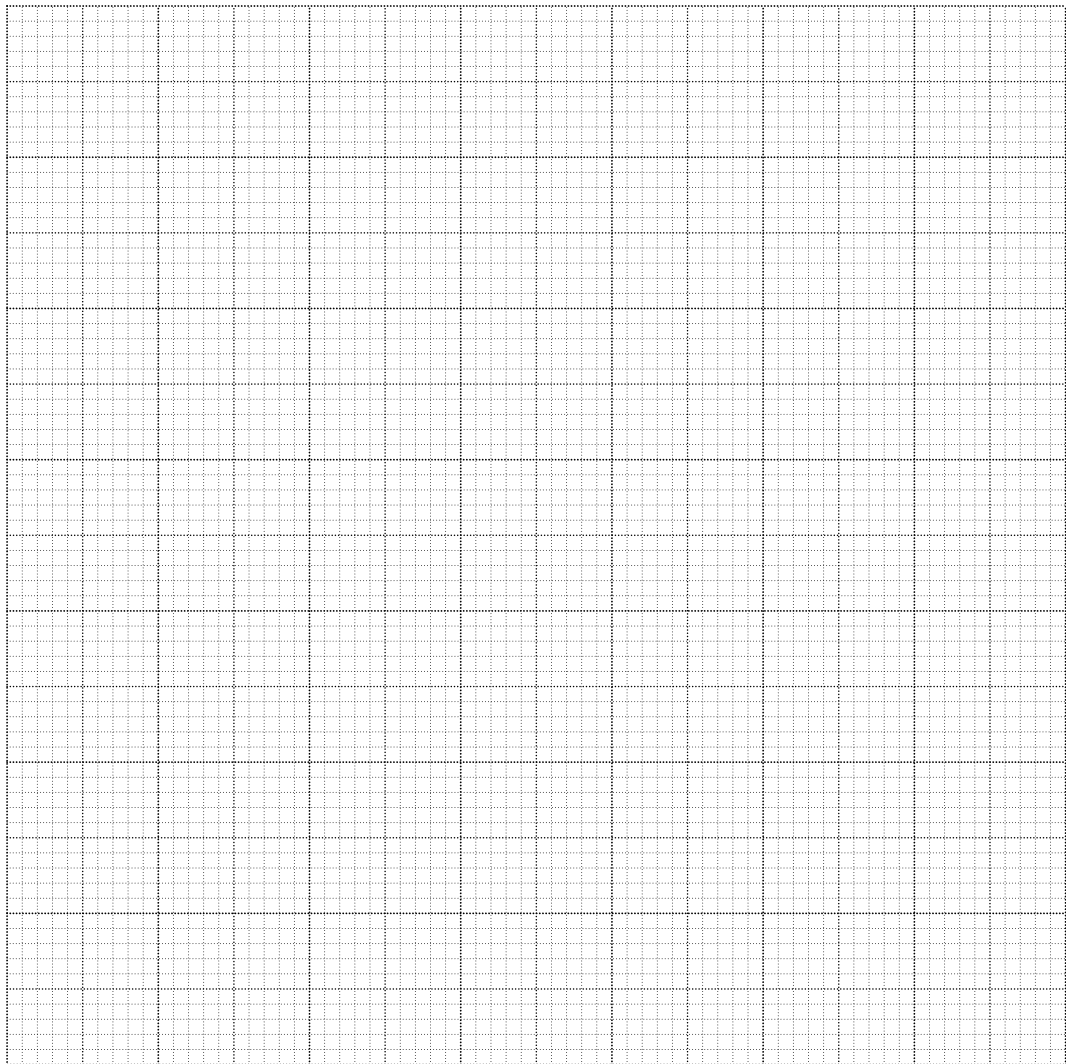
- (i) Find which class interval contains the lower quartile. [1]

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- (ii) On the grid, draw a histogram to illustrate the data in the table. [4]



2 The random variable X has the distribution $N(-3, \sigma^2)$. The probability that a randomly chosen value of X is positive is 0.25.

(i) Find the value of σ . [3]

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(ii) Find the probability that, of 8 random values of X , fewer than 2 will be positive. [3]

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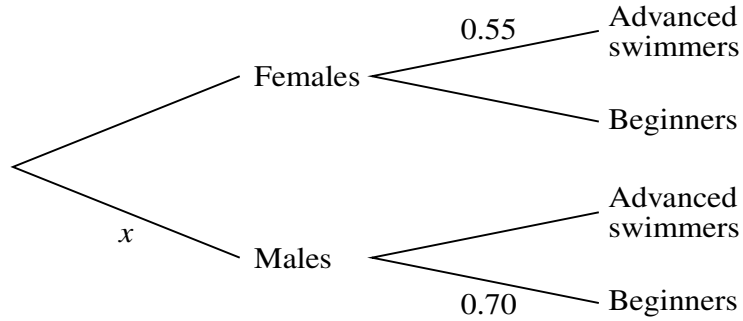
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- 3 The members of a swimming club are classified either as ‘Advanced swimmers’ or ‘Beginners’. The proportion of members who are male is x , and the proportion of males who are Beginners is 0.7. The proportion of females who are Advanced swimmers is 0.55. This information is shown in the tree diagram.



For a randomly chosen member, the probability of being an Advanced swimmer is the same as the probability of being a Beginner.

- (i) Find x . [3]

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- (ii) Given that a randomly chosen member is an Advanced swimmer, find the probability that the member is male. [3]

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7 Find the number of ways the 9 letters of the word SEVENTEEN can be arranged in each of the following cases.

(i) One of the letter Es is in the centre with 4 letters on either side. [2]

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(ii) No E is next to another E. [3]

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MATHEMATICS

9709/62

Paper 6 Probability & Statistics 1 (S1)

February/March 2018

1 hour 15 minutes

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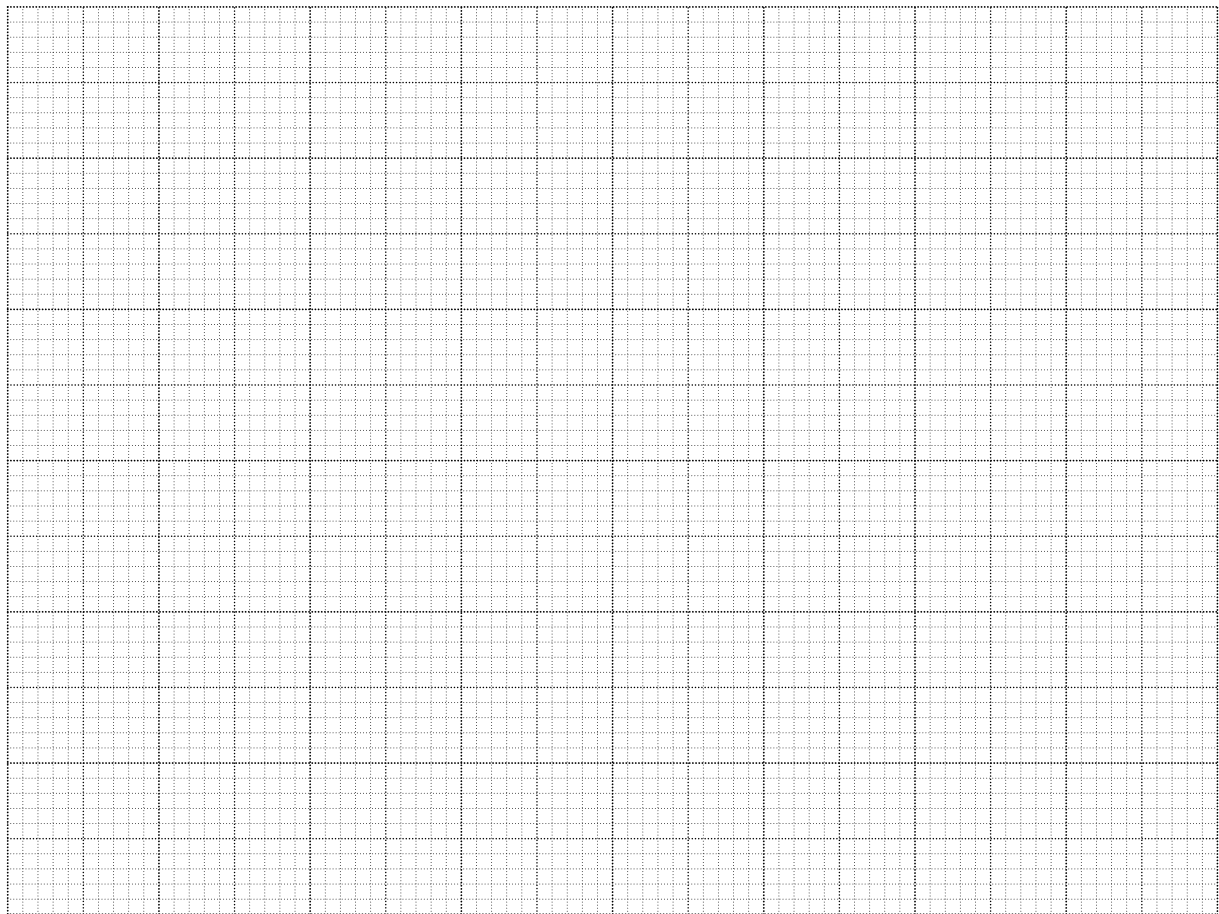
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- 1 There are 900 students in a certain year-group. An identical puzzle is given to each student and the time taken, t minutes, to complete the puzzle is recorded. These times are summarised in the following frequency table.

Time taken, t minutes	$t \leq 3$	$3 < t \leq 4$	$4 < t \leq 5$	$5 < t \leq 6$	$6 < t \leq 8$	$8 < t \leq 10$	$10 < t \leq 14$
Frequency	120	180	200	160	110	80	50

On the grid, draw a cumulative frequency graph to represent the data. Use your graph to estimate the median time taken by these students to complete the puzzle. [4]



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- 3 Last Saturday, Sarah recorded the colour and type of 160 cars in a car park. All the cars that were not red or silver in colour were grouped together as ‘other’. Her results are shown in the following table.

		Type of car		
		Saloon	Hatchback	Estate
Colour of car	Red	20	40	12
	Silver	14	26	10
	Other	6	24	8

- (i) Find the probability that a randomly chosen car in the car park is a silver estate car. [1]

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- (ii) Find the probability that a randomly chosen car in the car park is a hatchback car. [1]

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- (iii) Find the probability that a randomly chosen car in the car park is red, given that it is a hatchback car. [2]

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- (iv) One of the cars in the car park is chosen at random. Determine whether the events ‘the car is a hatchback car’ and ‘the car is red’ are independent, justifying your answer. [2]

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5 A summary of n values of x gave the following information:

$$\Sigma(x - 20) = 136, \quad \Sigma(x - 20)^2 = 2888.$$

The mean of the n values of x is 24.25.

(i) Find the value of n . [2]

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(ii) Find Σx^2 . [4]

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6 The digits 1, 3, 5, 6, 6, 6, 8 can be arranged to form many different 7-digit numbers.

(i) How many of the 7-digit numbers have all the even digits together and all the odd digits together? [3]

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(ii) How many of the 7-digit numbers are even? [3]

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8 The results of a survey at a certain large college show that the proportion of students who own a car is $\frac{1}{4}$.

(i) Five students at the college are chosen at random. Find the probability that at least four of these students own a car. [3]

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(ii) For a random sample of n students at the college, the probability that at least one of the students owns a car is greater than 0.995. Find the least possible value of n . [3]

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MATHEMATICS

9709/61

Paper 6 Probability & Statistics 1 (**S1**)

October/November 2017

1 hour 15 minutes

Candidates answer on the Question Paper.

Additional Materials: List of Formulae (MF9)

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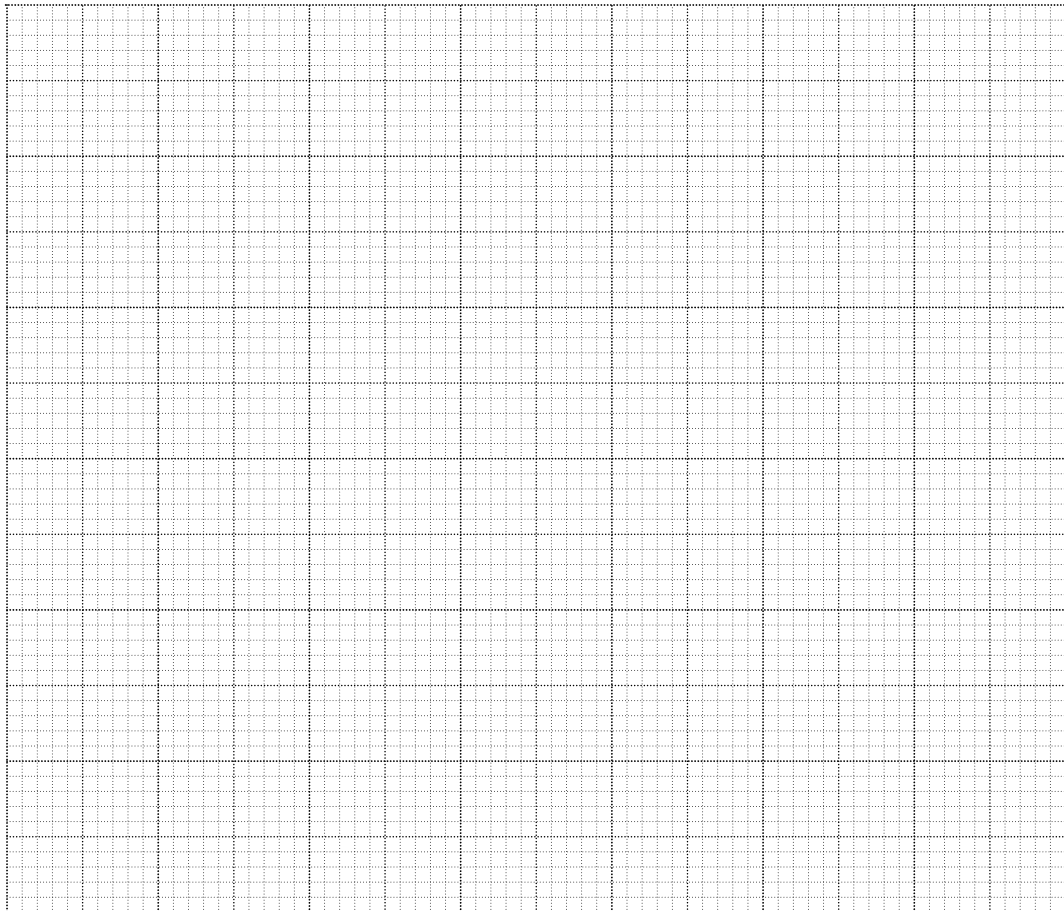


- 2 The time taken by a car to accelerate from 0 to 30 metres per second was measured correct to the nearest second. The results from 48 cars are summarised in the following table.

Time (seconds)	3 – 5	6 – 8	9 – 11	12 – 16	17 – 25
Frequency	10	15	17	4	2

- (i) On the grid, draw a cumulative frequency graph to represent this information.

[3]



- (ii) 35 of these cars accelerated from 0 to 30 metres per second in a time more than t seconds. Estimate the value of t .

[2]

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3 An experiment consists of throwing a biased die 30 times and noting the number of 4s obtained. This experiment was repeated many times and the average number of 4s obtained in 30 throws was found to be 6.21.

(i) Estimate the probability of throwing a 4. [1]

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(ii) find the variance of the number of 4s obtained in 30 throws, [1]

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(iii) find the probability that in 15 throws the number of 4s obtained is 2 or more. [3]

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5 Over a period of time Julian finds that on long-distance flights he flies economy class on 82% of flights. On the rest of the flights he flies first class. When he flies economy class, the probability that he gets a good night's sleep is x . When he flies first class, the probability that he gets a good night's sleep is 0.9.

(i) Draw a fully labelled tree diagram to illustrate this situation. [2]

The probability that Julian gets a good night's sleep on a randomly chosen flight is 0.285.

(ii) Find the value of x . [2]

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6 (a) A village hall has seats for 40 people, consisting of 8 rows with 5 seats in each row. Mary, Ahmad, Wayne, Elsie and John are the first to arrive in the village hall and no seats are taken before they arrive.

(i) How many possible arrangements are there of seating Mary, Ahmad, Wayne, Elsie and John assuming there are no restrictions? [2]

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(ii) How many possible arrangements are there of seating Mary, Ahmad, Wayne, Elsie and John if Mary and Ahmad sit together in the front row and the other three sit together in one of the other rows? [4]

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(ii) Find the weight exceeded by the heaviest 5% of pineapples. [3]

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(iii) Find the value of k such that $P(k < X < 610) = 0.3$. [5]

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MATHEMATICS

9709/62

Paper 6 Probability & Statistics 1 (**S1**)

October/November 2017

1 hour 15 minutes

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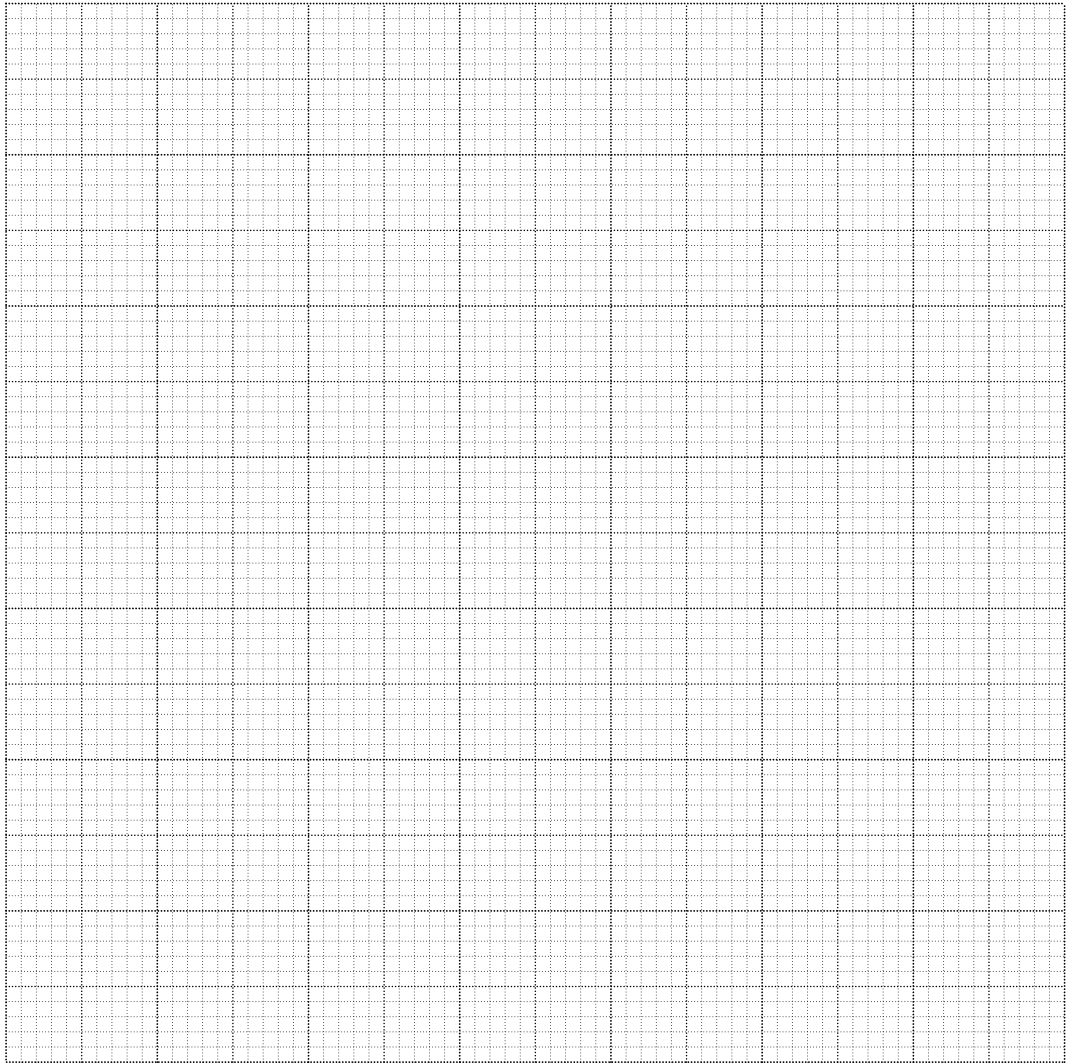
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- 2 The circumferences, c cm, of some trees in a wood were measured. The results are summarised in the table.

Circumference (c cm)	$40 < c \leq 50$	$50 < c \leq 80$	$80 < c \leq 100$	$100 < c \leq 120$
Frequency	14	48	70	8

- (i) On the grid, draw a cumulative frequency graph to represent the information. [3]



- (ii) Estimate the percentage of trees which have a circumference larger than 75 cm. [2]

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- 3 A box contains 6 identical-sized discs, of which 4 are blue and 2 are red. Discs are taken at random from the box in turn and not replaced. Let X be the number of discs taken, up to and including the first blue one.

(i) Show that $P(X = 3) = \frac{1}{15}$. [2]

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(ii) Draw up the probability distribution table for X . [3]

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4 A fair tetrahedral die has faces numbered 1, 2, 3, 4. A coin is biased so that the probability of showing a head when thrown is $\frac{1}{3}$. The die is thrown once and the number n that it lands on is noted. The biased coin is then thrown n times. So, for example, if the die lands on 3, the coin is thrown 3 times.

(i) Find the probability that the die lands on 4 and the number of times the coin shows heads is 2. [3]

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(ii) Find the probability that the die lands on 3 and the number of times the coin shows heads is 3. [1]

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(iii) Find the probability that the number the die lands on is the same as the number of times the coin shows heads. [3]

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6 (a) Find the number of different 3-digit numbers greater than 300 that can be made from the digits 1, 2, 3, 4, 6, 8 if

(i) no digit can be repeated, [3]

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(ii) a digit can be repeated and the number made is even. [3]

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(b) A team of 5 is chosen from 6 boys and 4 girls. Find the number of ways the team can be chosen if

(i) there are no restrictions, [1]

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(ii) the team contains more boys than girls. [3]

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7 In Jimpuri the weights, in kilograms, of boys aged 16 years have a normal distribution with mean 61.4 and standard deviation 12.3.

(i) Find the probability that a randomly chosen boy aged 16 years in Jimpuri weighs more than 65 kilograms. [3]

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(ii) For boys aged 16 years in Jimpuri, 25% have a weight between 65 kilograms and k kilograms, where k is greater than 65. Find k . [4]

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MATHEMATICS

9709/63

Paper 6 Probability & Statistics 1 (**S1**)

October/November 2017

1 hour 15 minutes

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3 At the end of a revision course in mathematics, students have to pass a test to gain a certificate. The probability of any student passing the test at the first attempt is 0.85. Those students who fail are allowed to retake the test once, and the probability of any student passing the retake test is 0.65.

(i) Draw a fully labelled tree diagram to show all the outcomes. [2]

(ii) Given that a student gains the certificate, find the probability that this student fails the test on the first attempt. [4]

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4 A fair die with faces numbered 1, 2, 2, 2, 3, 6 is thrown. The score, X , is found by squaring the number on the face the die shows and then subtracting 4.

(i) Draw up a table to show the probability distribution of X . [3]

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(ii) Find $E(X)$ and $\text{Var}(X)$. [3]

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- 5 The number of Olympic medals won in the 2012 Olympic Games by the top 27 countries is shown below.

104	88	82	65	44	38	35	34	28
28	18	18	17	17	14	13	13	12
12	10	10	10	9	6	5	2	2

- (i) Draw a stem-and-leaf diagram to illustrate the data.

[4]

(ii) Find the median and quartiles and draw a box-and-whisker plot on the grid.

[5]

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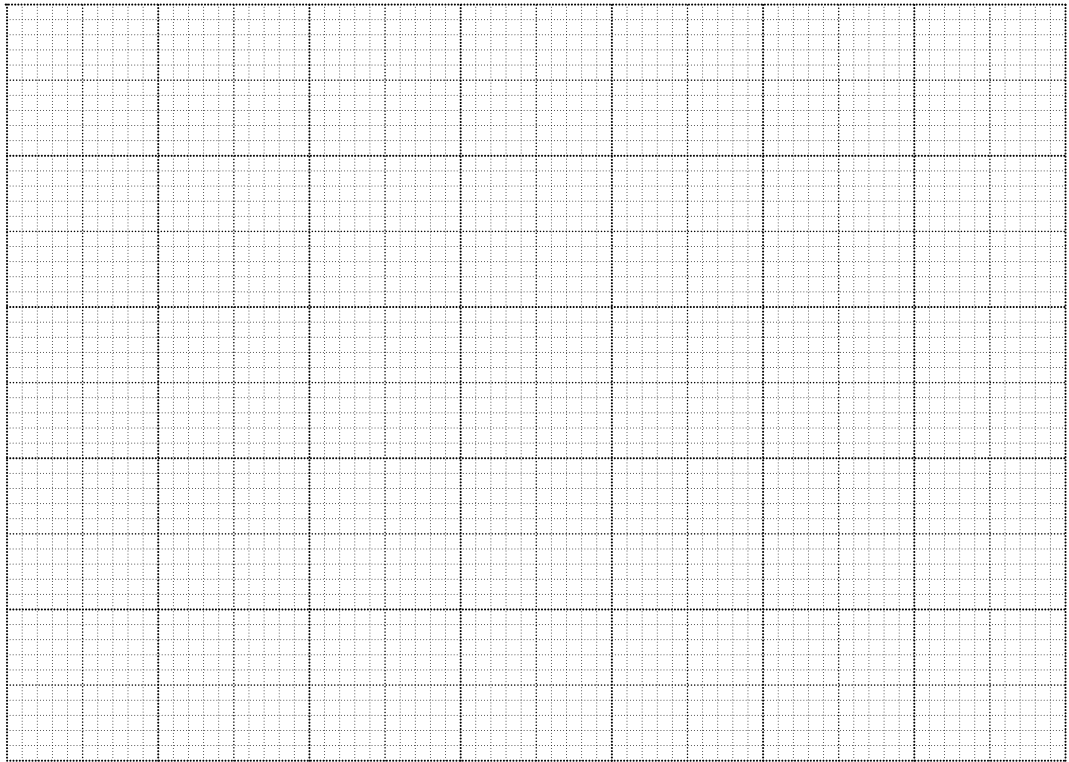
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7 Josie aims to catch a bus which departs at a fixed time every day. Josie arrives at the bus stop T minutes before the bus departs, where $T \sim N(5.3, 2.1^2)$.

(i) Find the probability that Josie has to wait longer than 6 minutes at the bus stop. [3]

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On 5% of days Josie has to wait longer than x minutes at the bus stop.

(ii) Find the value of x . [3]

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(iii) Find the probability that Josie waits longer than x minutes on fewer than 3 days in 10 days. [3]

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(iv) Find the probability that Josie misses the bus. [3]

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MATHEMATICS

9709/61

Paper 6 Probability & Statistics 1 (S1)

May/June 2017

1 hour 15 minutes

Candidates answer on the Question Paper.

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- 1 Kadijat noted the weights, x grams, of 30 chocolate buns. Her results are summarised by

$$\Sigma(x - k) = 315, \quad \Sigma(x - k)^2 = 4022,$$

where k is a constant. The mean weight of the buns is 50.5 grams.

- (i) Find the value of k .

[2]

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- (ii) Find the standard deviation of x .

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3 Redbury United soccer team play a match every week. Each match can be won, drawn or lost. At the beginning of the soccer season the probability that Redbury United win their first match is $\frac{3}{5}$, with equal probabilities of losing or drawing. If they win the first match, the probability that they win the second match is $\frac{7}{10}$ and the probability that they lose the second match is $\frac{1}{10}$. If they draw the first match they are equally likely to win, draw or lose the second match. If they lose the first match, the probability that they win the second match is $\frac{3}{10}$ and the probability that they draw the second match is $\frac{1}{20}$.

(i) Draw a fully labelled tree diagram to represent the first two matches played by Redbury United in the soccer season. [2]

(ii) Given that Redbury United win the second match, find the probability that they lose the first match. [4]

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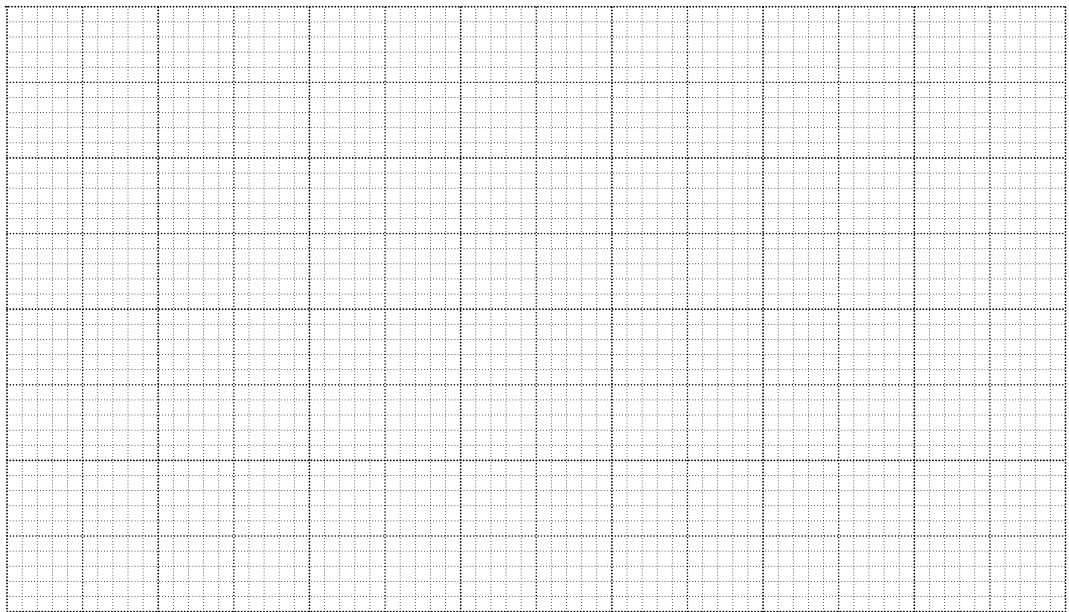
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4 The times taken, t seconds, by 1140 people to solve a puzzle are summarised in the table.

Time (t seconds)	$0 \leq t < 20$	$20 \leq t < 40$	$40 \leq t < 60$	$60 \leq t < 100$	$100 \leq t < 140$
Number of people	320	280	220	220	100

(i) On the grid, draw a histogram to illustrate this information. [4]



(ii) Calculate an estimate of the mean of t . [2]

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- (ii) Calculate the probability that a randomly chosen box contains at least 1 cracked egg. [2]

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- (iii) A shop sells n of these boxes of eggs. Find the smallest value of n such that the probability of there being at least 1 cracked egg in each box sold is less than 0.01. [2]

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6 (a) The random variable X has a normal distribution with mean μ and standard deviation σ . You are given that $\sigma = 0.25\mu$ and $P(X < 6.8) = 0.75$.

(i) Find the value of μ . [4]

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(ii) Find $P(X < 4.7)$. [3]

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- 7 (a) Eight children of different ages stand in a random order in a line. Find the number of different ways this can be done if none of the three youngest children stand next to each other. [3]

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- (b) David chooses 5 chocolates from 6 different dark chocolates, 4 different white chocolates and 1 milk chocolate. He must choose at least one of each type. Find the number of different selections he can make. [4]

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May/June 2017

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1 Rani and Diksha go shopping for clothes.

- (i) Rani buys 4 identical vests, 3 identical sweaters and 1 coat. Each vest costs \$5.50 and the coat costs \$90. The mean cost of Rani's 8 items is \$29. Find the cost of a sweater. [3]

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- (ii) Diksha buys 1 hat and 4 identical shirts. The mean cost of Diksha's 5 items is \$26 and the standard deviation is \$0. Explain how you can tell that Diksha spends \$104 on shirts. [2]

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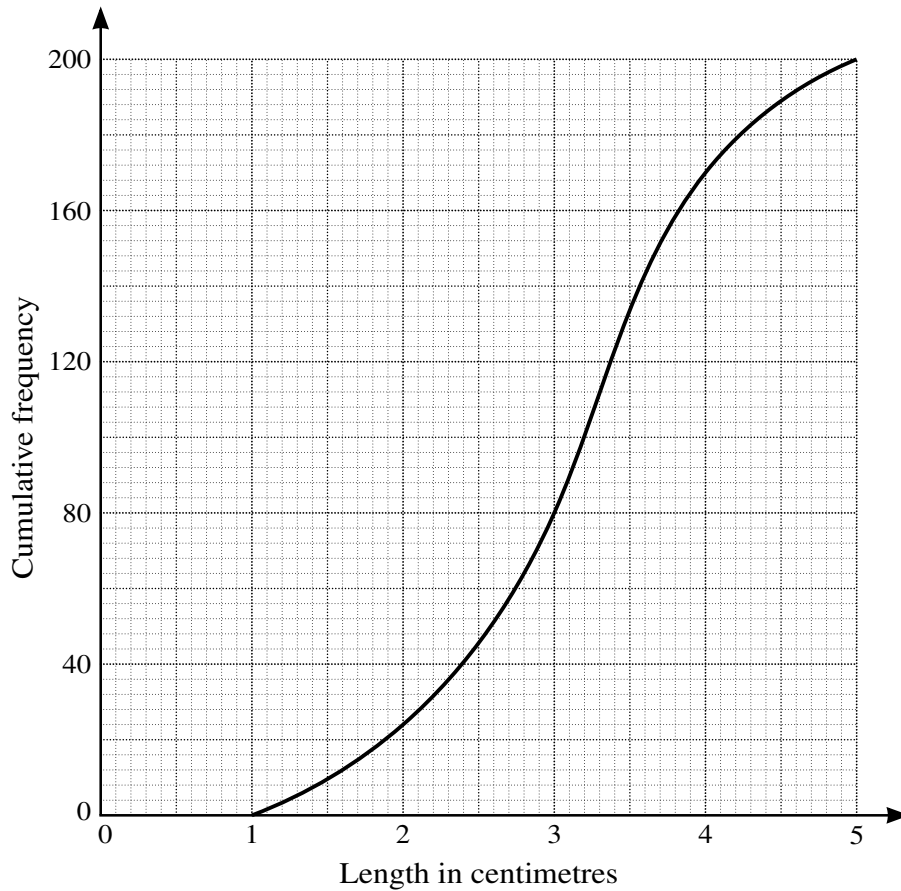
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2 Anabel measured the lengths, in centimetres, of 200 caterpillars. Her results are illustrated in the cumulative frequency graph below.



(i) Estimate the median and the interquartile range of the lengths. [3]

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(ii) Estimate how many caterpillars had a length of between 2 and 3.5 cm. [1]

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(iii) 6% of caterpillars were of length l centimetres or more. Estimate l . [2]

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5 The lengths of videos of a certain popular song have a normal distribution with mean 3.9 minutes. 18% of these videos last for longer than 4.2 minutes.

(i) Find the standard deviation of the lengths of these videos. [3]

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(ii) Find the probability that the length of a randomly chosen video differs from the mean by less than half a minute. [4]

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The lengths of videos of another popular song have a normal distribution with the same mean of 3.9 minutes but the standard deviation is twice the standard deviation in part (i). The probability that the length of a randomly chosen video of this song differs from the mean by less than half a minute is denoted by p .

(iii) Without any further calculation, determine whether p is more than, equal to, or less than your answer to part (ii). You must explain your reasoning. [2]

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7 During the school holidays, each day Khalid either rides on his bicycle with probability 0.6, or on his skateboard with probability 0.4. Khalid does not ride on both on the same day. If he rides on his bicycle then the probability that he hurts himself is 0.05. If he rides on his skateboard the probability that he hurts himself is 0.75.

(i) Find the probability that Khalid hurts himself on any particular day. [2]

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(ii) Given that Khalid hurts himself on a particular day, find the probability that he is riding on his skateboard. [2]

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(iii) There are 45 days of school holidays. Show that the variance of the number of days Khalid rides on his skateboard is the same as the variance of the number of days that Khalid rides on his bicycle. [2]

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(iv) Find the probability that Khalid rides on his skateboard on at least 2 of 10 randomly chosen days in the school holidays. [3]

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MATHEMATICS

9709/63

Paper 6 Probability & Statistics 1 (**S1**)

May/June 2017

1 hour 15 minutes

Candidates answer on the Question Paper.

Additional Materials: List of Formulae (MF9)

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3 A shop sells two makes of coffee, Café Premium and Café Standard. Both coffees come in two sizes, large jars and small jars. Of the jars on sale, 65% are Café Premium and 35% are Café Standard. Of the Café Premium, 40% of the jars are large and of the Café Standard, 25% of the jars are large. A jar is chosen at random.

(i) Find the probability that the jar is small. [2]

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(ii) Find the probability that the jar is Café Standard given that it is large. [3]

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- 4 (a) The random variable X has the distribution $N(\mu, \sigma^2)$, where $\mu = 1.5\sigma$. A random value of X is chosen. Find the probability that this value of X is greater than 0. [3]

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- (b) The life of a particular type of torch battery is normally distributed with mean 120 hours and standard deviation s hours. It is known that 87.5% of these batteries last longer than 70 hours. Find the value of s . [3]

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- 6 (a) Find how many numbers between 3000 and 5000 can be formed from the digits 1, 2, 3, 4 and 5,
(i) if digits are not repeated, [2]

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- (ii) if digits can be repeated and the number formed is odd. [3]

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(b) A box of 20 biscuits contains 4 different chocolate biscuits, 2 different oatmeal biscuits and 14 different ginger biscuits. 6 biscuits are selected from the box at random.

(i) Find the number of different selections that include the 2 oatmeal biscuits. [2]

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(ii) Find the probability that fewer than 3 chocolate biscuits are selected. [4]

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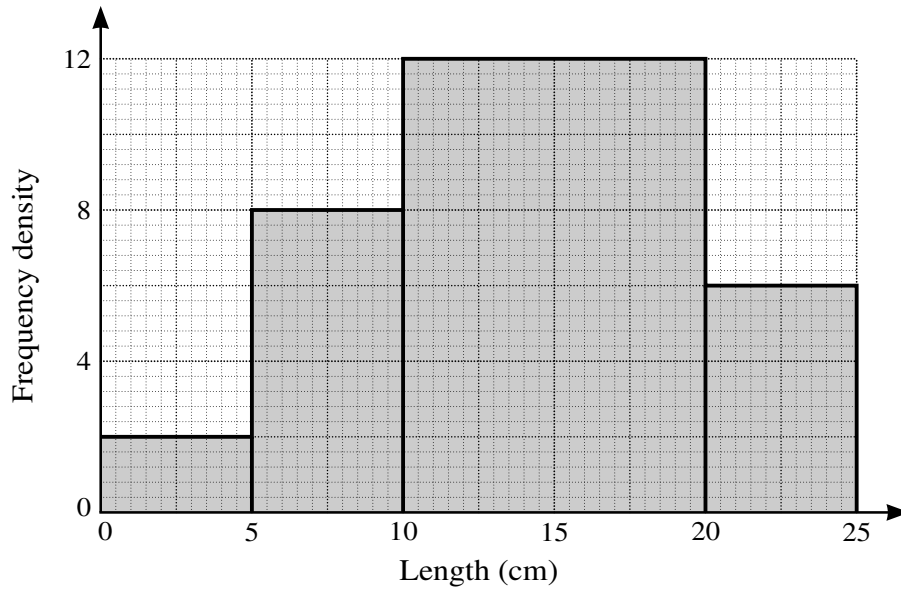
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7 The following histogram represents the lengths of worms in a garden.



(i) Calculate the frequencies represented by each of the four histogram columns. [2]

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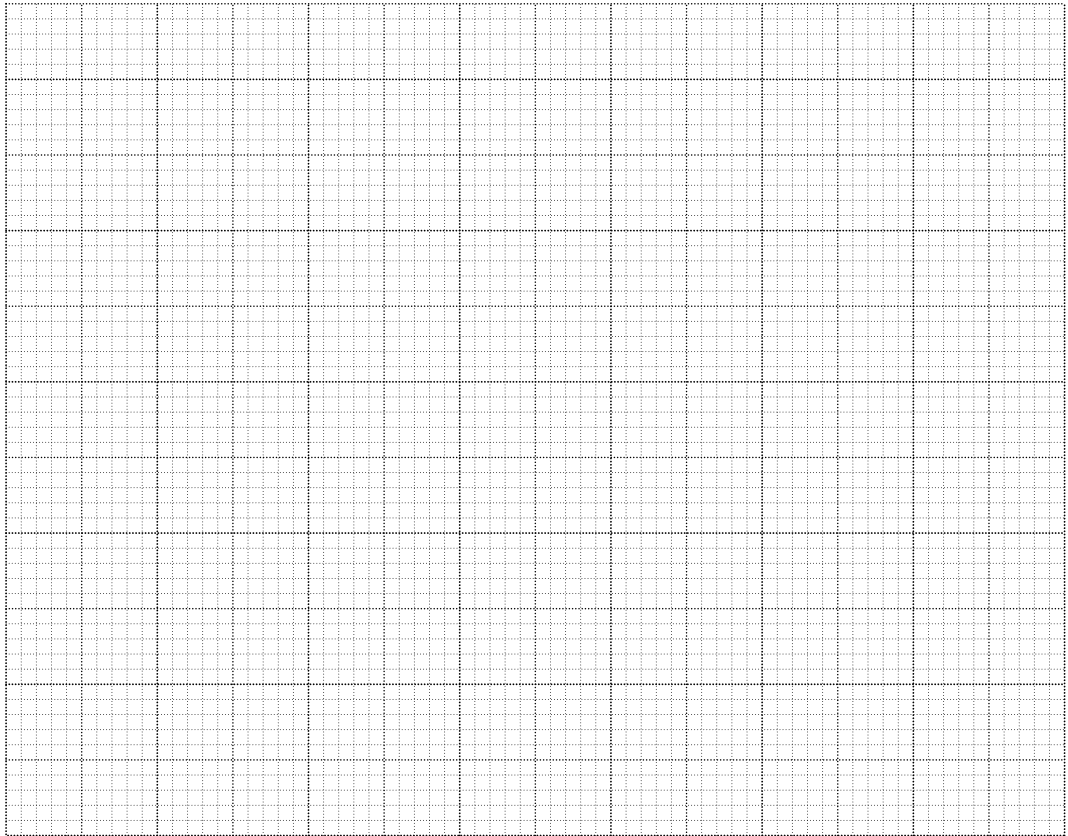
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(ii) On the grid on the next page, draw a cumulative frequency graph to represent the lengths of worms in the garden. [4]



(iii) Use your graph to estimate the median and interquartile range of the lengths of worms in the garden. [3]

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[Question 7 (iv) is printed on the next page.]

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MATHEMATICS

9709/62

Paper 6 Probability & Statistics 1 (S1)

February/March 2017

1 hour 15 minutes

Candidates answer on the Question Paper.

Additional Materials: List of Formulae (MF9)

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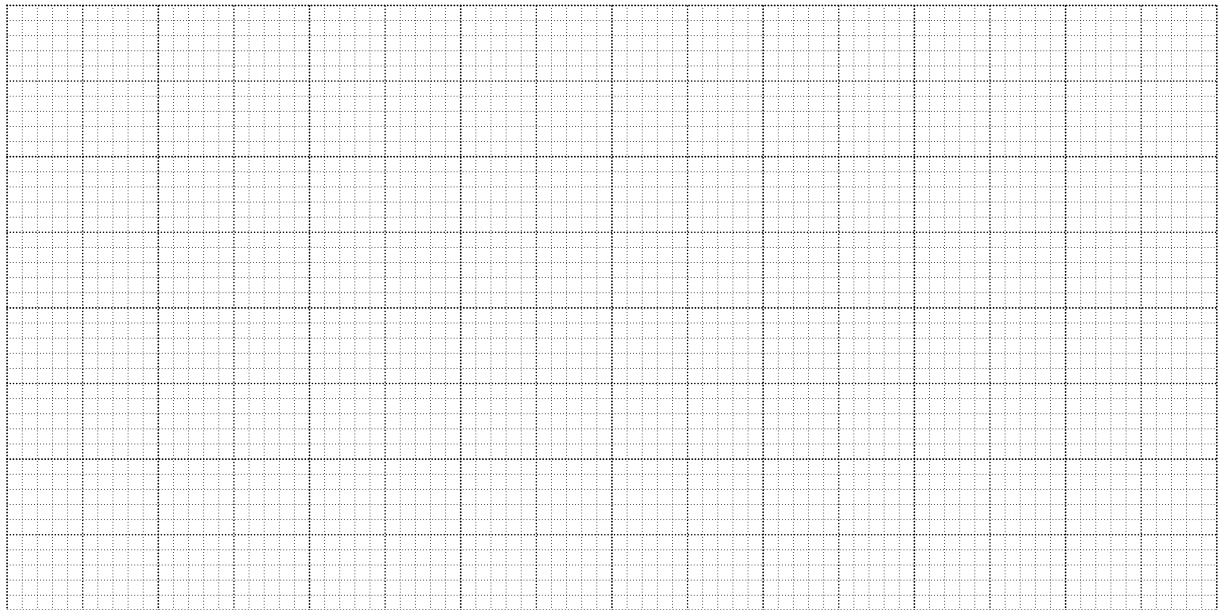


- 4 The weights in kilograms of packets of cereal were noted correct to 4 significant figures. The following stem-and-leaf diagram shows the data.

747	3		(1)
748	1 2 5 7 7 9		(6)
749	0 2 2 2 3 5 5 5 6 7 8 9		(12)
750	1 1 2 2 2 3 4 4 5 6 7 7 8 8 9		(15)
751	0 0 2 3 3 4 4 4 5 5 7 7 9		(13)
752	0 0 0 1 1 2 2 3 4 4 4		(11)
753	2		(1)

Key: 748 | 5 represents 0.7485 kg.

- (i) On the grid, draw a box-and-whisker plot to represent the data. [5]



- (ii) Name a distribution that might be a suitable model for the weights of this type of cereal packet. Justify your answer. [2]

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- 5 (i) A plate of cakes holds 12 different cakes. Find the number of ways these cakes can be shared between Alex and James if each receives an odd number of cakes. [3]

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- (ii) Another plate holds 7 cup cakes, each with a different colour icing, and 4 brownies, each of a different size. Find the number of different ways these 11 cakes can be arranged in a row if no brownie is next to another brownie. [3]

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(iii) A plate of biscuits holds 4 identical chocolate biscuits, 6 identical shortbread biscuits and 2 identical gingerbread biscuits. These biscuits are all placed in a row. Find how many different arrangements are possible if the chocolate biscuits are all kept together. [3]

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7 (a) The lengths, in centimetres, of middle fingers of women in Raneland have a normal distribution with mean μ and standard deviation σ . It is found that 25% of these women have fingers longer than 8.8 cm and 17.5% have fingers shorter than 7.7 cm.

(i) Find the values of μ and σ . [5]

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The lengths, in centimetres, of middle fingers of women in Snoland have a normal distribution with mean 7.9 and standard deviation 0.44. A random sample of 5 women from Snoland is chosen.

(ii) Find the probability that exactly 3 of these women have middle fingers shorter than 8.2 cm. [5]

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(b) The random variable X has a normal distribution with mean equal to the standard deviation. Find the probability that a particular value of X is less than 1.5 times the mean. [3]

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MATHEMATICS

9709/61

Paper 6 Probability & Statistics 1 (S1)

October/November 2016

1 hour 15 minutes

Additional Materials: List of Formulae (MF9)

READ THESE INSTRUCTIONS FIRST

An answer booklet and a graph paper booklet are provided inside this question paper. You should follow the instructions on the front cover of both booklets. If you need additional answer paper or graph paper ask the invigilator for a continuation booklet or graph paper booklet.

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This document consists of **3** printed pages, **1** blank page and **2** inserts.

- 1 The random variable X is such that $X \sim N(20, 49)$. Given that $P(X > k) = 0.25$, find the value of k . [3]
- 2 Two fair six-sided dice with faces numbered 1, 2, 3, 4, 5, 6 are thrown and the two scores are noted. The difference between the two scores is defined as follows.
- If the scores are equal the difference is zero.
 - If the scores are not equal the difference is the larger score minus the smaller score.
- Find the expectation of the difference between the two scores. [5]
- 3 Visitors to a Wildlife Park in Africa have independent probabilities of 0.9 of seeing giraffes, 0.95 of seeing elephants, 0.85 of seeing zebras and 0.1 of seeing lions.
- (i) Find the probability that a visitor to the Wildlife Park sees all these animals. [1]
- (ii) Find the probability that, out of 12 randomly chosen visitors, fewer than 3 see lions. [3]
- (iii) 50 people independently visit the Wildlife Park. Find the mean and variance of the number of these people who see zebras. [2]
- 4 Packets of rice are filled by a machine and have weights which are normally distributed with mean 1.04 kg and standard deviation 0.017 kg.
- (i) Find the probability that a randomly chosen packet weighs less than 1 kg. [3]
- (ii) How many packets of rice, on average, would the machine fill from 1000 kg of rice? [1]
- The factory manager wants to produce more packets of rice. He changes the settings on the machine so that the standard deviation is the same but the mean is reduced to μ kg. With this mean the probability that a packet weighs less than 1 kg is 0.0388.
- (iii) Find the value of μ . [3]
- (iv) How many packets of rice, on average, would the machine now fill from 1000 kg of rice? [1]
- 5 (a) Find the number of different ways of arranging all nine letters of the word PINEAPPLE if no vowel (A, E, I) is next to another vowel. [4]
- (b) A certain country has a cricket squad of 16 people, consisting of 7 batsmen, 5 bowlers, 2 all-rounders and 2 wicket-keepers. The manager chooses a team of 11 players consisting of 5 batsmen, 4 bowlers, 1 all-rounder and 1 wicket-keeper.
- (i) Find the number of different teams the manager can choose. [2]
- (ii) Find the number of different teams the manager can choose if one particular batsman refuses to be in the team when one particular bowler is in the team. [3]

- 6 Deeti has 3 red pens and 1 blue pen in her left pocket and 3 red pens and 1 blue pen in her right pocket. 'Operation T ' consists of Deeti taking one pen at random from her left pocket and placing it in her right pocket, then taking one pen at random from her right pocket and placing it in her left pocket.

(i) Find the probability that, when Deeti carries out operation T , she takes a blue pen from her left pocket and then a blue pen from her right pocket. [2]

The random variable X is the number of blue pens in Deeti's left pocket after carrying out operation T .

(ii) Find $P(X = 1)$. [3]

(iii) Given that the pen taken from Deeti's right pocket is blue, find the probability that the pen taken from Deeti's left pocket is blue. [4]

- 7 The masses, in grams, of components made in factory A and components made in factory B are shown below.

Factory A	0.049	0.050	0.053	0.054	0.057	0.058	0.058
	0.059	0.061	0.061	0.061	0.063	0.065	
Factory B	0.031	0.056	0.049	0.044	0.038	0.048	0.051
	0.064	0.035	0.042	0.047	0.054	0.058	

(i) Draw a back-to-back stem-and-leaf diagram to represent the masses of components made in the two factories. [5]

(ii) Find the median and the interquartile range for the masses of components made in factory B . [3]

(iii) Make two comparisons between the masses of components made in factory A and the masses of those made in factory B . [2]

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MATHEMATICS

9709/62

Paper 6 Probability & Statistics 1 (S1)

October/November 2016

1 hour 15 minutes

Additional Materials: List of Formulae (MF9)

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- 1 When Anya goes to school, the probability that she walks is 0.3 and the probability that she cycles is 0.65; if she does not walk or cycle she takes the bus. When Anya walks the probability that she is late is 0.15. When she cycles the probability that she is late is 0.1 and when she takes the bus the probability that she is late is 0.6. Given that Anya is late, find the probability that she cycles. [5]
- 2 Noor has 3 T-shirts, 4 blouses and 5 jumpers. She chooses 3 items at random. The random variable X is the number of T-shirts chosen.
- (i) Show that the probability that Noor chooses exactly one T-shirt is $\frac{27}{55}$. [3]
- (ii) Draw up the probability distribution table for X . [4]
- 3 On any day at noon, the probabilities that Kersley is asleep or studying are 0.2 and 0.6 respectively.
- (i) Find the probability that, in any 7-day period, Kersley is either asleep or studying at noon on at least 6 days. [3]
- (ii) Use an approximation to find the probability that, in any period of 100 days, Kersley is asleep at noon on at most 30 days. [5]
- 4 The time taken to cook an egg by people living in a certain town has a normal distribution with mean 4.2 minutes and standard deviation 0.6 minutes.
- (i) Find the probability that a person chosen at random takes between 3.5 and 4.5 minutes to cook an egg. [3]
- 12% of people take more than t minutes to cook an egg.
- (ii) Find the value of t . [3]
- (iii) A random sample of n people is taken. Find the smallest possible value of n if the probability that none of these people takes more than t minutes to cook an egg is less than 0.003. [3]
- 5 The number of people a football stadium can hold is called the ‘capacity’. The capacities of 130 football stadiums in the UK, to the nearest thousand, are summarised in the table.

Capacity	3000–7000	8000–12 000	13 000–22 000	23 000–42 000	43 000–82 000
Number of stadiums	40	30	18	34	8

- (i) On graph paper, draw a histogram to represent this information. Use a scale of 2 cm for a capacity of 10 000 on the horizontal axis. [5]
- (ii) Calculate an estimate of the mean capacity of these 130 stadiums. [2]
- (iii) Find which class in the table contains the median and which contains the lower quartile. [2]

- 6 Find the number of ways all 10 letters of the word COPENHAGEN can be arranged so that
- (i) the vowels (A, E, O) are together and the consonants (C, G, H, N, P) are together, [3]
 - (ii) the Es are not next to each other. [4]

Four letters are selected from the 10 letters of the word COPENHAGEN.

- (iii) Find the number of different selections if the four letters must contain the same number of Es and Ns with at least one of each. [5]

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MATHEMATICS

9709/63

Paper 6 Probability & Statistics 1 (S1)

October/November 2016

1 hour 15 minutes

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- 1 A committee of 5 people is to be chosen from 4 men and 6 women. William is one of the 4 men and Mary is one of the 6 women. Find the number of different committees that can be chosen if William and Mary refuse to be on the committee together. [3]
- 2 A fair triangular spinner has three sides numbered 1, 2, 3. When the spinner is spun, the score is the number of the side on which it lands. The spinner is spun four times.
- (i) Find the probability that at least two of the scores are 3. [3]
- (ii) Find the probability that the sum of the four scores is 5. [3]
- 3 Numbers are formed using some or all of the digits 4, 5, 6, 7 with no digit being used more than once.
- (i) Show that, using exactly 3 of the digits, there are 12 different odd numbers that can be formed. [3]
- (ii) Find how many odd numbers altogether can be formed. [3]
- 4 For a group of 250 cars the numbers, classified by colour and country of manufacture, are shown in the table.

	Germany	Japan	Korea
Silver	40	26	34
White	32	22	26
Red	28	12	30

One car is selected at random from this group. Find the probability that the selected car is

- (i) a red or silver car manufactured in Korea, [1]
- (ii) not manufactured in Japan. [1]

X is the event that the selected car is white. Y is the event that the selected car is manufactured in Germany.

- (iii) By using appropriate probabilities, determine whether events X and Y are independent. [5]

- 5 The tables summarise the heights, h cm, of 60 girls and 60 boys.

Height of girls (cm)	$140 < h \leq 150$	$150 < h \leq 160$	$160 < h \leq 170$	$170 < h \leq 180$	$180 < h \leq 190$
Frequency	12	21	17	10	0
Height of boys (cm)	$140 < h \leq 150$	$150 < h \leq 160$	$160 < h \leq 170$	$170 < h \leq 180$	$180 < h \leq 190$
Frequency	0	20	23	12	5

- (i) On graph paper, using the same set of axes, draw two cumulative frequency graphs to illustrate the data. [4]
- (ii) On a school trip the students have to enter a cave which is 165 cm high. Use your graph to estimate the percentage of the girls who will be unable to stand upright. [3]
- (iii) The students are asked to compare the heights of the girls and the boys. State one advantage of using a pair of box-and-whisker plots instead of the cumulative frequency graphs to do this. [1]
- 6 The weights of bananas in a fruit shop have a normal distribution with mean 150 grams and standard deviation 50 grams. Three sizes of banana are sold.

Small: under 95 grams

Medium: between 95 grams and 205 grams

Large: over 205 grams

- (i) Find the proportion of bananas that are small. [3]
- (ii) Find the weight exceeded by 10% of bananas. [3]
- The prices of bananas are 10 cents for a small banana, 20 cents for a medium banana and 25 cents for a large banana.
- (iii) (a) Show that the probability that a randomly chosen banana costs 20 cents is 0.7286. [1]
- (b) Calculate the expected total cost of 100 randomly chosen bananas. [3]
- 7 Each day Annabel eats rice, potato or pasta. Independently of each other, the probability that she eats rice is 0.75, the probability that she eats potato is 0.15 and the probability that she eats pasta is 0.1.

- (i) Find the probability that, in any week of 7 days, Annabel eats pasta on exactly 2 days. [2]
- (ii) Find the probability that, in a period of 5 days, Annabel eats rice on 2 days, potato on 1 day and pasta on 2 days. [3]
- (iii) Find the probability that Annabel eats potato on more than 44 days in a year of 365 days. [5]

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MATHEMATICS

9709/61

Paper 6 Probability & Statistics 1 (S1)

May/June 2016

1 hour 15 minutes

Additional Materials: List of Formulae (MF9)

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- 1 The height of maize plants in Mpapwa is normally distributed with mean 1.62 m and standard deviation σ m. The probability that a randomly chosen plant has a height greater than 1.8 m is 0.15. Find the value of σ . [3]

- 2 The faces of a biased die are numbered 1, 2, 3, 4, 5 and 6. The random variable X is the score when the die is thrown. The following is the probability distribution table for X .

x	1	2	3	4	5	6
$P(X = x)$	p	p	p	p	0.2	0.2

The die is thrown 3 times. Find the probability that the score is 4 on not more than 1 of the 3 throws. [5]

- 3 The probability that the school bus is on time on any particular day is 0.6. If the bus is on time the probability that Sam the driver gets a cup of coffee is 0.9. If the bus is not on time the probability that Sam gets a cup of coffee is 0.3.

(i) Find the probability that Sam gets a cup of coffee. [2]

(ii) Given that Sam does not get a cup of coffee, find the probability that the bus is not on time. [3]

- 4 A box contains 2 green sweets and 5 blue sweets. Two sweets are taken at random from the box, without replacement. The random variable X is the number of green sweets taken. Find $E(X)$ and $\text{Var}(X)$. [6]

- 5 Plastic drinking straws are manufactured to fit into drinks cartons which have a hole in the top. A straw fits into the hole if the diameter of the straw is less than 3 mm. The diameters of the straws have a normal distribution with mean 2.6 mm and standard deviation 0.25 mm.

(i) A straw is chosen at random. Find the probability that it fits into the hole in a drinks carton. [3]

(ii) 500 straws are chosen at random. Use a suitable approximation to find the probability that at least 480 straws fit into the holes in drinks cartons. [5]

(iii) Justify the use of your approximation. [1]

- 6 (a) (i) Find how many numbers there are between 100 and 999 in which all three digits are different. [3]

(ii) Find how many of the numbers in part (i) are odd numbers greater than 700. [4]

(b) A bunch of flowers consists of a mixture of roses, tulips and daffodils. Tom orders a bunch of 7 flowers from a shop to give to a friend. There must be at least 2 of each type of flower. The shop has 6 roses, 5 tulips and 4 daffodils, all different from each other. Find the number of different bunches of flowers that are possible. [4]

7 The amounts spent by 160 shoppers at a supermarket are summarised in the following table.

Amount spent (\$ x)	$0 < x \leq 30$	$30 < x \leq 50$	$50 < x \leq 70$	$70 < x \leq 90$	$90 < x \leq 140$
Number of shoppers	16	40	48	26	30

- (i) Draw a cumulative frequency graph of this distribution. [4]
- (ii) Estimate the median and the interquartile range of the amount spent. [3]
- (iii) Estimate the number of shoppers who spent more than \$115. [2]
- (iv) Calculate an estimate of the mean amount spent. [2]

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MATHEMATICS

9709/62

Paper 6 Probability & Statistics 1 (S1)

May/June 2016

1 hour 15 minutes

Additional Materials: List of Formulae (MF9)

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- 1 Ayman's breakfast drink is tea, coffee or hot chocolate with probabilities 0.65, 0.28, 0.07 respectively. When he drinks tea, the probability that he has milk in it is 0.8. When he drinks coffee, the probability that he has milk in it is 0.5. When he drinks hot chocolate he always has milk in it.

(i) Draw a fully labelled tree diagram to represent this information. [2]

(ii) Find the probability that Ayman's breakfast drink is coffee, given that his drink has milk in it. [3]

- 2 When visiting the dentist the probability of waiting less than 5 minutes is 0.16, and the probability of waiting less than 10 minutes is 0.88.

(i) Find the probability of waiting between 5 and 10 minutes. [1]

A random sample of 180 people who visit the dentist is chosen.

(ii) Use a suitable approximation to find the probability that more than 115 of these people wait between 5 and 10 minutes. [5]

- 3 A particular type of bird lays 1, 2, 3 or 4 eggs in a nest each year. The probability of x eggs is equal to kx , where k is a constant.

(i) Draw up a probability distribution table, in terms of k , for the number of eggs laid in a year and find the value of k . [3]

(ii) Find the mean and variance of the number of eggs laid in a year by this type of bird. [3]

- 4 When people visit a certain large shop, on average 34% of them do not buy anything, 53% spend less than \$50 and 13% spend at least \$50.

(i) 15 people visiting the shop are chosen at random. Calculate the probability that at least 14 of them buy something. [3]

(ii) n people visiting the shop are chosen at random. The probability that none of them spends at least \$50 is less than 0.04. Find the smallest possible value of n . [3]

- 5 The following are the maximum daily wind speeds in kilometres per hour for the first two weeks in April for two towns, Bronlea and Rogate.

Bronlea	21	45	6	33	27	3	32	14	28	24	13	17	25	22
Rogate	7	5	4	15	23	7	11	13	26	18	23	16	10	34

(i) Draw a back-to-back stem-and-leaf diagram to represent this information. [5]

(ii) Write down the median of the maximum wind speeds for Bronlea and find the interquartile range for Rogate. [3]

(iii) Use your diagram to make one comparison between the maximum wind speeds in the two towns. [1]

- 6** The time in minutes taken by Peter to walk to the shop and buy a newspaper is normally distributed with mean 9.5 and standard deviation 1.3.
- (i) Find the probability that on a randomly chosen day Peter takes longer than 10.2 minutes. [3]
 - (ii) On 90% of days he takes longer than t minutes. Find the value of t . [3]
 - (iii) Calculate an estimate of the number of days in a year (365 days) on which Peter takes less than 8.8 minutes to walk to the shop and buy a newspaper. [3]
- 7** (a) Find the number of different arrangements which can be made of all 10 letters of the word WALLFLOWER if
- (i) there are no restrictions, [1]
 - (ii) there are exactly six letters between the two Ws. [4]
- (b) A team of 6 people is to be chosen from 5 swimmers, 7 athletes and 4 cyclists. There must be at least 1 from each activity and there must be more athletes than cyclists. Find the number of different ways in which the team can be chosen. [4]

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MATHEMATICS

9709/63

Paper 6 Probability & Statistics 1 (S1)

May/June 2016

1 hour 15 minutes

Additional Materials: List of Formulae (MF9)

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- 1 In a group of 30 adults, 25 are right-handed and 8 wear spectacles. The number who are right-handed and do not wear spectacles is 19.

(i) Copy and complete the following table to show the number of adults in each category. [2]

	Wears spectacles	Does not wear spectacles	Total
Right-handed			
Not right-handed			
Total			30

An adult is chosen at random from the group. Event X is ‘the adult chosen is right-handed’; event Y is ‘the adult chosen wears spectacles’.

(ii) Determine whether X and Y are independent events, justifying your answer. [3]

- 2 A group of children played a computer game which measured their time in seconds to perform a certain task. A summary of the times taken by girls and boys in the group is shown below.

	Minimum	Lower quartile	Median	Upper quartile	Maximum
Girls	5	5.5	7	9	13
Boys	4	6	8.5	11	16

(i) On graph paper, draw two box-and-whisker plots in a single diagram to illustrate the times taken by girls and boys to perform this task. [3]

(ii) State two comparisons of the times taken by girls and boys. [2]

- 3 Two ordinary fair dice are thrown. The resulting score is found as follows.

- If the two dice show different numbers, the score is the smaller of the two numbers.
- If the two dice show equal numbers, the score is 0.

(i) Draw up the probability distribution table for the score. [4]

(ii) Calculate the expected score. [2]

- 4 The monthly rental prices, $\$x$, for 9 apartments in a certain city are listed and are summarised as follows.

$$\Sigma(x - c) = 1845 \quad \Sigma(x - c)^2 = 477\,450$$

The mean monthly rental price is \$2205.

(i) Find the value of the constant c . [2]

(ii) Find the variance of these values of x . [2]

(iii) Another apartment is added to the list. The mean monthly rental price is now \$2120.50. Find the rental price of this additional apartment. [2]

- 5 The heights of school desks have a normal distribution with mean 69 cm and standard deviation σ cm. It is known that 15.5% of these desks have a height greater than 70 cm.

(i) Find the value of σ . [3]

When Jodu sits at a desk, his knees are at a height of 58 cm above the floor. A desk is comfortable for Jodu if his knees are at least 9 cm below the top of the desk. Jodu's school has 300 desks.

(ii) Calculate an estimate of the number of these desks that are comfortable for Jodu. [5]

- 6 Find the number of ways all 9 letters of the word EVERGREEN can be arranged if

(i) there are no restrictions, [1]

(ii) the first letter is R and the last letter is G, [2]

(iii) the Es are all together. [2]

Three letters from the 9 letters of the word EVERGREEN are selected.

(iv) Find the number of selections which contain no Es and exactly 1 R. [1]

(v) Find the number of selections which contain no Es. [3]

- 7 Passengers are travelling to Picton by minibus. The probability that each passenger carries a backpack is 0.65, independently of other passengers. Each minibus has seats for 12 passengers.

(i) Find the probability that, in a full minibus travelling to Picton, between 8 passengers and 10 passengers inclusive carry a backpack. [3]

(ii) Passengers get on to an empty minibus. Find the probability that the fourth passenger who gets on to the minibus will be the first to be carrying a backpack. [2]

(iii) Find the probability that, of a random sample of 250 full minibuses travelling to Picton, more than 54 will contain exactly 7 passengers carrying backpacks. [6]

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MATHEMATICS

9709/62

Paper 6 Probability & Statistics 1 (S1)

February/March 2016

1 hour 15 minutes

Additional Materials: List of Formulae (MF9)

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- 1 For 10 values of x the mean is 86.2 and $\Sigma(x - a) = 362$. Find the value of
- (i) Σx , [1]
- (ii) the constant a . [2]
- 2 A flower shop has 5 yellow roses, 3 red roses and 2 white roses. Martin chooses 3 roses at random. Draw up the probability distribution table for the number of white roses Martin chooses. [4]
- 3 A fair eight-sided die has faces marked 1, 2, 3, 4, 5, 6, 7, 8. The score when the die is thrown is the number on the face the die lands on. The die is thrown twice.
- Event R is 'one of the scores is exactly 3 greater than the other score'.
 - Event S is 'the product of the scores is more than 19'.
- (i) Find the probability of R . [2]
- (ii) Find the probability of S . [2]
- (iii) Determine whether events R and S are independent. Justify your answer. [3]
- 4 A survey was made of the journey times of 63 people who cycle to work in a certain town. The results are summarised in the following cumulative frequency table.

Journey time (minutes)	≤ 10	≤ 25	≤ 45	≤ 60	≤ 80
Cumulative frequency	0	18	50	59	63

- (i) State how many journey times were between 25 and 45 minutes. [1]
- (ii) Draw a histogram on graph paper to represent the data. [4]
- (iii) Calculate an estimate of the mean journey time. [2]
- 5 In a certain town, 35% of the people take a holiday abroad and 65% take a holiday in their own country. Of those going abroad 80% go to the seaside, 15% go camping and 5% take a city break. Of those taking a holiday in their own country, 20% go to the seaside and the rest are divided equally between camping and a city break.
- (i) A person is chosen at random. Given that the person chosen goes camping, find the probability that the person goes abroad. [5]
- (ii) A group of n people is chosen randomly. The probability of all the people in the group taking a holiday in their own country is less than 0.002. Find the smallest possible value of n . [3]

- 6 Hannah chooses 5 singers from 15 applicants to appear in a concert. She lists the 5 singers in the order in which they will perform.

(i) How many different lists can Hannah make? [2]

Of the 15 applicants, 10 are female and 5 are male.

(ii) Find the number of lists in which the first performer is male, the second is female, the third is male, the fourth is female and the fifth is male. [2]

Hannah's friend Ami would like the group of 5 performers to include more males than females. The order in which they perform is no longer relevant.

(iii) Find the number of different selections of 5 performers with more males than females. [3]

(iv) Two of the applicants are Mr and Mrs Blake. Find the number of different selections that include Mr and Mrs Blake and also fulfil Ami's requirement. [3]

- 7 The times taken by a garage to fit a tow bar onto a car have a normal distribution with mean m hours and standard deviation 0.35 hours. It is found that 95% of times taken are longer than 0.9 hours.

(i) Find the value of m . [3]

(ii) On one day 4 cars have a tow bar fitted. Find the probability that none of them takes more than 2 hours to fit. [5]

The times in hours taken by another garage to fit a tow bar onto a car have the distribution $N(\mu, \sigma^2)$ where $\mu = 3\sigma$.

(iii) Find the probability that it takes more than 0.6μ hours to fit a tow bar onto a randomly chosen car at this garage. [3]

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MATHEMATICS

9709/61

Paper 6 Probability & Statistics 1 (S1)

October/November 2015

1 hour 15 minutes

Additional Materials: List of Formulae (MF9)

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- 1 In a certain town, 76% of cars are fitted with satellite navigation equipment. A random sample of 11 cars from this town is chosen. Find the probability that fewer than 10 of these cars are fitted with this equipment. [4]
- 2 The random variable X has the distribution $N(\mu, \sigma^2)$. It is given that $P(X < 54.1) = 0.5$ and $P(X > 50.9) = 0.8665$. Find the values of μ and σ . [4]
- 3 Robert has a part-time job delivering newspapers. On a number of days he noted the time, correct to the nearest minute, that it took him to do his job. Robert used his results to draw up the following table; two of the values in the table are denoted by a and b .

Time (t minutes)	60 – 62	63 – 64	65 – 67	68 – 71
Frequency (number of days)	3	9	6	b
Frequency density	1	a	2	1.5

- (i) Find the values of a and b . [3]
- (ii) On graph paper, draw a histogram to represent Robert's times. [3]
- 4 (a) Amy measured her pulse rate while resting, x beats per minute, at the same time each day on 30 days. The results are summarised below.
- $$\Sigma(x - 80) = -147 \qquad \Sigma(x - 80)^2 = 952$$
- Find the mean and standard deviation of Amy's pulse rate. [4]
- (b) Amy's friend Marok measured her pulse rate every day after running for half an hour. Marok's pulse rate, in beats per minute, was found to have a mean of 148.6 and a standard deviation of 18.5. Assuming that pulse rates have a normal distribution, find what proportion of Marok's pulse rates, after running for half an hour, were above 160 beats per minute. [3]
- 5 (a) Find the number of ways in which all nine letters of the word TENNESSEE can be arranged
- (i) if all the letters E are together, [3]
- (ii) if the T is at one end and there is an S at the other end. [3]
- (b) Four letters are selected from the nine letters of the word VENEZUELA. Find the number of possible selections which contain exactly one E. [3]

6 Nadia is very forgetful. Every time she logs in to her online bank she only has a 40% chance of remembering her password correctly. She is allowed 3 unsuccessful attempts on any one day and then the bank will not let her try again until the next day.

(i) Draw a fully labelled tree diagram to illustrate this situation. [3]

(ii) Let X be the number of unsuccessful attempts Nadia makes on any day that she tries to log in to her bank. Copy and complete the following table to show the probability distribution of X . [4]

x	0	1	2	3
$P(X = x)$		0.24		

(iii) Calculate the expected number of unsuccessful attempts made by Nadia on any day that she tries to log in. [2]

7 The faces of a biased die are numbered 1, 2, 3, 4, 5 and 6. The probabilities of throwing odd numbers are all the same. The probabilities of throwing even numbers are all the same. The probability of throwing an odd number is twice the probability of throwing an even number.

(i) Find the probability of throwing a 3. [3]

(ii) The die is thrown three times. Find the probability of throwing two 5s and one 4. [3]

(iii) The die is thrown 100 times. Use an approximation to find the probability that an even number is thrown at most 37 times. [5]

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MATHEMATICS

9709/62

Paper 6 Probability & Statistics 1 (S1)

October/November 2015

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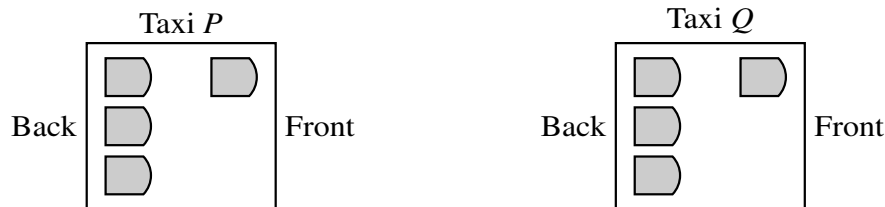
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- 1 For n values of the variable x , it is given that $\Sigma(x - 100) = 216$ and $\Sigma x = 2416$. Find the value of n . [3]
- 2 A committee of 6 people is to be chosen at random from 7 men and 9 women. Find the probability that there are no men on the committee. [3]
- 3 One plastic robot is given away free inside each packet of a certain brand of biscuits. There are four colours of plastic robot (red, yellow, blue and green) and each colour is equally likely to occur. Nick buys some packets of these biscuits. Find the probability that
- (i) he gets a green robot on opening his first packet, [1]
- (ii) he gets his first green robot on opening his fifth packet. [2]
- Nick's friend Amos is also collecting robots.
- (iii) Find the probability that the first four packets Amos opens all contain different coloured robots. [3]
- 4 A group of 8 friends travels to the airport in two taxis, P and Q . Each taxi can take 4 passengers.
- (i) The 8 friends divide themselves into two groups of 4, one group for taxi P and one group for taxi Q , with Jon and Sarah travelling in the same taxi. Find the number of different ways in which this can be done. [3]



Each taxi can take 1 passenger in the front and 3 passengers in the back (see diagram). Mark sits in the front of taxi P and Jon and Sarah sit in the back of taxi P next to each other.

- (ii) Find the number of different seating arrangements that are now possible for the 8 friends. [4]

- 5 The weights, in kilograms, of the 15 rugby players in each of two teams, A and B , are shown below.

Team A	97	98	104	84	100	109	115	99	122	82	116	96	84	107	91
Team B	75	79	94	101	96	77	111	108	83	84	86	115	82	113	95

- (i) Represent the data by drawing a back-to-back stem-and-leaf diagram with team A on the left-hand side of the diagram and team B on the right-hand side. [4]
- (ii) Find the interquartile range of the weights of the players in team A . [2]
- (iii) A new player joins team B as a substitute. The mean weight of the 16 players in team B is now 93.9 kg. Find the weight of the new player. [3]

- 6 A fair spinner A has edges numbered 1, 2, 3, 3. A fair spinner B has edges numbered -3 , -2 , -1 , 1. Each spinner is spun. The number on the edge that the spinner comes to rest on is noted. Let X be the sum of the numbers for the two spinners.

- (i) Copy and complete the table showing the possible values of X . [1]

		Spinner A			
		1	2	3	3
Spinner B	-3	-2			
	-2			1	
	-1				
	1				

- (ii) Draw up a table showing the probability distribution of X . [3]

- (iii) Find $\text{Var}(X)$. [3]

- (iv) Find the probability that X is even, given that X is positive. [2]

- 7 (a) A petrol station finds that its daily sales, in litres, are normally distributed with mean 4520 and standard deviation 560.

- (i) Find on how many days of the year (365 days) the daily sales can be expected to exceed 3900 litres. [4]

The daily sales at another petrol station are X litres, where X is normally distributed with mean m and standard deviation 560. It is given that $P(X > 8000) = 0.122$.

- (ii) Find the value of m . [3]

- (iii) Find the probability that daily sales at this petrol station exceed 8000 litres on fewer than 2 of 6 randomly chosen days. [3]

- (b) The random variable Y is normally distributed with mean μ and standard deviation σ . Given that $\sigma = \frac{2}{3}\mu$, find the probability that a random value of Y is less than 2μ . [3]

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MATHEMATICS

9709/63

Paper 6 Probability & Statistics 1 (S1)

October/November 2015

1 hour 15 minutes

Additional Materials: List of Formulae (MF9)

READ THESE INSTRUCTIONS FIRST

An answer booklet and a graph paper booklet are provided inside this question paper. You should follow the instructions on the front cover of both booklets. If you need additional answer paper or graph paper ask the invigilator for a continuation booklet or graph paper booklet.

Write in dark blue or black pen.

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Answer **all** the questions.

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The total number of marks for this paper is 50.

This document consists of 3 printed pages, 1 blank page and 2 inserts.

- 1** The time taken, t hours, to deliver letters on a particular route each day is measured on 250 working days. The mean time taken is 2.8 hours. Given that $\Sigma(t - 2.5)^2 = 96.1$, find the standard deviation of the times taken. [3]
- 2** In country X , 25% of people have fair hair. In country Y , 60% of people have fair hair. There are 20 million people in country X and 8 million people in country Y . A person is chosen at random from these 28 million people.
- (i) Find the probability that the person chosen is from country X . [1]
- (ii) Find the probability that the person chosen has fair hair. [2]
- (iii) Find the probability that the person chosen is from country X , given that the person has fair hair. [2]
- 3** Ellie throws two fair tetrahedral dice, each with faces numbered 1, 2, 3 and 4. She notes the numbers on the faces that the dice land on. Event S is ‘the sum of the two numbers is 4’. Event T is ‘the product of the two numbers is an odd number’.
- (i) Determine whether events S and T are independent, showing your working. [5]
- (ii) Are events S and T exclusive? Justify your answer. [1]
- 4** The time taken for cucumber seeds to germinate under certain conditions has a normal distribution with mean 125 hours and standard deviation σ hours.
- (i) It is found that 13% of seeds take longer than 136 hours to germinate. Find the value of σ . [3]
- (ii) 170 seeds are sown. Find the expected number of seeds which take between 131 and 141 hours to germinate. [4]
- 5** (a) Find the number of different ways that the 13 letters of the word ACCOMMODATION can be arranged in a line if all the vowels (A, I, O) are next to each other. [3]
- (b) There are 7 Chinese, 6 European and 4 American students at an international conference. Four of the students are to be chosen to take part in a television broadcast. Find the number of different ways the students can be chosen if at least one Chinese and at least one European student are included. [5]
- 6** The heights to the nearest metre of 134 office buildings in a certain city are summarised in the table below.

Height (m)	21 – 40	41 – 45	46 – 50	51 – 60	61 – 80
Frequency	18	15	21	52	28

- (i) Draw a histogram on graph paper to illustrate the data. [4]
- (ii) Calculate estimates of the mean and standard deviation of these heights. [5]

- 7 A factory makes water pistols, 8% of which do not work properly.
- (i) A random sample of 19 water pistols is taken. Find the probability that at most 2 do not work properly. [3]
 - (ii) In a random sample of n water pistols, the probability that at least one does not work properly is greater than 0.9. Find the smallest possible value of n . [3]
 - (iii) A random sample of 1800 water pistols is taken. Use an approximation to find the probability that there are at least 152 that do not work properly. [5]
 - (iv) Justify the use of your approximation in part (iii). [1]

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MATHEMATICS

9709/61

Paper 6 Probability & Statistics 1 (S1)

May/June 2015

1 hour 15 minutes

Additional Materials: Answer Booklet/Paper
Graph Paper
List of Formulae (MF9)

* 3 2 0 2 6 1 5 9 3 2 *



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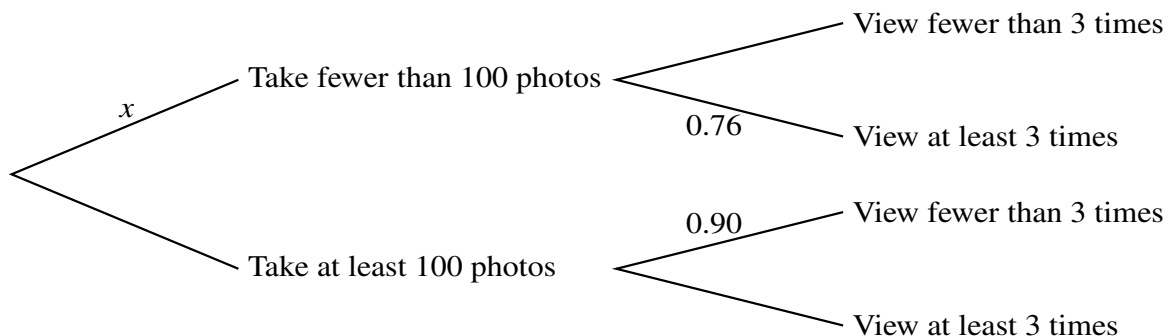
- 1 The lengths, in metres, of cars in a city are normally distributed with mean μ and standard deviation 0.714. The probability that a randomly chosen car has a length more than 3.2 metres and less than μ metres is 0.475. Find μ . [4]

- 2 The table summarises the lengths in centimetres of 104 dragonflies.

Length (cm)	2.0 – 3.5	3.5 – 4.5	4.5 – 5.5	5.5 – 7.0	7.0 – 9.0
Frequency	8	25	28	31	12

- (i) State which class contains the upper quartile. [1]
- (ii) Draw a histogram, on graph paper, to represent the data. [4]
- 3 Jason throws two fair dice, each with faces numbered 1 to 6. Event A is ‘one of the numbers obtained is divisible by 3 and the other number is not divisible by 3’. Event B is ‘the product of the two numbers obtained is even’.
- (i) Determine whether events A and B are independent, showing your working. [5]
- (ii) Are events A and B mutually exclusive? Justify your answer. [1]

4



A survey is undertaken to investigate how many photos people take on a one-week holiday and also how many times they view past photos. For a randomly chosen person, the probability of taking fewer than 100 photos is x . The probability that these people view past photos at least 3 times is 0.76. For those who take at least 100 photos, the probability that they view past photos fewer than 3 times is 0.90. This information is shown in the tree diagram. The probability that a randomly chosen person views past photos fewer than 3 times is 0.801.

- (i) Find x . [3]
- (ii) Given that a person views past photos at least 3 times, find the probability that this person takes at least 100 photos. [4]

- 5 The table shows the mean and standard deviation of the weights of some turkeys and geese.

	Number of birds	Mean (kg)	Standard deviation (kg)
Turkeys	9	7.1	1.45
Geese	18	5.2	0.96

- (i) Find the mean weight of the 27 birds. [2]
- (ii) The weights of individual turkeys are denoted by x_t kg and the weights of individual geese by x_g kg. By first finding Σx_t^2 and Σx_g^2 , find the standard deviation of the weights of all 27 birds. [5]
- 6 (i) In a certain country, 68% of households have a printer. Find the probability that, in a random sample of 8 households, 5, 6 or 7 households have a printer. [4]
- (ii) Use an approximation to find the probability that, in a random sample of 500 households, more than 337 households have a printer. [5]
- (iii) Justify your use of the approximation in part (ii). [1]
- 7 (a) Find how many different numbers can be made by arranging all nine digits of the number 223 677 888 if
- (i) there are no restrictions, [2]
- (ii) the number made is an even number. [4]
- (b) Sandra wishes to buy some applications (apps) for her smartphone but she only has enough money for 5 apps in total. There are 3 train apps, 6 social network apps and 14 games apps available. Sandra wants to have at least 1 of each type of app. Find the number of different possible selections of 5 apps that Sandra can choose. [5]

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MATHEMATICS

9709/62

Paper 6 Probability & Statistics 1 (S1)

May/June 2015

1 hour 15 minutes

Additional Materials: Answer Booklet/Paper
 Graph Paper
 List of Formulae (MF9)



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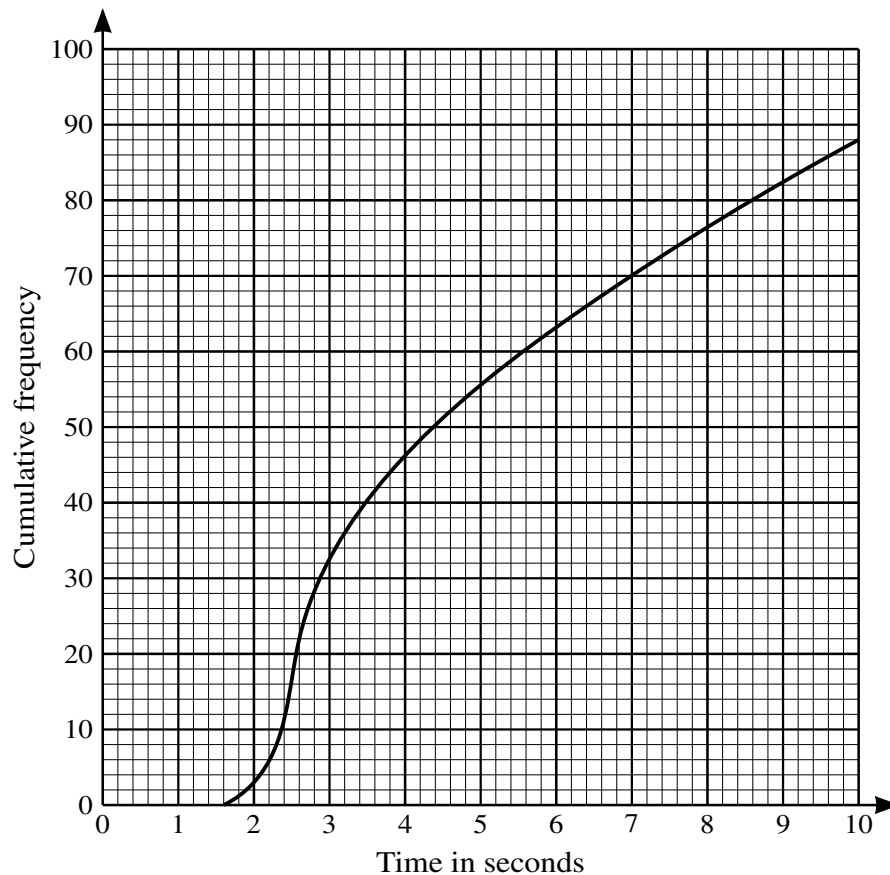
This document consists of **3** printed pages and **1** blank page.

- 1 A fair die is thrown 10 times. Find the probability that the number of sixes obtained is between 3 and 5 inclusive. [3]
- 2 120 people were asked to read an article in a newspaper. The times taken, to the nearest second, by the people to read the article are summarised in the following table.

Time (seconds)	1 – 25	26 – 35	36 – 45	46 – 55	56 – 90
Number of people	4	24	38	34	20

Calculate estimates of the mean and standard deviation of the reading times. [5]

3



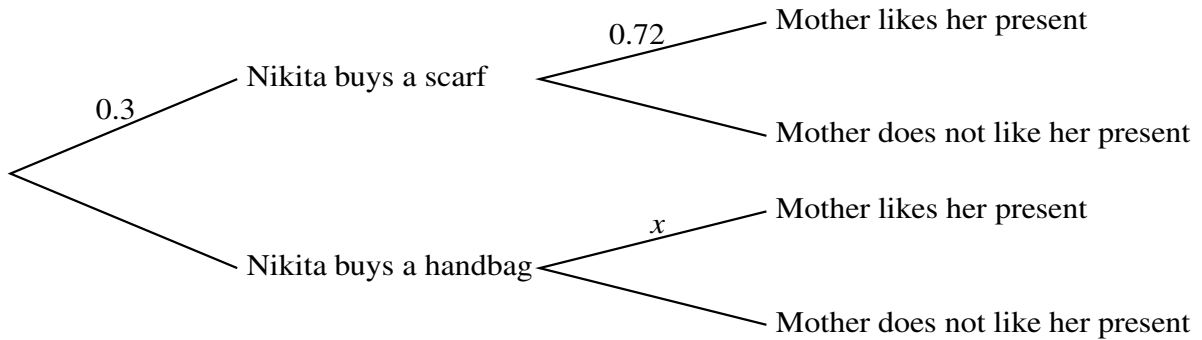
In an open-plan office there are 88 computers. The times taken by these 88 computers to access a particular web page are represented in the cumulative frequency diagram.

- (i) On graph paper draw a box-and-whisker plot to summarise this information. [4]

An 'outlier' is defined as any data value which is more than 1.5 times the interquartile range above the upper quartile, or more than 1.5 times the interquartile range below the lower quartile.

- (ii) Show that there are no outliers. [2]

4



Nikita goes shopping to buy a birthday present for her mother. She buys either a scarf, with probability 0.3, or a handbag. The probability that her mother will like the choice of scarf is 0.72. The probability that her mother will like the choice of handbag is x . This information is shown on the tree diagram. The probability that Nikita's mother likes the present that Nikita buys is 0.783.

(i) Find x . [3]

(ii) Given that Nikita's mother does not like her present, find the probability that the present is a scarf. [4]

5 A box contains 5 discs, numbered 1, 2, 4, 6, 7. William takes 3 discs at random, without replacement, and notes the numbers on the discs.

(i) Find the probability that the numbers on the 3 discs are two even numbers and one odd number. [3]

The smallest of the numbers on the 3 discs taken is denoted by the random variable S .

(ii) By listing all possible selections (126, 246 and so on) draw up the probability distribution table for S . [5]

6 (a) Find the number of different ways the 7 letters of the word BANANAS can be arranged

(i) if the first letter is N and the last letter is B, [3]

(ii) if all the letters A are next to each other. [3]

(b) Find the number of ways of selecting a group of 9 people from 14 if two particular people cannot both be in the group together. [3]

7 (a) Once a week Zak goes for a run. The time he takes, in minutes, has a normal distribution with mean 35.2 and standard deviation 4.7.

(i) Find the expected number of days during a year (52 weeks) for which Zak takes less than 30 minutes for his run. [4]

(ii) The probability that Zak's time is between 35.2 minutes and t minutes, where $t > 35.2$, is 0.148. Find the value of t . [3]

(b) The random variable X has the distribution $N(\mu, \sigma^2)$. It is given that $P(X < 7) = 0.2119$ and $P(X < 10) = 0.6700$. Find the values of μ and σ . [5]

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MATHEMATICS

9709/63

Paper 6 Probability & Statistics 1 (S1)

May/June 2015

1 hour 15 minutes

Additional Materials: Answer Booklet/Paper
Graph Paper
List of Formulae (MF9)



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- 1 The weights, in grams, of onions in a supermarket have a normal distribution with mean μ and standard deviation 22. The probability that a randomly chosen onion weighs more than 195 grams is 0.128. Find the value of μ . [3]
- 2 When Joanna cooks, the probability that the meal is served on time is $\frac{1}{5}$. The probability that the kitchen is left in a mess is $\frac{3}{5}$. The probability that the meal is not served on time and the kitchen is not left in a mess is $\frac{3}{10}$. Some of this information is shown in the following table.

	Kitchen left in a mess	Kitchen not left in a mess	Total
Meal served on time			$\frac{1}{5}$
Meal not served on time		$\frac{3}{10}$	
Total			1

- (i) Copy and complete the table. [3]
- (ii) Given that the kitchen is left in a mess, find the probability that the meal is not served on time. [2]
- 3 On a production line making cameras, the probability of a randomly chosen camera being substandard is 0.072. A random sample of 300 cameras is checked. Find the probability that there are fewer than 18 cameras which are substandard. [5]
- 4 A pet shop has 9 rabbits for sale, 6 of which are white. A random sample of two rabbits is chosen without replacement.
- (i) Show that the probability that exactly one of the two rabbits in the sample is white is $\frac{1}{2}$. [2]
- (ii) Construct the probability distribution table for the number of white rabbits in the sample. [3]
- (iii) Find the expected value of the number of white rabbits in the sample. [1]
- 5 The heights of books in a library, in cm, have a normal distribution with mean 21.7 and standard deviation 6.5. A book with a height of more than 29 cm is classified as 'large'.
- (i) Find the probability that, of 8 books chosen at random, fewer than 2 books are classified as large. [6]
- (ii) n books are chosen at random. The probability of there being at least 1 large book is more than 0.98. Find the least possible value of n . [3]

- 6 Seventy samples of fertiliser were collected and the nitrogen content was measured for each sample. The cumulative frequency distribution is shown in the table below.

Nitrogen content	≤ 3.5	≤ 3.8	≤ 4.0	≤ 4.2	≤ 4.5	≤ 4.8
Cumulative frequency	0	6	18	41	62	70

- (i) On graph paper draw a cumulative frequency graph to represent the data. [3]
- (ii) Estimate the percentage of samples with a nitrogen content greater than 4.4. [2]
- (iii) Estimate the median. [1]
- (iv) Construct the frequency table for these results and draw a histogram on graph paper. [5]
- 7 Rachel has 3 types of ornament. She has 6 different wooden animals, 4 different sea-shells and 3 different pottery ducks.
- (i) She lets her daughter Cherry choose 5 ornaments to play with. Cherry chooses at least 1 of each type of ornament. How many different selections can Cherry make? [5]

Rachel displays 10 of the 13 ornaments in a row on her window-sill. Find the number of different arrangements that are possible if

- (ii) she has a duck at each end of the row and no ducks anywhere else, [3]
- (iii) she has a duck at each end of the row and wooden animals and sea-shells are placed alternately in the positions in between. [3]

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MATHEMATICS

9709/61

Paper 6 Probability & Statistics 1 (S1)

October/November 2014

1 hour 15 minutes

Additional Materials: Answer Booklet/Paper
Graph Paper
List of Formulae (MF9)



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- 1 Find the mean and variance of the following data. [3]

5 -2 12 7 -3 2 -6 4 0 8

- 2 The number of phone calls, X , received per day by Sarah has the following probability distribution.

x	0	1	2	3	4	≥ 5
$P(X = x)$	0.24	0.35	$2k$	k	0.05	0

- (i) Find the value of k . [2]
- (ii) Find the mode of X . [1]
- (iii) Find the probability that the number of phone calls received by Sarah on any particular day is more than the mean number of phone calls received per day. [3]
- 3 Jodie tosses a biased coin and throws two fair tetrahedral dice. The probability that the coin shows a head is $\frac{1}{3}$. Each of the dice has four faces, numbered 1, 2, 3 and 4. Jodie's score is calculated from the numbers on the faces that the dice land on, as follows:

- if the coin shows a head, the two numbers from the dice are added together;
- if the coin shows a tail, the two numbers from the dice are multiplied together.

Find the probability that the coin shows a head given that Jodie's score is 8. [5]

- 4 The following back-to-back stem-and-leaf diagram shows the times to load an application on 61 smartphones of type A and 43 smartphones of type B .

	Type A		Type B	
(7)	9 7 6 6 4 3 3	2	1 3 5 8	(4)
(7)	5 5 4 4 2 2 2	3	0 4 4 5 6 6 6 6 7 8 8 9	(12)
(13)	9 9 8 8 8 7 6 6 4 3 2 2 0	4	0 1 1 2 3 6 8 8 9 9	(10)
(9)	6 5 5 4 3 2 1 1 0	5	2 5 6 6 9	(5)
(4)	9 7 3 0	6	1 3 8 9	(4)
(6)	8 7 4 4 1 0	7	5 7	(2)
(10)	7 6 6 6 5 3 3 2 1 0	8	1 2 4 4	(4)
(5)	8 6 5 5 5	9	0 6	(2)

Key: 3 | 2 | 1 means 0.23 seconds for type A and 0.21 seconds for type B .

- (i) Find the median and quartiles for smartphones of type A . [3]

You are given that the median, lower quartile and upper quartile for smartphones of type B are 0.46 seconds, 0.36 seconds and 0.63 seconds respectively.

- (ii) Represent the data by drawing a pair of box-and-whisker plots in a single diagram on graph paper. [3]
- (iii) Compare the loading times for these two types of smartphone. [1]

5 Screws are sold in packets of 15. Faulty screws occur randomly. A large number of packets are tested for faulty screws and the mean number of faulty screws per packet is found to be 1.2.

(i) Show that the variance of the number of faulty screws in a packet is 1.104. [2]

(ii) Find the probability that a packet contains at most 2 faulty screws. [3]

Damien buys 8 packets of screws at random.

(iii) Find the probability that there are exactly 7 packets in which there is at least 1 faulty screw. [4]

6 A farmer finds that the weights of sheep on his farm have a normal distribution with mean 66.4 kg and standard deviation 5.6 kg.

(i) 250 sheep are chosen at random. Estimate the number of sheep which have a weight of between 70 kg and 72.5 kg. [5]

(ii) The proportion of sheep weighing less than 59.2 kg is equal to the proportion weighing more than y kg. Find the value of y . [2]

Another farmer finds that the weights of sheep on his farm have a normal distribution with mean μ kg and standard deviation 4.92 kg. 25% of these sheep weigh more than 67.5 kg.

(iii) Find the value of μ . [3]

7 A committee of 6 people is to be chosen from 5 men and 8 women. In how many ways can this be done

(i) if there are more women than men on the committee, [4]

(ii) if the committee consists of 3 men and 3 women but two particular men refuse to be on the committee together? [3]

One particular committee consists of 5 women and 1 man.

(iii) In how many different ways can the committee members be arranged in a line if the man is not at either end? [3]

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MATHEMATICS

9709/62

Paper 6 Probability & Statistics 1 (S1)

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- 1** The 50 members of a club include both the club president and the club treasurer. All 50 members want to go on a coach tour, but the coach only has room for 45 people. In how many ways can 45 members be chosen if both the club president and the club treasurer must be included? [3]
- 2** Find the number of different ways that 6 boys and 4 girls can stand in a line if
- (i) all 6 boys stand next to each other, [3]
 - (ii) no girl stands next to another girl. [3]
- 3**
- (i) Four fair six-sided dice, each with faces marked 1, 2, 3, 4, 5, 6, are thrown. Find the probability that the numbers shown on the four dice add up to 5. [3]
 - (ii) Four fair six-sided dice, each with faces marked 1, 2, 3, 4, 5, 6, are thrown on 7 occasions. Find the probability that the numbers shown on the four dice add up to 5 on exactly 1 or 2 of the 7 occasions. [4]
- 4** Sharik attempts a multiple choice revision question on-line. There are 3 suggested answers, one of which is correct. When Sharik chooses an answer the computer indicates whether the answer is right or wrong. Sharik first chooses one of the three suggested answers at random. If this answer is wrong he has a second try, choosing an answer at random from the remaining 2. If this answer is also wrong Sharik then chooses the remaining answer, which must be correct.
- (i) Draw a fully labelled tree diagram to illustrate the various choices that Sharik can make until the computer indicates that he has answered the question correctly. [4]
 - (ii) The random variable X is the number of attempts that Sharik makes up to and including the one that the computer indicates is correct. Draw up the probability distribution table for X and find $E(X)$. [4]
- 5**
- (a) The time, X hours, for which people sleep in one night has a normal distribution with mean 7.15 hours and standard deviation 0.88 hours.
 - (i) Find the probability that a randomly chosen person sleeps for less than 8 hours in a night. [2]
 - (ii) Find the value of q such that $P(X < q) = 0.75$. [3]
 - (b) The random variable Y has the distribution $N(\mu, \sigma^2)$, where $2\sigma = 3\mu$ and $\mu \neq 0$. Find $P(Y > 4\mu)$. [3]

- 6 On a certain day in spring, the heights of 200 daffodils are measured, correct to the nearest centimetre. The frequency distribution is given below.

Height (cm)	4 – 10	11 – 15	16 – 20	21 – 25	26 – 30
Frequency	22	32	78	40	28

- (i) Draw a cumulative frequency graph to illustrate the data. [4]
- (ii) 28% of these daffodils are of height h cm or more. Estimate h . [2]
- (iii) You are given that the estimate of the mean height of these daffodils, calculated from the table, is 18.39 cm. Calculate an estimate of the standard deviation of the heights of these daffodils. [3]
- 7 In Marumbo, three quarters of the adults own a cell phone.
- (i) A random sample of 8 adults from Marumbo is taken. Find the probability that the number of adults who own a cell phone is between 4 and 6 inclusive. [3]
- (ii) A random sample of 160 adults from Marumbo is taken. Use an approximation to find the probability that more than 114 of them own a cell phone. [5]
- (iii) Justify the use of your approximation in part (ii). [1]

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MATHEMATICS

9709/63

Paper 6 Probability & Statistics 1 (S1)

October/November 2014

1 hour 15 minutes

Additional Materials: Answer Booklet/Paper
 Graph Paper
 List of Formulae (MF9)



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- 1 Packets of tea are labelled as containing 250 g. The actual weight of tea in a packet has a normal distribution with mean 260 g and standard deviation σ g. Any packet with a weight less than 250 g is classed as 'underweight'. Given that 1% of packets of tea are underweight, find the value of σ . [3]

- 2 A traffic camera measured the speeds, x kilometres per hour, of 8 cars travelling along a certain street, with the following results.

62.7 59.6 64.2 61.5 68.3 66.9 62.0 62.3

(i) Find $\Sigma(x - 62)$. [1]

(ii) Find $\Sigma(x - 62)^2$. [1]

(iii) Find the mean and variance of the speeds of the 8 cars. [3]

- 3 The number of books read by members of a book club each year has the binomial distribution $B(12, 0.7)$.

(i) State the greatest number of books that could be read by a member of the book club in a particular year and find the probability that a member reads this number of books. [2]

(ii) Find the probability that a member reads fewer than 10 books in a particular year. [3]

- 4 A random sample of 25 people recorded the number of glasses of water they drank in a particular week. The results are shown below.

23	19	32	14	25
22	26	36	45	42
47	28	17	38	15
46	18	26	22	41
19	21	28	24	30

(i) Draw a stem-and-leaf diagram to represent the data. [3]

(ii) On graph paper draw a box-and-whisker plot to represent the data. [5]

- 5 Gem stones from a certain mine have weights, X grams, which are normally distributed with mean 1.9 g and standard deviation 0.55 g. These gem stones are sorted into three categories for sale depending on their weights, as follows.

Small: under 1.2 g Medium: between 1.2 g and 2.5 g Large: over 2.5 g

(i) Find the proportion of gem stones in each of these three categories. [5]

(ii) Find the value of k such that $P(k < X < 2.5) = 0.8$. [4]

- 6 (a) Seven fair dice each with faces marked 1, 2, 3, 4, 5, 6 are thrown and placed in a line. Find the number of possible arrangements where the sum of the numbers at each end of the line add up to 4. [3]
- (b) Find the number of ways in which 9 different computer games can be shared out between Wainah, Jingyi and Hebe so that each person receives an odd number of computer games. [6]

- 7 A box contains 2 green apples and 2 red apples. Apples are taken from the box, one at a time, without replacement. When both red apples have been taken, the process stops. The random variable X is the number of apples which have been taken when the process stops.

(i) Show that $P(X = 3) = \frac{1}{3}$. [3]

(ii) Draw up the probability distribution table for X . [3]

Another box contains 2 yellow peppers and 5 orange peppers. Three peppers are taken at random from the box without replacement.

(iii) Given that at least 2 of the peppers taken from the box are orange, find the probability that all 3 peppers are orange. [5]

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MATHEMATICS

9709/61

Paper 6 Probability & Statistics 1 (S1)

May/June 2014

1 hour 15 minutes

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- 1 The petrol consumption of a certain type of car has a normal distribution with mean 24 kilometres per litre and standard deviation 4.7 kilometres per litre. Find the probability that the petrol consumption of a randomly chosen car of this type is between 21.6 kilometres per litre and 28.7 kilometres per litre. [4]
- 2 Lengths of a certain type of white radish are normally distributed with mean μ cm and standard deviation σ cm. 4% of these radishes are longer than 12 cm and 32% are longer than 9 cm. Find μ and σ . [5]
- 3 (i) State three conditions which must be satisfied for a situation to be modelled by a binomial distribution. [2]

George wants to invest some of his monthly salary. He invests a certain amount of this every month for 18 months. For each month there is a probability of 0.25 that he will buy shares in a large company, there is a probability of 0.15 that he will buy shares in a small company and there is a probability of 0.6 that he will invest in a savings account.

- (ii) Find the probability that George will buy shares in a small company in at least 3 of these 18 months. [3]
- 4 A book club sends 6 paperback and 2 hardback books to Mrs Hunt. She chooses 4 of these books at random to take with her on holiday. The random variable X represents the number of paperback books she chooses.
- (i) Show that the probability that she chooses exactly 2 paperback books is $\frac{3}{14}$. [2]
- (ii) Draw up the probability distribution table for X . [3]
- (iii) You are given that $E(X) = 3$. Find $\text{Var}(X)$. [2]

- 5 Playground equipment consists of swings (S), roundabouts (R), climbing frames (C) and play-houses (P). The numbers of pieces of equipment in each of 3 playgrounds are as follows.

Playground X	Playground Y	Playground Z
3S, 2R, 4P	6S, 3R, 1C, 2P	8S, 3R, 4C, 1P

Each day Nur takes her child to one of the playgrounds. The probability that she chooses playground X is $\frac{1}{4}$. The probability that she chooses playground Y is $\frac{1}{4}$. The probability that she chooses playground Z is $\frac{1}{2}$. When she arrives at the playground, she chooses one piece of equipment at random.

- (i) Find the probability that Nur chooses a play-house. [4]
- (ii) Given that Nur chooses a climbing frame, find the probability that she chose playground Y. [4]

6 Find the number of different ways in which all 8 letters of the word TANZANIA can be arranged so that

(i) all the letters A are together, [2]

(ii) the first letter is a consonant (T, N, Z), the second letter is a vowel (A, I), the third letter is a consonant, the fourth letter is a vowel, and so on alternately. [3]

4 of the 8 letters of the word TANZANIA are selected. How many possible selections contain

(iii) exactly 1 N and 1 A, [2]

(iv) exactly 1 N? [3]

7 A typing test is taken by 111 people. The numbers of typing errors they make in the test are summarised in the table below.

Number of typing errors	1 – 5	6 – 20	21 – 35	36 – 60	61 – 80
Frequency	24	9	21	15	42

(i) Draw a histogram on graph paper to represent this information. [5]

(ii) Calculate an estimate of the mean number of typing errors for these 111 people. [3]

(iii) State which class contains the lower quartile and which class contains the upper quartile. Hence find the least possible value of the interquartile range. [3]

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MATHEMATICS

9709/62

Paper 6 Probability & Statistics 1 (S1)

May/June 2014

1 hour 15 minutes

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- 1 In a certain country 12% of houses have solar heating. 19 houses are chosen at random. Find the probability that fewer than 4 houses have solar heating. [4]
- 2 A school club has members from 3 different year-groups: Year 1, Year 2 and Year 3. There are 7 members from Year 1, 2 members from Year 2 and 2 members from Year 3. Five members of the club are selected. Find the number of possible selections that include at least one member from each year-group. [4]
- 3 Roger and Andy play a tennis match in which the first person to win two sets wins the match. The probability that Roger wins the first set is 0.6. For sets after the first, the probability that Roger wins the set is 0.7 if he won the previous set, and is 0.25 if he lost the previous set. No set is drawn.
- (i) Find the probability that there is a winner of the match after exactly two sets. [3]
- (ii) Find the probability that Andy wins the match given that there is a winner of the match after exactly two sets. [2]
- 4 Coin *A* is weighted so that the probability of throwing a head is $\frac{2}{3}$. Coin *B* is weighted so that the probability of throwing a head is $\frac{1}{4}$. Coin *A* is thrown twice and coin *B* is thrown once.
- (i) Show that the probability of obtaining exactly 1 head and 2 tails is $\frac{13}{36}$. [3]
- (ii) Draw up the probability distribution table for the number of heads obtained. [4]
- (iii) Find the expectation of the number of heads obtained. [2]
- 5 Find how many different numbers can be made from some or all of the digits of the number 1 345 789 if
- (i) all seven digits are used, the odd digits are all together and no digits are repeated, [2]
- (ii) the numbers made are even numbers between 3000 and 5000, and no digits are repeated, [3]
- (iii) the numbers made are multiples of 5 which are less than 1000, and digits can be repeated. [3]
- 6 The times taken by 57 athletes to run 100 metres are summarised in the following cumulative frequency table.

Time (seconds)	< 10.0	< 10.5	< 11.0	< 12.0	< 12.5	< 13.5
Cumulative frequency	0	4	10	40	49	57

- (i) State how many athletes ran 100 metres in a time between 10.5 and 11.0 seconds. [1]
- (ii) Draw a histogram on graph paper to represent the times taken by these athletes to run 100 metres. [4]
- (iii) Calculate estimates of the mean and variance of the times taken by these athletes. [4]

- 7 The time Rafa spends on his homework each day in term-time has a normal distribution with mean 1.9 hours and standard deviation σ hours. On 80% of these days he spends more than 1.35 hours on his homework.
- (i) Find the value of σ . [3]
- (ii) Find the probability that, on a randomly chosen day in term-time, Rafa spends less than 2 hours on his homework. [2]
- (iii) A random sample of 200 days in term-time is taken. Use an approximation to find the probability that the number of days on which Rafa spends more than 1.35 hours on his homework is between 163 and 173 inclusive. [6]

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- 1 Some adults and some children each tried to estimate, without using a watch, the number of seconds that had elapsed in a fixed time-interval. Their estimates are shown below.

Adults:	55	58	67	74	63	61	63	71	56	53	54	78	73	64	62
Children:	86	95	89	72	61	84	77	92	81	54	43	68	62	67	83

- (i) Draw a back-to-back stem-and-leaf diagram to represent the data. [3]
- (ii) Make two comparisons between the estimates of the adults and the children. [2]
- 2 There is a probability of $\frac{1}{7}$ that Wenjie goes out with her friends on any particular day. 252 days are chosen at random.
- (i) Use a normal approximation to find the probability that the number of days on which Wenjie goes out with her friends is less than 30 or more than 44. [5]
- (ii) Give a reason why the use of a normal approximation is justified. [1]
- 3 A pet shop has 6 rabbits and 3 hamsters. 5 of these pets are chosen at random. The random variable X represents the number of hamsters chosen.
- (i) Show that the probability that exactly 2 hamsters are chosen is $\frac{10}{21}$. [2]
- (ii) Draw up the probability distribution table for X . [4]
- 4 The heights, x cm, of a group of 28 people were measured. The mean height was found to be 172.6 cm and the standard deviation was found to be 4.58 cm. A person whose height was 161.8 cm left the group.
- (i) Find the mean height of the remaining group of 27 people. [2]
- (ii) Find Σx^2 for the original group of 28 people. Hence find the standard deviation of the heights of the remaining group of 27 people. [4]
- 5 When Moses makes a phone call, the amount of time that the call takes has a normal distribution with mean 6.5 minutes and standard deviation 1.76 minutes.
- (i) 90% of Moses's phone calls take longer than t minutes. Find the value of t . [3]
- (ii) Find the probability that, in a random sample of 9 phone calls made by Moses, more than 7 take a time which is within 1 standard deviation of the mean. [5]

- 6** Tom and Ben play a game repeatedly. The probability that Tom wins any game is 0.3. Each game is won by either Tom or Ben. Tom and Ben stop playing when one of them (to be called the champion) has won two games.
- (i) Find the probability that Ben becomes the champion after playing exactly 2 games. [1]
 - (ii) Find the probability that Ben becomes the champion. [3]
 - (iii) Given that Tom becomes the champion, find the probability that he won the 2nd game. [4]
- 7** Nine cards are numbered 1, 2, 2, 3, 3, 4, 6, 6, 6.
- (i) All nine cards are placed in a line, making a 9-digit number. Find how many different 9-digit numbers can be made in this way
 - (a) if the even digits are all together, [4]
 - (b) if the first and last digits are both odd. [3]
 - (ii) Three of the nine cards are chosen and placed in a line, making a 3-digit number. Find how many different numbers can be made in this way
 - (a) if there are no repeated digits, [2]
 - (b) if the number is between 200 and 300. [2]

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Advanced Subsidiary Level and Advanced Level

MATHEMATICS

9709/61

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October/November 2013

1 hour 15 minutes

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- 1 It is given that $X \sim N(30, 49)$, $Y \sim N(30, 16)$ and $Z \sim N(50, 16)$. On a single diagram, with the horizontal axis going from 0 to 70, sketch three curves to represent the distributions of X , Y and Z . [3]
- 2 The people living in two towns, Mumbok and Bagville, are classified by age. The numbers in thousands living in each town are shown in the table below.

	Mumbok	Bagville
Under 18 years	15	35
18 to 60 years	55	95
Over 60 years	20	30

- One of the towns is chosen. The probability of choosing Mumbok is 0.6 and the probability of choosing Bagville is 0.4. Then a person is chosen at random from that town. Given that the person chosen is between 18 and 60 years old, find the probability that the town chosen was Mumbok. [5]
- 3 Swati measured the lengths, x cm, of 18 stick insects and found that $\Sigma x^2 = 967$. Given that the mean length is $\frac{58}{9}$ cm, find the values of $\Sigma(x - 5)$ and $\Sigma(x - 5)^2$. [5]

- 4 The following are the house prices in thousands of dollars, arranged in ascending order, for 51 houses from a certain area.

253 270 310 354 386 428 433 468 472 477 485 520 520 524 526 531 535
 536 538 541 543 546 548 549 551 554 572 583 590 605 614 638 649 652
 666 670 682 684 690 710 725 726 731 734 745 760 800 854 863 957 986

- (i) Draw a box-and-whisker plot to represent the data. [4]

An expensive house is defined as a house which has a price that is more than 1.5 times the interquartile range above the upper quartile.

- (ii) For the above data, give the prices of the expensive houses. [2]

- (iii) Give one disadvantage of using a box-and-whisker plot rather than a stem-and-leaf diagram to represent this set of data. [1]

- 5 Lengths of a certain type of carrot have a normal distribution with mean 14.2 cm and standard deviation 3.6 cm.

- (i) 8% of carrots are shorter than c cm. Find the value of c . [3]

- (ii) Rebekah picks 7 carrots at random. Find the probability that at least 2 of them have lengths between 15 and 16 cm. [6]

6 A shop has 7 different mountain bicycles, 5 different racing bicycles and 8 different ordinary bicycles on display. A cycling club selects 6 of these 20 bicycles to buy.

- (i) How many different selections can be made if there must be no more than 3 mountain bicycles and no more than 2 of each of the other types of bicycle? [4]

The cycling club buys 3 mountain bicycles, 1 racing bicycle and 2 ordinary bicycles and parks them in a cycle rack, which has a row of 10 empty spaces.

- (ii) How many different arrangements are there in the cycle rack if the mountain bicycles are all together with no spaces between them, the ordinary bicycles are both together with no spaces between them and the spaces are all together? [3]

- (iii) How many different arrangements are there in the cycle rack if the ordinary bicycles are at each end of the bicycles and there are no spaces between any of the bicycles? [3]

7 James has a fair coin and a fair tetrahedral die with four faces numbered 1, 2, 3, 4. He tosses the coin once and the die twice. The random variable X is defined as follows.

- If the coin shows a **head** then X is the **sum** of the scores on the two throws of the die.
- If the coin shows a **tail** then X is the score on the **first throw** of the die only.

- (i) Explain why $X = 1$ can only be obtained by throwing a tail, and show that $P(X = 1) = \frac{1}{8}$. [2]

- (ii) Show that $P(X = 3) = \frac{3}{16}$. [4]

- (iii) Copy and complete the probability distribution table for X . [3]

x	1	2	3	4	5	6	7	8
$P(X = x)$	$\frac{1}{8}$		$\frac{3}{16}$		$\frac{1}{8}$		$\frac{1}{16}$	$\frac{1}{32}$

Event Q is 'James throws a tail'. Event R is 'the value of X is 7'.

- (iv) Determine whether events Q and R are exclusive. Justify your answer. [2]

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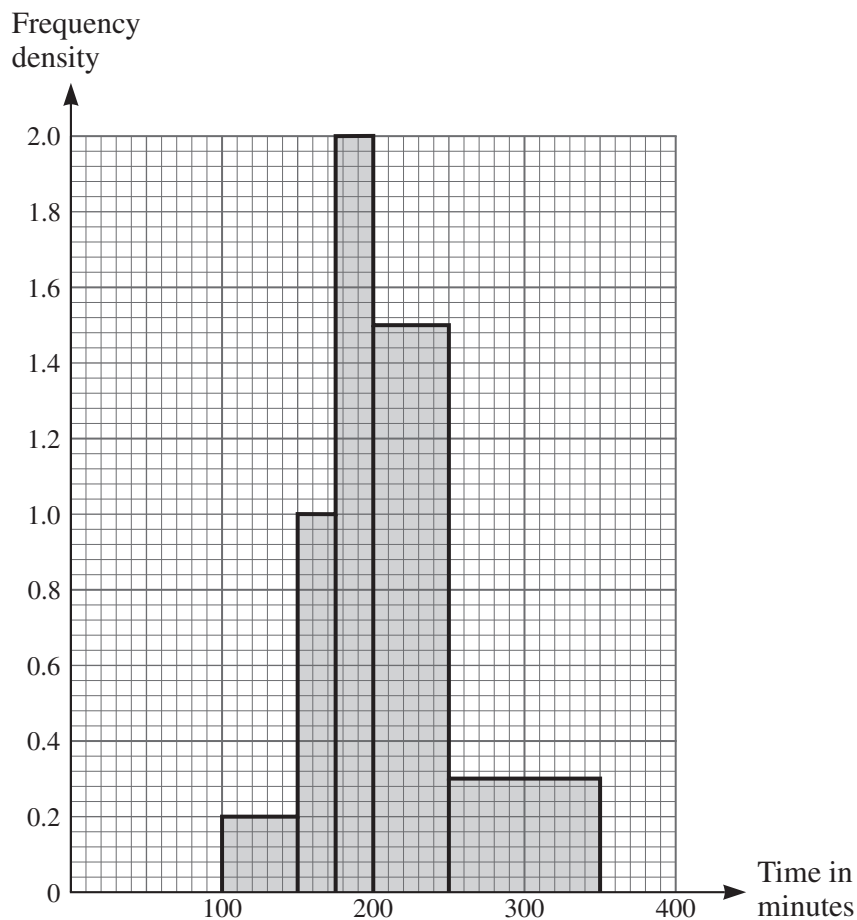
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- 1 It is given that $X \sim N(1.5, 3.2^2)$. Find the probability that a randomly chosen value of X is less than -2.4 . [3]
- 2 On Saturday afternoons Mohit goes shopping with probability 0.25, or goes to the cinema with probability 0.35 or stays at home. If he goes shopping the probability that he spends more than \$50 is 0.7. If he goes to the cinema the probability that he spends more than \$50 is 0.8. If he stays at home he spends \$10 on a pizza.
- (i) Find the probability that Mohit will go to the cinema and spend less than \$50. [1]
- (ii) Given that he spends less than \$50, find the probability that he went to the cinema. [4]
- 3 The amount of fibre in a packet of a certain brand of cereal is normally distributed with mean 160 grams. 19% of packets of cereal contain more than 190 grams of fibre.
- (i) Find the standard deviation of the amount of fibre in a packet. [3]
- (ii) Kate buys 12 packets of cereal. Find the probability that at least 1 of the packets contains more than 190 grams of fibre. [2]
- 4 The following histogram summarises the times, in minutes, taken by 190 people to complete a race.



- (i) Show that 75 people took between 200 and 250 minutes to complete the race. [1]
- (ii) Calculate estimates of the mean and standard deviation of the times of the 190 people. [6]
- (iii) Explain why your answers to part (ii) are estimates. [1]

- 5 On trains in the morning rush hour, each person is either a student with probability 0.36, or an office worker with probability 0.22, or a shop assistant with probability 0.29 or none of these.
- (i) 8 people on a morning rush hour train are chosen at random. Find the probability that between 4 and 6 inclusive are office workers. [3]
 - (ii) 300 people on a morning rush hour train are chosen at random. Find the probability that between 31 and 49 inclusive are neither students nor office workers nor shop assistants. [6]
- 6 The 11 letters of the word REMEMBRANCE are arranged in a line.
- (i) Find the number of different arrangements if there are no restrictions. [1]
 - (ii) Find the number of different arrangements which start and finish with the letter M. [2]
 - (iii) Find the number of different arrangements which do not have all 4 vowels (E, E, A, E) next to each other. [3]
- 4 letters from the letters of the word REMEMBRANCE are chosen.
- (iv) Find the number of different selections which contain no Ms and no Rs and at least 2 Es. [3]
- 7 Rory has 10 cards. Four of the cards have a 3 printed on them and six of the cards have a 4 printed on them. He takes three cards at random, without replacement, and adds up the numbers on the cards.
- (i) Show that $P(\text{the sum of the numbers on the three cards is } 11) = \frac{1}{2}$. [3]
 - (ii) Draw up a probability distribution table for the sum of the numbers on the three cards. [4]
- Event R is ‘the sum of the numbers on the three cards is 11’. Event S is ‘the number on the first card taken is a 3’.
- (iii) Determine whether events R and S are independent. Justify your answer. [3]
 - (iv) Determine whether events R and S are exclusive. Justify your answer. [1]

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UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education
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MATHEMATICS

9709/63

Paper 6 Probability & Statistics 1 (S1)

October/November 2013

1 hour 15 minutes

Additional Materials: Answer Booklet/Paper
 Graph Paper
 List of Formulae (MF9)



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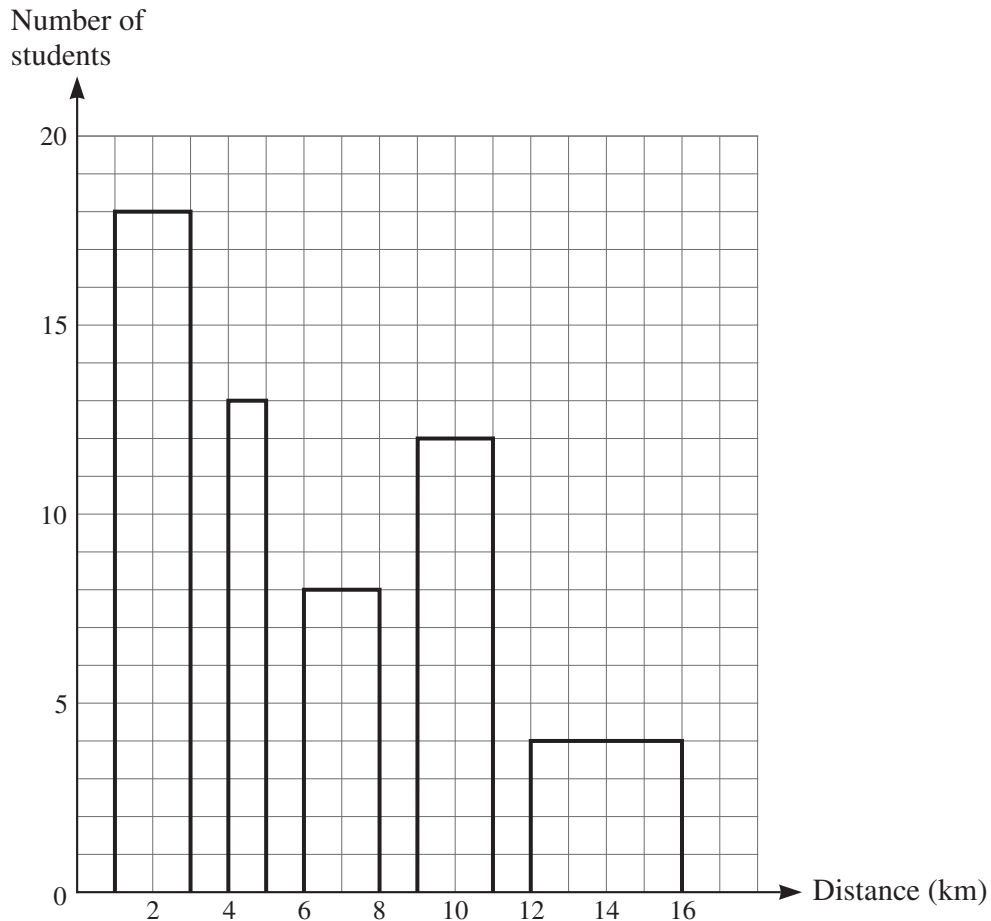
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- 1 The distance of a student's home from college, correct to the nearest kilometre, was recorded for each of 55 students. The distances are summarised in the following table.

Distance from college (km)	1 – 3	4 – 5	6 – 8	9 – 11	12 – 16
Number of students	18	13	8	12	4

Dominic is asked to draw a histogram to illustrate the data. Dominic's diagram is shown below.



Give two reasons why this is not a correct histogram.

[2]

- 2 A factory produces flower pots. The base diameters have a normal distribution with mean 14 cm and standard deviation 0.52 cm. Find the probability that the base diameters of exactly 8 out of 10 randomly chosen flower pots are between 13.6 cm and 14.8 cm. [5]
- 3 In a large consignment of mangoes, 15% of mangoes are classified as small, 70% as medium and 15% as large.
- (i) Yue-chen picks 14 mangoes at random. Find the probability that fewer than 12 of them are medium or large. [3]
- (ii) Yue-chen picks n mangoes at random. The probability that none of these n mangoes is small is at least 0.1. Find the largest possible value of n . [3]

- 4 Barry weighs 20 oranges and 25 lemons. For the oranges, the mean weight is 220 g and the standard deviation is 32 g. For the lemons, the mean weight is 118 g and the standard deviation is 12 g.
- (i) Find the mean weight of the 45 fruits. [2]
 - (ii) The individual weights of the oranges in grams are denoted by x_o , and the individual weights of the lemons in grams are denoted by x_l . By first finding Σx_o^2 and Σx_l^2 , find the variance of the weights of the 45 fruits. [5]
- 5 (a) The random variable X is normally distributed with mean 82 and standard deviation 7.4. Find the value of q such that $P(82 - q < X < 82 + q) = 0.44$. [3]
- (b) The random variable Y is normally distributed with mean μ and standard deviation σ . It is given that $5\mu = 2\sigma^2$ and that $P(Y < \frac{1}{2}\mu) = 0.281$. Find the values of μ and σ . [4]
- 6 (i) Find the number of different ways that the 9 letters of the word AGGREGATE can be arranged in a line if the first letter is R. [2]
- (ii) Find the number of different ways that the 9 letters of the word AGGREGATE can be arranged in a line if the 3 letters G are together, both letters A are together and both letters E are together. [2]
- (iii) The letters G, R and T are consonants and the letters A and E are vowels. Find the number of different ways that the 9 letters of the word AGGREGATE can be arranged in a line if consonants and vowels occur alternately. [3]
- (iv) Find the number of different selections of 4 letters of the word AGGREGATE which contain exactly 2 Gs or exactly 3 Gs. [3]
- 7 Dayo chooses two digits at random, without replacement, from the 9-digit number 113 333 555.
- (i) Find the probability that the two digits chosen are equal. [3]
 - (ii) Find the probability that one digit is a 5 and one digit is not a 5. [3]
 - (iii) Find the probability that the first digit Dayo chose was a 5, given that the second digit he chose is not a 5. [4]
 - (iv) The random variable X is the number of 5s that Dayo chooses. Draw up a table to show the probability distribution of X . [3]

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General Certificate of Education
Advanced Subsidiary Level and Advanced Level

MATHEMATICS

9709/61

Paper 6 Probability & Statistics 1 (S1)

May/June 2013

1 hour 15 minutes

Additional Materials: Answer Booklet/Paper
Graph Paper
List of Formulae (MF9)



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- 1 A summary of 30 values of x gave the following information:

$$\Sigma(x - c) = 234, \quad \Sigma(x - c)^2 = 1957.5,$$

where c is a constant.

- (i) Find the standard deviation of these values of x . [2]
- (ii) Given that the mean of these values is 86, find the value of c . [2]
- 2 Assume that, for a randomly chosen person, their next birthday is equally likely to occur on any day of the week, independently of any other person's birthday. Find the probability that, out of 350 randomly chosen people, at least 47 will have their next birthday on a Monday. [5]
- 3 The following back-to-back stem-and-leaf diagram shows the annual salaries of a group of 39 females and 39 males.

	Females		Males	
(4)	5 2 0 0	20	3	(1)
(9)	9 8 8 7 6 4 0 0 0	21	0 0 7	(3)
(8)	8 7 5 3 3 1 0 0	22	0 0 4 5 6 6	(6)
(6)	6 4 2 1 0 0	23	0 0 2 3 3 5 6 7 7	(9)
(6)	7 5 4 0 0 0	24	0 1 1 2 5 5 6 8 8 9	(10)
(4)	9 5 0 0	25	3 4 5 7 7 8 9	(7)
(2)	5 0	26	0 4 6	(3)

Key: 2 | 20 | 3 means \$20 200 for females and \$20 300 for males.

- (i) Find the median and the quartiles of the females' salaries. [2]
- You are given that the median salary of the males is \$24 000, the lower quartile is \$22 600 and the upper quartile is \$25 300.
- (ii) Represent the data by means of a pair of box-and-whisker plots in a single diagram on graph paper. [3]
- 4 (a) The random variable Y is normally distributed with positive mean μ and standard deviation $\frac{1}{2}\mu$. Find the probability that a randomly chosen value of Y is negative. [3]
- (b) The weights of bags of rice are normally distributed with mean 2.04 kg and standard deviation σ kg. In a random sample of 8000 such bags, 253 weighed over 2.1 kg. Find the value of σ . [4]

- 5 Fiona uses her calculator to produce 12 random integers between 7 and 21 inclusive. The random variable X is the number of these 12 integers which are multiples of 5.

(i) State the distribution of X and give its parameters. [3]

(ii) Calculate the probability that X is between 3 and 5 inclusive. [3]

Fiona now produces n random integers between 7 and 21 inclusive.

(iii) Find the least possible value of n if the probability that none of these integers is a multiple of 5 is less than 0.01. [3]

- 6 Four families go to a theme park together. Mr and Mrs Lin take their 2 children. Mr O'Connor takes his 2 children. Mr and Mrs Ahmed take their 3 children. Mrs Burton takes her son. The 14 people all have to go through a turnstile one at a time to enter the theme park.

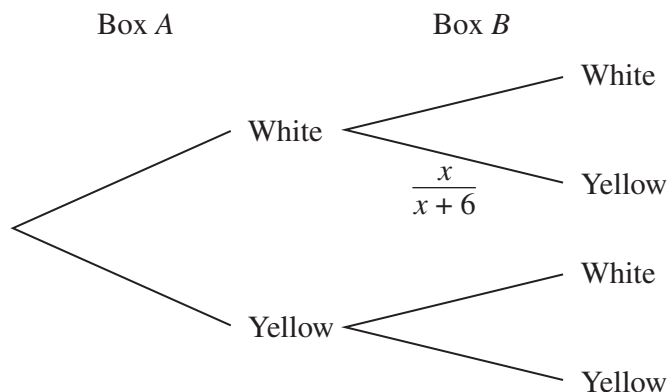
(i) In how many different orders can the 14 people go through the turnstile if each family stays together? [3]

(ii) In how many different orders can the 8 children and 6 adults go through the turnstile if no two adults go consecutively? [3]

Once inside the theme park, the children go on the roller-coaster. Each roller-coaster car holds 3 people.

(iii) In how many different ways can the 8 children be divided into two groups of 3 and one group of 2 to go on the roller-coaster? [3]

- 7 Box A contains 8 white balls and 2 yellow balls. Box B contains 5 white balls and x yellow balls. A ball is chosen at random from box A and placed in box B. A ball is then chosen at random from box B. The tree diagram below shows the possibilities for the colours of the balls chosen.



(i) Justify the probability $\frac{x}{x+6}$ on the tree diagram. [1]

(ii) Copy and complete the tree diagram. [4]

(iii) If the ball chosen from box A is white then the probability that the ball chosen from box B is also white is $\frac{1}{3}$. Show that the value of x is 12. [2]

(iv) Given that the ball chosen from box B is yellow, find the conditional probability that the ball chosen from box A was yellow. [4]

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MATHEMATICS

9709/62

Paper 6 Probability & Statistics 1 (S1)

May/June 2013

1 hour 15 minutes

Additional Materials: Answer Booklet/Paper
Graph Paper
List of Formulae (MF9)



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- 1 The random variable Y is normally distributed with mean equal to five times the standard deviation. It is given that $P(Y > 20) = 0.0732$. Find the mean. [3]

- 2 A summary of the speeds, x kilometres per hour, of 22 cars passing a certain point gave the following information:

$$\Sigma(x - 50) = 81.4 \quad \text{and} \quad \Sigma(x - 50)^2 = 671.0.$$

Find the variance of the speeds and hence find the value of Σx^2 . [4]

- 3 Cans of lemon juice are supposed to contain 440 ml of juice. It is found that the actual volume of juice in a can is normally distributed with mean 445 ml and standard deviation 3.6 ml.

- (i) Find the probability that a randomly chosen can contains less than 440 ml of juice. [3]

It is found that 94% of the cans contain between $(445 - c)$ ml and $(445 + c)$ ml of juice.

- (ii) Find the value of c . [3]

- 4 Robert uses his calculator to generate 5 random integers between 1 and 9 inclusive.

- (i) Find the probability that at least 2 of the 5 integers are less than or equal to 4. [3]

Robert now generates n random integers between 1 and 9 inclusive. The random variable X is the number of these n integers which are less than or equal to a certain integer k between 1 and 9 inclusive. It is given that the mean of X is 96 and the variance of X is 32.

- (ii) Find the values of n and k . [4]

- 5 The following are the annual amounts of money spent on clothes, to the nearest \$10, by 27 people.

10	40	60	80	100	130	140	140	140
150	150	150	160	160	160	160	170	180
180	200	210	250	270	280	310	450	570

- (i) Construct a stem-and-leaf diagram for the data. [3]

- (ii) Find the median and the interquartile range of the data. [3]

An 'outlier' is defined as any data value which is more than 1.5 times the interquartile range above the upper quartile, or more than 1.5 times the interquartile range below the lower quartile.

- (iii) List the outliers. [3]

6 A town council plans to plant 12 trees along the centre of a main road. The council buys the trees from a garden centre which has 4 different hibiscus trees, 9 different jacaranda trees and 2 different oleander trees for sale.

(i) How many different selections of 12 trees can be made if there must be at least 2 of each type of tree? [4]

The council buys 4 hibiscus trees, 6 jacaranda trees and 2 oleander trees.

(ii) How many different arrangements of these 12 trees can be made if the hibiscus trees have to be next to each other, the jacaranda trees have to be next to each other and the oleander trees have to be next to each other? [3]

(iii) How many different arrangements of these 12 trees can be made if no hibiscus tree is next to another hibiscus tree? [3]

7 Susan has a bag of sweets containing 7 chocolates and 5 toffees. Ahmad has a bag of sweets containing 3 chocolates, 4 toffees and 2 boiled sweets. A sweet is taken at random from Susan's bag and put in Ahmad's bag. A sweet is then taken at random from Ahmad's bag.

(i) Find the probability that the two sweets taken are a toffee from Susan's bag and a boiled sweet from Ahmad's bag. [2]

(ii) Given that the sweet taken from Ahmad's bag is a chocolate, find the probability that the sweet taken from Susan's bag was also a chocolate. [4]

(iii) The random variable X is the number of times a chocolate is taken. State the possible values of X and draw up a table to show the probability distribution of X . [5]

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MATHEMATICS

9709/63

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- 1 Q is the event ‘Nicola throws two fair dice and gets a total of 5’. S is the event ‘Nicola throws two fair dice and gets one low score (1, 2 or 3) and one high score (4, 5 or 6)’. Are events Q and S independent? Justify your answer. [4]
- 2 The 12 houses on one side of a street are numbered with even numbers starting at 2 and going up to 24. A free newspaper is delivered on Monday to 3 different houses chosen at random from these 12. Find the probability that at least 2 of these newspapers are delivered to houses with numbers greater than 14. [4]
- 3 Buildings in a certain city centre are classified by height as tall, medium or short. The heights can be modelled by a normal distribution with mean 50 metres and standard deviation 16 metres. Buildings with a height of more than 70 metres are classified as tall.
- (i) Find the probability that a building chosen at random is classified as tall. [2]
- (ii) The rest of the buildings are classified as medium and short in such a way that there are twice as many medium buildings as there are short ones. Find the height below which buildings are classified as short. [5]
- 4 In a certain country, on average one student in five has blue eyes.
- (i) For a random selection of n students, the probability that none of the students has blue eyes is less than 0.001. Find the least possible value of n . [3]
- (ii) For a random selection of 120 students, find the probability that fewer than 33 have blue eyes. [4]
- 5 (a) John plays two games of squash. The probability that he wins his first game is 0.3. If he wins his first game, the probability that he wins his second game is 0.6. If he loses his first game, the probability that he wins his second game is 0.15. Given that he wins his second game, find the probability that he won his first game. [4]
- (b) Jack has a pack of 15 cards. 10 cards have a picture of a robot on them and 5 cards have a picture of an aeroplane on them. Emma has a pack of cards. 7 cards have a picture of a robot on them and $x - 3$ cards have a picture of an aeroplane on them. One card is taken at random from Jack’s pack and one card is taken at random from Emma’s pack. The probability that both cards have pictures of robots on them is $\frac{7}{18}$. Write down an equation in terms of x and hence find the value of x . [4]

- 6 The weights, x kilograms, of 144 people were recorded. The results are summarised in the cumulative frequency table below.

Weight (x kilograms)	$x < 40$	$x < 50$	$x < 60$	$x < 65$	$x < 70$	$x < 90$
Cumulative frequency	0	12	34	64	92	144

- (i) On graph paper, draw a cumulative frequency graph to represent these results. [2]
- (ii) 64 people weigh more than c kg. Use your graph to find the value of c . [2]
- (iii) Calculate estimates of the mean and standard deviation of the weights. [6]
- 7 There are 10 spaniels, 14 retrievers and 6 poodles at a dog show. 7 dogs are selected to go through to the final.
- (i) How many selections of 7 different dogs can be made if there must be at least 1 spaniel, at least 2 retrievers and at least 3 poodles? [4]
- 2 spaniels, 2 retrievers and 3 poodles go through to the final. They are placed in a line.
- (ii) How many different arrangements of these 7 dogs are there if the spaniels stand together and the retrievers stand together? [3]
- (iii) How many different arrangements of these 7 dogs are there if no poodle is next to another poodle? [3]

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