OCR
RECOGNISING ACHIEVEMENT

OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Advanced Subsidiary General Certificate of Education
Advanced General Certificate of Education

MEI STRUCTURED MATHEMATICS **4766**

Statistics 1

Tuesday **18 JANUARY 2005** Afternoon 1 hour 30 minutes

Additional materials:
Answer booklet
Graph paper
MEI Examination Formulae and Tables (MF2)

TIME 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the spaces provided on the answer booklet.
- Answer **all** the questions.
- You are permitted to use a graphical calculator in this paper.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [ ] at the end of each question or part question.
- You are advised that an answer may receive **no marks** unless you show sufficient detail of the working to indicate that a correct method is being used.
- Final answers should be given to a degree of accuracy appropriate to the context.
- The total number of marks for this paper is 72.

This question paper consists of 6 printed pages and 2 blank pages.

Section A (36 marks)

1 The number of minutes of recorded music on a sample of 100 CDs is summarised below.

Time (t minutes)	$40 \leqslant t < 45$	$45 \leqslant t < 50$	$50 \leqslant t < 60$	$60 \leqslant t < 70$	$70 \leqslant t < 90$
Number of CDs	26	18	31	16	9

(i) Illustrate the data by means of a histogram. [5]

(ii) Identify two features of the distribution. [2]

2 A sprinter runs many 100-metre trials, and the time, x seconds, for each is recorded. A sample of eight of these times is taken, as follows.

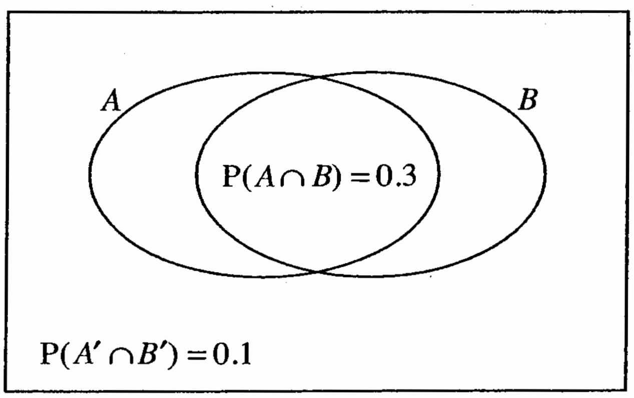
10.53 10.61 10.04 10.49 10.63 10.55 10.47 10.63

(i) Calculate the sample mean, $\bar{x}$, and sample standard deviation, s, of these times. [3]

(ii) Show that the time of 10.04 seconds may be regarded as an outlier. [2]

(iii) Discuss briefly whether or not the time of 10.04 seconds should be discarded. [2]

3 The Venn diagram illustrates the occurrence of two events A and B.



You are given that $\mathrm{P}(A \cap B) = 0.3$ and that the probability that neither A nor B occurs is 0.1. You are also given that $\mathrm{P}(A) = 2\mathrm{P}(B)$.

Find $\mathrm{P}(B)$. [3]

4 The number, X, of children per family in a certain city is modelled by the probability distribution $\mathrm{P}(X = r) = k(6-r)(1+r)$ for $r = 0, 1, 2, 3, 4$.

(i) Copy and complete the following table and hence show that the value of k is $\frac{1}{50}$. [3]

r	0	1	2	3	4
$\mathrm{P}(X=r)$	$6k$	$10k$			

(ii) Calculate $\mathrm{E}(X)$. [2]

(iii) Hence write down the probability that a randomly selected family in this city has more than the mean number of children. [1]

5 A rugby union team consists of 15 players made up of 8 forwards and 7 backs. A manager has to select his team from a squad of 12 forwards and 11 backs.

(i) In how many ways can the manager select the forwards? [2]

(ii) In how many ways can the manager select the team? [3]

6 An amateur weather forecaster describes each day as either sunny, cloudy or wet. He keeps a record each day of his forecast and of the actual weather. His results for one particular year are given in the table.

		Weather Forecast			Total
		Sunny	Cloudy	Wet	
Actual Weather	Sunny	55	12	7	74
	Cloudy	17	128	29	174
	Wet	3	33	81	117
Total		75	173	117	365

A day is selected at random from that year.

(i) Show that the probability that the forecast is correct is $\frac{264}{365}$. [2]

Find the probability that

(ii) the forecast is correct, given that the forecast is sunny, [2]

(iii) the forecast is correct, given that the weather is wet, [2]

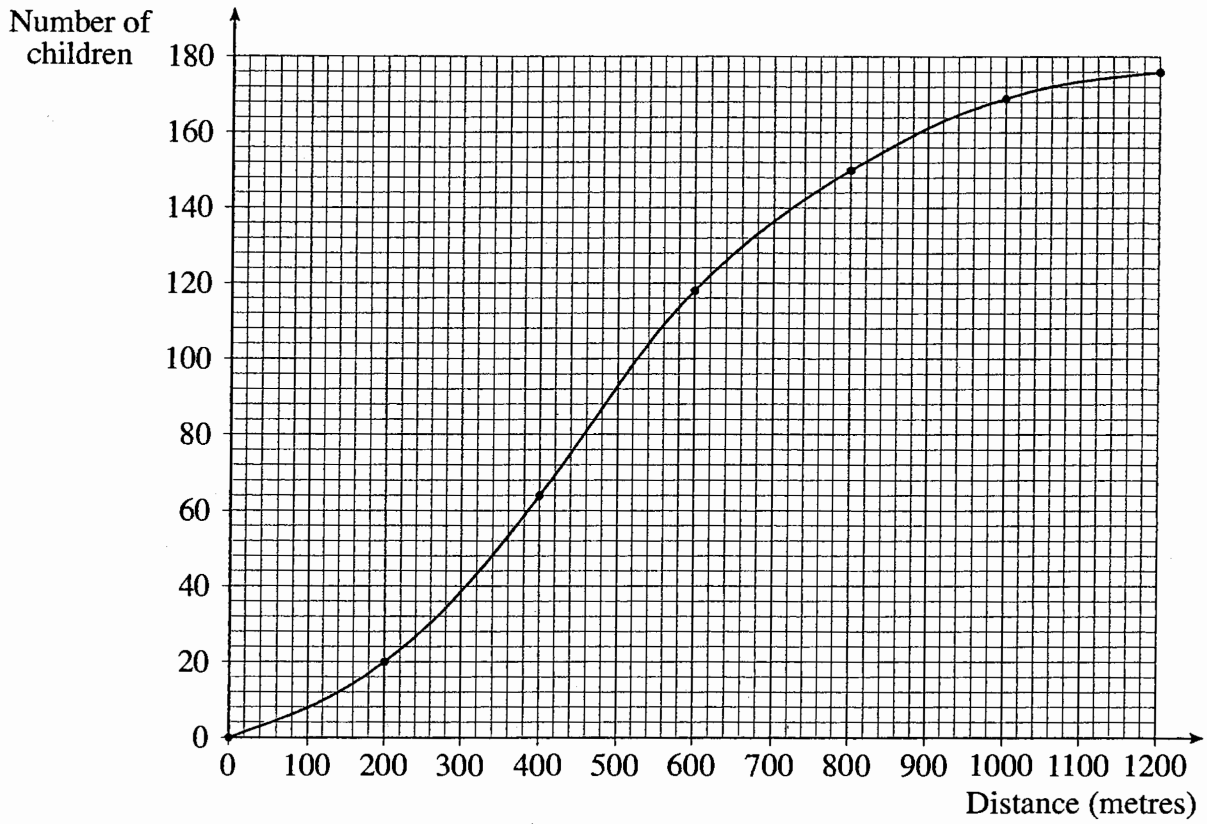
(iv) the weather is cloudy, given that the forecast is correct. [2]

[Turn over

Section B (36 marks)

7 The cumulative frequency graph below illustrates the distances that 176 children live from their primary school.

Distance from school



(i) Use the graph to estimate, to the nearest 10 metres,

(*A*) the median distance from school, [2]

(*B*) the lower quartile, upper quartile and interquartile range. [3]

(ii) Draw a box and whisker plot to illustrate the data. [3]

[Question 7 continues on the next page.]

The graph on page 4 used the following grouped data.

Distance (metres)	200	400	600	800	1000	1200
Cumulative frequency	20	64	118	150	169	176

(iii) Copy and complete the grouped frequency table below describing the same data. [2]

Distance (d metres)	Frequency
$0 < d \leqslant 200$	20
$200 < d \leqslant 400$	

(iv) Hence estimate the mean distance these children live from school. [3]

It is subsequently found that none of the 176 children lives within 100 metres of the school.

(v) Calculate the revised estimate of the mean distance. [2]

(vi) Describe what change needs to be made to the cumulative frequency graph. [2]

[Question 8 is printed overleaf.]

8 At a doctor's surgery, records show that 20% of patients who make an appointment fail to turn up. During afternoon surgery the doctor has time to see 16 patients.

There are 16 appointments to see the doctor one afternoon.

(i) Find the probability that all 16 patients turn up. [2]

(ii) Find the probability that more than 3 patients do not turn up. [3]

To improve efficiency, the doctor decides to make more than 16 appointments for afternoon surgery, although there will still only be enough time to see 16 patients. There must be a probability of at least 0.9 that the doctor will have enough time to see all the patients who turn up.

(iii) The doctor makes 17 appointments for afternoon surgery. Find the probability that at least one patient does not turn up. Hence show that making 17 appointments is satisfactory. [3]

(iv) Now find the greatest number of appointments the doctor can make for afternoon surgery and still have a probability of at least 0.9 of having time to see all patients who turn up. [4]

A computerised appointment system is introduced at the surgery. It is decided to test, at the 5% level, whether the proportion of patients failing to turn up for their appointments has changed. There are always 20 appointments to see the doctor at morning surgery. On a randomly chosen morning, 1 patient does not turn up.

(v) Write down suitable hypotheses and carry out the test. [7]

OCR

RECOGNISING ACHIEVEMENT

OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Advanced Subsidiary General Certificate of Education
Advanced General Certificate of Education

MEI STRUCTURED MATHEMATICS — 4766

Statistics 1

Thursday **9 JUNE 2005** Morning 1 hour 30 minutes

Additional materials:
Answer booklet
Graph paper
MEI Examination Formulae and Tables (MF2)

TIME 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the spaces provided on the answer booklet.
- Answer **all** the questions.
- There is an **insert** for use in Questions **2**, **5** and **6.**
- You are permitted to use a graphical calculator in this paper.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [ ] at the end of each question or part question.
- You are advised that an answer may receive **no marks** unless you show sufficient detail of the working to indicate that a correct method is being used.
- Final answers should be given to a degree of accuracy appropriate to the context.
- The total number of marks for this paper is 72.

This question paper consists of 5 printed pages, 3 blank pages and an insert.

Section A (36 marks)

1 At a certain stage of a football league season, the numbers of goals scored by a sample of 20 teams in the league were as follows.

22 23 23 23 26 28 28 30 31 33 33 34 35 35 36 36 37 46 49 49

(i) Calculate the sample mean and sample variance, s^2, of these data. [3]

(ii) The three teams with the most goals appear to be well ahead of the other teams. Determine whether or not any of these three pieces of data may be considered outliers. [2]

2 **Answer part (i) of this question on the insert provided.**

A taxi driver operates from a taxi rank at a main railway station in London. During one particular week he makes 120 journeys, the lengths of which are summarised in the table.

Length (x miles)	$0 < x \leqslant 1$	$1 < x \leqslant 2$	$2 < x \leqslant 3$	$3 < x \leqslant 4$	$4 < x \leqslant 6$	$6 < x \leqslant 10$
Number of journeys	38	30	21	14	9	8

(i) On the insert, draw a cumulative frequency diagram to illustrate the data. [3]

(ii) Use your graph to estimate the median length of journey and the quartiles.

Hence find the interquartile range. [4]

(iii) State the type of skewness of the distribution of the data. [1]

3 Jeremy is a computing consultant who sometimes works at home. The number, X, of days that Jeremy works at home in any given week is modelled by the probability distribution

$$\mathrm{P}(X = r) = \tfrac{1}{40}r(r+1) \quad \text{for } r = 1, 2, 3, 4.$$

(i) Verify that $\mathrm{P}(X = 4) = \frac{1}{2}$. [1]

(ii) Calculate $\mathrm{E}(X)$ and $\mathrm{Var}(X)$. [5]

(iii) Jeremy works for 45 weeks each year. Find the expected number of weeks during which he works at home for exactly 2 days. [2]

4 An examination paper consists of three sections.

- Section A contains 6 questions of which the candidate must answer 3
- Section B contains 7 questions of which the candidate must answer 4
- Section C contains 8 questions of which the candidate must answer 5

(i) In how many ways can a candidate choose 3 questions from Section A? [2]

(ii) In how many ways can a candidate choose 3 questions from Section A, 4 from Section B and 5 from Section C? [3]

A candidate does not read the instructions and selects 12 questions at random.

(iii) Find the probability that they happen to be 3 from Section A, 4 from Section B and 5 from Section C. [3]

5 **Answer part (i) of this question on the insert provided.**

The lowest common multiple of two integers, x and y, is the smallest positive integer which is a multiple of both x and y. So, for example, the lowest common multiple of 4 and 6 is 12.

(i) On the insert, complete the table giving the lowest common multiples of all pairs of integers between 1 and 6. [1]

		Second integer					
		1	2	3	4	5	6
First integer	1	1	2	3	4	5	6
	2	2	2	6	4	10	6
	3	3	6	3	12	15	6
	4	4	4	12			12
	5	5	10	15			
	6	6	6	6	12		

Two fair dice are thrown and the lowest common multiple of the two scores is found.

(ii) Use the table to find the probabilities of the following events.

(A) The lowest common multiple is greater than 6. [1]

(B) The lowest common multiple is a multiple of 5. [1]

(C) The lowest common multiple is both greater than 6 and a multiple of 5. [2]

(iii) Use your answers to part **(ii)** to show that the events "the lowest common multiple is greater than 6" and "the lowest common multiple is a multiple of 5" are not independent. [2]

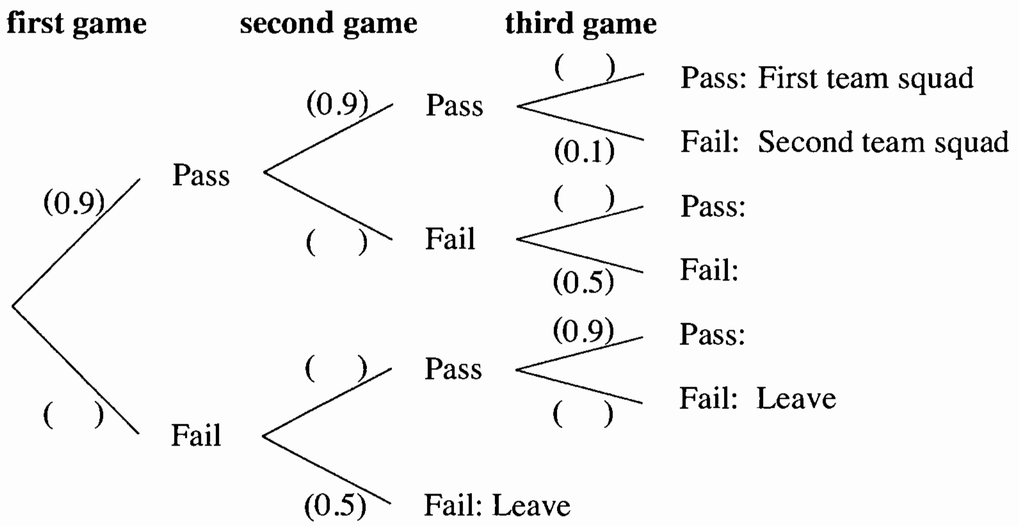
Section B (36 marks)

6 Answer part (i) of this question on the insert provided.

Mancaster Hockey Club invite prospective new players to take part in a series of three trial games. At the end of each game the performance of each player is assessed as pass or fail. Players who achieve a pass in all three games are invited to join the first team squad. Players who achieve a pass in two games are invited to join the second team squad. Players who fail in two games are asked to leave. This may happen after two games.

- The probability of passing the first game is 0.9
- Players who pass any game have probability 0.9 of passing the next game
- Players who fail any game have probability 0.5 of failing the next game

(i) On the insert, complete the tree diagram which illustrates the information above. [2]



(ii) Find the probability that a randomly selected player

(*A*) is invited to join the first team squad, [2]

(*B*) is invited to join the second team squad. [3]

(iii) Hence write down the probability that a randomly selected player is asked to leave. [1]

(iv) Find the probability that a randomly selected player is asked to leave after two games, given that the player is asked to leave. [2]

Angela, Bryony and Shareen attend the trials at the same time. Assuming their performances are independent, find the probability that

(v) at least one of the three is asked to leave, [3]

(vi) they pass a total of 7 games between them. [5]

7 A game requires 15 identical ordinary dice to be thrown in each turn.

Assuming the dice to be fair, find the following probabilities for any given turn.

(i) No sixes are thrown. [2]

(ii) Exactly four sixes are thrown. [3]

(iii) More than three sixes are thrown. [2]

David and Esme are two players who are not convinced that the dice are fair. David believes that the dice are biased against sixes, while Esme believes the dice to be biased in favour of sixes.

In his next turn, David throws no sixes. In her next turn, Esme throws 5 sixes.

(iv) Writing down your hypotheses carefully in each case, decide whether

(*A*) David's turn provides sufficient evidence at the 10% level that the dice are biased against sixes, [5]

(*B*) Esme's turn provides sufficient evidence at the 10% level that the dice are biased in favour of sixes. [4]

(v) Comment on your conclusions from part **(iv)**. [2]

Candidate Name	Centre Number	Candidate Number

RECOGNISING ACHIEVEMENT

OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Advanced Subsidiary General Certificate of Education
Advanced General Certificate of Education

MEI STRUCTURED MATHEMATICS 4766

Statistics 1

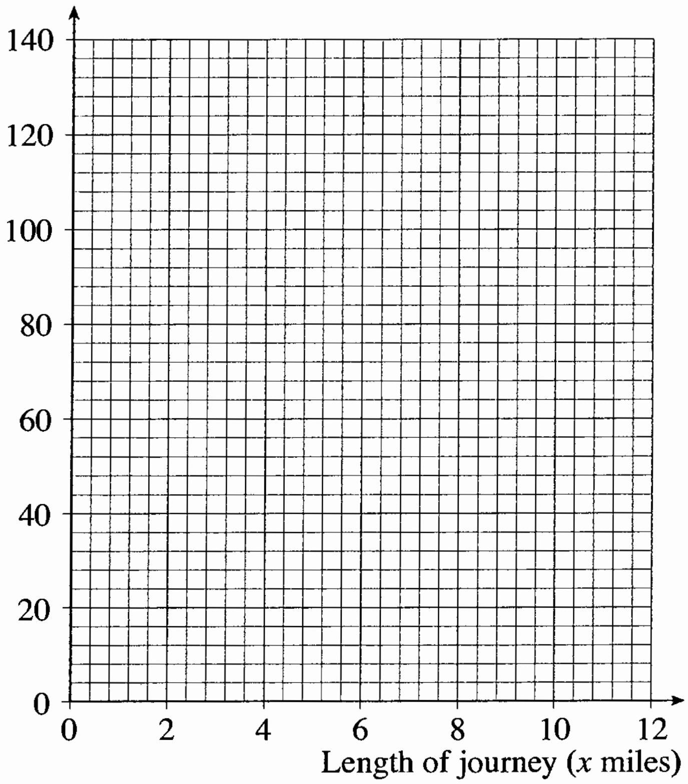
INSERT

Thursday **9 JUNE 2005** Morning 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

- This insert should be used in Questions **2** part **(i)**, **5** part **(i)** and **6** part **(i)**.
- Write your name, centre number and candidate number in the spaces provided at the top of this page and attach it to your answer booklet.

2 (i)



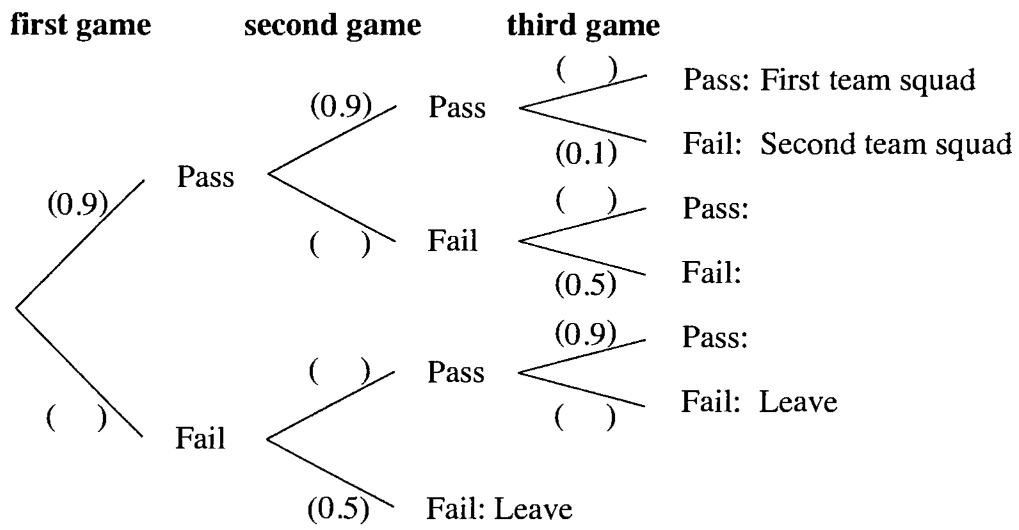
This insert consists of 2 printed pages.

[Turn over

5 (i)

		Second integer					
		1	2	3	4	5	6
First integer	1	1	2	3	4	5	6
	2	2	2	6	4	10	6
	3	3	6	3	12	15	6
	4	4	4	12			12
	5	5	10	15			
	6	6	6	6	12		

6 (i)



OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Advanced Subsidiary General Certificate of Education
Advanced General Certificate of Education

MEI STRUCTURED MATHEMATICS 4766

Statistics 1

Advanced Subsidiary General Certificate of Education

MEI STATISTICS G241

Statistics 1 (Z1)

Thursday **12 JANUARY 2006** Afternoon 1 hour 30 minutes

Additional materials:
8 page answer booklet
Graph paper
MEI Examination Formulae and Tables (MF2)

TIME 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the spaces provided on the answer booklet.
- Answer **all** the questions.
- You are permitted to use a graphical calculator in this paper.
- Final answers should be given to a degree of accuracy appropriate to the context.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [ ] at the end of each question or part question.
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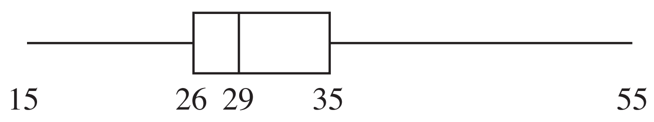
- The total number of marks for this paper is 72.

This question paper consists of 6 printed pages and 2 blank pages.

Section A (36 marks)

1 The times taken, in minutes, by 80 people to complete a crossword puzzle are summarised by the box and whisker plot below.



(i) Write down the range and the interquartile range of the times. [2]

(ii) Determine whether any of the times can be regarded as outliers. [3]

(iii) Describe the shape of the distribution of the times. [1]

2 Four letters are taken out of their envelopes for signing. Unfortunately they are replaced randomly, one in each envelope.

The probability distribution for the number of letters, X, which are now in the correct envelope is given in the following table.

r	0	1	2	3	4
$\mathrm{P}(X = r)$	$\frac{3}{8}$	$\frac{1}{3}$	$\frac{1}{4}$	0	$\frac{1}{24}$

(i) Explain why the case $X = 3$ is impossible. [1]

(ii) Explain why $\mathrm{P}(X = 4) = \frac{1}{24}$. [2]

(iii) Calculate $\mathrm{E}(X)$ and $\mathrm{Var}(X)$. [5]

3 Over a long period of time, 20% of all bowls made by a particular manufacturer are imperfect and cannot be sold.

(i) Find the probability that fewer than 4 bowls from a random sample of 10 made by the manufacturer are imperfect. [2]

The manufacturer introduces a new process for producing bowls. To test whether there has been an improvement, each of a random sample of 20 bowls made by the new process is examined. From this sample, 2 bowls are found to be imperfect.

(ii) Show that this does not provide evidence, at the 5% level of significance, of a reduction in the proportion of imperfect bowls. You should show your hypotheses and calculations clearly. [6]

4 A company sells sugar in bags which are labelled as containing 450 grams.

Although the mean weight of sugar in a bag is more than 450 grams, there is concern that too many bags are underweight. The company can adjust the mean or the standard deviation of the weight of sugar in a bag.

(i) State two adjustments the company could make. [2]

The weights, x grams, of a random sample of 25 bags are now recorded.

(ii) Given that $\sum x = 11\,409$ and $\sum x^2 = 5206937$, calculate the sample mean and sample standard deviation of these weights. [3]

5 A school athletics team has 10 members. The table shows which competitions each of the members can take part in.

		Competiton				
		100 m	200 m	110 m hurdles	400 m	Long jump
Athlete	Abel	✓	✓			✓
	Bernoulli		✓		✓	
	Cauchy	✓		✓		✓
	Descartes	✓	✓			
	Einstein		✓		✓	
	Fermat	✓		✓		
	Galois				✓	✓
	Hardy	✓	✓			✓
	Iwasawa		✓		✓	
	Jacobi			✓		

An athlete is selected at random. Events A, B, C, D are defined as follows.

A: the athlete can take part in exactly 2 competitions.
B: the athlete can take part in the 200 m.
C: the athlete can take part in the 110 m hurdles.
D: the athlete can take part in the long jump.

(i) Write down the value of $\mathrm{P}(A \cap B)$. [1]

(ii) Write down the value of $\mathrm{P}(C \cup D)$. [1]

(iii) Which two of the four events A, B, C, D are mutually exclusive? [1]

(iv) Show that events B and D are not independent. [2]

6 A band has a repertoire of 12 songs suitable for a live performance. From these songs, a selection of 7 has to be made.

(i) Calculate the number of different selections that can be made. [2]

(ii) Once the 7 songs have been selected, they have to be arranged in playing order. In how many ways can this be done? [2]

Section B (36 marks)

7 At East Cornwall College, the mean GCSE score of each student is calculated. This is done by allocating a number of points to each GCSE grade in the following way.

Grade	A*	A	B	C	D	E	F	G	U
Points	8	7	6	5	4	3	2	1	0

(i) Calculate the mean GCSE score, X, of a student who has the following GCSE grades:

A*, A*, A, A, A, B, B, B, B, C, D. [2]

60 students study AS Mathematics at the college. The mean GCSE scores of these students are summarised in the table below.

Mean GCSE score	Number of students
$4.5 \leqslant X < 5.5$	8
$5.5 \leqslant X < 6.0$	14
$6.0 \leqslant X < 6.5$	19
$6.5 \leqslant X < 7.0$	13
$7.0 \leqslant X \leqslant 8.0$	6

(ii) Draw a histogram to illustrate this information. [3]

(iii) Calculate estimates of the sample mean and the sample standard deviation. [5]

The scoring system for AS grades is shown in the table below.

AS Grade	A	B	C	D	E	U
Score	60	50	40	30	20	0

The Mathematics department at the college predicts each student's AS score, Y, using the formula $Y = 13X - 46$, where X is the student's average GCSE score.

(iv) What AS grade would the department predict for a student with an average GCSE score of 7.4? [2]

(v) What do you think the prediction should be for a student with an average GCSE score of 5.5? Give a reason for your answer. [3]

(vi) Using your answers to part **(iii)**, estimate the sample mean and sample standard deviation of the predicted AS scores of the 60 students in the department. [3]

8 Jane buys 5 jam doughnuts, 4 cream doughnuts and 3 plain doughnuts.

On arrival home, each of her three children eats one of the twelve doughnuts. The different kinds of doughnut are indistinguishable by sight and so selection of doughnuts is random.

Calculate the probabilities of the following events.

(i) All 3 doughnuts eaten contain jam. [3]

(ii) All 3 doughnuts are of the same kind. [3]

(iii) The 3 doughnuts are all of a different kind. [3]

(iv) The 3 doughnuts contain jam, given that they are all of the same kind. [3]

On 5 successive Saturdays, Jane buys the same combination of 12 doughnuts and her three children eat one each. Find the probability that all 3 doughnuts eaten contain jam on

(v) exactly 2 Saturdays out of the 5, [3]

(vi) at least 1 Saturday out of the 5. [3]

RECOGNISING ACHIEVEMENT

OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Advanced Subsidiary General Certificate of Education
Advanced General Certificate of Education

MEI STRUCTURED MATHEMATICS **4766**

Statistics 1

Advanced Subsidiary General Certificate of Education

MEI STATISTICS **G241**

Statistics 1 (Z1)

Wednesday **24 MAY 2006** Afternoon 1 hour 30 minutes

Additional materials:
8 page answer booklet
Graph paper
MEI Examination Formulae and Tables (MF2)

TIME 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the spaces provided on the answer booklet.
- Answer **all** the questions.
- You are permitted to use a graphical calculator in this paper.
- Final answers should be given to a degree of accuracy appropriate to the context.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [ ] at the end of each question or part question.
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- The total number of marks for this paper is 72.

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Section A (36 marks)

1 Every day, George attempts the quiz in a national newspaper. The quiz always consists of 7 questions. In the first 25 days of January, the numbers of questions George answers correctly each day are summarised in the table below.

Number correct	1	2	3	4	5	6	7
Frequency	1	2	3	3	4	7	5

(i) Draw a vertical line chart to illustrate the data. [2]

(ii) State the type of skewness shown by your diagram. [1]

(iii) Calculate the mean and the mean squared deviation of the data. [3]

(iv) How many correct answers would George need to average over the next 6 days if he is to achieve an average of 5 correct answers for all 31 days of January? [2]

2 Isobel plays football for a local team. Sometimes her parents attend matches to watch her play.

- A is the event that Isobel's parents watch a match.
- B is the event that Isobel scores in a match.

You are given that $\mathrm{P}(B \mid A) = \frac{3}{7}$ and $\mathrm{P}(A) = \frac{7}{10}$.

(i) Calculate $\mathrm{P}(A \cap B)$. [2]

The probability that Isobel does not score and her parents do not attend is 0.1.

(ii) Draw a Venn diagram showing the events A and B, and mark in the probability corresponding to each of the regions of your diagram. [2]

(iii) Are events A and B independent? Give a reason for your answer. [2]

(iv) By comparing $\mathrm{P}(B \mid A)$ with $\mathrm{P}(B)$, explain why Isobel should ask her parents not to attend. [2]

3 The score, X, obtained on a given throw of a biased, four-faced die is given by the probability distribution

$$\mathrm{P}(X = r) = kr(8 - r) \text{ for } r = 1, 2, 3, 4.$$

(i) Show that $k = \frac{1}{50}$. [2]

(ii) Calculate $\mathrm{E}(X)$ and $\mathrm{Var}(X)$. [5]

4 Peter and Esther visit a restaurant for a three-course meal. On the menu there are 4 starters, 5 main courses and 3 sweets. Peter and Esther each order a starter, a main course and a sweet.

(i) Calculate the number of ways in which Peter may choose his three-course meal. [2]

(ii) Suppose that Peter and Esther choose different dishes from each other.

(A) Show that the number of possible combinations of starters is 6. [1]

(B) Calculate the number of possible combinations of 6 dishes for both meals. [1]

(iii) Suppose instead that Peter and Esther choose their dishes independently.

(A) Write down the probability that they choose the same main course. [1]

(B) Find the probability that they choose different dishes from each other for every course. [2]

5 Douglas plays darts, and the probability that he hits the number he is aiming at is 0.87 for any particular dart.

Douglas aims a set of three darts at the number 20; the number of times he is successful can be modelled by $\mathrm{B}(3, 0.87)$.

(i) Calculate the probability that Douglas hits 20 twice. [3]

(ii) Douglas aims fifty sets of 3 darts at the number 20. Find the expected number of sets for which Douglas hits 20 twice. [1]

(iii) Douglas aims four sets of 3 darts at the number 20. Calculate the probability that he hits 20 twice for two sets out of the four. [2]

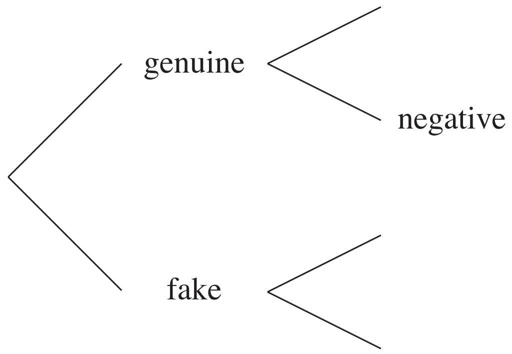
Section B (36 marks)

6 It has been estimated that 90% of paintings offered for sale at a particular auction house are genuine, and that the other 10% are fakes. The auction house has a test to determine whether or not a given painting is genuine. If this test gives a positive result, it suggests that the painting is genuine. A negative result suggests that the painting is a fake.

If a painting is genuine, the probability that the test result is positive is 0.95.

If a painting is a fake, the probability that the test result is positive is 0.2.

(i) Copy and complete the probability tree diagram below, to illustrate the information above. [2]



Calculate the probabilities of the following events.

(ii) The test gives a positive result. [2]

(iii) The test gives a correct result. [2]

(iv) The painting is genuine, given a positive result. [3]

(v) The painting is a fake, given a negative result. [3]

A second test is more accurate, but very expensive. The auction house has a policy of only using this second test on those paintings with a negative result on the original test.

(vi) Using your answers to parts **(iv)** and **(v)**, explain why the auction house has this policy. [2]

The probability that the second test gives a correct result is 0.96 whether the painting is genuine or a fake.

(vii) Three paintings are independently offered for sale at the auction house. Calculate the probability that all three paintings are genuine, are judged to be fakes in the first test, but are judged to be genuine in the second test. [4]

7 A geologist splits rocks to look for fossils. On average 10% of the rocks selected from a particular area do in fact contain fossils.

The geologist selects a random sample of 20 rocks from this area.

(i) Find the probability that

(A) exactly one of the rocks contains fossils, [3]

(B) at least one of the rocks contains fossils. [3]

(ii) A random sample of n rocks is selected from this area. The geologist wants to have a probability of 0.8 or greater of finding fossils in at least one of the n rocks. Find the least possible value of n. [3]

(iii) The geologist explores a new area in which it is claimed that less than 10% of rocks contain fossils. In order to investigate the claim, a random sample of 30 rocks from this area is selected, and the number which contain fossils is recorded. A hypothesis test is carried out at the 5% level.

(A) Write down suitable hypotheses for the test. [3]

(B) Show that the critical region consists only of the value 0. [4]

(C) In fact, 2 of the 30 rocks in the sample contain fossils. Complete the test, stating your conclusions clearly. [2]

RECOGNISING ACHIEVEMENT

ADVANCED SUBSIDIARY GCE UNIT

4766/01

MATHEMATICS (MEI)

Statistics 1

FRIDAY 12 JANUARY 2007

Morning

Time: 1 hour 30 minutes

Additional Materials:
- Answer booklet (8 pages)
- Graph paper
- MEI Examination Formulae and Tables (MF2)

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the spaces provided on the answer booklet.
- Answer **all** the questions.
- You are permitted to use a graphical calculator in this paper.
- Final answers should be given to a degree of accuracy appropriate to the context.

INFORMATION FOR CANDIDATES

- 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 72.

ADVICE TO CANDIDATES

- Read each question carefully and make sure you know what you have to do before starting your answer.
- You are advised that an answer may receive **no marks** unless you show sufficient detail of the working to indicate that a correct method is being used.

This document consists of **6** printed pages and **2** blank pages.

Section A (36 marks)

1 The total annual emissions of carbon dioxide, x tonnes per person, for 13 European countries are given below.

6.2 6.7 6.8 8.1 8.1 8.5 8.6 9.0 9.9 10.1 11.0 11.8 22.8

(i) Find the mean, median and midrange of these data. [4]

(ii) Comment on how useful each of these is as a measure of central tendency for these data, giving a brief reason for each of your answers. [3]

2 The numbers of absentees per day from Mrs Smith's reception class over a period of 50 days are summarised below.

Number of absentees	0	1	2	3	4	5	6	>6
Frequency	8	15	11	8	3	4	1	0

(i) Illustrate these data by means of a vertical line chart. [2]

(ii) Calculate the mean and root mean square deviation of these data. [3]

(iii) There are 30 children in Mrs Smith's class altogether. Find the mean and root mean square deviation of the number of children who are present during the 50 days. [2]

3 The times taken for 480 university students to travel from their accommodation to lectures are summarised below.

Time (t minutes)	$0 \leqslant t < 5$	$5 \leqslant t < 10$	$10 \leqslant t < 20$	$20 \leqslant t < 30$	$30 \leqslant t < 40$	$40 \leqslant t < 60$
Frequency	34	153	188	73	27	5

(i) Illustrate these data by means of a histogram. [5]

(ii) Identify the type of skewness of the distribution. [1]

4 A fair six-sided die is rolled twice. The random variable X represents the higher of the two scores. The probability distribution of X is given by the formula

$$P(X = r) = k(2r - 1) \text{ for } r = 1, 2, 3, 4, 5, 6.$$

(i) Copy and complete the following probability table and hence find the exact value of k, giving your answer as a fraction in its simplest form. [3]

r	1	2	3	4	5	6
$P(X = r)$	k					$11k$

(ii) Find the mean of X. [2]

A fair six-sided die is rolled three times.

(iii) Find the probability that the total score is 16. [3]

5 Each day the probability that Ashwin wears a tie is 0.2. The probability that he wears a jacket is 0.4. If he wears a jacket, the probability that he wears a tie is 0.3.

(i) Find the probability that, on a randomly selected day, Ashwin wears a jacket and a tie. [2]

(ii) Draw a Venn diagram, using one circle for the event ‘wears a jacket’ and one circle for the event ‘wears a tie’. Your diagram should include the probability for each region. [3]

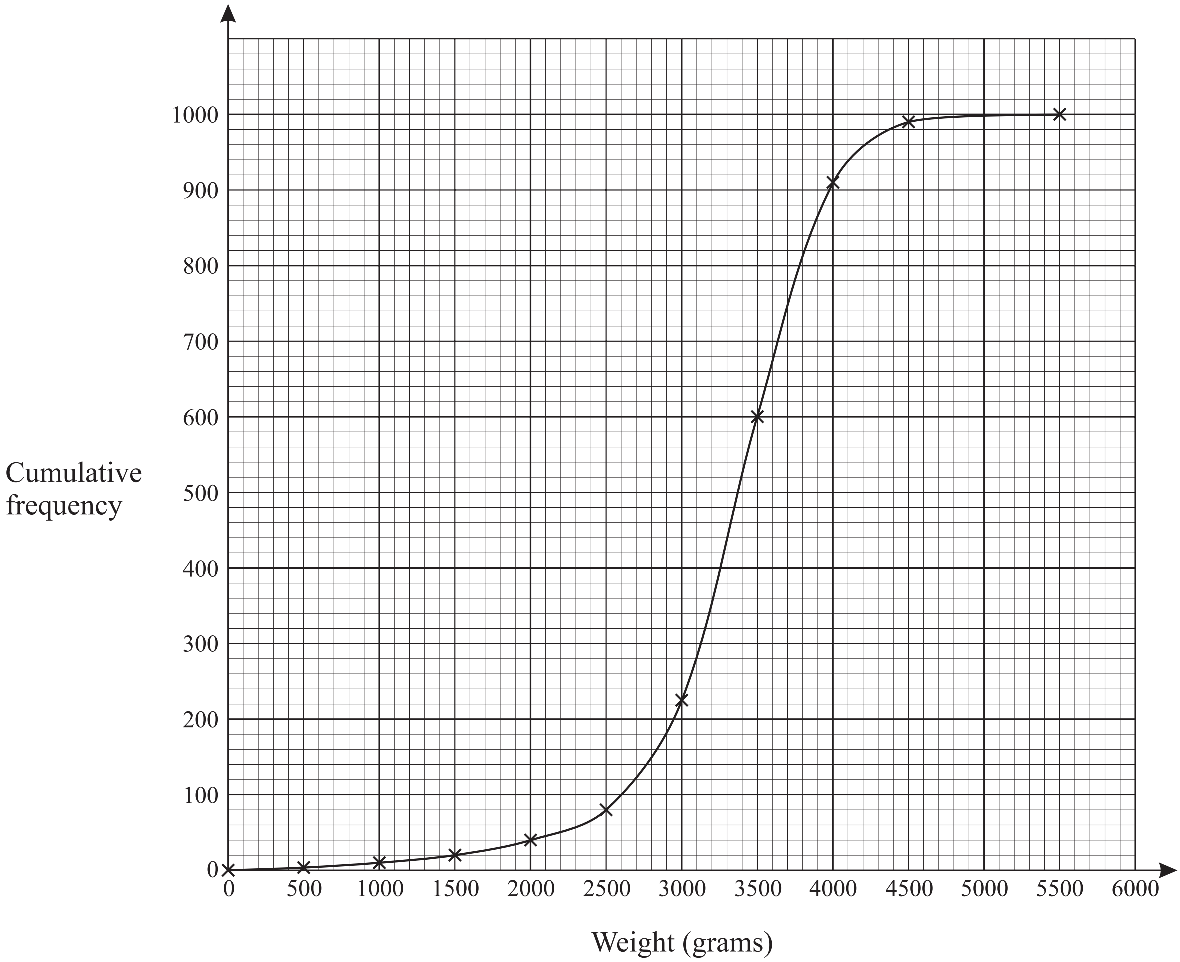
(iii) Using your Venn diagram, or otherwise, find the probability that, on a randomly selected day, Ashwin

(A) wears either a jacket or a tie (or both),

(B) wears no tie or no jacket (or wears neither). [3]

Section B (36 marks)

6 The birth weights in grams of a random sample of 1000 babies are displayed in the cumulative frequency diagram below.



(i) Use the diagram to estimate the median and interquartile range of the data. [3]

(ii) Use your answers to part **(i)** to estimate the number of outliers in the sample. [4]

(iii) Should these outliers be excluded from any further analysis? Briefly explain your answer. [2]

(iv) Any baby whose weight is below the 10th percentile is selected for careful monitoring. Use the diagram to determine the range of weights of the babies who are selected. [2]

12% of new-born babies require some form of special care. A maternity unit has 17 new-born babies. You may assume that these 17 babies form an independent random sample.

(v) Find the probability that

(A) exactly 2 of these 17 babies require special care, [3]

(B) more than 2 of the 17 babies require special care. [3]

(vi) On 100 independent occasions the unit has 17 babies. Find the expected number of occasions on which there would be more than 2 babies who require special care. [1]

7 When onion seeds are sown outdoors, on average two-thirds of them germinate. A gardener sows seeds in pairs, in the hope that at least one will germinate.

(i) Assuming that germination of one of the seeds in a pair is independent of germination of the other seed, find the probability that, if a pair of seeds is selected at random,

(A) both seeds germinate,

(B) just one seed germinates,

(C) neither seed germinates. [3]

(ii) Explain why the assumption of independence is necessary in order to calculate the above probabilities. Comment on whether the assumption is likely to be valid. [2]

(iii) A pair of seeds is sown. Find the expectation and variance of the number of seeds in the pair which germinate. [3]

(iv) The gardener plants 200 pairs of seeds. If both seeds in a pair germinate, the gardener destroys one of the two plants so that only one is left to grow. Of the plants that remain after this, only 85% successfully grow to form an onion. Find the expected number of onions grown from the 200 pairs of seeds. [3]

If the seeds are sown in a greenhouse, the germination rate is higher. The seed manufacturing company claims that the germination rate is 90%. The gardener suspects that the rate will not be as high as this, and carries out a trial to investigate. 18 randomly selected seeds are sown in the greenhouse and it is found that 14 germinate.

(v) Write down suitable hypotheses and carry out a test at the 5% level to determine whether there is any evidence to support the gardener's suspicions. [7]

RECOGNISING ACHIEVEMENT

ADVANCED SUBSIDIARY GCE UNIT **G241/01**

MEI STATISTICS

Statistics 1 (Z1)

TUESDAY 5 JUNE 2007 Afternoon

Time: 1 hour 30 minutes

Additional Materials:
- Answer booklet (8 pages)
- Graph paper
- MEI Examination Formulae and Tables (MF2)

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the spaces provided on the answer booklet.
- Answer **all** the questions.
- You are permitted to use a graphical calculator in this paper.
- Final answers should be given to a degree of accuracy appropriate to the context.

INFORMATION FOR CANDIDATES

- 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 72.

ADVICE TO CANDIDATES

- Read each question carefully and make sure you know what you have to do before starting your answer.
- You are advised that an answer may receive **no marks** unless you show sufficient detail of the working to indicate that a correct method is being used.

This document consists of **7** printed pages and **1** blank page.

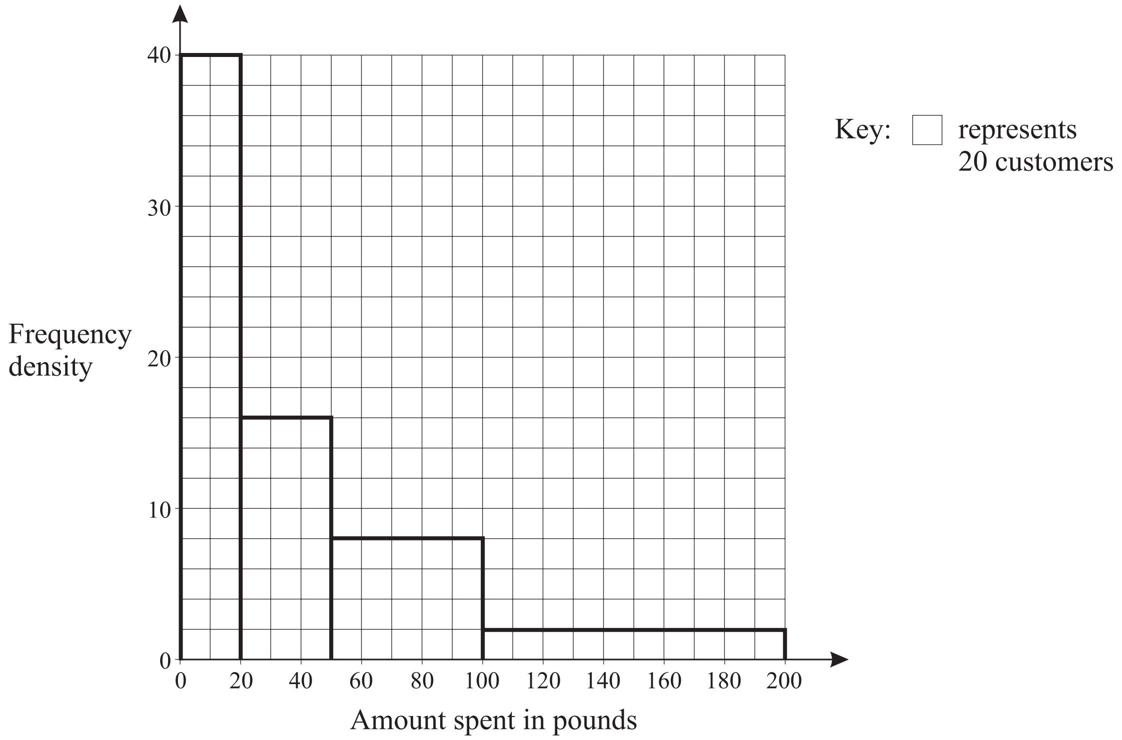
Section A (36 marks)

1 A girl is choosing tracks from an album to play at her birthday party. The album has 8 tracks and she selects 4 of them.

(i) In how many ways can she select the 4 tracks? [2]

(ii) In how many different orders can she arrange the 4 tracks once she has chosen them? [1]

2 The histogram shows the amount of money, in pounds, spent by the customers at a supermarket on a particular day.



(i) Express the data in the form of a grouped frequency table. [2]

(ii) Use your table to estimate the total amount of money spent by customers on that day. [2]

3 The marks x scored by a sample of 56 students in an examination are summarised by

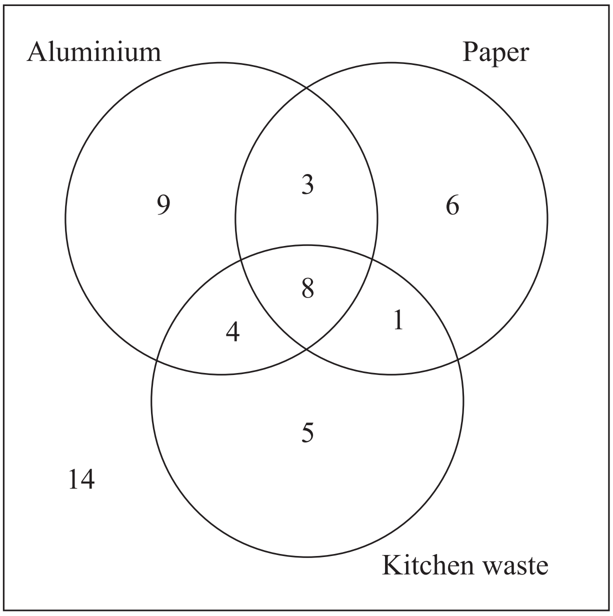
$$n = 56, \quad \Sigma x = 3026, \quad \Sigma x^2 = 178\,890.$$

(i) Calculate the mean and standard deviation of the marks. [3]

(ii) The highest mark scored by any of the 56 students in the examination was 93. Show that this result may be considered to be an outlier. [2]

(iii) The formula $y = 1.2x - 10$ is used to scale the marks. Find the mean and standard deviation of the scaled marks. [3]

4 A local council has introduced a recycling scheme for aluminium, paper and kitchen waste. 50 residents are asked which of these materials they recycle. The numbers of people who recycle each type of material are shown in the Venn diagram.



One of the residents is selected at random.

(i) Find the probability that this resident recycles

(A) at least one of the materials, [1]

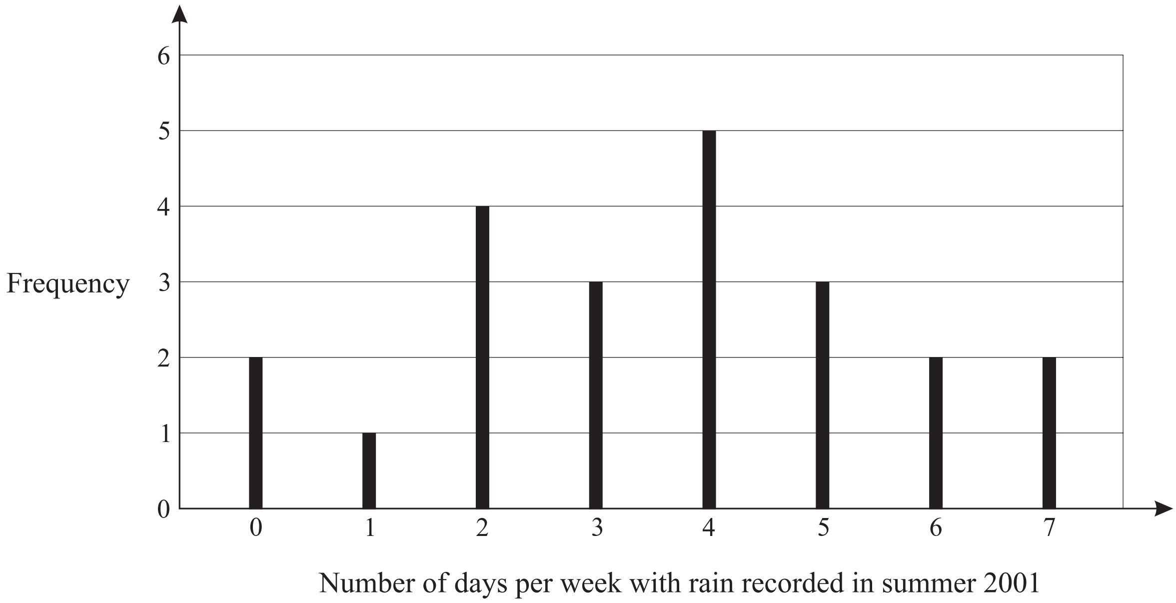
(B) exactly one of the materials. [2]

(ii) Given that the resident recycles aluminium, find the probability that this resident does not recycle paper. [2]

Two residents are selected at random.

(iii) Find the probability that exactly one of them recycles kitchen waste. [3]

5 A GCSE geography student is investigating a claim that global warming is causing summers in Britain to have more rainfall. He collects rainfall data from a local weather station for 2001 and 2006. The vertical line chart shows the number of days per week on which some rainfall was recorded during the 22 weeks of summer 2001.



(i) Show that the median of the data is 4, and find the interquartile range. [3]

(ii) For summer 2006 the median is 3 and the interquartile range is also 3. The student concludes that the data demonstrate that global warming is causing summer rainfall to decrease rather than increase. Is this a valid conclusion from the data? Give two brief reasons to justify your answer. [3]

6 In a phone-in competition run by a local radio station, listeners are given the names of 7 local personalities and are told that 4 of them are in the studio. Competitors phone in and guess which 4 are in the studio.

(i) Show that the probability that a randomly selected competitor guesses all 4 correctly is $\frac{1}{35}$. [2]

Let X represent the number of correct guesses made by a randomly selected competitor. The probability distribution of X is shown in the table.

r	0	1	2	3	4
$\mathrm{P}(X = r)$	0	$\frac{4}{35}$	$\frac{18}{35}$	$\frac{12}{35}$	$\frac{1}{35}$

(ii) Find the expectation and variance of X. [5]

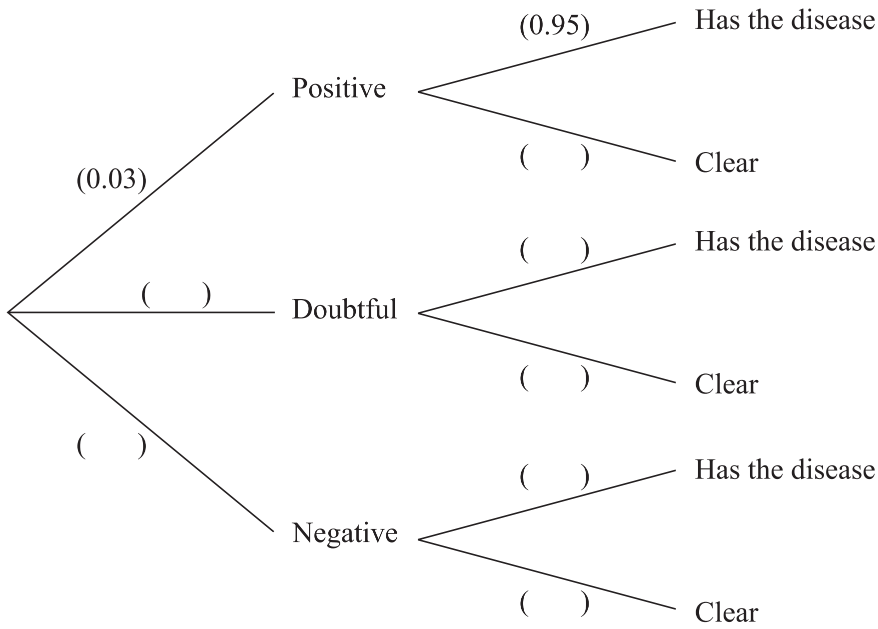
Section B (36 marks)

7 A screening test for a particular disease is applied to everyone in a large population. The test classifies people into three groups: 'positive', 'doubtful' and 'negative'. Of the population, 3% is classified as positive, 6% as doubtful and the rest negative.

In fact, of the people who test positive, only 95% have the disease. Of the people who test doubtful, 10% have the disease. Of the people who test negative, 1% actually have the disease.

People who do not have the disease are described as 'clear'.

(i) Copy and complete the tree diagram to show this information. [4]



(ii) Find the probability that a randomly selected person tests negative and is clear. [2]

(iii) Find the probability that a randomly selected person has the disease. [3]

(iv) Find the probability that a randomly selected person tests negative **given** that the person has the disease. [3]

(v) Comment briefly on what your answer to part **(iv)** indicates about the effectiveness of the screening test. [2]

Once the test has been carried out, those people who test doubtful are given a detailed medical examination. If a person has the disease the examination will correctly identify this in 98% of cases. If a person is clear, the examination will always correctly identify this.

(vi) A person is selected at random. Find the probability that this person either tests negative originally or tests doubtful and is then cleared in the detailed medical examination. [4]

8 A multinational accountancy firm receives a large number of job applications from graduates each year. On average 20% of applicants are successful.

A researcher in the human resources department of the firm selects a random sample of 17 graduate applicants.

(i) Find the probability that at least 4 of the 17 applicants are successful. [3]

(ii) Find the expected number of successful applicants in the sample. [2]

(iii) Find the most likely number of successful applicants in the sample, justifying your answer. [3]

It is suggested that mathematics graduates are more likely to be successful than those from other fields. In order to test this suggestion, the researcher decides to select a new random sample of 17 mathematics graduate applicants. The researcher then carries out a hypothesis test at the 5% significance level.

(iv) (A) Write down suitable null and alternative hypotheses for the test.

(B) Give a reason for your choice of the alternative hypothesis. [4]

(v) Find the critical region for the test at the 5% level, showing all of your calculations. [4]

(vi) Explain why the critical region found in part **(v)** would be unaltered if a 10% significance level were used. [2]

RECOGNISING ACHIEVEMENT

ADVANCED SUBSIDIARY GCE **4766/01**

MATHEMATICS (MEI)

Statistics 1

TUESDAY 15 JANUARY 2008 Morning

Time: 1 hour 30 minutes

Additional materials: Answer Booklet (8 pages)
Graph paper
MEI Examination Formulae and Tables (MF2)

INSTRUCTIONS TO CANDIDATES

- Write your name in capital letters, your Centre Number and Candidate Number in the spaces provided on the Answer Booklet.
- Read each question carefully and make sure you know what you have to do before starting your answer.
- Answer **all** the questions.
- You are permitted to use a graphical calculator in this paper.
- Final answers should be given to a degree of accuracy appropriate to the context.

INFORMATION FOR CANDIDATES

- 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 72.
- You are advised that an answer may receive **no marks** unless you show sufficient detail of the working to indicate that a correct method is being used.

This document consists of **4** printed pages.

[Turn over

Section A (36 marks)

1 Alice carries out a survey of the 28 students in her class to find how many text messages each sent on the previous day. Her results are shown in the stem and leaf diagram.

0	0 0 1 1 3 5 7 7 7 8 8
1	0 1 2 3 3 4 4 6 9
2	0 1 3 3 7
3	5 7
4	
5	8

Key: 2 | 3 represents 23

(i) Find the mode and median of the number of text messages. [2]

(ii) Identify the type of skewness of the distribution. [1]

(iii) Alice is considering whether to use the mean or the median as a measure of central tendency for these data.

(A) In view of the skewness of the distribution, state whether Alice should choose the mean or the median. [1]

(B) What other feature of the distribution confirms Alice's choice? [1]

(iv) The mean number of text messages is 14.75. If each message costs 10 pence, find the total cost of all of these messages. [2]

2 Codes of three letters are made up using only the letters A, C, T, G. Find how many different codes are possible

(i) if all three letters used must be different, [3]

(ii) if letters may be repeated. [2]

3 Steve is going on holiday. The probability that he is delayed on his outward flight is 0.3. The probability that he is delayed on his return flight is 0.2, independently of whether or not he is delayed on the outward flight.

(i) Find the probability that Steve is delayed on his outward flight but not on his return flight. [2]

(ii) Find the probability that he is delayed on at least one of the two flights. [3]

(iii) Given that he is delayed on at least one flight, find the probability that he is delayed on both flights. [3]

4 A company is searching for oil reserves. The company has purchased the rights to make test drillings at four sites. It investigates these sites one at a time but, if oil is found, it does not proceed to any further sites. At each site, there is probability 0.2 of finding oil, independently of all other sites.

The random variable X represents the number of sites investigated. The probability distribution of X is shown below.

r	1	2	3	4
$\mathrm{P}(X = r)$	0.2	0.16	0.128	0.512

(i) Find the expectation and variance of X. [5]

(ii) It costs £45 000 to investigate each site. Find the expected total cost of the investigation. [1]

(iii) Draw a suitable diagram to illustrate the distribution of X. [2]

5 Sophie and James are having a tennis competition. The winner of the competition is the first to win 2 matches in a row. If the competition has not been decided after 5 matches, then the player who has won more matches is declared the winner of the competition.

For example, the following sequences are two ways in which Sophie could win the competition. (**S** represents a match won by Sophie; **J** represents a match won by James.)

SJSS **SJSJS**

(i) Explain why the sequence **SSJ** is not possible. [1]

(ii) Write down the other three possible sequences in which Sophie wins the competition. [3]

(iii) The probability that Sophie wins a match is 0.7. Find the probability that she wins the competition in no more than 4 matches. [4]

Section B (36 marks)

6 The maximum temperatures x degrees Celsius recorded during each month of 2005 in Cambridge are given in the table below.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
9.2	7.1	10.7	14.2	16.6	21.8	22.0	22.6	21.1	17.4	10.1	7.8

These data are summarised by $n = 12$, $\Sigma x = 180.6$, $\Sigma x^2 = 3107.56$.

(i) Calculate the mean and standard deviation of the data. [3]

(ii) Determine whether there are any outliers. [3]

(iii) The formula $y = 1.8x + 32$ is used to convert degrees Celsius to degrees Fahrenheit. Find the mean and standard deviation of the 2005 maximum temperatures in degrees Fahrenheit. [3]

(iv) In New York, the monthly maximum temperatures are recorded in degrees Fahrenheit. In 2005 the mean was 63.7 and the standard deviation was 16.0. Briefly compare the maximum monthly temperatures in Cambridge and New York in 2005. [2]

The total numbers of hours of sunshine recorded in Cambridge during the month of January for each of the last 48 years are summarised below.

Hours h	$70 \leqslant h < 100$	$100 \leqslant h < 110$	$110 \leqslant h < 120$	$120 \leqslant h < 150$	$150 \leqslant h < 170$	$170 \leqslant h < 190$
Number of years	6	8	10	11	10	3

(v) Draw a cumulative frequency graph for these data. [5]

(vi) Use your graph to estimate the 90th percentile. [2]

7 A particular product is made from human blood given by donors. The product is stored in bags. The production process is such that, on average, 5% of bags are faulty. Each bag is carefully tested before use.

(i) 12 bags are selected at random.

(A) Find the probability that exactly one bag is faulty. [3]

(B) Find the probability that at least two bags are faulty. [2]

(C) Find the expected number of faulty bags in the sample. [2]

(ii) A random sample of n bags is selected. The production manager wishes there to be a probability of one third or less of finding any faulty bags in the sample. Find the maximum possible value of n, showing your working clearly. [3]

(iii) A scientist believes that a new production process will reduce the proportion of faulty bags. A random sample of 60 bags made using the new process is checked and one bag is found to be faulty. Write down suitable hypotheses and carry out a hypothesis test at the 10% level to determine whether there is evidence to suggest that the scientist is correct. [8]

RECOGNISING ACHIEVEMENT

ADVANCED SUBSIDIARY GCE **4766/01**

MATHEMATICS (MEI)

Statistics 1

FRIDAY 6 JUNE 2008 Afternoon

Time: 1 hour 30 minutes

Additional materials (enclosed): None

Additional materials (required):
Answer Booklet (8 pages)
Graph paper
MEI Examination Formulae and Tables (MF2)

INSTRUCTIONS TO CANDIDATES

- Write your name in capital letters, your Centre Number and Candidate Number in the spaces provided on the Answer Booklet.
- Read each question carefully and make sure you know what you have to do before starting your answer.
- Answer **all** the questions.
- You are permitted to use a graphical calculator in this paper.
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INFORMATION FOR CANDIDATES

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- The total number of marks for this paper is **72**.
- You are advised that an answer may receive **no marks** unless you show sufficient detail of the working to indicate that a correct method is being used.

This document consists of **6** printed pages and **2** blank pages.

Section A (36 marks)

1 In a survey, a sample of 44 fields is selected. Their areas (x hectares) are summarised in the grouped frequency table.

Area (x)	$0 < x \leqslant 3$	$3 < x \leqslant 5$	$5 < x \leqslant 7$	$7 < x \leqslant 10$	$10 < x \leqslant 20$
Frequency	3	8	13	14	6

(i) Calculate an estimate of the sample mean and the sample standard deviation. [4]

(ii) Determine whether there could be any outliers at the upper end of the distribution. [2]

2 In the 2001 census, people living in Wales were asked whether or not they could speak Welsh. A resident of Wales is selected at random.

- W is the event that this person speaks Welsh.
- C is the event that this person is a child.

You are given that $\mathrm{P}(W) = 0.20$, $\mathrm{P}(C) = 0.17$ and $\mathrm{P}(W \cap C) = 0.06$.

(i) Determine whether the events W and C are independent. [2]

(ii) Draw a Venn diagram, showing the events W and C, and fill in the probability corresponding to each region of your diagram. [3]

(iii) Find $\mathrm{P}(W \mid C)$. [2]

(iv) Given that $\mathrm{P}(W \mid C') = 0.169$, use this information and your answer to part **(iii)** to comment very briefly on how the ability to speak Welsh differs between children and adults. [1]

3 In a game of darts, a player throws three darts. Let X represent the number of darts which hit the bull's-eye. The probability distribution of X is shown in the table.

r	0	1	2	3
$\mathrm{P}(X = r)$	0.5	0.35	p	q

(i) (A) Show that $p + q = 0.15$. [1]

(B) Given that the expectation of X is 0.67, show that $2p + 3q = 0.32$. [1]

(C) Find the values of p and q. [2]

(ii) Find the variance of X. [3]

4 A small business has 8 workers. On a given day, the probability that any particular worker is off sick is 0.05, independently of the other workers.

(i) A day is selected at random. Find the probability that

(A) no workers are off sick, [2]

(B) more than one worker is off sick. [3]

(ii) There are 250 working days in a year. Find the expected number of days in the year on which more than one worker is off sick. [2]

5 A psychology student is investigating memory. In an experiment, volunteers are given 30 seconds to try to memorise a number of items. The items are then removed and the volunteers have to try to name all of them. It has been found that the probability that a volunteer names all of the items is 0.35. The student believes that this probability may be increased if the volunteers listen to the same piece of music while memorising the items and while trying to name them.

The student selects 15 volunteers at random to do the experiment while listening to music. Of these volunteers, 8 name all of the items.

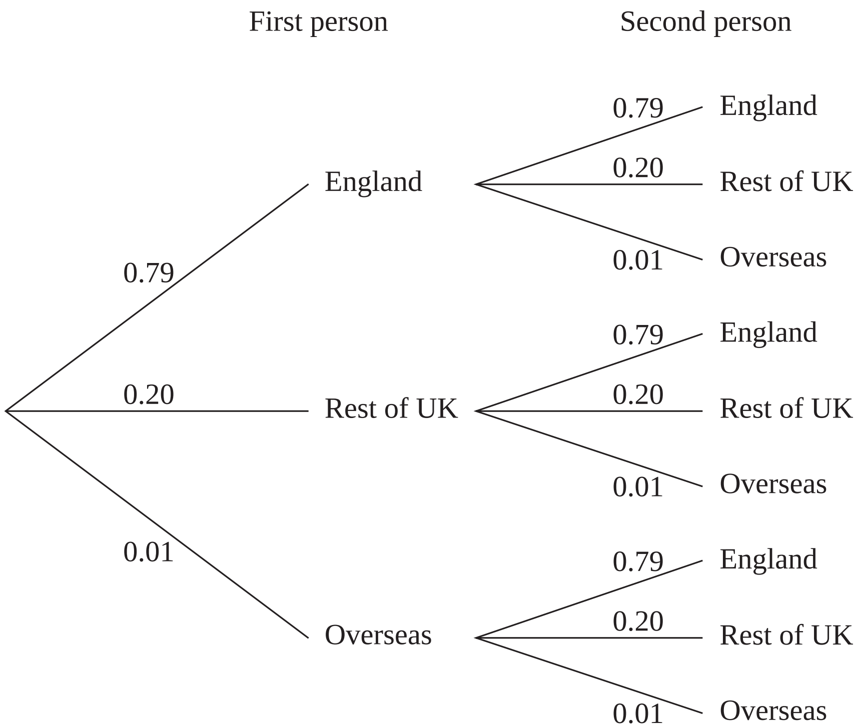
(i) Write down suitable hypotheses for a test to determine whether there is any evidence to support the student's belief, giving a reason for your choice of alternative hypothesis. [4]

(ii) Carry out the test at the 5% significance level. [4]

Section B (36 marks)

6 In a large town, 79% of the population were born in England, 20% in the rest of the UK and the remaining 1% overseas. Two people are selected at random.

You may use the tree diagram below in answering this question.



(i) Find the probability that

(A) both of these people were born in the rest of the UK, [2]

(B) at least one of these people was born in England, [3]

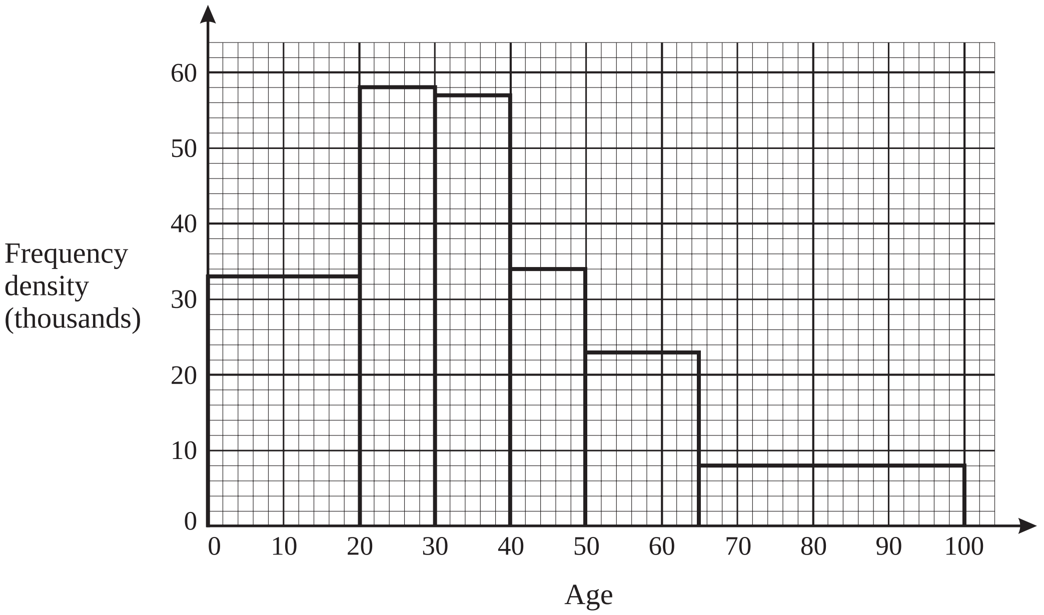
(C) neither of these people was born overseas. [2]

(ii) Find the probability that both of these people were born in the rest of the UK given that neither was born overseas. [3]

(iii) (A) Five people are selected at random. Find the probability that at least one of them was not born in England. [3]

(B) An interviewer selects n people at random. The interviewer wishes to ensure that the probability that at least one of them was not born in England is more than 90%. Find the least possible value of n. You must show working to justify your answer. [3]

7 The histogram shows the age distribution of people living in Inner London in 2001.



(i) State the type of skewness shown by the distribution. [1]

(ii) Use the histogram to estimate the number of people aged under 25. [3]

(iii) The table below shows the cumulative frequency distribution.

Age	20	30	40	50	65	100
Cumulative frequency (thousands)	660	1240	1810	a	2490	2770

(*A*) Use the histogram to find the value of a. [2]

(*B*) Use the table to calculate an estimate of the median age of these people. [3]

The ages of people living in Outer London in 2001 are summarised below.

Age (x years)	$0 \leqslant x < 20$	$20 \leqslant x < 30$	$30 \leqslant x < 40$	$40 \leqslant x < 50$	$50 \leqslant x < 65$	$65 \leqslant x < 100$
Frequency (thousands)	1120	650	770	590	680	610

(iv) Illustrate these data by means of a histogram. [5]

(v) Make two brief comments on the differences between the age distributions of the populations of Inner London and Outer London. [2]

(vi) The data given in the table for Outer London are used to calculate the following estimates.

Mean 38.5, median 35.7, midrange 50, standard deviation 23.7, interquartile range 34.4.

The final group in the table assumes that the maximum age of any resident is 100 years. These estimates are to be recalculated, based on a maximum age of 105, rather than 100. For each of the five estimates, state whether it would increase, decrease or be unchanged. [4]

OCR
RECOGNISING ACHIEVEMENT

ADVANCED SUBSIDIARY GCE

MATHEMATICS (MEI) 4766

Statistics 1

Candidates answer on the Answer Booklet

OCR Supplied Materials:
- 8 page Answer Booklet
- Graph paper
- MEI Examination Formulae and Tables (MF2)

Other Materials Required:
None

Monday 19 January 2009
Afternoon

Duration: 1 hour 30 minutes

* 4 7 6 6 *

INSTRUCTIONS TO CANDIDATES

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the spaces provided on the Answer Booklet.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- You are permitted to use a graphical calculator in this paper.
- Final answers should be given to a degree of accuracy appropriate to the context.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- You are advised that an answer may receive **no marks** unless you show sufficient detail of the working to indicate that a correct method is being used.
- The total number of marks for this paper is **72**.
- This document consists of **8** pages. Any blank pages are indicated.

Section A (36 marks)

1 A supermarket chain buys a batch of 10 000 scratchcard draw tickets for sale in its stores. 50 of these tickets have a £10 prize, 20 of them have a £100 prize, one of them has a £5000 prize and all of the rest have no prize. This information is summarised in the frequency table below.

Prize money	£0	£10	£100	£5000
Frequency	9929	50	20	1

(i) Find the mean and standard deviation of the prize money per ticket. **[4]**

(ii) I buy two of these tickets at random. Find the probability that I win either two £10 prizes or two £100 prizes. **[3]**

2 Thomas has six tiles, each with a different letter of his name on it.

(i) Thomas arranges these letters in a random order. Find the probability that he arranges them in the correct order to spell his name. **[2]**

(ii) On another occasion, Thomas picks three of the six letters at random. Find the probability that he picks the letters T, O and M (in any order). **[3]**

3 A zoologist is studying the feeding behaviour of a group of 4 gorillas. The random variable X represents the number of gorillas that are feeding at a randomly chosen moment. The probability distribution of X is shown in the table below.

r	0	1	2	3	4
$\mathrm{P}(X = r)$	p	0.1	0.05	0.05	0.25

(i) Find the value of p. **[1]**

(ii) Find the expectation and variance of X. **[5]**

(iii) The zoologist observes the gorillas on two further occasions. Find the probability that there are at least two gorillas feeding on both occasions. **[2]**

4 A pottery manufacturer makes teapots in batches of 50. On average 3% of teapots are faulty.

(i) Find the probability that in a batch of 50 there is

(A) exactly one faulty teapot, **[3]**

(B) more than one faulty teapot. **[3]**

(ii) The manufacturer produces 240 batches of 50 teapots during one month. Find the expected number of batches which contain exactly one faulty teapot. **[2]**

5 Each day Anna drives to work.

- R is the event that it is raining.
- L is the event that Anna arrives at work late.

You are given that $\mathrm{P}(R) = 0.36$, $\mathrm{P}(L) = 0.25$ and $\mathrm{P}(R \cap L) = 0.2$.

(i) Determine whether the events R and L are independent. **[2]**

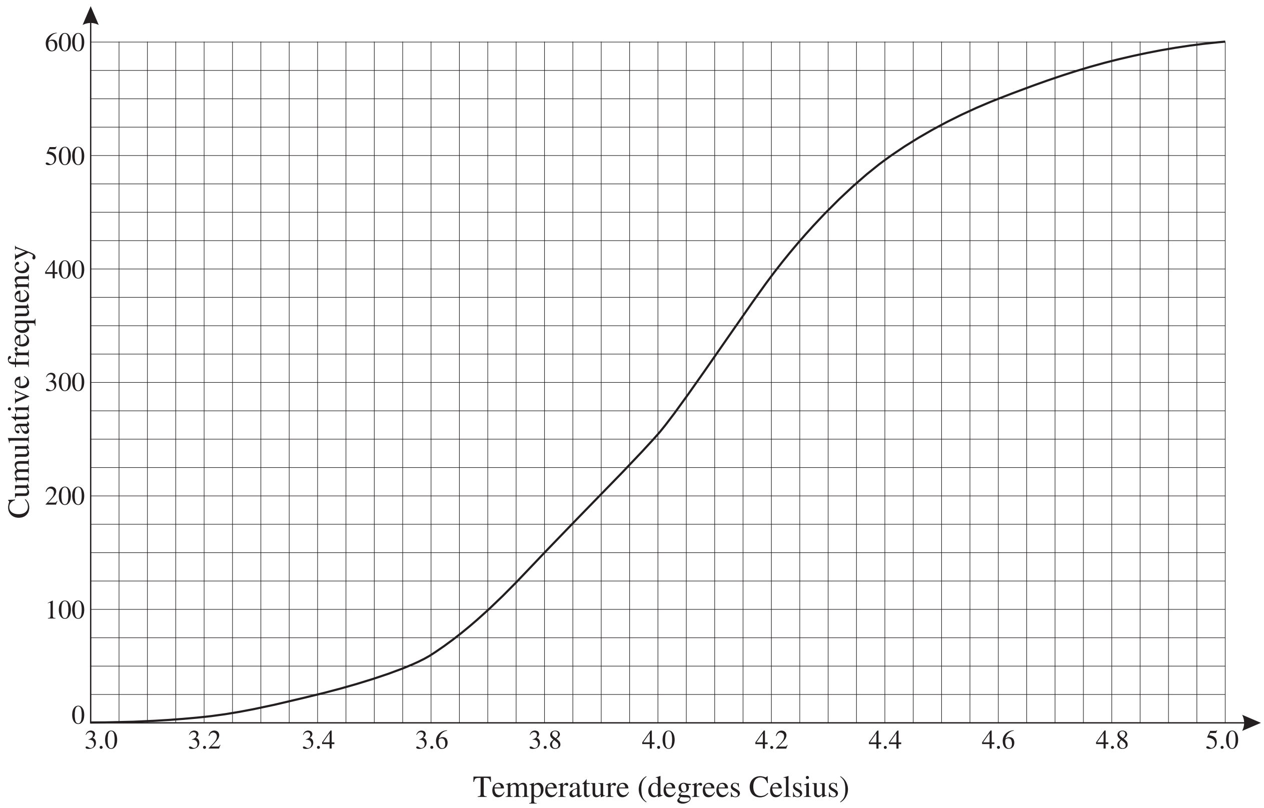
(ii) Draw a Venn diagram showing the events R and L. Fill in the probability corresponding to each of the four regions of your diagram. **[3]**

(iii) Find $\mathrm{P}(L \mid R)$. State what this probability represents. **[3]**

[Question 6 is printed overleaf.]

Section B (36 marks)

6 The temperature of a supermarket fridge is regularly checked to ensure that it is working correctly. Over a period of three months the temperature (measured in degrees Celsius) is checked 600 times. These temperatures are displayed in the cumulative frequency diagram below.



(i) Use the diagram to estimate the median and interquartile range of the data. **[3]**

(ii) Use your answers to part **(i)** to show that there are very few, if any, outliers in the sample. **[4]**

(iii) Suppose that an outlier is identified in these data. Discuss whether it should be excluded from any further analysis. **[2]**

(iv) Copy and complete the frequency table below for these data. **[3]**

Temperature (t degrees Celsius)	$3.0 \leqslant t \leqslant 3.4$	$3.4 < t \leqslant 3.8$	$3.8 < t \leqslant 4.2$	$4.2 < t \leqslant 4.6$	$4.6 < t \leqslant 5.0$
Frequency			243	157	

(v) Use your table to calculate an estimate of the mean. **[2]**

(vi) The standard deviation of the temperatures in degrees Celsius is 0.379. The temperatures are converted from degrees Celsius into degrees Fahrenheit using the formula $F = 1.8C + 32$. Hence estimate the mean and find the standard deviation of the temperatures in degrees Fahrenheit. **[3]**

7 An online shopping company takes orders through its website. On average 80% of orders from the website are delivered within 24 hours. The quality controller selects 10 orders at random to check when they are delivered.

(i) Find the probability that

(A) exactly 8 of these orders are delivered within 24 hours, **[3]**

(B) at least 8 of these orders are delivered within 24 hours. **[2]**

The company changes its delivery method. The quality controller suspects that the changes will mean that fewer than 80% of orders will be delivered within 24 hours. A random sample of 18 orders is checked and it is found that 12 of them arrive within 24 hours.

(ii) Write down suitable hypotheses and carry out a test at the 5% significance level to determine whether there is any evidence to support the quality controller's suspicion. **[7]**

(iii) A statistician argues that it is possible that the new method could result in either better or worse delivery times. Therefore it would be better to carry out a 2-tail test at the 5% significance level. State the alternative hypothesis for this test. Assuming that the sample size is still 18, find the critical region for this test, showing all of your calculations. **[7]**

OCR
RECOGNISING ACHIEVEMENT

ADVANCED SUBSIDIARY GCE

MATHEMATICS (MEI) 4766

Statistics 1

Candidates answer on the Answer Booklet

OCR Supplied Materials:
- 8 page Answer Booklet
- Graph paper
- MEI Examination Formulae and Tables (MF2)

Other Materials Required:
None

Monday 15 June 2009
Afternoon

Duration: 1 hour 30 minutes

4766

INSTRUCTIONS TO CANDIDATES

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the spaces provided on the Answer Booklet.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
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INFORMATION FOR CANDIDATES

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Section A (36 marks)

1 In a traffic survey, the number of people in each car passing the survey point is recorded. The results are given in the following frequency table.

Number of people	1	2	3	4
Frequency	50	31	16	5

(i) Write down the median and mode of these data. **[2]**

(ii) Draw a vertical line diagram for these data. **[2]**

(iii) State the type of skewness of the distribution. **[1]**

2 There are 14 girls and 11 boys in a class. A quiz team of 5 students is to be chosen from the class.

(i) How many different teams are possible? **[2]**

(ii) If the team must include 3 girls and 2 boys, find how many different teams are possible. **[3]**

3 Dwayne is a car salesman. The numbers of cars, x, sold by Dwayne each month during the year 2008 are summarised by

$$n = 12, \qquad \Sigma x = 126, \qquad \Sigma x^2 = 1582.$$

(i) Calculate the mean and standard deviation of the monthly numbers of cars sold. **[3]**

(ii) Dwayne earns £500 each month plus £100 commission for each car sold. Show that the mean of Dwayne's monthly earnings is £1550. Find the standard deviation of Dwayne's monthly earnings. **[3]**

(iii) Marlene is a car saleswoman and is paid in the same way as Dwayne. During 2008 her monthly earnings have mean £1625 and standard deviation £280. Briefly compare the monthly numbers of cars sold by Marlene and Dwayne during 2008. **[2]**

4 The table shows the probability distribution of the random variable X.

r	10	20	30	40
$\mathrm{P}(X = r)$	0.2	0.3	0.3	0.2

(i) Explain why $\mathrm{E}(X) = 25$. **[1]**

(ii) Calculate $\mathrm{Var}(X)$. **[3]**

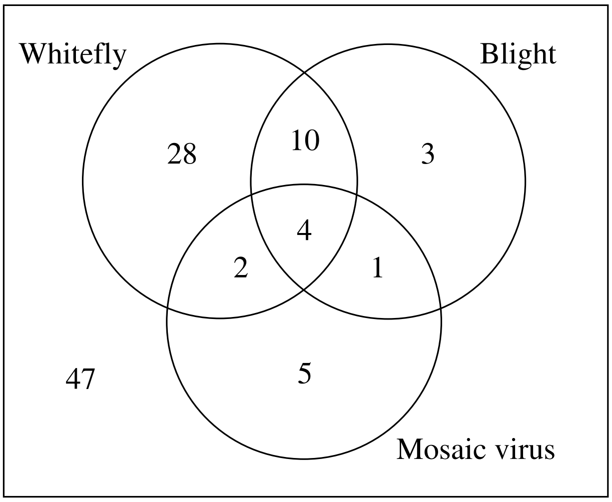
5 The frequency table below shows the distance travelled by 1200 visitors to a particular UK tourist destination in August 2008.

Distance (d miles)	$0 \leqslant d < 50$	$50 \leqslant d < 100$	$100 \leqslant d < 200$	$200 \leqslant d < 400$
Frequency	360	400	307	133

(i) Draw a histogram on graph paper to illustrate these data. **[5]**

(ii) Calculate an estimate of the median distance. **[3]**

6 Whitefly, blight and mosaic virus are three problems which can affect tomato plants. 100 tomato plants are examined for these problems. The numbers of plants with each type of problem are shown in the Venn diagram. 47 of the plants have none of the problems.



(i) One of the 100 plants is selected at random. Find the probability that this plant has

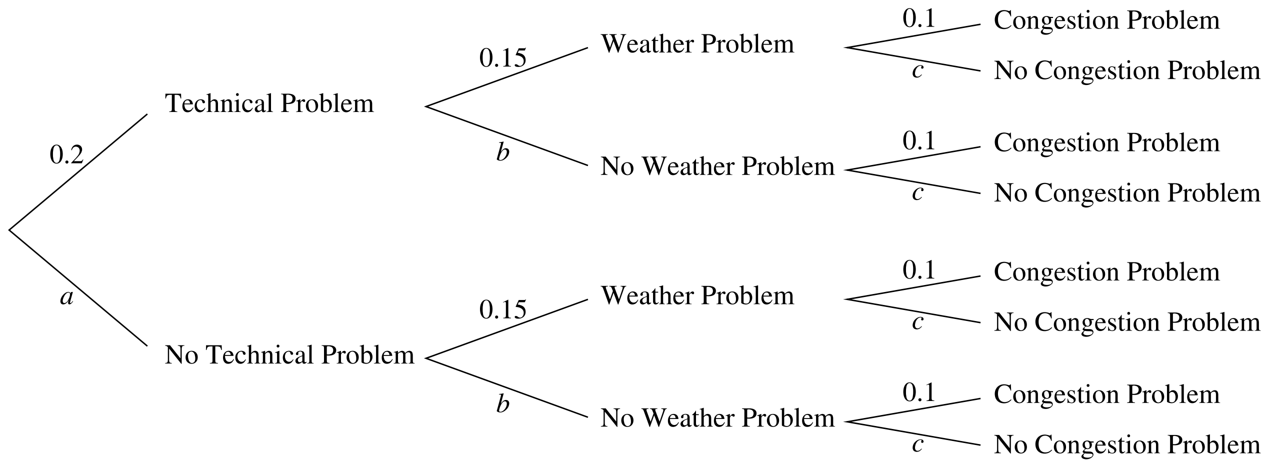
(A) at most one of the problems, **[1]**

(B) exactly two of the problems. **[2]**

(ii) Three of the 100 plants are selected at random. Find the probability that all of them have at least one of the problems. **[3]**

Section B (36 marks)

7 Laura frequently flies to business meetings and often finds that her flights are delayed. A flight may be delayed due to technical problems, weather problems or congestion problems, with probabilities 0.2, 0.15 and 0.1 respectively. The tree diagram shows this information.



(i) Write down the values of the probabilities a, b and c shown in the tree diagram. **[2]**

One of Laura's flights is selected at random.

(ii) Find the probability that Laura's flight is not delayed and hence write down the probability that it is delayed. **[4]**

(iii) Find the probability that Laura's flight is delayed due to just one of the three problems. **[4]**

(iv) Given that Laura's flight is delayed, find the probability that the delay is due to just one of the three problems. **[3]**

(v) Given that Laura's flight has no technical problems, find the probability that it is delayed. **[3]**

(vi) In a particular year, Laura has 110 flights. Find the expected number of flights that are delayed. **[2]**

8 The Department of Health 'eat five a day' advice recommends that people should eat at least five portions of fruit and vegetables per day. In a particular school, 20% of pupils eat at least five a day.

(i) 15 children are selected at random.

(A) Find the probability that exactly 3 of them eat at least five a day. **[3]**

(B) Find the probability that at least 3 of them eat at least five a day. **[3]**

(C) Find the expected number who eat at least five a day. **[2]**

A programme is introduced to encourage children to eat more portions of fruit and vegetables per day. At the end of this programme, the diets of a random sample of 15 children are analysed. A hypothesis test is carried out to examine whether the proportion of children in the school who eat at least five a day has increased.

(ii) (A) Write down suitable null and alternative hypotheses for the test.

(B) Give a reason for your choice of the alternative hypothesis. **[4]**

(iii) Find the critical region for the test at the 10% significance level, showing all of your calculations. Hence complete the test, given that 7 of the 15 children eat at least five a day. **[6]**

OCR
RECOGNISING ACHIEVEMENT

ADVANCED SUBSIDIARY GCE

MATHEMATICS (MEI) 4766

Statistics 1

Candidates answer on the Answer Booklet

OCR Supplied Materials:
- 8 page Answer Booklet
- Graph paper
- MEI Examination Formulae and Tables (MF2)

Other Materials Required:
None

Monday 25 January 2010
Morning

Duration: 1 hour 30 minutes

* 4 7 6 6 *

INSTRUCTIONS TO CANDIDATES

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the spaces provided on the Answer Booklet.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
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INFORMATION FOR CANDIDATES

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- You are advised that an answer may receive **no marks** unless you show sufficient detail of the working to indicate that a correct method is being used.
- The total number of marks for this paper is **72**.
- This document consists of **8** pages. Any blank pages are indicated.

Section A (36 marks)

1 A camera records the speeds in miles per hour of 15 vehicles on a motorway. The speeds are given below.

73 67 75 64 52 63 75 81 77 72 68 74 79 72 71

(i) Construct a sorted stem and leaf diagram to represent these data, taking stem values of 50, 60, … . **[4]**

(ii) Write down the median and midrange of the data. **[2]**

(iii) Which of the median and midrange would you recommend to measure the central tendency of the data? Briefly explain your answer. **[2]**

2 In her purse, Katharine has two £5 notes, two £10 notes and one £20 note. She decides to select two of these notes at random to donate to a charity. The total value of these two notes is denoted by the random variable £X.

(i) (A) Show that $P(X = 10) = 0.1$. **[1]**

(B) Show that $P(X = 30) = 0.2$. **[2]**

The table shows the probability distribution of X.

r	10	15	20	25	30
$P(X = r)$	0.1	0.4	0.1	0.2	0.2

(ii) Find $E(X)$ and $Var(X)$. **[5]**

3 In a survey, a large number of young people are asked about their exercise habits. One of these people is selected at random.

- G is the event that this person goes to the gym.
- R is the event that this person goes running.

You are given that $P(G) = 0.24$, $P(R) = 0.13$ and $P(G \cap R) = 0.06$.

(i) Draw a Venn diagram, showing the events G and R, and fill in the probability corresponding to each of the four regions of your diagram. **[3]**

(ii) Determine whether the events G and R are independent. **[2]**

(iii) Find $P(R \mid G)$. **[3]**

4 In a multiple-choice test there are 30 questions. For each question, there is a 60% chance that a randomly selected student answers correctly, independently of all other questions.

(i) Find the probability that a randomly selected student gets a total of exactly 20 questions correct. **[3]**

(ii) If 100 randomly selected students take the test, find the expected number of students who get exactly 20 questions correct. **[2]**

5 My credit card has a 4-digit code called a PIN. You should assume that any 4-digit number from 0000 to 9999 can be a PIN.

(i) If I cannot remember any digits and guess my number, find the probability that I guess it correctly. **[1]**

In fact my PIN consists of four different digits. I can remember all four digits, but cannot remember the correct order.

(ii) If I now guess my number, find the probability that I guess it correctly. **[2]**

6 Three prizes, one for English, one for French and one for Spanish, are to be awarded in a class of 20 students.

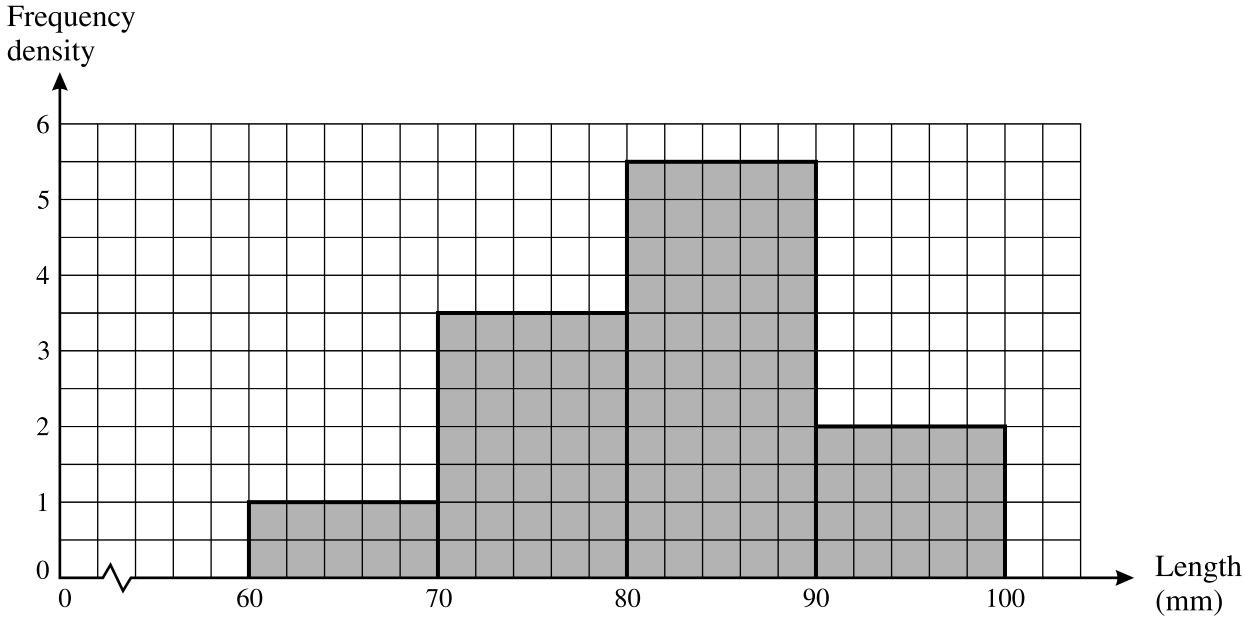
Find the number of different ways in which the three prizes can be awarded if

(i) no student may win more than 1 prize, **[2]**

(ii) no student may win all 3 prizes. **[2]**

Section B (36 marks)

7 A pear grower collects a random sample of 120 pears from his orchard. The histogram below shows the lengths, in mm, of these pears.



(i) Calculate the number of pears which are between 90 and 100 mm long. **[2]**

(ii) Calculate an estimate of the mean length of the pears. Explain why your answer is only an estimate. **[4]**

(iii) Calculate an estimate of the standard deviation. **[3]**

(iv) Use your answers to parts **(ii)** and **(iii)** to investigate whether there are any outliers. **[4]**

(v) Name the type of skewness of the distribution. **[1]**

(vi) Illustrate the data using a cumulative frequency diagram. **[5]**

8 An environmental health officer monitors the air pollution level in a city street. Each day the level of pollution is classified as low, medium or high. The probabilities of each level of pollution on a randomly chosen day are as given in the table.

Pollution level	Low	Medium	High
Probability	0.5	0.35	0.15

(i) Three days are chosen at random. Find the probability that the pollution level is

(A) low on all 3 days, **[2]**

(B) low on at least one day, **[2]**

(C) low on one day, medium on another day, and high on the other day. **[3]**

(ii) Ten days are chosen at random. Find the probability that

(A) there are no days when the pollution level is high, **[2]**

(B) there is exactly one day when the pollution level is high. **[3]**

The environmental health officer believes that pollution levels will be low more frequently in a different street. On 20 randomly selected days she monitors the pollution level in this street and finds that it is low on 15 occasions.

(iii) Carry out a test at the 5% level to determine if there is evidence to suggest that she is correct. Use hypotheses H_0: $p = 0.5$, H_1: $p > 0.5$, where p represents the probability that the pollution level in this street is low. Explain why H_1 has this form. **[5]**

ADVANCED SUBSIDIARY GCE

MATHEMATICS (MEI) 4766

Statistics 1

QUESTION PAPER

Candidates answer on the Printed Answer Book

OCR Supplied Materials:
- Printed Answer Book 4766
- MEI Examination Formulae and Tables (MF2)

Other Materials Required:
- Scientific or graphical calculator

Friday 18 June 2010
Afternoon

Duration: 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

These instructions are the same on the Printed Answer Book and the Question Paper.

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the spaces provided on the Printed Answer Book.
- **The questions are on the inserted Question Paper.**
- **Write your answer to each question in the space provided in the Printed Answer Book.** Additional paper may be used if necessary but you must clearly show your Candidate Number, Centre Number and question number(s).
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- You are permitted to use a graphical calculator in this paper.
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INFORMATION FOR CANDIDATES

This information is the same on the Printed Answer Book and the Question Paper.

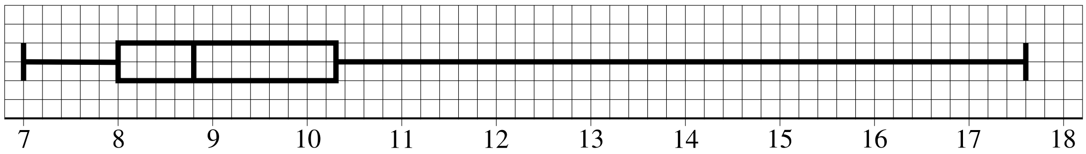
- The number of marks is given in brackets **[ ]** at the end of each question or part question on the Question Paper.
- You are advised that an answer may receive **no marks** unless you show sufficient detail of the working to indicate that a correct method is being used.
- The total number of marks for this paper is **72**.
- The Printed Answer Book consists of **12** pages. The Question Paper consists of **4** pages. Any blank pages are indicated.

INSTRUCTION TO EXAMS OFFICER / INVIGILATOR

- Do not send this Question Paper for marking; it should be retained in the centre or destroyed.

Section A (36 marks)

1 A business analyst collects data about the distribution of hourly wages, in £, of shop-floor workers at a factory. These data are illustrated in the box and whisker plot.



(i) Name the type of skewness of the distribution. **[1]**

(ii) Find the interquartile range and hence show that there are no outliers at the lower end of the distribution, but there is at least one outlier at the upper end. **[5]**

(iii) Suggest possible reasons why this may be the case. **[2]**

2 The probability distribution of the random variable X is given by the formula

$$P(X = r) = kr(5 - r) \quad \text{for} \quad r = 1, 2, 3, 4.$$

(i) Show that $k = 0.05$. **[2]**

(ii) Find $E(X)$ and $Var(X)$. **[5]**

3 The lifetimes in hours of 90 components are summarised in the table.

Lifetime (x hours)	$0 < x \leqslant 20$	$20 < x \leqslant 30$	$30 < x \leqslant 50$	$50 < x \leqslant 65$	$65 < x \leqslant 100$
Frequency	24	13	14	21	18

(i) Draw a histogram to illustrate these data. **[5]**

(ii) In which class interval does the median lie? Justify your answer. **[2]**

4 Each packet of *Cruncho* cereal contains one free fridge magnet. There are five different types of fridge magnet to collect. They are distributed, with equal probability, randomly and independently in the packets. Keith is about to start collecting these fridge magnets.

(i) Find the probability that the first 2 packets that Keith buys contain the same type of fridge magnet. **[2]**

(ii) Find the probability that Keith collects all five types of fridge magnet by buying just 5 packets. **[3]**

(iii) Hence find the probability that Keith has to buy more than 5 packets to acquire a complete set. **[1]**

5 A retail analyst records the numbers of loaves of bread of a particular type bought by a sample of shoppers in a supermarket.

Number of loaves	0	1	2	3	4	5
Frequency	37	23	11	3	0	1

(i) Calculate the mean and standard deviation of the numbers of loaves bought per person. **[5]**

(ii) Each loaf costs £1.04. Calculate the mean and standard deviation of the amount spent on loaves per person. **[3]**

Section B (36 marks)

6 A manufacturer produces tiles. On average 10% of the tiles produced are faulty. Faulty tiles occur randomly and independently.

A random sample of 18 tiles is selected.

(i) (A) Find the probability that there are exactly 2 faulty tiles in the sample. **[3]**

(B) Find the probability that there are more than 2 faulty tiles in the sample. **[3]**

(C) Find the expected number of faulty tiles in the sample. **[2]**

A cheaper way of producing the tiles is introduced. The manufacturer believes that this may increase the proportion of faulty tiles. In order to check this, a random sample of 18 tiles produced using the cheaper process is selected and a hypothesis test is carried out.

(ii) (A) Write down suitable null and alternative hypotheses for the test.

(B) Explain why the alternative hypothesis has the form that it does. **[4]**

(iii) Find the critical region for the test at the 5% level, showing all of your calculations. **[4]**

(iv) In fact there are 4 faulty tiles in the sample. Complete the test, stating your conclusion clearly. **[2]**

7 One train leaves a station each hour. The train is either on time or late. If the train is on time, the probability that the next train is on time is 0.95. If the train is late, the probability that the next train is on time is 0.6. On a particular day, the 09 00 train is on time.

(i) Illustrate the possible outcomes for the 10 00, 11 00 and 12 00 trains on a probability tree diagram. **[4]**

(ii) Find the probability that

(A) all three of these trains are on time, **[2]**

(B) just one of these three trains is on time, **[4]**

(C) the 12 00 train is on time. **[4]**

(iii) Given that the 12 00 train is on time, find the probability that the 10 00 train is also on time. **[4]**

3 (i) **Write any calculations on page 5.**

OCR
RECOGNISING ACHIEVEMENT

ADVANCED SUBSIDIARY GCE

MATHEMATICS (MEI) 4766

Statistics 1

QUESTION PAPER

Candidates answer on the printed answer book.

OCR supplied materials:
- Printed answer book 4766
- MEI Examination Formulae and Tables (MF2)

Other materials required:
- Scientific or graphical calculator

Monday 24 January 2011
Morning

Duration: 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

These instructions are the same on the printed answer book and the question paper.

- The question paper will be found in the centre of the printed answer book.
- Write your name, centre number and candidate number in the spaces provided on the printed answer book. Please write clearly and in capital letters.
- **Write your answer to each question in the space provided in the printed answer book.** Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
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- Read each question carefully. Make sure you know what you have to do before starting your answer.
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INSTRUCTION TO EXAMS OFFICER / INVIGILATOR

- Do not send this question paper for marking; it should be retained in the centre or destroyed.

Section A (36 marks)

1 The stem and leaf diagram shows the weights, rounded to the nearest 10 grams, of 25 female iguanas.

8	3 9
9	3 5 6 6 6 8 9 9
10	0 2 2 3 4 6 9
11	2 4 7 8
12	3 4 5
13	2

Key: 11 | 2 represents 1120 grams

(i) Find the mode and the median of the data. **[2]**

(ii) Identify the type of skewness of the distribution. **[1]**

2 The table shows all the possible products of the scores on two fair four-sided dice.

		Score on second die			
		1	2	3	4
Score on first die	1	1	2	3	4
	2	2	4	6	8
	3	3	6	9	12
	4	4	8	12	16

(i) Find the probability that the product of the two scores is less than 10. **[1]**

(ii) Show that the events 'the score on the first die is even' and 'the product of the scores on the two dice is less than 10' are not independent. **[3]**

3 There are 13 men and 10 women in a running club. A committee of 3 men and 3 women is to be selected.

(i) In how many different ways can the three men be selected? **[2]**

(ii) In how many different ways can the whole committee be selected? **[2]**

(iii) A random sample of 6 people is selected from the running club. Find the probability that this sample consists of 3 men and 3 women. **[2]**

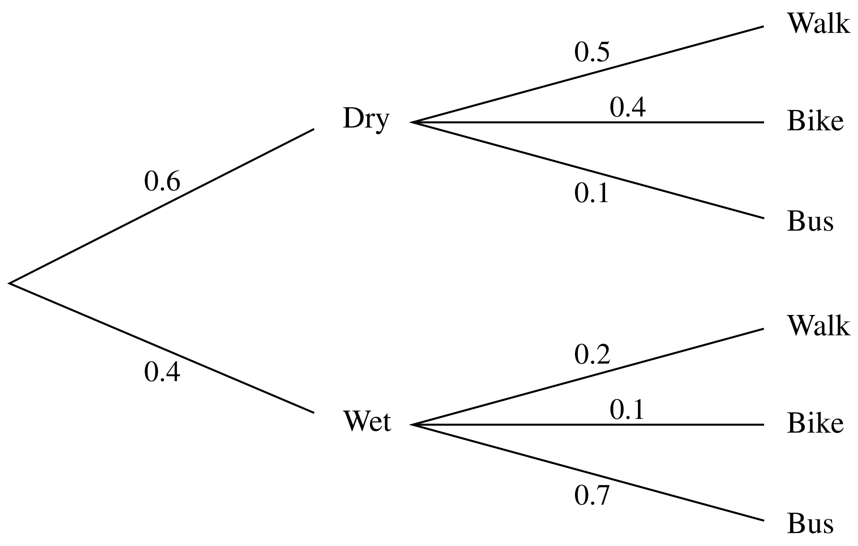
4 The probability distribution of the random variable X is given by the formula

$$P(X = r) = kr(r + 1) \quad \text{for } r = 1, 2, 3, 4, 5.$$

(i) Show that $k = \frac{1}{70}$. **[2]**

(ii) Find $E(X)$ and $Var(X)$. **[5]**

5 Andy can walk to work, travel by bike or travel by bus. The tree diagram shows the probabilities of any day being dry or wet and the corresponding probabilities for each of Andy's methods of travel.



A day is selected at random. Find the probability that

(i) the weather is wet and Andy travels by bus, **[2]**

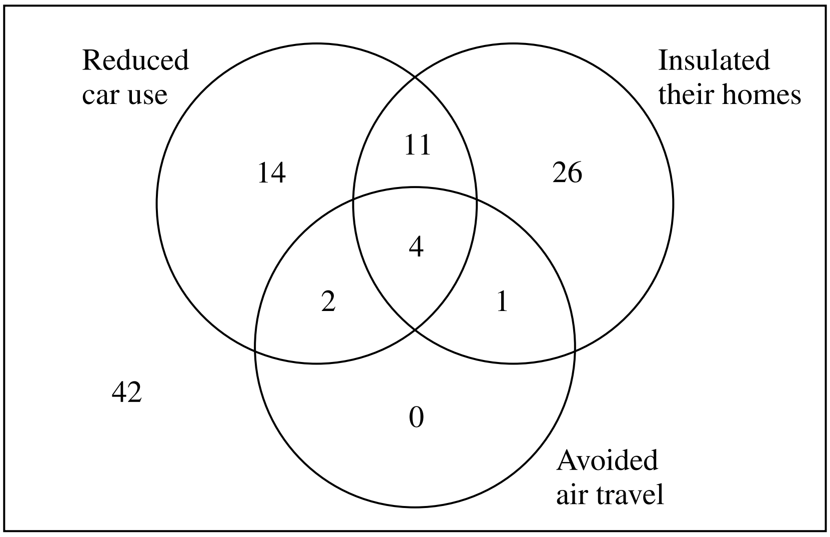
(ii) Andy walks or travels by bike, **[3]**

(iii) the weather is dry given that Andy walks or travels by bike. **[3]**

6 A survey is being carried out into the carbon footprint of individual citizens. As part of the survey, 100 citizens are asked whether they have attempted to reduce their carbon footprint by any of the following methods.

- Reducing car use
- Insulating their homes
- Avoiding air travel

The numbers of citizens who have used each of these methods are shown in the Venn diagram.



One of the citizens is selected at random.

(i) Find the probability that this citizen

(A) has avoided air travel, **[1]**

(B) has used at least two of the three methods. **[2]**

(ii) Given that the citizen has avoided air travel, find the probability that this citizen has reduced car use. **[2]**

Three of the citizens are selected at random.

(iii) Find the probability that none of them have avoided air travel. **[3]**

Section B (36 marks)

7 The incomes of a sample of 918 households on an island are given in the table below.

Income (x thousand pounds)	$0 \leqslant x \leqslant 20$	$20 < x \leqslant 40$	$40 < x \leqslant 60$	$60 < x \leqslant 100$	$100 < x \leqslant 200$
Frequency	238	365	142	128	45

(i) Draw a histogram to illustrate the data. **[5]**

(ii) Calculate an estimate of the mean income. **[3]**

(iii) Calculate an estimate of the standard deviation of the incomes. **[4]**

(iv) Use your answers to parts **(ii)** and **(iii)** to show there are almost certainly some outliers in the sample. Explain whether or not it would be appropriate to exclude the outliers from the calculation of the mean and the standard deviation. **[4]**

(v) The incomes were converted into another currency using the formula $y = 1.15x$. Calculate estimates of the mean and variance of the incomes in the new currency. **[3]**

8 Mark is playing solitaire on his computer. The probability that he wins a game is 0.2, independently of all other games that he plays.

(i) Find the expected number of wins in 12 games. **[2]**

(ii) Find the probability that

(A) he wins exactly 2 out of the next 12 games that he plays, **[3]**

(B) he wins at least 2 out of the next 12 games that he plays. **[3]**

(iii) Mark's friend Ali also plays solitaire. Ali claims that he is better at winning games than Mark. In a random sample of 20 games played by Ali, he wins 7 of them. Write down suitable hypotheses for a test at the 5% level to investigate whether Ali is correct. Give a reason for your choice of alternative hypothesis. Carry out the test. **[9]**

OCR
RECOGNISING ACHIEVEMENT

ADVANCED SUBSIDIARY GCE

MATHEMATICS (MEI) 4766

Statistics 1

QUESTION PAPER

Candidates answer on the printed answer book.

OCR supplied materials:
- Printed answer book 4766
- MEI Examination Formulae and Tables (MF2)

Other materials required:
- Scientific or graphical calculator

Thursday 26 May 2011
Morning

Duration: 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

These instructions are the same on the printed answer book and the question paper.

- The question paper will be found in the centre of the printed answer book.
- Write your name, centre number and candidate number in the spaces provided on the printed answer book. Please write clearly and in capital letters.
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INSTRUCTION TO EXAMS OFFICER / INVIGILATOR

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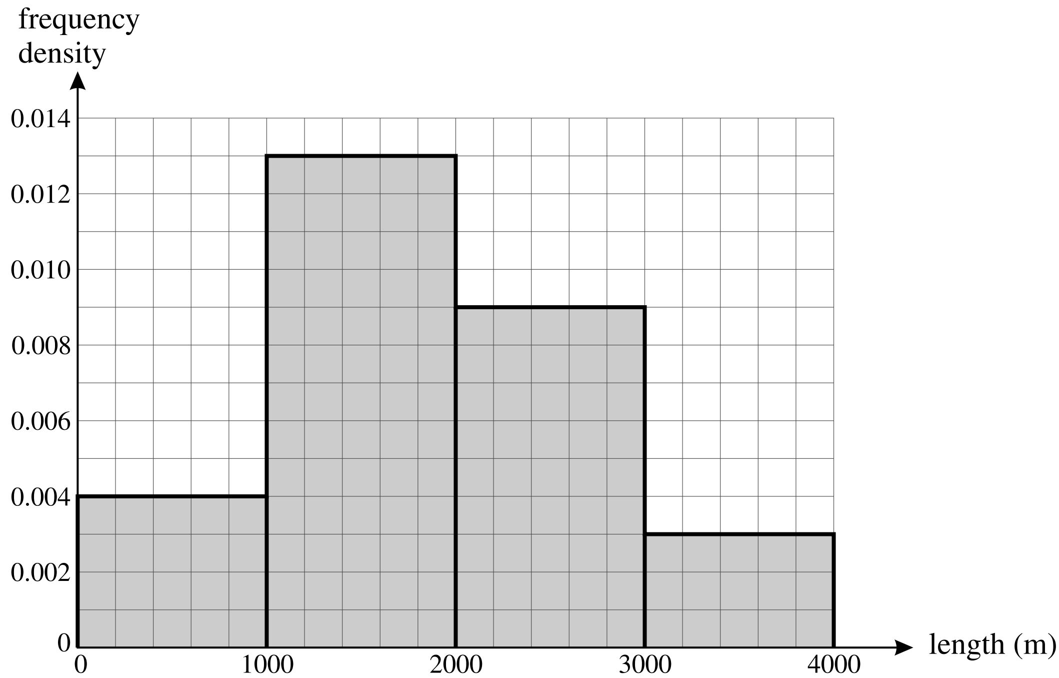
Section A (36 marks)

1 In the Paris-Roubaix cycling race, there are a number of sections of cobbled road. The lengths of these sections, measured in metres, are illustrated in the histogram.



(i) Find the number of sections which are between 1000 and 2000 metres in length. **[2]**

(ii) Name the type of skewness suggested by the histogram. **[1]**

(iii) State the minimum and maximum possible values of the midrange. **[2]**

2 I have 5 books, each by a different author. The authors are Austen, Brontë, Clarke, Dickens and Eliot.

(i) If I arrange the books in a random order on my bookshelf, find the probability that the authors are in alphabetical order with Austen on the left. **[2]**

(ii) If I choose two of the books at random, find the probability that I choose the books written by Austen and Brontë. **[3]**

3 25% of the plants of a particular species have red flowers. A random sample of 6 plants is selected.

(i) Find the probability that there are no plants with red flowers in the sample. **[2]**

(ii) If 50 random samples of 6 plants are selected, find the expected number of samples in which there are no plants with red flowers. **[2]**

4 Two fair six-sided dice are thrown. The random variable X denotes the difference between the scores on the two dice. The table shows the probability distribution of X.

r	0	1	2	3	4	5
$P(X = r)$	$\frac{1}{6}$	$\frac{5}{18}$	$\frac{2}{9}$	$\frac{1}{6}$	$\frac{1}{9}$	$\frac{1}{18}$

(i) Draw a vertical line chart to illustrate the probability distribution. **[2]**

(ii) Use a probability argument to show that

(A) $P(X = 1) = \frac{5}{18}$, **[2]**

(B) $P(X = 0) = \frac{1}{6}$. **[1]**

(iii) Find the mean value of X. **[2]**

5 In a recent survey, a large number of working people were asked whether they worked full-time or part-time, with part-time being defined as less than 25 hours per week. One of the respondents is selected at random.

- W is the event that this person works part-time.
- F is the event that this person is female.

You are given that $P(W) = 0.14$, $P(F) = 0.41$ and $P(W \cap F) = 0.11$.

(i) Draw a Venn diagram showing the events W and F, and fill in the probability corresponding to each of the four regions of your diagram. **[3]**

(ii) Determine whether the events W and F are independent. **[2]**

(iii) Find $P(W \mid F)$ and explain what this probability represents. **[3]**

6 The numbers of eggs laid by a sample of 70 female herring gulls are shown in the table.

Number of eggs	1	2	3	4
Frequency	10	40	15	5

(i) Find the mean and standard deviation of the number of eggs laid per gull. **[5]**

(ii) The sample did not include female herring gulls that laid no eggs. How would the mean and standard deviation change if these gulls were included? **[2]**

Section B (36 marks)

7 Any patient who fails to turn up for an outpatient appointment at a hospital is described as a 'no-show'. At a particular hospital, on average 15% of patients are no-shows. A random sample of 20 patients who have outpatient appointments is selected.

(i) Find the probability that

(A) there is exactly 1 no-show in the sample, **[3]**

(B) there are at least 2 no-shows in the sample. **[2]**

The hospital management introduces a policy of telephoning patients before appointments. It is hoped that this will reduce the proportion of no-shows. In order to check this, a random sample of n patients is selected. The number of no-shows in the sample is recorded and a hypothesis test is carried out at the 5% level.

(ii) Write down suitable null and alternative hypotheses for the test. Give a reason for your choice of alternative hypothesis. **[4]**

(iii) In the case that $n = 20$ and the number of no-shows in the sample is 1, carry out the test. **[4]**

(iv) In another case, where n is large, the number of no-shows in the sample is 6 and the critical value for the test is 8. Complete the test. **[3]**

(v) In the case that $n \leqslant 18$, explain why there is no point in carrying out the test at the 5% level. **[2]**

8 The heating quality of the coal in a sample of 50 sacks is measured in suitable units. The data are summarised below.

Heating quality (x)	$9.1 \leqslant x \leqslant 9.3$	$9.3 < x \leqslant 9.5$	$9.5 < x \leqslant 9.7$	$9.7 < x \leqslant 9.9$	$9.9 < x \leqslant 10.1$
Frequency	5	7	15	16	7

(i) Draw a cumulative frequency diagram to illustrate these data. **[5]**

(ii) Use the diagram to estimate the median and interquartile range of the data. **[3]**

(iii) Show that there are no outliers in the sample. **[3]**

(iv) Three of these 50 sacks are selected at random. Find the probability that

(A) in all three, the heating quality x is more than 9.5, **[3]**

(B) in at least two, the heating quality x is more than 9.5. **[4]**

OCR
RECOGNISING ACHIEVEMENT

Monday 23 January 2012 – Morning

AS GCE MATHEMATICS (MEI)

4766 Statistics 1

QUESTION PAPER

Candidates answer on the Printed Answer Book.

OCR supplied materials:
- Printed Answer Book 4766
- MEI Examination Formulae and Tables (MF2)

Other materials required:
- Scientific or graphical calculator

Duration: 1 hour 30 minutes

4732150112

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INSTRUCTION TO EXAMS OFFICER / INVIGILATOR

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Section A (36 marks)

1 The mean daily maximum temperatures at a research station over a 12-month period, measured to the nearest degree Celsius, are given below.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
8	15	25	29	31	31	34	36	34	26	15	8

(i) Construct a sorted stem and leaf diagram to represent these data, taking stem values of 0, 10, ... **[4]**

(ii) Write down the median of these data. **[1]**

(iii) The mean of these data is 24.3. Would the mean or the median be a better measure of central tendency of the data? Briefly explain your answer. **[2]**

2 The hourly wages, £x, of a random sample of 60 employees working for a company are summarised as follows.

$$n = 60 \qquad \Sigma x = 759.00 \qquad \Sigma x^2 = 11\,736.59$$

(i) Calculate the mean and standard deviation of x. **[3]**

(ii) The workers are offered a wage increase of 2%. Use your answers to part **(i)** to deduce the new mean and standard deviation of the hourly wages after this increase. **[2]**

(iii) As an alternative the workers are offered a wage increase of 25p per hour. Write down the new mean and standard deviation of the hourly wages after this 25p increase. **[2]**

3 Jimmy and Alan are playing a tennis match against each other. The winner of the match is the first player to win three sets. Jimmy won the first set and Alan won the second set. For each of the remaining sets, the probability that Jimmy wins a set is

- 0.7 if he won the previous set,
- 0.4 if Alan won the previous set.

It is not possible to draw a set.

(i) Draw a probability tree diagram to illustrate the possible outcomes for each of the remaining sets. **[3]**

(ii) Find the probability that Alan wins the match. **[3]**

(iii) Find the probability that the match ends after exactly four sets have been played. **[2]**

4 In a food survey, a large number of people are asked whether they like tomato soup, mushroom soup, both or neither. One of these people is selected at random.

- T is the event that this person likes tomato soup.
- M is the event that this person likes mushroom soup.

You are given that $\mathrm{P}(T) = 0.55$, $\mathrm{P}(M) = 0.33$ and $\mathrm{P}(T \mid M) = 0.80$.

(i) Use this information to show that the events T and M are not independent. **[1]**

(ii) Find $\mathrm{P}(T \cap M)$. **[2]**

(iii) Draw a Venn diagram showing the events T and M, and fill in the probability corresponding to each of the four regions of your diagram. **[3]**

5 A couple plan to have at least one child of each sex, after which they will have no more children. However, if they have four children of one sex, they will have no more children. You should assume that each child is equally likely to be of either sex, and that the sexes of the children are independent. The random variable X represents the total number of girls the couple have.

(i) Show that $\mathrm{P}(X = 1) = \frac{11}{16}$. **[3]**

The table shows the probability distribution of X.

r	0	1	2	3	4
$\mathrm{P}(X = r)$	$\frac{1}{16}$	$\frac{11}{16}$	$\frac{1}{8}$	$\frac{1}{16}$	$\frac{1}{16}$

(ii) Find $\mathrm{E}(X)$ and $\mathrm{Var}(X)$. **[5]**

Section B (36 marks)

6 It is known that 25% of students in a particular city are smokers. A random sample of 20 of the students is selected.

(i) (A) Find the probability that there are exactly 4 smokers in the sample. **[3]**

(B) Find the probability that there are at least 3 but no more than 6 smokers in the sample. **[3]**

(C) Write down the expected number of smokers in the sample. **[1]**

A new health education programme is introduced. This programme aims to reduce the percentage of students in this city who are smokers. After the programme has been running for a year, it is decided to carry out a hypothesis test to assess the effectiveness of the programme. A random sample of 20 students is selected.

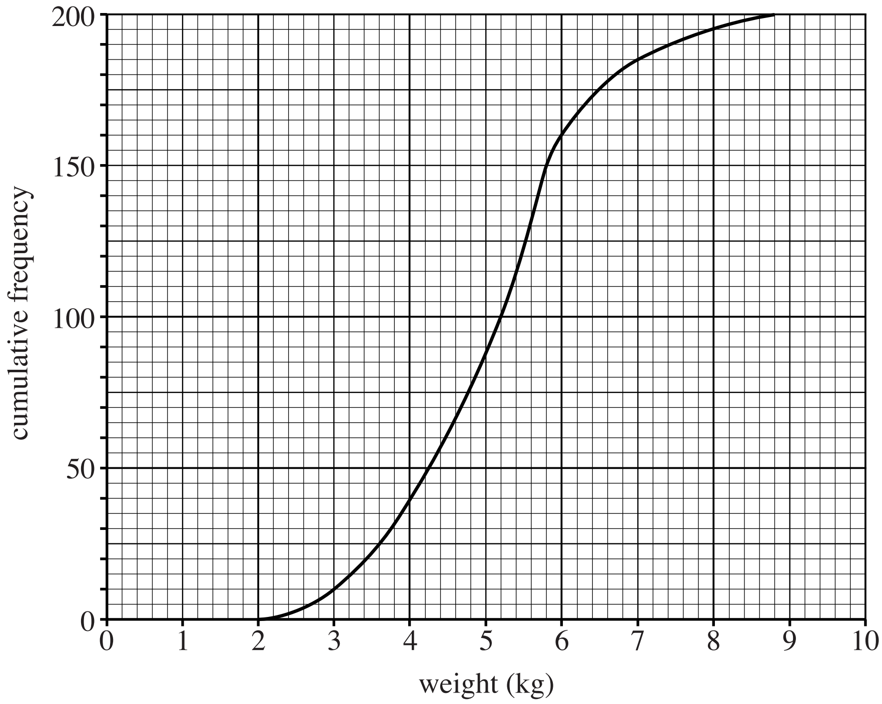
(ii) (A) Write down suitable null and alternative hypotheses for the test. **[3]**

(B) Explain why the alternative hypothesis has the form that it does. **[1]**

(iii) Find the critical region for the test at the 5% level, showing all of your calculations. **[4]**

(iv) In fact there are 3 smokers in the sample. Complete the test, stating your conclusion clearly. **[2]**

7 The birth weights of 200 lambs from crossbred sheep are illustrated by the cumulative frequency diagram below.

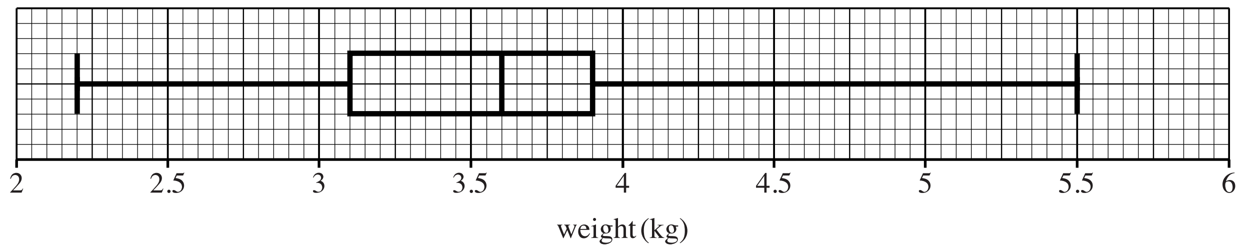


(i) Estimate the percentage of lambs with birth weight over 6 kg. **[2]**

(ii) Estimate the median and interquartile range of the data. **[3]**

(iii) Use your answers to part **(ii)** to show that there are very few, if any, outliers. Comment briefly on whether any outliers should be disregarded in analysing these data. **[4]**

The box and whisker plot shows the birth weights of 100 lambs from Welsh Mountain sheep.



(iv) Use appropriate measures to compare briefly the central tendencies and variations of the weights of the two types of lamb. **[4]**

(v) The weight of the largest Welsh Mountain lamb was originally recorded as 6.5 kg, but then corrected. If this error had not been corrected, how would this have affected your answers to part **(iv)**? Briefly explain your answer. **[2]**

(vi) One lamb of each type is selected at random. Estimate the probability that the birth weight of both lambs is at least 3.9 kg. **[4]**

OCR
RECOGNISING ACHIEVEMENT

Thursday 24 May 2012 – Morning

AS GCE MATHEMATICS (MEI)

4766 Statistics 1

QUESTION PAPER

4715830612

Candidates answer on the Printed Answer Book.

OCR supplied materials:
- Printed Answer Book 4766
- MEI Examination Formulae and Tables (MF2)

Other materials required:
- Scientific or graphical calculator

Duration: 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

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INSTRUCTION TO EXAMS OFFICER / INVIGILATOR

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Section A (36 marks)

1 At a garden centre there is a box containing 50 hyacinth bulbs. Of these, 30 will produce a blue flower and the remaining 20 will produce a red flower. Unfortunately they have become mixed together so that it is not known which of the bulbs will produce a blue flower and which will produce a red flower.

Karen buys 3 of these bulbs.

(i) Find the probability that all 3 of these bulbs will produce blue flowers. **[3]**

(ii) Find the probability that Karen will have at least one flower of each colour from her 3 bulbs. **[3]**

2 An examination paper consists of two sections. Section A has 5 questions and Section B has 9 questions. Candidates are required to answer 6 questions.

(i) In how many different ways can a candidate choose 6 questions, if 3 are from Section A and 3 are from Section B? **[3]**

(ii) Another candidate randomly chooses 6 questions to answer. Find the probability that this candidate chooses 3 questions from each section. **[3]**

3 At a call centre, 85% of callers are put on hold before being connected to an operator. A random sample of 30 callers is selected.

(i) Find the probability that exactly 29 of these callers are put on hold. **[3]**

(ii) Find the probability that at least 29 of these callers are put on hold. **[3]**

(iii) If 10 random samples, each of 30 callers, are selected, find the expected number of samples in which at least 29 callers are put on hold. **[2]**

4 It is known that 8% of the population of a large city use a particular web browser. A researcher wishes to interview some people from the city who use this browser. He selects people at random, one at a time.

(i) Find the probability that the first person that he finds who uses this browser is

(A) the third person selected, **[3]**

(B) the second or third person selected. **[2]**

(ii) Find the probability that at least one of the first 20 people selected uses this browser. **[3]**

5 A manufacturer produces titanium bicycle frames. The bicycle frames are tested before use and on average 5% of them are found to be faulty. A cheaper manufacturing process is introduced and the manufacturer wishes to check whether the proportion of faulty bicycle frames has increased. A random sample of 18 bicycle frames is selected and it is found that 4 of them are faulty. Carry out a hypothesis test at the 5% significance level to investigate whether the proportion of faulty bicycle frames has increased. **[8]**

Section B (36 marks)

6 The engine sizes $x\,\text{cm}^3$ of a sample of 80 cars are summarised in the table below.

Engine size x	$500 \leqslant x \leqslant 1000$	$1000 < x \leqslant 1500$	$1500 < x \leqslant 2000$	$2000 < x \leqslant 3000$	$3000 < x \leqslant 5000$
Frequency	7	22	26	18	7

(i) Draw a histogram to illustrate the distribution. **[5]**

(ii) A student claims that the midrange is $2750\,\text{cm}^3$. Discuss briefly whether he is likely to be correct. **[1]**

(iii) Calculate estimates of the mean and standard deviation of the engine sizes. Explain why your answers are only estimates. **[5]**

(iv) Hence investigate whether there are any outliers in the sample. **[3]**

(v) A vehicle duty of £1000 is proposed for all new cars with engine size greater than $2000\,\text{cm}^3$. Assuming that this sample of cars is representative of all new cars in Britain and that there are 2.5 million new cars registered in Britain each year, calculate an estimate of the total amount of money that this vehicle duty would raise in one year. **[3]**

(vi) Why in practice might your estimate in part **(v)** turn out to be too high? **[1]**

7 Yasmin has 5 coins. One of these coins is biased with P(heads) = 0.6. The other 4 coins are fair. She tosses all 5 coins once and records the number of heads, X.

(i) Show that $\mathrm{P}(X = 0) = 0.025$. **[2]**

(ii) Show that $\mathrm{P}(X = 1) = 0.1375$. **[4]**

The table shows the probability distribution of X.

r	0	1	2	3	4	5
$\mathrm{P}(X=r)$	0.025	0.1375	0.3	0.325	0.175	0.0375

(iii) Draw a vertical line chart to illustrate the probability distribution. **[2]**

(iv) Comment on the skewness of the distribution. **[1]**

(v) Find $\mathrm{E}(X)$ and $\mathrm{Var}(X)$. **[5]**

(vi) Yasmin tosses the 5 coins three times. Find the probability that the total number of heads is 3. **[4]**

THERE ARE NO QUESTIONS WRITTEN ON THIS PAGE.

OCR
RECOGNISING ACHIEVEMENT

Friday 25 January 2013 – Afternoon

AS GCE MATHEMATICS (MEI)

4766/01 Statistics 1

QUESTION PAPER

Candidates answer on the Printed Answer Book.

OCR supplied materials:
- Printed Answer Book 4766/01
- MEI Examination Formulae and Tables (MF2)

Other materials required:
- Scientific or graphical calculator

Duration: 1 hour 30 minutes

4732980113

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INSTRUCTION TO EXAMS OFFICER / INVIGILATOR

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This paper has been pre modified for carrier language

Section A (36 marks)

1 The stem and leaf diagram illustrates the heights in metres of 25 young oak trees.

3	4 6 7 8 9 9
4	0 2 2 3 4 6 8 9
5	0 1 3 5 8
6	2 4 5
7	4 6
8	1

Key: 4 | 2 represents 4.2

(i) State the type of skewness of the distribution. **[1]**

(ii) Use your calculator to find the mean and standard deviation of these data. **[3]**

(iii) Determine whether there are any outliers. **[4]**

2 The probability distribution of the random variable X is given by the formula

$$\mathrm{P}(X=r)=k(r^2-1) \text{ for } r = 2, 3, 4, 5.$$

(i) Show the probability distribution in a table, and find the value of k. **[3]**

(ii) Find $\mathrm{E}(X)$ and $\mathrm{Var}(X)$. **[5]**

3 Each weekday Alan drives to work. On his journey, he goes over a level crossing. Sometimes he has to wait at the level crossing for a train to pass.

- W is the event that Alan has to wait at the level crossing.
- L is the event that Alan is late for work.

You are given that $\mathrm{P}(L|W)=0.4$, $\mathrm{P}(W)=0.07$ and $\mathrm{P}(L\cup W)=0.08$.

(i) Calculate $\mathrm{P}(L\cap W)$. **[2]**

(ii) Draw a Venn diagram, showing the events L and W. Fill in the probability corresponding to each of the four regions of your diagram. **[3]**

(iii) Determine whether the events L and W are independent, explaining your method clearly. **[3]**

4 At a dog show, three out of eleven dogs are to be selected for a national competition.

(i) Find the number of possible selections. **[2]**

(ii) Five of the eleven dogs are terriers. Assuming that the dogs are selected at random, find the probability that at least two of the three dogs selected for the national competition are terriers. **[5]**

5 Malik is playing a game in which he has to throw a 6 on a fair six-sided die to start the game. Find the probability that

(i) Malik throws a 6 for the first time on his third attempt, **[3]**

(ii) Malik needs at most ten attempts to throw a 6. **[2]**

Section B (36 marks)

6 The heights x cm of 100 boys in Year 7 at a school are summarised in the table below.

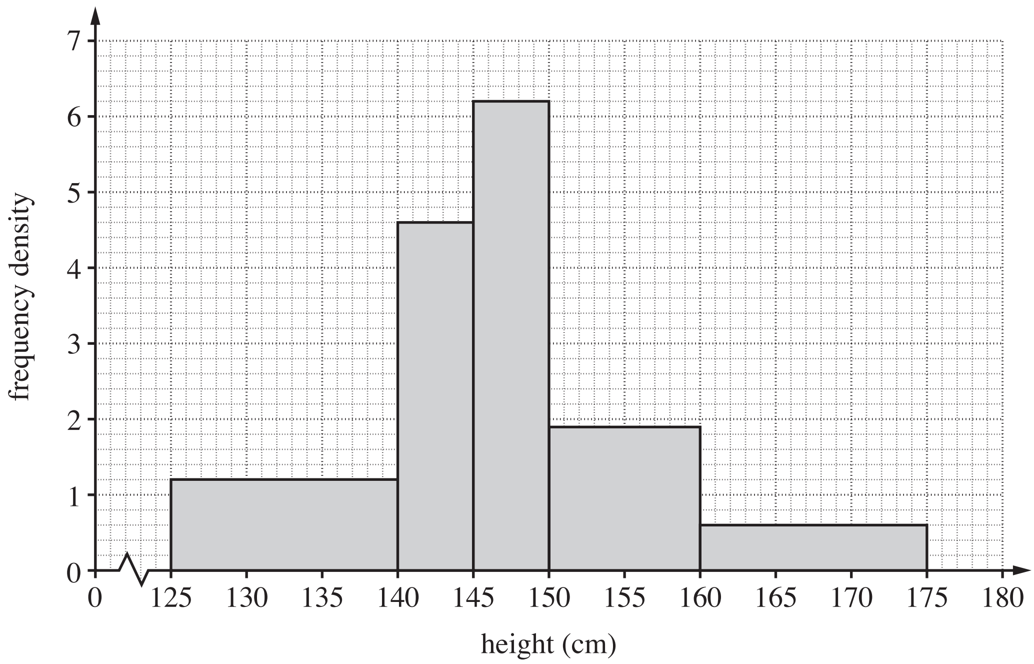
Height	$125 \leqslant x \leqslant 140$	$140 < x \leqslant 145$	$145 < x \leqslant 150$	$150 < x \leqslant 160$	$160 < x \leqslant 170$
Frequency	25	29	24	18	4

(i) Estimate the number of boys who have heights of at least 155 cm. **[2]**

(ii) Calculate an estimate of the median height of the 100 boys. **[3]**

(iii) Draw a histogram to illustrate the data. **[5]**

The histogram below shows the heights of 100 girls in Year 7 at the same school.



(iv) How many more girls than boys had heights exceeding 160 cm? **[3]**

(v) Calculate an estimate of the mean height of the 100 girls. **[5]**

7 A coffee shop provides free internet access for its customers. It is known that the probability that a randomly selected customer is accessing the internet is 0.35, independently of all other customers.

(i) 10 customers are selected at random.

(A) Find the probability that exactly 5 of them are accessing the internet. **[3]**

(B) Find the probability that at least 5 of them are accessing the internet. **[2]**

(C) Find the expected number of these customers who are accessing the internet. **[2]**

Another coffee shop also provides free internet access. It is suspected that the probability that a randomly selected customer at this coffee shop is accessing the internet may be different from 0.35. A random sample of 20 customers at this coffee shop is selected. Of these, 10 are accessing the internet.

(ii) Carry out a hypothesis test at the 5% significance level to investigate whether the probability for this coffee shop is different from 0.35. Give a reason for your choice of alternative hypothesis. **[9]**

(iii) To get a more reliable result, a much larger random sample of 200 customers is selected over a period of time, and another hypothesis test is carried out. You are given that 90 of the 200 customers were accessing the internet. You are also given that, if X has the binomial distribution with parameters n = 200 and p = 0.35, then $\mathrm{P}(X \geqslant 90) = 0.0022$. Using the same hypotheses and significance level which you used in part **(ii)**, complete this test. **[2]**

OCR RECOGNISING ACHIEVEMENT

Friday 24 May 2013 – Morning

AS GCE MATHEMATICS (MEI)

4766/01 Statistics 1

QUESTION PAPER

Candidates answer on the Printed Answer Book.

OCR supplied materials:
- Printed Answer Book 4766/01
- MEI Examination Formulae and Tables (MF2)

Other materials required:
- Scientific or graphical calculator

Duration: 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

These instructions are the same on the Printed Answer Book and the Question Paper.

- The Question Paper will be found in the centre of the Printed Answer Book.
- Write your name, centre number and candidate number in the spaces provided on the Printed Answer Book. Please write clearly and in capital letters.
- **Write your answer to each question in the space provided in the Printed Answer Book**. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- You are permitted to use a scientific or graphical calculator in this paper.
- Final answers should be given to a degree of accuracy appropriate to the context.

INFORMATION FOR CANDIDATES

This information is the same on the Printed Answer Book and the Question Paper.

- The number of marks is given in brackets **[ ]** at the end of each question or part question on the Question Paper.
- You are advised that an answer may receive **no marks** unless you show sufficient detail of the working to indicate that a correct method is being used.
- The total number of marks for this paper is **72**.
- The Printed Answer Book consists of **12** pages. The Question Paper consists of **4** pages. Any blank pages are indicated.

INSTRUCTION TO EXAMS OFFICER / INVIGILATOR

- Do not send this Question Paper for marking; it should be retained in the centre or recycled. Please contact OCR Copyright should you wish to re-use this document.

Section A (36 marks)

1 The weights, x grams, of 100 potatoes are summarised as follows.

$$n = 100 \qquad \Sigma x = 24\,940 \qquad \Sigma x^2 = 6\,240\,780$$

(i) Calculate the mean and standard deviation of x. **[3]**

(ii) The weights, y grams, of the potatoes after they have been peeled are given by the formula $y = 0.9x - 15$. Deduce the mean and standard deviation of the weights of the potatoes after they have been peeled. **[3]**

2 Every evening, 5 men and 5 women are chosen to take part in a phone-in competition. Of these 10 people, exactly 3 will win a prize. These 3 prize-winners are chosen at random.

(i) Find the probability that, on a particular evening, 2 of the prize-winners are women and the other is a man. Give your answer as a fraction in its simplest form. **[4]**

(ii) Four evenings are selected at random. Find the probability that, on at least three of the four evenings, 2 of the prize-winners are women and the other is a man. **[4]**

3 The weights of bags of a particular brand of flour are quoted as 1.5 kg. In fact, on average 10% of bags are underweight.

(i) Find the probability that, in a random sample of 50 bags, there are exactly 5 bags which are underweight. **[3]**

(ii) Bags are randomly chosen and packed into boxes of 20. Find the probability that there is at least one underweight bag in a box. **[2]**

(iii) A crate contains 48 boxes. Find the expected number of boxes in the crate which contain at least one underweight bag. **[2]**

4 Martin has won a competition. For his prize he is given six sealed envelopes, of which he is allowed to open exactly three and keep their contents. Three of the envelopes each contain £5 and the other three each contain £1000. Since the envelopes are identical on the outside, he chooses three of them at random. Let £X be the total amount of money that he receives in prize money.

(i) Show that $\mathrm{P}(X = 15) = 0.05$. **[2]**

The probability distribution of X is given in the table below.

r	15	1010	2005	3000
$\mathrm{P}(X = r)$	0.05	0.45	0.45	0.05

(ii) Find $\mathrm{E}(X)$ and $\mathrm{Var}(X)$. **[5]**

5 A researcher is investigating whether people can identify whether a glass of water they are given is bottled water or tap water. She suspects that people do no better than they would by guessing. Twenty people are selected at random; thirteen make a correct identification. She carries out a hypothesis test.

(i) Explain why the null hypothesis should be $p = 0.5$, where p represents the probability that a randomly selected person makes a correct identification. **[2]**

(ii) Briefly explain why she uses an alternative hypothesis of $p > 0.5$. **[1]**

(iii) Complete the test at the 5% significance level. **[5]**

Section B (36 marks)

6 The birth weights in kilograms of 25 female babies are shown below, in ascending order.

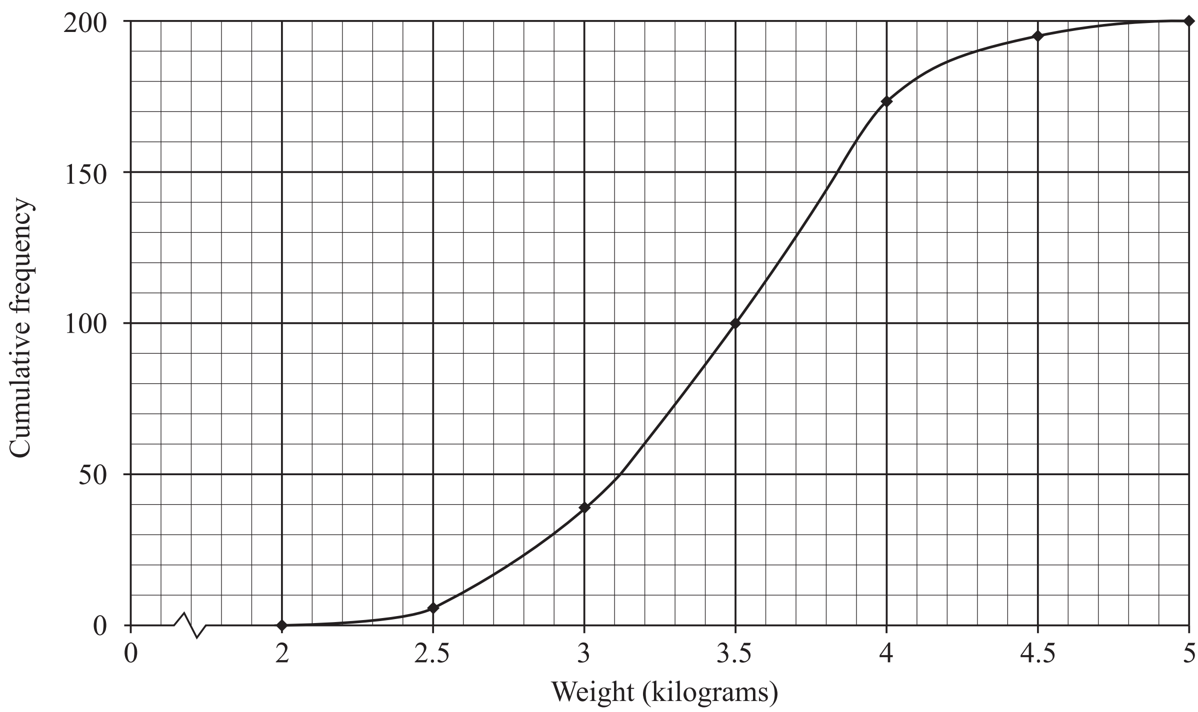
1.39	2.50	2.68	2.76	2.82	2.82	2.84	3.03	3.06	3.16	3.16	3.24	3.32
3.36	3.40	3.54	3.56	3.56	3.70	3.72	3.72	3.84	4.02	4.24	4.34	

(i) Find the median and interquartile range of these data. **[3]**

(ii) Draw a box and whisker plot to illustrate the data. **[3]**

(iii) Show that there is exactly one outlier. Discuss whether this outlier should be removed from the data. **[4]**

The cumulative frequency curve below illustrates the birth weights of 200 male babies.



(iv) Find the median and interquartile range of the birth weights of the male babies. **[3]**

(v) Compare the weights of the female and male babies. **[2]**

(vi) Two of these male babies are chosen at random. Calculate an estimate of the probability that both of these babies weigh more than any of the female babies. **[3]**

7 Jenny has six darts. She throws darts, one at a time, aiming each at the bull's-eye. The probability that she hits the bull's-eye with her first dart is 0.1. For any subsequent throw, the probability of hitting the bull's-eye is 0.2 if the previous dart hit the bull's-eye and 0.05 otherwise.

(i) Illustrate the possible outcomes for her first, second and third darts on a probability tree diagram. **[4]**

(ii) Find the probability that

(A) she hits the bull's-eye with at least one of her first three darts, **[3]**

(B) she hits the bull's-eye with exactly one of her first three darts. **[4]**

(iii) Given that she hits the bull's-eye with at least one of her first three darts, find the probability that she hits the bull's-eye with exactly one of them. **[3]**

Jenny decides that, if she hits the bull's-eye with any of her first three darts, she will stop after throwing three darts. Otherwise she will throw all six darts.

(iv) Find the probability that she hits the bull's-eye three times in total. **[4]**