

**Wednesday 24 May 2017 – Morning**

**AS GCE MATHEMATICS (MEI)**

**4766/01** Statistics 1

**QUESTION PAPER**

A 61

B 55

C 49

D 43

E 37

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 inside 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.** If additional space is required, you should use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.
- 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 barcodes.
- 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

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**Section A** (36 marks)

- 1 The numbers of units of electricity,  $x$  kWh (kilowatt-hours), used by 50 customers of an energy firm in a period of one month are summarised as follows.

$$\Sigma x = 17\,100$$

$$\Sigma x^2 = 6\,115\,108$$

- (i) Calculate the mean and standard deviation of  $x$ . [3]
- (ii) The cost, £ $y$ , of the electricity used by each customer is given by the formula  $y = 0.108x + 7.2$ . Use your answers to part (i) to deduce the mean and standard deviation of the costs of the electricity used by these customers. [3]
- 2 Tom is carrying out a survey into the way in which students travel to school. He selects 50 students and asks each of them 'How did you get to school this morning?' The results are given in the table below.

Walk	Cycle	Bus	Car
17	9	13	11

Tom then randomly selects 4 of these students to interview in more detail.

- (i) Find the number of ways in which Tom can select the 4 students. [2]
- (ii) Find the probability that all 4 of these students walked to school. [2]
- (iii) Find the probability that at least 2 of the 4 students used the same method to get to school. [4]
- 3 Two fair four-sided dice, with faces numbered 1 to 4, are thrown. The random variable  $X$  denotes the difference between the scores on the two dice.

- (i) Show that  $P(X = 1) = \frac{3}{8}$ . [2]

The table shows the complete probability distribution of  $X$ .

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

- (ii) Find  $E(X)$  and  $\text{Var}(X)$ . [5]
- 4 Every day Axel takes the train to work. The probability that he gets a seat on his journey to work is 0.4. The probability that he gets a seat on his journey back home from work is 0.8, independently of whether he gets a seat on his journey to work.
- (i) Find the probability that Axel gets a seat on his journey home, but not on his journey to work. [2]
- (ii) Find the probability that he gets a seat on at least one of the journeys on a day. [3]
- (iii) Given that he gets a seat on at least one of the journeys on a day, find the probability that he gets a seat on both journeys. [3]

- 5 Sakura and Emily are playing a table tennis match. The winner of the match is the first player to win three games. The probability that Sakura wins a game is 0.55, independently of all other games. Games cannot be drawn.
- (i) Find the probability that Sakura wins the match in three games. [2]
- (ii) Find the probability that Emily wins the match. [5]

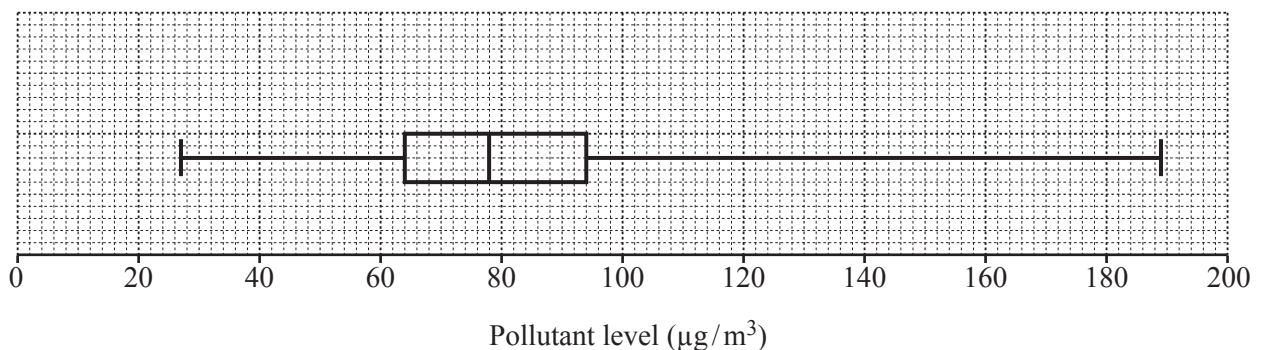
**Section B (36 marks)**

- 6 The table below shows the maximum daily level of the pollutant nitrogen dioxide in Marylebone Road in London in 2015. The levels are measured in micrograms per cubic metre ( $\mu\text{g}/\text{m}^3$ ). There were 7 days where no figures were available.

Pollutant level ( $x \mu\text{g}/\text{m}^3$ )	$40 \leq x < 80$	$80 \leq x < 120$	$120 \leq x < 140$	$140 \leq x < 180$	$180 \leq x < 220$	$220 \leq x \leq 300$
Frequency	29	74	52	129	64	10

- (i) Draw a cumulative frequency diagram to illustrate the data. [5]
- (ii) Levels of nitrogen dioxide below 200 are classified as low. Estimate the proportion of days on which the level was low. [2]
- (iii) Use your diagram to estimate the median and interquartile range of the data. [3]
- (iv) For each end of the distribution, explain whether outliers definitely exist, may possibly exist or definitely do not exist. [4]
- (v) Draw a box and whisker plot to illustrate the data. [3]

The box and whisker plot below shows similar data for a roadside location in Tower Hamlets in London.



- (vi) Compare the skewness of the data from the two locations. [2]

- 7 A type of shampoo is known to relieve the symptoms of 75% of dogs who suffer from a particular minor allergy.

- (i) 12 dogs who suffer from this allergy are selected at random. Find the probability that the number of these dogs who have their symptoms relieved is

(A) exactly 9, [3]

(B) at least 9. [2]

A new type of shampoo has been developed to treat the allergy. A hypothesis test is to be carried out to determine whether it relieves the symptoms of a higher proportion of dogs who suffer from the allergy.

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

A random sample of  $n$  dogs who suffer from the allergy is selected.

- (iii) (A) Given that  $n = 18$  and the symptoms of 16 dogs are relieved, carry out the test at the 10% significance level. [4]

- (B) Given instead that  $n = 50$  and the symptoms of 42 dogs are relieved, carry out the test at the 10% significance level. You may use the information that, for  $X \sim B(50, 0.75)$ ,

$$P(X = 41) = 0.0721, \quad P(X = 42) = 0.0463, \quad P(X \leq 41) = 0.9084, \quad P(X \leq 42) = 0.9547. \quad [4]$$

### END OF QUESTION PAPER

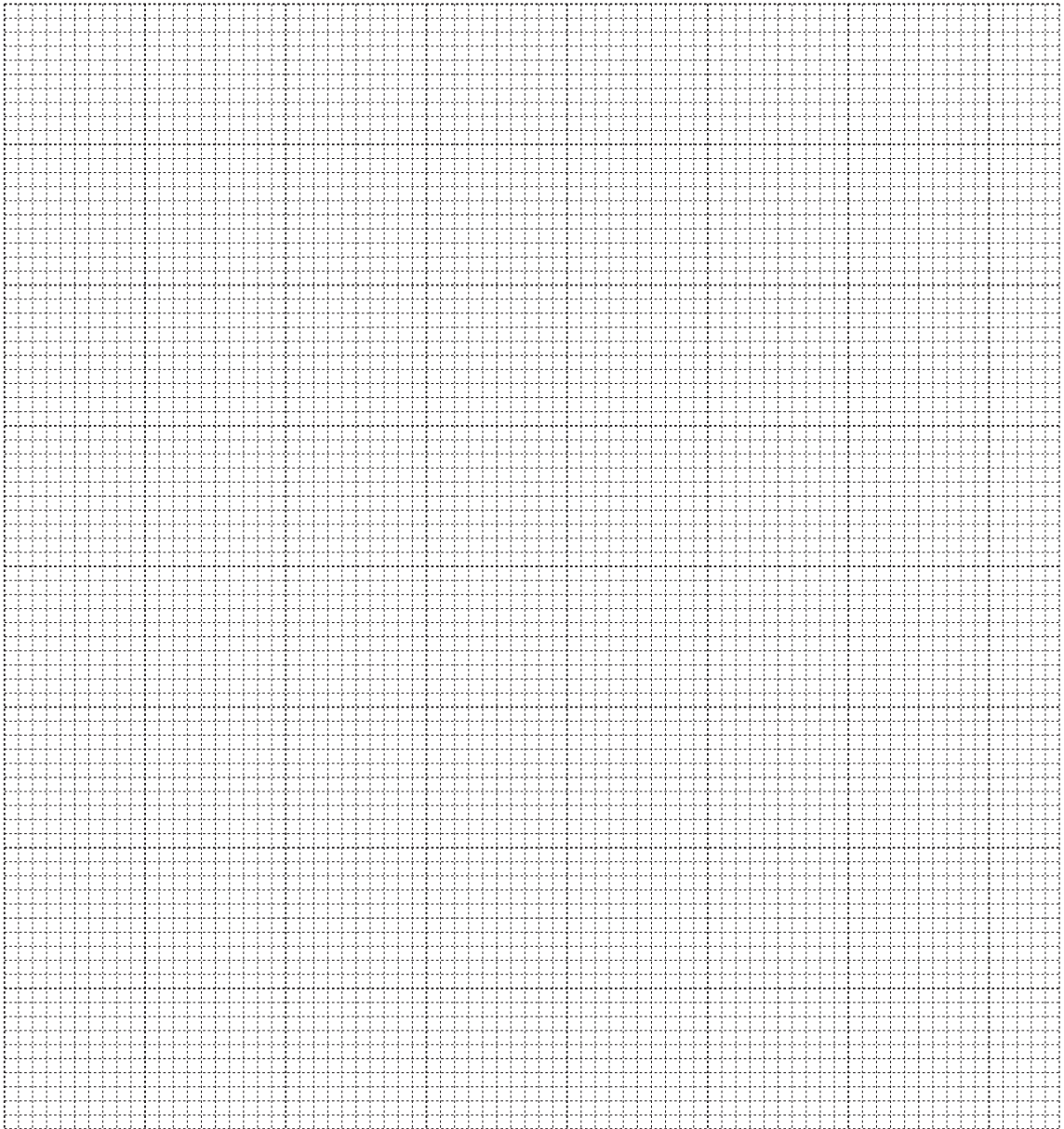
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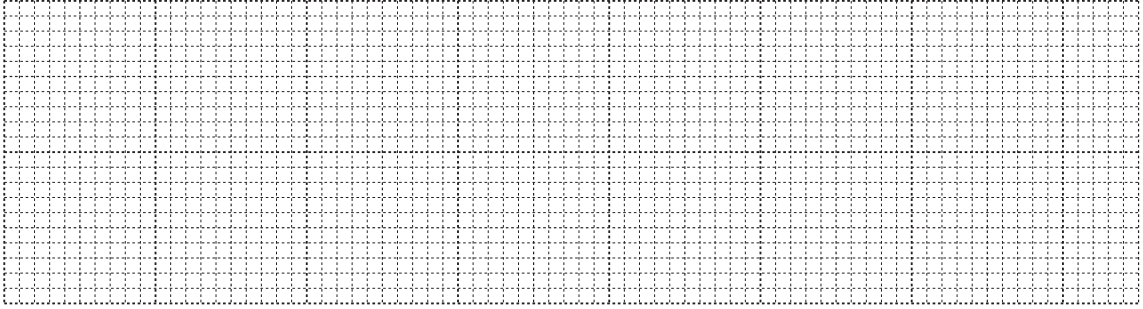
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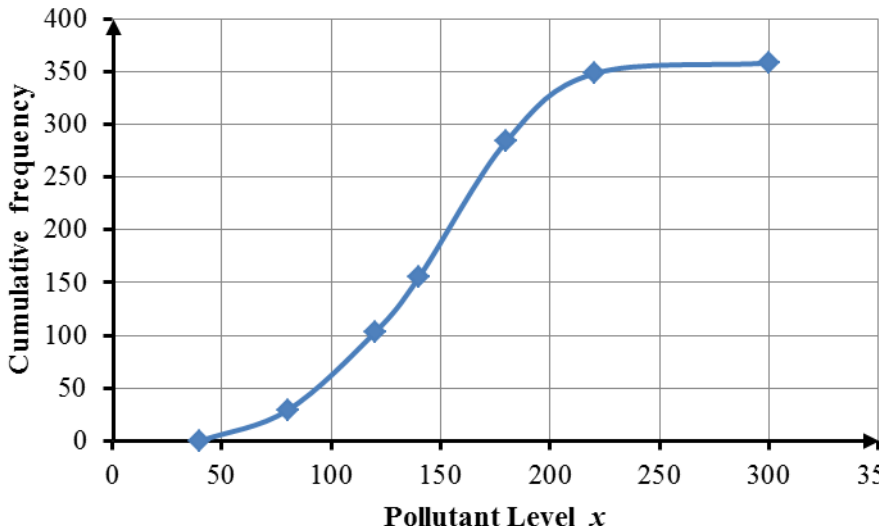
**Section B (36 marks)****6(i)**

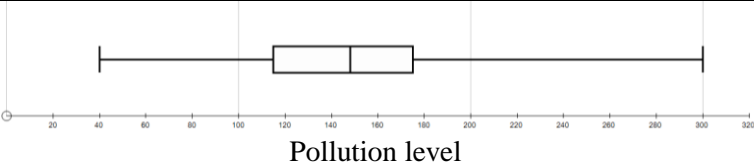
**6 (v)****6 (vi)**

Question			Answer	Marks	Guidance
1	(i)		$\text{Mean} = \frac{17100}{50} = 342$ $S_{xx} = 6115108 - \frac{17100^2}{50} = 266908$ $s = \sqrt{\frac{266908}{49}} = \sqrt{5447.10} = 73.8 \text{ (73.8044...)}$	B1  M1  A1 <b>[3]</b>	Ignore units CAO  For $S_{xx}$ M1 for $6115108 - 50 \times \text{their mean}^2$ BUT NOTE M0 if their $S_{xx} < 0$ CAO ignore units M1A0 for RMSD = 73.1 (73.062...)
1	(ii)		New mean = $(0.108 \times 342) + 7.2 = \text{£}44.14$  New sd = $0.108 \times 73.8 = \text{£}7.97$  Using RMSD gives $\text{£}7.89$ Using variance gives 588.29	B1  M1 A1 <b>[3]</b>	FT their mean Allow $\text{£}44.1$ or better provided answer is positive  FT their sd (unless negative) for M1 and A1  NB If candidate 'starts again' only award marks for CAO Do not penalise lack of units in mean or sd Deduct at most 1 mark overall in whole question for over-specification of either mean or SD or both
2	(i)		$\binom{50}{4} = \frac{50!}{4!46!} = 230300$	M1 A1 <b>[2]</b>	
2	(ii)		$\frac{17}{50} \times \frac{16}{49} \times \frac{15}{48} \times \frac{14}{47} = \frac{17}{1645} = 0.0103$ Or: $\binom{17}{4} \div \binom{50}{4} = \frac{2380}{230300} = 0.0103$	M1  A1 <b>[2]</b>  M1 A1	$17/50 \times$ or $0.34 \times$ <b>NB</b> $\left(\frac{17}{50}\right)^4$ or $0.34^4$ scores M1A0  But M0 if part of a binomial expression CAO Uncancelled fraction gets M1A0  Uncancelled fraction gets M1A0 Allow 0.010 with working but not 0.01

Question	Answer	Marks	Guidance
2 (iii)	$1 - 4! \times \frac{17}{50} \times \frac{9}{49} \times \frac{13}{48} \times \frac{11}{47}$ $= 1 - 24 \times 0.0003958..$ $= 1 - 0.09500217 = 0.905 \text{ (0.904997...)}$ <p>Or:</p> $1 - \left[ \binom{17}{1} \times \binom{9}{1} \times \binom{13}{1} \times \binom{11}{1} \div \binom{50}{4} \right] = 1 - 0.09500 = 0.905$	M1 M1 M1 A1 [4]  M1 M1 M1 A1	For correct product For $\times 4!$ For 1 – with product of four fractions but with or without a coefficient CAO If denominators all 50 then max M0M1M1A0 Allow 0.90 with working  For product of four correct nCr terms For division of product of four nCr terms by 50C4 For 1 - product of four nCr terms divided by 50C4
3 (i)	Possibilities are (1,2), (2,3), (3,4), (2,1), (3,2), (4,3) So 6 out of 16 or $\frac{3}{8}$ <u><b>NB ANSWER GIVEN</b></u>	M1 A1 [2]	Or M1 for table showing scores on both dice and differences SC1 for stating 3 different ways of getting diff of 1 and 2 ways round for each and 16 possibilities altogether so $\frac{3}{8}$ or similar
3 (ii)	$E(X) = \left(0 \times \frac{1}{4}\right) + \left(1 \times \frac{3}{8}\right) + \left(2 \times \frac{1}{4}\right) + \left(3 \times \frac{1}{8}\right) = \frac{10}{8} = \frac{5}{4} = 1.25$ $E(X^2) = \left(0 \times \frac{1}{4}\right) + \left(1 \times \frac{3}{8}\right) + \left(4 \times \frac{1}{4}\right) + \left(9 \times \frac{1}{8}\right) = \frac{10}{4} = 2.5$ $\text{Var}(X) = 2.5 - 1.25^2 = 0.9375 \quad \text{or} \quad \frac{10}{4} - \left(\frac{5}{4}\right)^2 = \frac{15}{16} = 0.9375$ Allow 0.938. Condone 0.94	M1 A1  M1*  M1* dep A1 [5]	For $\Sigma rp$ (at least 3 terms correct) CAO  For $\Sigma r^2 p$ (at least 3 terms correct)  for – their $(E(X))^2$ FT their $E(X)$ provided $\text{Var}(X) > 0$ Use of $E(X - \mu)^2$ gets M1 for attempt at $(x - \mu)^2$ should see $(-1.25)^2, (-0.25)^2, (0.75)^2, (1.75)^2$ (if $E(X)$ wrong FT their $E(X)$ ) (all 4 correct for M1), then M1 for $\Sigma p(x - \mu)^2$ (at least 3 terms correct) Division by 4 or other spurious value at end and/or rooting final answer gives max M1A1M1M1A0, or

Question			Answer	Marks	Guidance
					M1A0M1M1A0 if E(X) also divided by 4. Unsupported correct answers get 5 marks (Probably from calculator)
4	(i)		Probability = $(1 - 0.4) \times 0.8 = 0.48 \left( = \frac{12}{25} \right)$	M1 A1 [2]	
4	(ii)		<p><i>Either:</i> <math>P(A \cup B) = P(A) + P(B) - P(A \cap B)</math></p> $= 0.4 + 0.8 - 0.4 \times 0.8$ $= 0.88 \left( = \frac{22}{25} \right)$ <p><i>Or:</i> <math>P(A \cup B) = 0.4 \times 0.8 + 0.6 \times 0.8 + 0.4 \times 0.2</math></p> $= 0.32 + 0.48 + 0.08 = 0.88$ <p><i>Or:</i> <math>P(A \cup B) = 1 - P(A' \cap B')</math></p> $= 1 - 0.6 \times 0.2 = 1 - 0.12 = 0.88$	M1 M1 A1 CAO [3]  M1 M1 A1 M1 M1 A1	for use of formula for $0.4 \times 0.8$  For any two terms For all three terms  For $0.6 \times 0.2$ For complete method
4	(iii)		$P_{(A B)} = \frac{P(A \cap B)}{P(B)} = \frac{0.32}{0.88} = \frac{4}{11} = 0.364 = (0.3636\dots)$	M1 M1 A1FT [3]	For numerator As part of fraction (with denominator) For denominator As part of fraction (with numerator) FT their answer to part (ii)  Accept $0.\dot{3}\dot{6}$ (dots above) Accept 0.36 with correct working
5	(i)		$0.55^3 = 0.166 \quad (0.166375) \left( = \frac{1331}{8000} \right)$	M1 A1 [2]	For $0.55^3$ Accept 0.17 with working Condone answer of 0.166375 (over-specified)
5	(ii)		P(Wins in 3 games) = $0.45^3 = 0.091125$ P(Wins in 4 games) = $3 \times 0.45^2 \times 0.55 \times 0.45 = 0.150356$ P(Wins in 5 games) = $6 \times 0.45^2 \times 0.55^2 \times 0.45 = 0.165392$ NB Answer if no coefficients used is 0.168809... $= 0.091125 + 3 \times 0.05011875 + 6 \times 0.0275653125$ P(Emily wins) = 0.407 (0.406873...) $1 - P(\text{Sakura wins})$ can get all marks (use similar scheme) so eg $1 - 0.55^3$ gets M1M0M0M0A0	M1 M1 M1 M1 A1 [5]	For P(Wins in 3 games) P(Wins in 4 games) with any or no coefficient P(Wins in 5 games) with any or no coefficient For either coefficient correct CAO SC2 for P(Sakura wins) = 0.593 (0.593126...)

Question			Answer	Marks	Guidance																
6	(i)		<table><tr><td>Upper bound</td><td>40</td><td>80</td><td>120</td><td>140</td><td>180</td><td>220</td><td>300</td></tr><tr><td>Cumulative frequency</td><td>0</td><td>29</td><td>103</td><td>155</td><td>284</td><td>348</td><td>358</td></tr></table>  <p>NB If you receive a script where the graph is drawn on lined paper, rather than on the grid, please mark it and then refer it to your team leader <u>BEFORE</u> you submit it.</p>	Upper bound	40	80	120	140	180	220	300	Cumulative frequency	0	29	103	155	284	348	358	B1  G1   G1  G1   G1	Cumulative frequencies All correct. May be implied from graph. Condone omission of 0 at this stage.  For points Plotted as (UCB, their cf). Ignore (40,0) at this stage. No midpoint or LCB plots or non-linear scales Plotted within ½ small square If cf not given then allow B1G1 for all correct  For joining points (within ½ a square) For joining all of ‘their points’ (line or smooth curve) AND now including (40,0) Not for midpoint or LCB plots or non-linear scales  For scales Linear horizontal scale. Allow if start at 40 (no inequality scales - Not even <40, <60, <80 ...) Linear vertical scale Allow full credit if axes reversed correctly  For labels Pollutant level or $x$ and Cumulative frequency or just CF or similar but not frequency or fd nor cumulative fd All four dep on attempt at cumulative frequency. Mid-point or LCB plots or cum freq bars may score first and last two marks <b>NOTE With one error in cfs last 4 marks still available (EG 0, 29, 103, 145, 274, 338, 348)</b>
Upper bound	40	80	120	140	180	220	300														
Cumulative frequency	0	29	103	155	284	348	358														
6	(ii)		Estimate from curve is 327 Proportion = $327/358 = 0.913$ or 91.3% $315/368 = 87.99\%$ $316/358 = 88.3\%$  NB Linear interpolation gives $284 + \frac{1}{2} \times 64 = 316$	M1 A1 [2]	<b>Allow 315 to 330 without checking graph (unless non-linear scales in which case allow 316 by LI)</b> <b>Otherwise FT their graph</b> within one square (allow a slight slip in scales - contact TL if unsure) <b>Max M1A0 if final answer given as a fraction</b>																

Question		Answer	Marks	Guidance
6	(iii)	<p>Median = 148 <b>Allow 145 to 152 without checking graph</b>  <math>Q_1 = 115</math> <b>Allow 110 to 115 without checking graph</b>  <math>Q_3 = 175</math> <b>Allow 175 to 180 without checking graph</b>  IQR = 60</p> <p>If quartiles not specified give B1B0 for 'IQR is <math>115 &lt; x &lt; 175</math>' or similar  If answer only for IQR, check if quartiles given in part (iv) or (v) – if not then check graph</p>	<p>B1 B1  B1 [3]</p>	<p>For <math>Q_1</math> or <math>Q_3</math></p> <p>For IQR  FT their cf graph for all 3 marks within one square (on both scales)  (allow a slight slip in scales - contact TL if unsure)</p>
6	(iv)	<p>Lower limit <math>Q_1 - 1.5 \times \text{IQR}</math> '<math>115 - (1.5 \times 60)</math>' (= 25)  Upper limit <math>Q_3 + 1.5 \times \text{IQR}</math> '<math>175 + (1.5 \times 60)</math>' (= 265)</p> <p>There are definitely no outliers at the lower end as the lowest data value is 40 which is below the lower limit.</p> <p>It is uncertain whether there are outliers at the upper end as the highest class includes the upper limit.</p> <p>Use of mean = 145.08 and sd = 45.09 gives 54.9 and 235.26 for M2  So could be some outliers at lower and could be some at upper end but not sure. E1E1</p>	<p>M1 M1  A1      A1 [4]</p>	<p>FT their quartiles provided between 40 and 300</p> <p>Allow 'No values below (their) 25' for first A1  Allow 'Lower limit = (their) 25 so no outliers'  You must be convinced that comments about no outliers refer to <b>lower tail only</b>. Allow <u>additional</u> comment that since some data is lost there could be one or more outliers  If their lower limit &gt;40 then A0</p> <p>Do not allow 'There <u>IS</u> at least one outlier.' oe  There must be an element of doubt.  However, condone 'There is probably at least one outlier.'  You must be convinced that comments about some outliers refer to upper tail only.  If their upper limit &lt;220 or &gt;300 then A0</p>
6	(v)		<p>G1*  G1*dp  G1*dp</p>	<p>FT their median and quartiles provided between 40 and 300 and <math>Q_1 &lt; \text{median} &lt; Q_3</math> Can restart from graph  For linear scale shown. Dep on attempt at box and whisker plot with at least a box and one whisker.  Condone lack of label.</p> <p>For boxes (<math>Q_1</math>, median, <math>Q_3</math>) in correct positions, within half a square</p>

Question			Answer	Marks	Guidance
				[3]	For whiskers at 40 and 300 within half a square Upper whisker could be partially dotted
6	(vi)		<p>The readings from Tower Hamlets show (stronger) positive skewness</p> <p>The readings from Marylebone Road show little evidence of skewness Accept 'No skewness'</p> <p>For 2 marks must suggest that TH has higher positive skew than MR</p>	<p>E1</p> <p>E1</p> <p>[2]</p>	<p>Allow '<u>slight</u> positive skewness' Do <u>not</u> FT their diagram but must have boxplot in part (v) to get second mark</p> <p>'TH shows more evidence of positive skewness than MR' gets E2</p>
7	(i)	(A)	<p><math>X \sim B(12, 0.75)</math></p> <p><math>P(X = 9) = \binom{12}{9} \times 0.75^9 \times 0.25^3 = 0.258 \text{ (0.258103...)}</math></p> <p>Or: From tables  <math>P(X \leq 9) - P(X \leq 8) = 0.6093 - 0.3512 = 0.2581</math></p>	<p>M1</p> <p>M1</p> <p>A1</p> <p>M2</p> <p>A1</p> <p>[3]</p>	<p>For <math>0.75^9 \times 0.25^3</math></p> <p>For <math>\binom{12}{9} \times p^9 \times q^3</math> With <math>p + q = 1</math></p> <p>Also for <math>220 \times 0.00117...</math>  Allow 0.26 or better <b>with working</b>  <b>CAO</b></p> <p>For <math>0.6093 - 0.3512</math>  <b>CAO</b></p>
7	(i)	(B)	$P(X \geq 9) = 1 - P(X \leq 8) = 1 - 0.3512 = 0.6488$	<p>M1</p> <p>A1</p> <p>[2]</p>	<p>For 0.3512  <b>CAO</b></p> <p>Accept 0.649 and 0.65 with working  For <math>P(X=9) + P(X=10) + P(X=11) + P(X=12)</math> allow M1A1 for awrt 0.649. Otherwise M0A0.</p>
7	(ii)		<p>(Let <math>X \sim B(18, 0.75)</math>)  Let <math>p</math> = probability of dog having allergy relieved by the new shampoo (for population)</p> <p><math>H_0: p = 0.75</math>  <math>H_1: p &gt; 0.75</math></p> <p><math>H_1</math> has this form as the test is to determine whether the new shampoo relieves</p>	<p>B1</p> <p>B1</p> <p>B1</p> <p>E1</p>	<p>For definition of <math>p</math> (in context)  Do NOT allow <u>number</u> in place of probability.  See below for additional notes</p> <p>For <math>H_0</math>  For <math>H_1</math></p> <p>Dep on <math>&gt; 0.75</math> used in <math>H_1</math></p>

Question			Answer	Marks	Guidance
			the symptoms of a higher proportion of dogs who suffer from the allergy.  For use of B(18, 0.25), please consult your Team Leader	[4]	E0 for simply stating $H_1$ in words Condone number instead of proportion. Do Not allow just 'proportion will be higher' or similar.
7	(iii)	(A)	$P(X \geq 16) = 1 - P(X \leq 15) = 1 - 0.8647 = 0.1353$ $0.1353 > 0.1$ So not significant. Accept $H_0$ Conclude that there is not enough evidence to support the idea that the new shampoo relieves the symptoms of a higher proportion of dogs who suffer from the allergy.  $0.8647 < 0.9$ scores M2 and can get A1 E1 if $P(X \leq 15)$ oe seen and all correct	M1* *M1dep p A1* E1dep [4]	For sight of 0.1353 or 0.135 For (explicit) comparison with 10% or 0.1 Do NOT FT wrong $H_1$ but first mark available if $H_1$ or $H_0$ wrong For A1 need $P(X \geq 16)$ somewhere oe eg $P(\geq 16)$ Allow SC2 for clearly indicating use of B(18, 0.75) but with no mention of 0.1353 with convincing reasoning and final answer correct No marks if point probabilities used. Do not condone number instead of proportion  Must include 'not enough evidence' oe
			ALTERNATIVE METHOD Provided they are using CR method $P(X \geq 16) = 0.1353$ $P(X \geq 17) = 0.0395$ OR 0.8647 and 0.9605  $0.1353 > 0.1$ or $0.0395 < 0.1$ OR $0.8647 < 0.9$ or $0.9605 > 0.9$  So critical region is {17, 18} so not significant. or 16 not in CR so not significant  Conclude that there is enough evidence to support the idea that the new shampoo relieves the symptoms of a higher proportion of dogs who suffer from the allergy.	B1   M1  A1*  E1* dep	For both probabilities Do not insist on correct notation as candidates have to work out two probabilities for full marks.  For at least one comparison with 10% Allow comparison in form of statement 'critical region at 10% level is ...'  CAO dep on the two correct probabilities  Ignore any work on lower critical region  No marks if CR not justified. However SC2 above still applies Condone $X \geq 17$ , , oe but not $P(X \geq 17)$ etc Assume using first method unless you are convinced that candidate is using CR method. No marks if point probabilities used
7	(iii)	(B)	$P(X \geq 42) = 1 - P(X \leq 41) = 1 - 0.9084 = 0.0916$	B1	For use of $P(X \leq 41)$

Question			Answer	Marks	Guidance
			$0.0916 < 0.1$ or $0.9084 > 0.9$  So significant. Reject $H_0$ Conclude that there is enough evidence to support the idea that the new shampoo relieves the symptoms of a higher proportion of dogs who suffer from the allergy.	M1*  A1* E1*de p <b>[4]</b>	For comparison with 10%  dep on first two marks  NB If more than one attempt please mark the final one. Do not penalise 'number' rather than 'proportion' twice in parts A and B NB No marks for critical region method unless find $P(X \leq 40) = 0.9084 - 0.0721 = 0.8363$ in which case follow above scheme for part (iii)(A) so should have 0.1637 $> 0.1$ and $0.0916 < 0.1$ or $0.8363 < 0.9$ and $0.9084 > 0.9$ etc (giving CR{42, 43, 44, 45, 46, 47, 48, 49, 50})

### **NOTE RE OVER-SPECIFICATION OF ANSWERS**

If answers are grossly over-specified, deduct the final answer mark. Note in Q1 only deduct 1 mark altogether even if both mean and sd over-specified.

Probabilities should also be rounded to a sensible degree of accuracy. In general final non probability answers should not be given to more than 4 significant figures. Allow probabilities given to 5 sig fig.(and condone 6 sig fig in Q5(i)). **You must highlight any over-specified answers.**

### **ANNOTATION RULES**

See note 12 above and particularly 12a. Remember to put full annotation on all practice and standardisation scripts unless the candidate has scored full marks or zero. In addition for all marking in Q6(i) and Q6(v) if the candidate has not scored full marks then show which B marks have been awarded in the right hand margin, in the same order as they are given in the mark scheme. You should indicate any errors made.

### **Reminder of note 7 above which is a change from previous years:**

Award No Response (NR) if:

- there is nothing written in the answer space

Award Zero '0' if:

- anything is written in the answer space and is not worthy of credit (this includes text and symbols).

### **Additional notes re Q7 part ii**

Minimum needed for B1 is  $p$  = probability allergy relieved

Allow  $p$  = P(allergy relieved )

Definition of  $p$  must include word probability (or chance or proportion or percentage or likelihood but NOT possibility, number or amount).

Preferably given as a separate comment. However can be at end of  $H_0$  as long as it is a clear definition ' $p$  = the probability that the allergy is relieved.'

Do NOT allow ' $p$  = the probability that the allergy is relieved is greater'

Allow  $p=75\%$ , allow only  $p$  or  $\theta$  or  $\pi$  or  $\rho$ . However allow any single symbol if defined (including  $x$ )

Allow  $H_0 = p=0.75$ , Allow NH and AH in place of  $H_0$  and  $H_1$

Do not allow  $H_0: P(X=x) = 0.75$

Do not allow  $H_0: =0.75, =75\%, P(0.0.75), p(x)=0.75, x=0.75$  (unless  $x$  correctly defined as a probability)

Do not allow  $H_0$  and  $H_1$  reversed

For hypotheses given in words allow Maximum B0B1B1

Hypotheses in words must include probability (or chance or proportion or percentage or %) and the figure 0.75 or

Thus eg  $H_0: P(\text{allergy relieved}) = 0.75, H_1: P(\text{allergy relieved}) > 0.75$  gets B0B1B1