



GuideMyGrades

— YOUR GOALS. OUR EXPERTISE. —

EDEXCEL A LEVEL MATHEMATICS: QUESTIONS BY TOPIC

Statistical Distributions (14)

A Level Mathematics Topic 14

12 questions · 128 marks · Mark schemes included

Pearson Edexcel A Level Mathematics (9MA0), June 2018 - June 2025

 guidemygrades.com

 [@Guidemygrades](https://www.instagram.com/Guidemygrades)

 [@Guidemygrades](https://twitter.com/Guidemygrades)

 [@Guidemygrades](https://www.youtube.com/Guidemygrades)

 info@guidemygrades.com

 Piccadilly Business Centre, Unit C, Aldow Enterprise Park
Blackett Street, Manchester, M12 6AE

HOW TO USE THIS BOOKLET

Questions are grouped by specification sub-topic and run from the lowest mark tariff to the highest within each one.

Click any row below to jump straight to that sub-topic or question.

On every question page, click ANSWER in the top-right corner to jump to its mark scheme.

Diagrams, graphs, tables and data are printed exactly as they appeared in the original papers.

QUESTION	SOURCE	MARKS	PAGE
14.1 DISCRETE DISTRIBUTIONS AND THE BINOMIAL DISTRIBUTION		6 Qs · 51 marks	3
1. Q6 <i>also Topic 13</i>	Paper 3: Statistics and Mechanics November2021	7	4
2. Q5 <i>also Topic 13</i>	Paper 3: Statistics and Mechanics June2023	8	7
3. Q4 <i>also Topic 11 & 12 & 13</i>	Paper 3: Statistics and Mechanics June2019	9	11
4. Q4 <i>also Topic 13</i>	Paper 3: Statistics and Mechanics October2020	10	15
5. Q3 <i>also Topic 15</i>	Paper 3: Statistics and Mechanics June2025	6	19
6. Q6	Paper 3: Statistics and Mechanics June2025	11	21
14.2 THE NORMAL DISTRIBUTION		6 Qs · 77 marks	26
7. Q2 <i>also Topic 12</i>	Paper 3: Statistics and Mechanics June2019	11	27
8. Q5 <i>also Topic 11 & 12 & 13</i>	Paper 3: Statistics and Mechanics June2019	13	31
9. Q5 <i>also Topic 11 & 12 & 13</i>	Paper 3: Statistics and Mechanics June2018	14	34
10. Q6 <i>also Topic 11 & 12</i>	Paper 3: Statistics and Mechanics June2023	14	38
11. Q5 <i>also Topic 11 & 12 & 13 & 15</i>	Paper 3: Statistics and Mechanics October2020	15	43
12. Q5	Paper 3: Statistics and Mechanics June2025	10	48



QUESTIONS

12 questions · 128 marks · 2 sub-topics



SUB-TOPIC 14.1

DISCRETE DISTRIBUTIONS AND THE BINOMIAL DISTRIBUTION

Sub-topic 14.1 · 6 questions · 51 marks · lowest tariff first



6. The discrete random variable X has the following probability distribution

x	a	b	c
$P(X=x)$	$\log_{36} a$	$\log_{36} b$	$\log_{36} c$

where

- a, b and c are distinct integers ($a < b < c$)
- all the probabilities are greater than zero

(a) Find

- (i) the value of a
- (ii) the value of b
- (iii) the value of c

Show your working clearly.

(5)

The independent random variables X_1 and X_2 each have the same distribution as X

(b) Find $P(X_1 = X_2)$

(2)





Question 6 continued.

(Total for Question 6 is 7 marks)



5. Tisam is playing a game.
She uses a ball, a cup and a spinner.

The random variable X represents the number the spinner lands on when it is spun.
The probability distribution of X is given in the following table

x	20	50	80	100
$P(X = x)$	a	b	c	d

where a , b , c and d are probabilities.

To play the game

- the spinner is spun to obtain a value of x
- Tisam then stands x cm from the cup and tries to throw the ball into the cup

The event S represents the event that Tisam successfully throws the ball into the cup.

To model this game Tisam assumes that

- $P(S | \{X = x\}) = \frac{k}{x}$ where k is a constant
- $P(S \cap \{X = x\})$ should be the same whatever value of x is obtained from the spinner

Using Tisam's model,

(a) show that $c = \frac{8}{5}b$ (2)

(b) find the probability distribution of X (5)

Nav tries, a large number of times, to throw the ball into the cup from a distance of 100 cm.

He successfully gets the ball in the cup 30% of the time.

(c) State, giving a reason, why Tisam's model of this game is not suitable to describe Nav playing the game for all values of X (1)





(Total for Question 5 is 8 marks)



4. Magali is studying the mean total cloud cover, in oktas, for Leuchars in 1987 using data from the large data set. The daily mean total cloud cover for all 184 days from the large data set is summarised in the table below.

Daily mean total cloud cover (oktas)	0	1	2	3	4	5	6	7	8
Frequency (number of days)	0	1	4	7	10	30	52	52	28

One of the 184 days is selected at random.

- (a) Find the probability that it has a daily mean total cloud cover of 6 or greater.

(1)

Magali is investigating whether the daily mean total cloud cover can be modelled using a binomial distribution.

She uses the random variable X to denote the daily mean total cloud cover and believes that $X \sim B(8, 0.76)$

Using Magali's model,

- (b) (i) find $P(X \geq 6)$

(2)

- (ii) find, to 1 decimal place, the expected number of days in a sample of 184 days with a daily mean total cloud cover of 7

(2)

- (c) Explain whether or not your answers to part (b) support the use of Magali's model.

(1)

There were 28 days that had a daily mean total cloud cover of 8

For these 28 days the daily mean total cloud cover for the **following** day is shown in the table below.

Daily mean total cloud cover (oktas)	0	1	2	3	4	5	6	7	8
Frequency (number of days)	0	0	1	1	2	1	5	9	9

- (d) Find the proportion of these days when the daily mean total cloud cover was 6 or greater.

(1)

- (e) Comment on Magali's model in light of your answer to part (d).

(2)



This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.



This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.



This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

(Total for Question 4 is 9 marks)



4. The discrete random variable D has the following probability distribution

d	10	20	30	40	50
$P(D = d)$	$\frac{k}{10}$	$\frac{k}{20}$	$\frac{k}{30}$	$\frac{k}{40}$	$\frac{k}{50}$



Question 4 continued

(Total for Question 4 is 10 marks)



On average 1.5% of the components made are defective.

- (3)

A random sample of 260 components is taken and 8 are found to be defective.

- (3)



Question 3 continued

(Total for Question 3 is 6 marks)



6. The discrete random variable R takes even integer values from 2 to $2n$ inclusive.

The probability distribution of R is given by

$$P(R = r) = \frac{r}{k} \quad r = 2, 4, 6, \dots, 2n$$

where k is a constant.

- (a) Show that $k = n(n + 1)$

(4)

When $n = 20$

- (b) find the exact value of $P(16 \leq R < 26)$

(2)

When $n = 20$, a random value g of R is taken and the quadratic equation in x

$$x^2 + gx + 3g = 5$$

is formed.

- (c) Find the exact probability that the equation has no real roots.

(5)



Question 6 continued



Question 6 continued







SUB-TOPIC 14.2

THE NORMAL DISTRIBUTION

Sub-topic 14.2 · 6 questions · 77 marks · lowest tariff first



2.

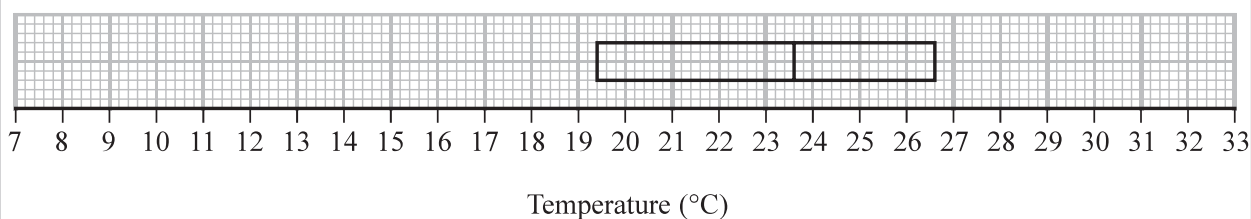


Figure 1

The partially completed box plot in Figure 1 shows the distribution of daily mean air temperatures using the data from the large data set for Beijing in 2015

An outlier is defined as a value

more than $1.5 \times \text{IQR}$ below Q_1 or
more than $1.5 \times \text{IQR}$ above Q_3

The three lowest air temperatures in the data set are 7.6°C , 8.1°C and 9.1°C

The highest air temperature in the data set is 32.5°C

(a) Complete the box plot in Figure 1 showing clearly any outliers.

(4)

(b) Using your knowledge of the large data set, suggest from which month the two outliers are likely to have come.

(1)

Using the data from the large data set, Simon produced the following summary statistics for the daily mean air temperature, $x^\circ\text{C}$, for Beijing in 2015

$$n = 184 \quad \sum x = 4153.6 \quad S_{xx} = 4952.906$$

(c) Show that, to 3 significant figures, the standard deviation is 5.19°C

(1)

Simon decides to model the air temperatures with the random variable

$$T \sim N(22.6, 5.19^2)$$

(d) Using Simon's model, calculate the 10th to 90th interpercentile range.

(3)

Simon wants to model another variable from the large data set for Beijing using a normal distribution.

(e) State two variables from the large data set for Beijing that are **not** suitable to be modelled by a normal distribution. Give a reason for each answer.

(2)

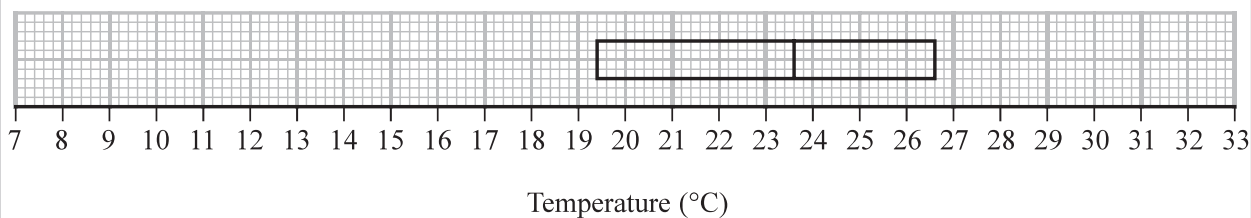
This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.



This image shows a full page of blank, lined paper. It features approximately 28 horizontal blue or grey lines spaced evenly apart, typical of notebook paper. The lines extend across the entire width of the page, leaving small margins at the top and bottom. There are no vertical lines, text, or other markings on the page.

Question 2 continued

Only use this grid if you need to redraw your box plot.



(Total for Question 2 is 11 marks)



5. A machine puts liquid into bottles of perfume. The amount of liquid put into each bottle, D ml, follows a normal distribution with mean 25 ml

Given that 15% of bottles contain less than 24.63 ml

- (a) find, to 2 decimal places, the value of k such that $P(24.63 < D < k) = 0.45$

(5)

A random sample of 200 bottles is taken.

- (b) Using a normal approximation, find the probability that fewer than half of these bottles contain between 24.63 ml and k ml

(3)

The machine is adjusted so that the standard deviation of the liquid put in the bottles is now 0.16 ml

Following the adjustments, Hannah believes that the mean amount of liquid put in each bottle is less than 25 ml

She takes a random sample of 20 bottles and finds the mean amount of liquid to be 24.94 ml

- (c) Test Hannah's belief at the 5% level of significance.
You should state your hypotheses clearly.

(6)



This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.



[illegible]



6. A medical researcher is studying the number of hours, T , a patient stays in hospital following a particular operation.

The histogram on the page opposite summarises the results for a random sample of 90 patients.

- (a) Use the histogram to estimate $P(10 < T < 30)$

(2)

For these 90 patients the time spent in hospital following the operation had

- a mean of 14.9 hours
- a standard deviation of 9.3 hours

Tomas suggests that T can be modelled by $N(14.9, 9.3^2)$

- (b) With reference to the histogram, state, giving a reason, whether or not Tomas' model could be suitable.

(1)

Xiang suggests that the frequency polygon based on this histogram could be modelled by a curve with equation

$$y = kxe^{-x} \quad 0 \leq x \leq 4$$

where

- x is measured in **tens of hours**
- k is a constant

- (c) Use algebraic integration to show that

$$\int_0^n xe^{-x} dx = 1 - (n+1)e^{-n} \quad (4)$$

- (d) Show that, for Xiang's model, $k = 99$ to the nearest integer.

(3)

- (e) Estimate $P(10 < T < 30)$ using

- (i) Tomas' model of $T \sim N(14.9, 9.3^2)$

(1)

- (ii) Xiang's curve with equation $y = 99xe^{-x}$ and the answer to part (c)

(2)

The researcher decides to use Xiang's curve to model $P(a < T < b)$

- (f) State one limitation of Xiang's model.

(1)



A histogram showing the frequency density of time spent on a task. The x-axis is labeled 'Time in hours' and ranges from 0 to 40 with major grid lines every 5 units and minor grid lines every 1 unit. The y-axis is labeled 'Frequency density' and ranges from 0 to 5 with major grid lines every 1 unit and minor grid lines every 0.2 units. The histogram consists of five bars with the following widths and heights:

Time Interval (hours)	Frequency Density
0 to 4	2.5
4 to 8	3.0
8 to 13	4.2
13 to 17	4.0
17 to 40	1.0





(Total for Question 6 is 14 marks)









(Total for Question 3 is 15 marks)





Question 5 continued



(Total for Question 3 is 10 marks)



MARK SCHEMES

official mark schemes



Qu 6	Scheme	Marks	AO	
(a)	[Sum of probs = 1 implies] $\log_{36} a + \log_{36} b + \log_{36} c = 1$	M1	3.1a	
	$\Rightarrow \log_{36}(abc) = 1$ so $abc = 36$	A1	3.4	
	All probabilities greater than 0 implies each of a , b and $c > 1$	B1	2.2a	
	$36 = 2^2 \times 3^2$ (or 3 numbers that multiply to give 36 e.g. 2, 2, 9 etc)	dM1	2.1	
	Since a , b and c are distinct must be <u>2, 3, 6</u> (<u>$a = 2, b = 3, c = 6$</u>)	A1	3.2a	
(b)	$(\log_{36} a)^2 + (\log_{36} b)^2 + (\log_{36} c)^2$ [= 0.0374137...+ 0.09398737...+0.25] = 0.38140... awrt <u>0.381</u>	(5)		
		M1	3.4	
		A1	1.1b	
		(2)		
		(7 marks)		
Notes				
(a)	1 st M1 for a start to the problem using sum of probabilities leading to eq'n in a , b and c			
	1 st A1 for reducing to the equation $abc = 36$ [Must follow from their equation.]			
	NB Can go straight from $abc = 36$ to the answer for full marks for part (a).			
	B1 for deducing that each value > 1 (may be implied by 3 integers all > 1 in the next line)			
	2 nd dM1 (dep on M1A1) for writing 36 as a product of prime factors <u>or</u> 3 values with product = 36 and none = 1			
SC	2 nd A1 for 2, 3 and 6 as a list or $a = 2, b = 3$ and $c = 6$			
	M0M0 If no method marks scored but a correct answer given score: M0A0B1M0A1 (2/5)			
	Ans only This gets the SC score of 2/5 [Question says show your working clearly]			
	(b)	M1 for a correct expression in terms of a , b and c or values; ft their integers a , b and c Condone invisible brackets if the answer implies they are used.		
		A1 for awrt 0.381		

G.B. Attwood 26/10/2021



Qu 5	Scheme	Marks	AO
(a)	$P(S \cap \{X = 50\}) = P(S \cap \{X = 80\}) [= \text{a constant, } V] \Rightarrow b \times \frac{k}{50} = c \times \frac{k}{80}$	M1	3.1a
	May see: $\frac{k}{50} = \frac{V}{b}$ <u>and</u> $\frac{k}{80} = \frac{V}{c}$ (condone any <u>letter</u> for V even S)		
	So $\underline{c = \frac{8}{5}b} \quad *$	A1cso*	1.1b
	(2)		
	(b)	$d = 2b$ or $a = \frac{2}{5}b$ or $c = 4a$ or $d = 5a$ or $d = \frac{5}{4}c$	M1 A1
	$\frac{2}{5}b + b + \frac{8}{5}b + 2b = 1$	M1	2.1
	$\Rightarrow 5b = 1$ so $b = \frac{1}{5}$ (o.e.)	A1	1.1b
	$\underline{\underline{a = \frac{2}{25} \quad b = \frac{1}{5} \quad c = \frac{8}{25} \quad d = \frac{2}{5}}}$	A1	3.2a
	(5)		
	(c)	[Experiment suggests for Nav] $P(S \mid \{X = 100\}) = 0.3 \Rightarrow k = 30$ or $0.3 = \frac{V}{0.4} \Rightarrow V = 0.12$ So model won't work since $P(S \mid X = 20) = \frac{30}{20}$ <u>or</u> $\frac{0.12}{0.08}$ and so would be greater than 1	B1
		(1)	
		(8 marks)	
Notes			
(a)	M1 for use of $P(S \mid X = x) \times P(X = x)$ for $x = 50$ <u>and</u> $x = 80$ (Must see k or their V) Any expression or equation MUST be based on the probability statements in qu.		
*	A1cso for rearranging to required result, no incorrect work seen, condone poor notation		
NB	Use of values e.g. $b = \frac{50}{20 + 50 + 80 + 100}$ to prove (a) is M0A0 but scores 2 nd M1A1 in (b)		
Marks for (b) may be awarded for work seen in (a)			
(b)	1 st M1 for at least one other relationship (either probability the subject) from the list. 1 st A1 for a second different relationship (either probability the subject) from the list. <u>or</u> Allow for: $\frac{ak}{20} = \frac{bk}{50} = \frac{ck}{80} = \frac{dk}{100}$ for 1 st M1 1 st A1 2 nd M1 for using or stating sum of prob's = 1 May be implied by one correct probability. 2 nd A1 for one correct probability e.g. $b = \frac{1}{5}$ or exact equivalent such as 0.2 3 rd A1 for all correct probabilities. Allow exact equivalents e.g. $c = 0.32$ Sight of correct distribution or list of probs with no obvious incorrect working is 5/5		
(c)	B1 for deducing $k = 30$ and giving a suitable example to show model breaks down		



Question	Scheme	Marks	AOs
4 (a)	$\frac{132}{184} = 0.71739...$ awrt 0.717	B1	1.1b
		(1)	
(b)(i)	$P(X \geq 6) = 1 - P(X \leq 5)$ or $P([X =]6) + P([X =]7) + P([X =]8)$	M1	3.4
	$= 1 - 0.296722...$ awrt 0.703	A1	1.1b
		(2)	
(b)(ii)	$184 \times P(X = 7)$ [= $184 \times 0.2811...$]	M1	1.1b
	$= 51.7385...$ awrt 51.7	A1	1.1b
		(2)	
(c)	Part (a) and part (b)(i) are similar and the expected number of 7s (51.7 or 0.281) matches with the number of 7s found in the data set (52 or 0.283) so Magali's model is supported.	B1ft	3.5a
		(1)	
(d)	$\frac{23}{28} = 0.82142...$ awrt 0.821	B1	1.1b
		(1)	
(e)	Any one of... - Part (d)/'0.821' differs from part (a)/(b)(i)/(0.7...) - there is a greater/different probability of high cloud cover/more likely to have high cloud cover if the previous day had high cloud cover independence(o.e.) does not hold	B1	2.4
	...therefore Magali's (binomial) model may not be suitable.	dB1	3.5a
		(2)	
(9 marks)			
Notes			
	Allow fractions, decimals or percentages throughout this question.		
(a)	Allow equivalent fraction, e.g. $\frac{33}{46}$		
(b)(i)	M1: for writing or using $1 - P(X \leq 5)$ or $P(X = 6) + P(X = 7) + P(X = 8)$ A1: awrt 0.703 (correct answer scores 2 out of 2)		
(b)(ii)	M1: for $184 \times P(X = 7)$ o.e. e.g., $184 \times [P(X \leq 7) - P(X \leq 6)]$ A1: awrt 51.7		
(c)	B1ft: comparing '0.717' with '0.703' <u>and</u> '51.7' or '0.281' with 52 or 0.283 and concluding that Magali's model is supported (must be comparing prob. with prob. <u>and</u> days with days). Allow not supported or mixed conclusions if consistent with their f.t. answers in (a) and (b)		
(e)	B1: Any bullet point dB1: (dep on previous B1) for Magali's model may not be suitable (o.e.) Condone not accurate for not suitable SC: part (d) is similar to part (a)/(b)(i) and a compatible conclusion (i.e. Magali's model is supported) to score B1B1.		

Qu 4	Scheme	Marks	AO
(a)	$\frac{k}{10} + \frac{k}{20} + \frac{k}{30} + \frac{k}{40} + \frac{k}{50} = 1$ or $\frac{1}{600}(60k + 30k + 20k + 15k + 12k) = 1$ $\text{So } k = \frac{600}{137} \quad (*)$	M1 A1cso	1.1b 1.1b
(b)	(Cases are:) $D_1 = 30, D_2 = 50$ and $D_1 = 50, D_2 = 30$ and $D_1 = 40, D_2 = 40$ $P(D_1 + D_2 = 80) = \frac{k}{50} \times \frac{k}{30} \times 2 + \left(\frac{k}{40}\right)^2$ $= 0.0375619... \text{ awrt } \underline{\underline{0.0376}}$	M1 M1 A1	2.1 3.4 1.1b
(c)	Angles are: $a, a + d, a + 2d, a + 3d$ $S_4 = a + (a + d) + (a + 2d) + (a + 3d) = 360$ $2a + 3d = 180 \text{ (o.e.)}$ Smallest angle is $a > 50$ consider cases: $d = 10$ so $a = 75$ <u>or</u> $d = 20$ so $a = 60$ [$d = 30$ gives $a = 45$ no good] $P(D = 10 \text{ or } 20) = \frac{3k}{20} = \frac{90}{137}$	M1 M1 A1 M1 A1	3.1a 2.1 2.2a 3.1b 1.1b
(5)			
(10 marks)			
Notes			
(a)	M1 for clear use of sum of probabilities = 1 (all terms seen) A1 cso (*) M1 scored and no incorrect working seen. Verify (Assume $k = \frac{600}{137}$) to score the final A1 they must have a <u>final</u> comment " $\therefore k = \frac{600}{137}$ "		
(b)	1 st M1 for selecting at least 2 of the relevant cases (may be implied by their correct probs) e.g. allow 30, 50 and 50,30 i.e. D_1 and D_2 labels not required 2 nd M1 for using the model to obtain a correct expression for two different probabilities. May use letter k or their value for k . $\text{Allow for } \frac{k}{50} \times \frac{k}{30} + \left(\frac{k}{40}\right)^2 \text{ or } 2 \times \left(\frac{k}{50} \times \frac{k}{30} + \left(\frac{k}{40}\right)^2\right)$		
	A1 for awrt 0.0376 (exact fraction is $\frac{705}{18769}$)		
(c)	1 st M1 for recognising the 4 angles and finding expressions in terms of d and their a 2 nd M1 for using property of quad with these 4 angles (equation can be un-simplified) Allow these two marks for use of a (possible) value of d e.g. $a + a + 10 + a + 20 + a + 30 = 360$ (If at least 3 cases seen allow A1 for e.g. $4a = 300$) <u>or</u> allow M1M1 for a set of 4 angles with sum 360 and possible value of d (3 cases for A1) e.g. (for $d = 20$) 60, 80, 100, 120 1 st A1 for $2a + 3d = 180$ condition (o.e.) [Must be in the form $pa + qd = N$] 3 rd M1 for examining cases and getting $d = 10$ and $d = 20$ only 2 nd A1 for $\frac{90}{137}$ or exact equivalent The correct answer and no obviously incorrect working will score 5/5 A final answer of awrt 0.657 (0.65693...) with no obviously incorrect working scores 4/5		



Question	Scheme		Marks	AOs
3(a) (i) (ii)	[Let D = the number of defective components] $D \sim B(36, 0.015)$		M1	3.3
	[$P(D = 2) =]$ 0.084792... awrt <u>0.0848</u>		A1	1.1b
	[$P(D > 3) = 1 - P(D \leq 3) = 1 - 0.9979... =]$ 0.002032... awrt <u>0.00203</u>		A1	1.1b
			(3)	
3(b)	[Let X = the number of defective components] $X \sim B(260, 0.015)$		M1	3.3
	[$P(X \geq 8) =]$ 0.0441(1...)		A1	1.1b
	[$0.04 > 0.025$ so not significant] <u>Insufficient</u> evidence that <u>proportion/probability</u> of defective <u>components</u> has <u>changed</u> (o.e.)		A1	2.2b
			(3)	
(6 marks)				
Notes:				
(a) (i) (ii)	M1	for selecting $B(36, 0.015)$ sight of or use of. Must be $B(...)$ [Implied by sight of $Po(0.54)$] May be implied by sight of: 0.0848 <u>or</u> awrt 0.085 <u>or</u> 0.00203 <u>or</u> 0.998 <u>or</u> 0.002		
	A1	for awrt 0.0848		
	A1	for awrt 0.00203 [Allow 2.03×10^{-3}]		
	Use of Poisson $Po(0.54)$ (i) 0.08496 scores A0 (ii) 0.002309... awrt 0.00231 scores A1			
Notation: We do not accept “calculator speak” e.g. $N = 36, p = 0.015$ instead of $B(36, 0.015)$				
(b)	M1	for sight of $B(260, 0.015)$ may be implied by probability of awrt 0.0441 <u>or</u> awrt 0.0264 <u>or</u> awrt 0.956 <u>or</u> correct CR $X = 0$ [<u>or</u> ≤ 0] and $X \geq 9$ <u>or</u> $P(X \geq 8) = 0.04$ or better		
	A1	for probability of awrt 0.0441 (selected if more probabilities seen) Condone $P(X = 8) = 0.0441...$ If $P(X \geq 8)$ is explicitly seen allow 0.04 or better <u>or</u> for the correct CR $X = 0$ [<u>or</u> ≤ 0] and $X \geq 9$. Allow acceptance region $[1, 8]$ (o.e.)		
	A1	dep on M1A1 for a correct conclusion in context. Allow e.g: <u>proportion/probability</u> of defective <u>components</u> has <u>not changed</u> <u>proportion/probability</u> of defective <u>components</u> is still <u>0.015</u> Allow “defectives” instead of “components” If a comparison is seen (other than $0.956 < 0.975$) it must be with 0.025 Incorrect comparisons score A0 (condone missing comparison) Do not accept contradictory statements e.g. “significant so insufficient evidence of change in proportion” would score A0 “Insufficient evidence that $p \neq 0.015$ ” is A0, we need the words.		
SC	Poisson Approximation (If you see $Po(3.9)$ or probability 0.0454...)			
	B2 and mark as M0A1A1			
	B1	for probability of awrt 0.0454 <u>or</u> 0.04... if $P(X \geq 8)$ seen <u>or</u> CR as above		
	B1	for correct conclusion in context (same rules as above)		



Question	Scheme		Marks	AOs
6(a)	Use sum of probs = 1: $1 = \frac{1}{k}(2 + 4 + \dots + 2n)$ Allow $1 = \frac{S_r}{k}$ where $S_r = \sum_{r=1}^n 2r$		M1	3.1a
	Sum e.g. $\frac{n}{2}[4 + 2(n-1)]$ or $\frac{n}{2}[2 + 2n]$ or use $\sum_1^n r = \frac{n(n+1)}{2}$		M1	2.1
	Use sum formula: e.g. $1 = \frac{1}{k} \times \frac{n}{2}[4 + 2(n-1)]$ or $1 = \frac{n}{2} \left[\frac{2}{k} + \frac{2n}{k} \right]$		A1	1.1b
	$k = n(n+1) *$		A1*cso	1.1b
			(4)	
6(b)	Cases: $R = 16, 18, 20, 22$ and 24		M1	3.4
	Probability = $\left[\frac{16+18+20+22+24}{20 \times 21} \right] = \frac{5}{21}$		A1	1.1b
			(2)	
6(c)	[No real roots $\Rightarrow \Delta < 0$] so $g^2 - 4(3g - 5) < 0$		M1	3.1a
	$[g^2 - 12g + 20 < 0 \Rightarrow] \quad (g-10)(g-2) < 0$		M1	2.1
	So require $2 < g < 10$ or $4 \leq g \leq 8$		M1	1.1b
	So require $g = 4, 6, 8$ only		dM1	1.1b
	Probability = $\left[\frac{4+6+8}{20 \times 21} \right] = \frac{18}{420} = \frac{3}{70}$		A1	3.2a
			(5)	
(11 marks)				
Notes:				
(a)	M1	for clear attempt/intention to use sum of probs = 1 for n terms. Must see k and “= 1” Condone missing ... $\sum_2^{2n} r$ is M0 since not n terms		
	M1	for using an arithmetic series or Σr to find sum to n terms. No need for k		
	A1	(dep on M1M1) for a correct working leading to a correct equation in k and n		
	A1*	cso for correct solution with both Ms clearly scored and no incorrect working seen		
	SC	Start with $1 = \frac{n}{2} \left[\frac{2}{k} + \frac{2n}{k} \right]$ or $1 = \frac{1}{k} \times \frac{n}{2} [4 + 2(n-1)]$ and no mention of a and l or a and d Score SC B2 (M1M0A1A0) 1 st B1 for the start and 2 nd B1cso for completing to printed answer.		
(b)	M1	for identifying the correct values of R		
	A1	for a correct probability (any exact equivalent) Allow $0.\dot{2}3809\dot{5}$ Correct answer with no working scores 2 marks		
(c)	M1	for attempt to use discriminant [< 0 not needed here]. Condone $g^2 - 12g$		
	M1	for attempting to factorise or find critical values for their 3TQ (ignore their $<$ & allow $= 0$)		
	M1	for choosing the correct (inside) region, ft their critical values from a 3TQ with < 0		
	dM1	(dep on 3 rd M1) for choosing/identifying the appropriate values of g (ft their critical values from 3TQ with < 0 used)		
	A1	for an exact probability in any form. Allow $0.0\dot{4}2857\dot{1}$ A correct answer with no incorrect working will score full marks		
Acc	If scored A0 for an answer of awrt 0.238 in (b), allow A1 in (c) for awrt 0.0429			



Question	Scheme		Marks	AOs
2(a)	IQR = 26.6 – 19.4 [= 7.2]		B1	2.1
	19.4 – 1.5 × ‘7.2’ [= 8.6] or 26.6 + 1.5 × ‘7.2’ [= 37.4]		M1	1.1b
	Plotting one upper whisker to 32.5 and one lower whisker to 8.6 or 9.1		A1	1.1b
	Plotting 7.6 and 8.1 as the only two outliers		A1	1.1b
			(4)	
(b)	<u>October</u> (since it is the month with the coldest temperatures between May and October in Beijing)		B1	2.4
			(1)	
(c)	$[\sigma = \sqrt{\frac{4952.906}{184}}]$ or e.g. $[\sigma = \sqrt{\frac{S_{xx}}{n}} = 5.188...]$ [=5.19*]		B1cso*	1.1b
			(1)	
(d)	$z = (\pm) 1.28(16)$	$[P_{90} =]29.251... \text{ or } [P_{10} =]15.948...$	B1	3.1b
	$2 \times 1.2816 \times 5.19$	‘29.251...’ – ‘15.948...’	M1	1.1b
	= awrt 13.3		A1	1.1b
			(3)	
(e)	Daily mean <u>wind speed</u> /Beaufort conversion since it is <u>qualitative</u> <u>Rainfall</u> since it is not symmetric/lots of days with 0 rainfall		B1 B1	2.4 2.4
			(2)	
(11 marks)				
Notes				
(a)	B1: for a correct calculation for the IQR (implied by 10.8 or 8.6 or 37.4 seen) M1: for a complete method for either lower outlier limit or upper outlier limit (allow ft on their IQR) (may be implied by the 1 st A1 or a lower whisker at 8.6) A1: both whiskers plotted correctly (allow ½ square tolerance) A1: only two outliers plotted, 7.6 and 8.1 (must be disconnected from whisker) NOTE: A fully correct box plot with no incorrect working scores 4/4			
(c)	B1cso*: Correct expression with square root or correct formula and 5.188 or better Allow a complete correct method finding $\sum x^2 = \text{awrt } 98720$ and $\sigma = \sqrt{\frac{98715.9...}{184} - \left(\frac{4153.6}{184}\right)^2}$			
(d)	B1: Identifying z-value for 10th or 90th percentile (allow awrt (±) 1.28) or for identifying $[P_{90} =]29.251... \text{ (awrt 29.3) or } [P_{10} =]15.948... \text{ (awrt 15.9)}$ (This may be implied by a correct answer awrt 13.3) M1: for $2 \times z \times 5.19$ where $1 < z < 2$ or for their $P_{90} - P_{10}$ where $25 < P_{90} < 35$ and $10 < P_{10} < 20$ A1: awrt 13.3			
(e)	B1: for one variable identified and a correct supporting reason B1: for two variables identified and a correct supporting reason for each Allow any two of the following: • <u>Wind speed/Beaufort</u> since the data is <u>non-numeric</u> (o.e.). They need not mention Beaufort provided there is a description of the data as non-numeric (Do not allow wind direction/wind gust) • <u>Rainfall</u> as not symmetric/is skewed/is not bell shaped/lots of 0s /many days with no rain/mean≠mode or median • <u>Date</u> since each data value appears once/it is uniformly distributed • Daily mean <u>pressure</u> since it is not symmetric/is skewed/not bell shaped • Daily mean <u>wind speed</u> since it is not symmetric/is skewed/not bell shaped Do not allow ‘not continuous’ or ‘discrete’ as a supporting reason. Ignore extraneous non-contradicting statements			



Question	Scheme	Marks	AOs
5(a)	$\frac{24.63 - 25}{\sigma} = -1.0364$	M1	3.1b
	$[\sigma =]0.357$ (must come from compatible signs)	A1	1.1b
	$P(D > k) = 0.4$ or $P(D < k) = 0.6$	B1	1.1b
	$\frac{k - 25}{0.357} = 0.2533$	M1	3.4
	$k = \text{awrt } \underline{25.09}$	A1	1.1b
		(5)	
(b)	$[Y \sim B(200, 0.45) \rightarrow] W \sim N(90, 49.5)$	B1	3.3
	$P(Y < 100) \approx P(W < 99.5) \left[= P\left(Z < \frac{99.5 - 90}{\sqrt{49.5}}\right) \right]$	M1	3.4
	$= 0.9115...$ awrt <u>0.912</u>	A1	1.1b
		(3)	
(c)	$H_0 : \mu = 25$ $H_1 : \mu < 25$	B1	2.5
	$[\bar{D} \sim N\left(25, \frac{0.16^2}{20}\right)]$	M1	3.3
	$P(\bar{D} < 24.94) [= P(Z < -1.677...)] = 0.046766...$	A1	3.4
	$p = 0.047 < 0.05$ or $z = -1.677... < -1.6449$ or $24.94 < 24.94115...$ or reject H_0 / in the critical region/significant	M1	1.1b
	There is sufficient evidence to support <u>Hannah's belief</u> .	A1	2.2b
		(5)	
(13 marks)			
Notes			
(a)	M1: for standardising 24.63, 25 and ' σ ' (ignore label) and setting = to z where $1 < z < 2$ A1: $[\sigma =]$ awrt 0.36. Do not award this mark if signs are not compatible. B1: for either correct probability statement (may be implied by correct answer) this mark may be scored for a correct region shown on a diagram M1: for a correct expression with $z =$ awrt 0.253 (may be implied by correct answer) A1: awrt 25.09 (Correct answer with no incorrect working scores 5 out of 5)		
(b)	B1: setting up normal distribution approximation of binomial $N(90, 49.5)$ (may be implied by a correct answer) Look out for e.g. $\sigma = \frac{3\sqrt{22}}{2}$ or $\sigma =$ awrt 7.04 M1: attempting a probability using a continuity correction i.e. $P(W < 100.5)$, $P(W < 99.5)$ or $P(W < 98.5)$ condone $\leq$ (The continuity correction may be seen in a standardisation). A1: awrt 0.912 [Note: 0.911299... from binomial scores 0 out of 3]		
(c)	B1: for both hypotheses in terms of μ M1: selecting suitable model must see $N(\text{ormal})$, mean 25, $sd = \frac{0.16}{\sqrt{20}}$ (o.e.) or $var = \frac{4}{3125}$ (o.e.) Condone $N(25, \frac{0.16}{\sqrt{20}})$ if $\frac{0.16}{\sqrt{20}}$ then used as s.d. A1: p value = awrt 0.047 or test statistic awrt -1.68 or CV awrt 24.941 (any of these values imply the M1 provided they do not come from Normal mean = 24.94) M1: a correct comparison (including compatible signs) or correct non-contextual conclusion (f.t. their p value, test statistic or critical value in the comparison) M1 may be implied by a correct contextual statement NB Any contradictory non contextual statements/comparisons score M0A0 e.g. ' $p < 0.05$, not significant' A1: correct conclusion in context mentioning <u>Hannah's belief</u> or the mean <u>amount/liquid</u> in each bottle is now <u>less than 25ml</u> (dep on M1A1M1)		



Qu 5	Scheme	Marks	AO
(a)	$P(L > 16) = 0.69146...$ awrt 0.691	B1 (1)	1.1b
(b)	$P(L > 20 L > 16) = \frac{P(L > 20)}{P(L > 16)}$ $= \frac{0.308537...}{(a)} \text{ or } \frac{1-(a)}{(a)}, = 0.44621...$ For calc to work require $(0.44621...) ^4 = 0.03964...$ awrt 0.0396	M1 A1ft, A1 dM1 A1 (5)	3.1b 1.1b 1.1b 2.1 1.1b
(c)	Require: $[P(L > 4)]^2 \times [P(L > 20 L > 16)]^2$ $= (0.99976...) ^2 \times ("0.44621...")^2$ $= 0.19901...$ awrt 0.199 (*)	M1 A1ft A1cso* (3)	1.1a 1.1b 1.1b
(d)	$H_0 : \mu = 18 \quad H_1 : \mu > 18$ $\bar{L} \sim N\left(18, \left(\frac{4}{\sqrt{20}}\right)^2\right)$ $P(\bar{L} > 19.2) = P(Z > 1.3416...) = 0.089856...$ (0.0899 > 5%) or (19.2 < 19.5) or $1.34 < 1.6449$ so not significant Insufficient evidence to support Alice's claim (or belief)	B1 M1 A1 A1 A1 (5)	2.5 3.3 3.4 1.1b 3.5a
(14 marks)			
Notes			
(a)	B1 for evaluating probability using their calculator (awrt 0.691) Accept 0.6915		
(b)	1 st M1 for a first step of identifying a suitable conditional probability (either form) 1 st A1ft for a ratio of probabilities with numerator = awrt 0.309 or $1 - (a)$ and denom = their (a) 2 nd A1 for awrt 0.446 (o.e.) Accept 0.4465 (from $\frac{0.3085}{0.691} = 0.44645...$) NB $\frac{P(16 < L < 20)}{P(L > 16)} = 0.5538...$ scores M1A1A1 when they do $1 - 0.5538 = 0.4462...$ 2 nd M1 (dep on 1 st M1) for 2 nd correct step i.e. (their 0.446...) ⁴ or $X \sim B(4, "0.446")$ and $P(X = 4)$ 3 rd A1 for awrt 0.0396		
(c)	1 st M1 for a correct approach to solving the problem (May be implied by A1ft) 1 st A1ft for $P(L > 4) =$ awrt 0.9998 used and ft their 0.44621 in correct expression If use $P(L > 20) = 0.3085..$ as 0.446.. in (b) then M1 for $(0.3085..) ^2 \times [P(L > 4)]^2$; A1ft as above * 2 nd A1cso for 0.199 or better with clear evidence of M1 [NB $(0.4662..) ^2 = 0.199...$ is M0A0A0] Must see M1 scored by correct expression in symbols or values (M1A1ft)		
(d)	B1 for both hypotheses in terms of μ M1 for selecting a suitable model. Sight of <u>normal</u> , <u>mean</u> 18, <u>sd</u> $\frac{4}{\sqrt{20}}$ (o.e.) or <u>variance</u> = 0.8 1 st A1 for using the model correctly. Allow awrt 0.0899 or 0.09 from correct prob. statement ALT CR $(\bar{L}) > 19.471...$ (accept awrt 19.5) or CV of 1.6449 (or better: calc 1.6448536..)		
	2 nd A1 for correct non-contextual conclusion. Wrong comparison or contradictions A0 Error giving 2 nd A0 implies 3 rd A0 but just a correct contextual conclusion can score A1A1 3 rd A1 dep on M1 and 1 st A1 for a correct contextual conclusion mentioning <u>Alice's claim</u> / <u>belief</u> or there is insufficient evidence that the mean <u>lifetime</u> is more than 18 hours		



Qu 6	Scheme	Marks	AO
(a)	$2 \times 4.2, 4 \times 4, 4 \times 3.5, 10 \times 1$ ($= 8.4 + 16 + 14 + 10 = 48.4$) $[\text{So } P(10 < T < 30) =] \quad \left[\frac{48.4}{90} \right] = \frac{121}{225} = 0.53777... \quad \underline{\underline{0.53 \sim 0.54}}$ (2sf OK)	M1 A1	1.1b 1.1b
(b)	(Not suitable as) data is not symmetric <u>or</u> is skew (normal is symmetric) (“Even” distribution or a diagram <u>on its own</u> is not enough so B0)	(2) B1 (1)	2.4
(c)	$\int x e^{-x} (dx) = \int x d(-e^{-x})$ $= [-x e^{-x}] - \int (-e^{-x}) (dx) \quad (+c)$ $\int_0^n x e^{-x} (dx) = [-x e^{-x} - e^{-x}]_0^n = (-n e^{-n} - e^{-n}) - [-(0) - 1]$ $= 1 - (n+1)e^{-n} \quad (*)$	M1 A1 dM1 A1cso*	2.1 1.1b 1.1b 1.1b
(d)	Require area = 90 i.e. $k \int_{(0)}^{(n)} x e^{-x} dx = 90$ (ignore limits) Using the result in part (c) with $n = 4$ gives $k[1 - 5e^{-4}] = 90$ $(k =) \underline{\underline{99.0729...}} \quad (*)$	M1 M1 A1cso*	3.1a 2.1 1.1b
(e)(i)	$[P(10 < T < 30) =] \quad 0.64863... \quad \text{awrt } \underline{\underline{0.649}}$	B1	1.1b
(ii)	$[\text{No. of patients} =] \quad (99) \left[(1 - 4e^{-3}) - (1 - 2e^{-1}) \right] \quad (= 53.1...)$ $\text{Prob} = \frac{0.5366... \times 99}{90} = 0.59027... [\text{or } 0.5907...] = \text{awrt } \underline{\underline{0.590 \text{ or } 0.591}}$	M1 A1	3.4 3.2a
(f)	eg Patients might stay longer than 40 hours (Can ignore other comments unless clearly contradictory.)	B1	3.5b
(14 marks)			
Notes			
(a)	M1 for an attempt to find the number between 10 and 30 (2 correct products or 48 or 48.4 seen) A1 for 2sf answer in $[0.53 \sim 0.54]$ NB use of 48 gives 0.5333... [Correct ans implies 2/2]		
(b)	B1 for a comment suggesting not suitable based on (lack of) symmetry <u>or</u> “not bell shaped”		
(c)	1 st M1 for attempting integration by parts in right direction. Must have $u = x$ and $v = \pm e^{-x}$ 1 st A1 for a correct first step, correct first integration and expression for second integral 2 nd dM1 (dep on 1 st M1) for all integration attempted and some use of at least one limit * 2 nd A1 for cso with no incorrect working seen. Minimum is correct int and use of limits seen.		
(d)	1 st M1 for realising need area under the curve (implied by the integral) = 90 2 nd M1 for use of (c) with $n = 4$ and set = 90 May be implied by sight of 99.07... or better * A1cso for $k = 99$ or awrt 99.1 NB Allow use of $k = 99$ and show area = awrt 89.9 with a conclusion to score 3/3		
(e)(i)	B1 for awrt 0.649		
(ii)	M1 for use of (c) with $n = 1$ and $n = 3$ Don’t need the 99. Implied by sight of awrt 0.54 A1 for awrt 0.590 or awrt 0.591 Allow 0.59 from correct working seen.		
(f)	B1 eg for comment, in context, about the upper limit for <u>time</u> (<u>t or x</u>)(time/hour may be implied)		

Qu 5	Scheme	Marks	AO
(a)	{ Let X = time spent, $P(X > 15) = \}$ 0.105649... awrt 0.106	B1 (1)	1.1b
(b)	$H_0: \mu = 10$ $H_1: \mu > 10$ $\bar{X} \sim N\left(10, \left(\frac{4}{\sqrt{20}}\right)^2\right)$; $P(\bar{X} > 11.5) = 0.046766...$ [Condone 0.9532...] [This is significant (< 5%) so] there is evidence to support the complaint	B1 M1;A1 A1 (4)	2.5 3.3;3.4 2.2b
(c)(i)	$[P(T < 2) =]$ 0.1956... awrt 0.196	B1 (1)	1.1b
(ii)	Require $\frac{P(0 < T < 2)}{P(T > 0)} = \frac{0.119119...}{0.923436...}$; = 0.1289955... awrt 0.129	M1 A1;A1 (3)	3.4 1.1bx2
(iii)	The current model suggests non-negligible probability of T values < 0 which is impossible	B1 (1)	3.5b
(d)	Require t such that $P(T > t T > 2) = 0.5$ or $P(T < t T > 2) = 0.5$ e.g. $\frac{P(T > t)}{P(T > 2)} = 0.5$; so $P(T > t) = 0.5 \times [1 - (c)(i)]$ or $P(T > t) = 0.5 \times 0.8043..$ [i.e. $P(T > t) = 0.40...$ implies] $\frac{t-5}{3.5} = 0.2533$ or $P(T < t) = "0.5978.."$ $t = 5.886...$ or from calculator 5.867... so awrt 5.9	M1 M1; A1ft M1 A1 (5)	3.1b 1.1b 3.4 1.1b 1.1b
(15 marks)			
Notes			
(a)	B1 for awrt 0.106 (from calculator) [Allow 10.6%]		
(b)	B1 for both hypotheses correct in terms of μ . M1 for selection of a correct model (sight or use of correct normal- may not have label $\bar{X}$) 1 st A1 for use of this model to get probability allow 0.046~0.047 [Condone awrt 0.953]		
ALT	OR test statistic $z = 1.677...$ (awrt 1.68) and cv of 1.64 (or better) or CR $\bar{X} > 11.47..$		
	2 nd A1 (dep on 1 st A1 or at least $P(\bar{X} > 11.5) < 0.05$ (o.e.))		
	for a correct conclusion in context -must mention complaint /claim or time /mins is > 10		
SC	(M0 for $\bar{X} \sim N(11.5, ...)$ for correct probability and conclusion (score M0A0A1 on open)		
(c)(i)	B1 for awrt 0.196 (from calculator) [Allow 19.6%]		
(ii)	M1 for a correct probability ratio expression (may be implied by 1 st A1 scored) 1 st A1 for a correct ratio of probabilities (both correct or truncated to 2 dp) 2 nd A1 for awrt 0.129		
(iii)	B1 for a suitable explanation of why model is not suitable based on negative T values Must say that a significant proportion of values < 0 (o.e.) e.g. $P(T > 0)$ should be closer to 1 or Difference between $P(T < 2 T > 0)$ and $P(T < 2)$ is too big (o.e.)		
(d)	1 st M1 for a correct conditional probability statement to start the problem or $0.5 \times P(T > 2)$ 2 nd M1 for correct ratio of probability expressions [Must have $P(T > t)$ or $P(2 < T < t)$] 1 st A1ft for a correct equation for $P(T > t)$ (o.e.) ft their answer to part (c)[May be in a diagram] 3 rd M1 for attempt to find t (standardising and sight of 0.2533) or prepare to use calc (ft) Arriving at $P(T < \text{median}) = 1 - 0.5 \times \text{their } 0.8043$ will score 1 st 4 marks 2 nd A1 for awrt 5.9 Sight of awrt 5.9 and at least one M mark scores 5/5 [Answer only send to review]		

Question	Scheme		Marks	AOs
5(a)(i)	[Let M be the height of a man from the club, $P(M > 186) =]$ 0.270187... = awrt 0.270		B1	1.1b
	(ii) [$P(175 < M < 185) =]$ 0.6071520... = awrt 0.607		B1	3.4
			(2)	
5(b)	[Let F be the height of a women from the club] $P(F < 170) = 0.40 \Rightarrow \frac{170 - \mu}{\sigma} = -0.2533$ [calc gives - 0.253347...]		M1	3.1b
	$P(F > 175) = 0.15 \Rightarrow \frac{175 - \mu}{\sigma} = 1.0364$ [calc gives 1.036433...]		M1	3.4
	Solving: $5 = \sigma (1.0364 + 0.2533)$		M1	1.1b
	$\sigma = 3.87687...$ awrt 3.88		A1	1.1b
	$\mu = 170.9820...$ awrt 171		A1	3.2b
			(5)	
5(c)	[$P(170 < F < 175) =]$ $1 - (0.40 + 0.15) = 0.45$ (allow awrt 0.45) [$P(170 < M < 175) =]$ 0.047282... = (allow awrt 0.047)		M1	3.4
	[$P(170 < F < 175) \times P(170 < M < 175) =]$ "0.45"×"0.047" <u>or</u> 0.021...		A1ft	1.1b
	So $P(\text{both}) = 0.021277...$ awrt 0.021		A1	1.1b
			(3)	
(10 marks)				
Notes:				
(a)(i)	B1	for awrt 0.270 (accept just 0.27)		
	(ii)	B1	for awrt 0.607	
(b)	M1	for standardising 170 with μ and σ and set equal to a z value $0 < z < 0.3$		
	M1	for standardising 175 with μ and σ and set equal to a z value $1 < z < 2$		
	M1	for solving their 2 linear equations, reducing to a linear equation in one variable This can be implied by two answers that are correct to 2sf.		
	To award the A marks they must have scored 1 st M1 and 2 nd M1			
	A1	for σ awrt 3.88		
	A1	for μ awrt 171 (Must not be from incorrect working e.g. $\sigma < 0$)		
	Ans only	We need to see the linear equations in μ and σ to start awarding marks. If 1 st M1 and 2 nd M1 are scored and correct answers are seen we can award 5 marks.		
	MR	(15% as 0.015) 2 nd M1 for $z = 2.17...$, 3 rd M1 implied by $\sigma = 2.06...$ and $\mu = 170.5 ...$ i.e. Maximum M1M1M1A0A0		
	(c)	M1	for correct probability for women <u>or</u> correct probability for men <u>or</u> clear intention to multiply $P(170 < F < 175)$ by $P(170 < M < 175)$	
A1ft		for using $P(170 < F < 175) \times P(170 < M < 175)$ with one probability correct to 2sf		
A1		for awrt 0.021. Correct answer only is 3 marks.		
MR		(if used in (b)) $P(170 < F < 175) = 0.585$ (or awrt 0.58 or 0.59) answer awrt 0.027 or 0.028 All 3 marks can be scored here.		

