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Mark Scheme (Results)

January 2025

Pearson Edexcel International Advanced Level
In Statistics 2 (WST02) Paper 01

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

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General Instructions for Marking

1. The total number of marks for the paper is 75.

2. The Edexcel Mathematics mark schemes use the following types of marks:

   - **M** marks: method marks are awarded for 'knowing a method and attempting to apply it', unless otherwise indicated.
   - **A** marks: Accuracy marks can only be awarded if the relevant method (M) marks have been earned.
   - **B** marks are unconditional accuracy marks (independent of M marks)
   - Marks should not be subdivided.

3. Abbreviations

   These are some of the traditional marking abbreviations that will appear in the mark schemes.

   - bod – benefit of doubt
   - ft – follow through
   - the symbol $\surd$ will be used for correct ft
   - cao – correct answer only
   - cso - correct solution only. There must be no errors in this part of the question to obtain this mark
   - isw – ignore subsequent working
   - awrt – answers which round to
   - SC: special case
   - oe – or equivalent (and appropriate)
   - dep – dependent
   - indep – independent
   - dp decimal places
   - sf significant figures
   - * The answer is printed on the paper
   - ⎡ The second mark is dependent on gaining the first mark

4. All A marks are 'correct answer only' (cao.), unless shown, for example, as A1 ft to indicate that previous wrong working is to be followed through. After a misread however, the subsequent A marks affected are treated as A ft, but manifestly absurd answers should never be awarded A marks.

5. For misreading which does not alter the character of a question or materially simplify it, deduct two from any A or B marks gained, in that part of the question affected.

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6. If a candidate makes more than one attempt at any question:
   - If all but one attempt is crossed out, mark the attempt which is NOT crossed out.
   - If either all attempts are crossed out or none are crossed out, mark all the attempts and score the highest single attempt.

7. Ignore wrong working or incorrect statements following a correct answer

Special notes for marking Statistics exams (for AAs only)

- Any correct method should gain credit. If you cannot see how to apply the mark scheme but believe the method to be correct then please send to review.
- For method marks, we generally allow or condone a slip or transcription error if these are seen in an expression. We do not, however, condone or allow these errors in accuracy marks.

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Question Number	Scheme	Marks
1(a)	$\mathrm{P}(X=2)=\binom{100}{2}\times 0.05^2\times 0.95^{98}=0.081181\ldots$	M1
	awrt 0.0812	A1
		(2)
(b)	$\lambda = np = 5$	M1
	$\mathrm{P}(X=2)=\dfrac{\mathrm{e}^{-5}\times 5^2}{2!}=0.084224\cdots$	
	awrt 0.0842	A1
		(2)
(c)	$\dfrac{"0.084224"-"0.0812"}{"0.0812"}\times 100$ or $\left(\dfrac{"0.084224"}{"0.0812"}-1\right)\times 100$	M1
	awrt 3.7%	A1
		(2)
(d)	Eg Large values of n **and** small values of p	B1
		(1)
(e)	$\mathrm{P(Y=6)}=0.1601=\dfrac{\mathrm{e}^{-\lambda}\times\lambda^6}{6!}$ and $\mathrm{P(Y=7)}=0.1418=\dfrac{\mathrm{e}^{-\lambda}\times\lambda^7}{7!}$	M1
	$\dfrac{0.1418}{0.1601}="\dfrac{\frac{\mathrm{e}^{-\lambda}\times\lambda^7}{7!}}{\frac{\mathrm{e}^{-\lambda}\times\lambda^6}{6!}}"$	M1
	$\lambda = 7\times\dfrac{0.1418}{0.1601}$ oe e.g. $\dfrac{\text{awrt } 715}{\text{awrt } 115}$ or $7\times 0.88(5696...)\ 1\div 0.16(08...)$	M1
	$\lambda = 6.19987\cdots$ awrt $\lambda = 6.2$	A1
		(4)
	Notes	**Total 11**
(a)	**M1** attempt to find P(X=2) using a correct binomial distribution. Either the calculation shown or can be implied by awrt 0.081. Allow ${}^{100}C_2$ or ${}^{100}C_{98}$ or $\dfrac{100!}{2!98!}$ for $\binom{100}{2}$	
	A1 awrt 0.0812	
(b)	**M1** for mean = 5 stated or implied by working	
	A1 awrt 0.0842 or accept 0.0843 if tables used (0.1247 – 0.0404 = 0.0843) may be seen in (c)	
(c)	**M1** correct method using their answers to (a) and (b) (can be implied by correct answer)	
	A1 awrt 3.7% or accept 3.75%. Condone awrt 3.8% if using 0.0843. Do not accept e.g. 0.037	
(d)	**B1** any two suitable comments which refer to n/sample/trials being large/big and p/probability/ chance being small/little, specific values not expected but allow values e.g. "$n>50,\ p<0.2$" but not just "$np<10$". Allow e.g. "$np<10$ if $n>50$". Ignore non-contradictory comments	
(e)	**M1** Two correct simultaneous equations in terms of λ.	
	M1 for using ratio of probabilities for their two simultaneous equations (one must have been correct or implied). May be implied by awrt 6.2. Condone errors dealing with their Poisson expressions $\dfrac{\mathrm{e}^{-\lambda}\times\lambda^7}{7!}$ provided they attempt to divide the two given probabilities either way round.	

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	M1	for solving their linear equation in λ from two simultaneous equations (one must have been correct or implied) via a correct rearrangement. i.e. $7\times$their $\frac{0.1418}{0.1601}$ $\left(=\frac{9926}{1601}\text{ or }=\frac{89334}{14409}\right)$ Condone premature rounding/truncation of these numbers in the expression. May be implied by awrt 6.2.
	A1	awrt 6.2 following two correct simultaneous equations or a correct equation in λ. **Do not allow following an invalid method seen** e.g. using the equation solver on the individual equations leading to values of 6.20004 and 6.1998 which scores M1M0M0A0

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Question Number	Scheme	Marks
2(i)(a)	μ is not (a statistic) as it is an **unknown** (parameter)	B1
(b)	$\bar{x}$ is (a statistic) as it is **based on (known) observations**.	B1
		(2)
(ii)	Outcomes $Y_1 = 2$, $Y_2 = 5$ or $Y_1 = 2$, $Y_2 = 6$ or $Y_1 = 5$, $Y_2 = 6$ oe only	M1
	$\mathrm{P}(Y_1 < Y_2) = \frac{1}{3}\times\frac{1}{4}+\frac{1}{3}\times\frac{5}{12}+\frac{1}{4}\times\frac{5}{12}\ \left(=\frac{1}{3}\times\frac{2}{3}+\frac{1}{4}\times\frac{5}{12}\right)$	M1
	$=\frac{47}{144}=0.32638\cdots$ awrt 0.326	A1
		(3)
(iii)(a)	Possible ordered outputs (3, 4), (3, 5), (4, 3), (4, 5), (5, 3), (5, 4)	B1
		(1)
(b)	{10, 11, 13, 14}	M1, A1
		(2)
(c)	Probability of any one outcome $=\frac{1}{6}$ oe	B1

t	10	11	13	14
$\mathrm{P}(T=t)$	$\frac{1}{6}$	$\frac{1}{3}$	$\frac{1}{3}$	$\frac{1}{6}$

M1A1

(3)

	Notes	Total 11
		Mark (i)(a) and (i)(b) together
(i)(a)	**B1**	correct answer and valid reason that μ is either (usually) unknown or a population parameter oe
(i)(b)	**B1**	correct answer and valid reason suggests one of the following that $\bar{x}$ is • based (solely) on observations/calculations/values/information/data/a function oe • contains no unknown population parameters • calculated/measured • numerical property of a sample/derived from a sample Do not allow "it is a statistic because it is known"
		SC B1B0 for μ is not a statistic and $\bar{x}$ is a statistic stated or with insufficient/incorrect reasoning
(ii)	**M1**	correct outcomes stated or implied and no extras. Accept $(2,5)$ $(2,6)$ $(5,6)$ or e.g. $2<5,\ 2<6,\ 5<6$ May consider all outcomes but indicate the rows which are required. Condone the order the other way round for the pairs i.e. $(5,2)$ $(6,2)$ $(6,5)$
	M1	at least two correct products. If $\frac{1}{3}\times\frac{2}{3}$ oe is seen then this is sufficient for M1
	A1	awrt 0.326 Correct answer 3/3
		Mark (iii)(a), (iii)(b) and (iii)(c) together
(iii)(a)	**B1**	Ordered outputs stated or may be seen e.g. in a list/table but not within calculations and no extras. Cannot be implied by their final table in (c). Check by the question for their combinations. Isw if the 6 combinations are stated but they subsequently write 7, 8 and 9 (the sums of the combinations). Do not accept (3, 4) ×2 (3, 5) ×2, (5, 4) ×2

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<table>
<tr><td rowspan="2">(iii)(b)</td><td>M1</td><td>at least 2 correct values from 10, 11, 13 and 14 (accept any list form or within a table as part of their calculations). Condone repeats/extras
Condone with replacement at least 2 correct values from 9, 10, 11, 12, 13, 14 and 15</td></tr>
<tr><td>A1</td><td>all correct and no extras/repeats removed. May be implied by final table in (c)</td></tr>
<tr><td>(iii)(c)</td><td>B1</td><td>probability of $\frac{1}{6}$ or equivalent calculation eg $\frac{1}{3}\times\frac{1}{2}$. May be implied by a correct probability for one of the values in the table.</td></tr>
<tr><td rowspan="2"></td><td>M1</td><td>at least 2 correct probabilities or calculations correctly paired with the correct values of t
Condone with replacement at least 2 from:
<table>
<tr><td>t</td><td>9</td><td>10</td><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td></tr>
<tr><td>P($T = t$)</td><td>$\frac{1}{9}$</td><td>$\frac{1}{9}$</td><td>$\frac{2}{9}$</td><td>$\frac{1}{9}$</td><td>$\frac{2}{9}$</td><td>$\frac{1}{9}$</td><td>$\frac{1}{9}$</td></tr>
</table></td></tr>
<tr><td>A1</td><td>fully correct. Need not be in a table but must have a correct probability associated with correct value. Condone a different variable to T eg X
a correct table with no incorrect working seen implies full marks for (iii)(b) and (iii)(c)</td></tr>
</table>

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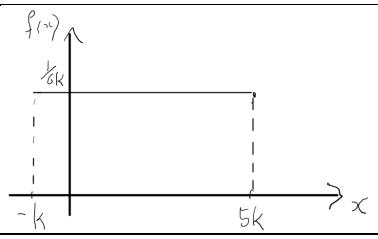
Question Number	Scheme	Marks
3(a)	$\begin{cases} \frac{1}{6k} & -k \leqslant x \leqslant 5k \\ 0 & \text{otherwise} \end{cases}$	B1 B1
		(2)
(b)		B1 B1ft
		(2)
(c)	$\mathrm{E}(X) = \frac{-k+5k}{2} = 2k$	B1
		(1)
(d)	$\mathrm{F}(X) = \int_{(-k)}^{(x)} "\frac{1}{6k}" \,(\mathrm{d}a)$	M1
	$= \left[\frac{a}{6k}\right]_{a=-k}^{a=x} \Rightarrow \mathrm{F}(x) = \frac{x}{6k} + \frac{1}{6}$ oe Alt: $\mathrm{F}(x) = \frac{x}{6k} + c$ Use of $\mathrm{F}(-k) = 0$ or $\mathrm{F}(5k) = 1$ giving $c = \frac{1}{6}$	A1
	$\begin{cases} 0 & x < -k \\ \frac{x}{6k} + \frac{1}{6} & -k \leqslant x \leqslant 5k \\ 1 & x > 5k \end{cases}$	B1 A1
		(4)
(e)	$\mathrm{Var}(X) = \frac{1}{12}(5k - -k)^2 = 3k^2$ Alt: $\mathrm{E}(X^2) = \int_{(-k)}^{(5k)} "\frac{x^2}{6k}" (\mathrm{d}x)$	M1
	$\mathrm{E}(Y) = \mathrm{E}(X^2) = \mathrm{Var}(X) + (\mathrm{E}(X))^2 = 3k^2 + "(2k)"^2$ $= "\frac{1}{6k}\left[\frac{x^3}{3}\right]_{-k}^{5k}"$	dM1
	$= 7k^2$ $\frac{125k^3 + k^3}{18k} = 7k^2$	A1
		(3)
(f)	$\left(\mathrm{P}(Y < 2k^2) = \mathrm{P}(X^2 < 2k^2) =\right) \ \mathrm{P}(-\sqrt{2}k < X < \sqrt{2}k)$	M1
	$= \mathrm{P}(-k < X < \sqrt{2}k)$	M1
	$\left(= \frac{\sqrt{2}k - -k}{6k}\right) = \frac{\sqrt{2}+1}{6}$ or exact equivalent	A1
		(3)
		Total 15

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	Notes	
(a)	**B1**	correct pdf. Condone $\frac{1}{5k+k}$ but not $\frac{1}{5k--k}$. Must be seen in (a).
	B1	all correct, allow use of < instead of ⩽. B0B1 is not possible.
(b)	**B1**	correct horizontal line / rectangle drawn which must be both sides of the *y*-axis. Ignore the presence or absence of vertical lines at -*k* and 5*k*
	B1ft	labels correct, -*k*, 5*k* and $"\frac{1}{6k}"$ ft on their f(*x*), provided f(*x*) is a constant.
(c)	**B1**	cao (condone $2\times k$)
(d)	**M1**	a correct integral expression for their pdf from (a). Ignore/condone missing limits. May be implied by their integrated expression. Alternatively, attempts the equation of the line between $(-k,0)$ and $(5k,1)$
	A1	$\frac{x}{6k}+\frac{1}{6}$ oe A correct expression for $-k$ „ x „ $5k$ e.g. $\frac{x+k}{6k}$ will imply M1A1
	B1	1st and 3rd lines of cdf correct, allow use of 'otherwise' for one of these lines
	A1	for correct 2nd line of cdf correct: $\frac{x}{6k}+\frac{1}{6}$ oe e.g. $\frac{x+k}{6k}$ **and** $-k$ „ x „ $5k$ (oe), allow use of < instead of ⩽
(e)	**M1**	correct calculation to find Var(X), does not need to be simplified. **Alt** correct integral for their pdf in (a) (not just the general expression). Condone missing limits.
	dM1	dep on previous M1 for a correct calculation to find E(Y) using their part (c). **Alt** attempt integration (not wrt *k*) for their pdf in (a), which must be **a constant** i.e. $\frac{x^2}{"6k"}\rightarrow ...x^3$, and correct limits shown or used
	A1	cao
(f)	**M1**	for an attempt to find the range of possible values for X (inside region) involving $\sqrt{2}k$ or $\sqrt{2}k^2$ or $\sqrt{2k}$. May be implied by further work. May attempt 1 – outside region. You do not need to see P(…)
	M1	$-k < X < "\sqrt{2}k"$ seen or implied. e.g. F($"\sqrt{2}k"$), P($X<"\sqrt{2}k"$) May attempt $1-\text{P}("\sqrt{2}k<X<5k)$ do not be concerned with strict or inclusive inequality signs used.
	A1	cao or exact equivalent e.g. $\frac{\sqrt{2}}{6}+\frac{1}{6}$ or $\frac{\sqrt{2}k+k}{6k}$ (note decimal answer awrt 0.402 is M1M1A0) isw after correct answer seen

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Question Number	Scheme	Marks
4(i)(a)	$\mathrm{E}(X^2) = \int_1^3 x^2 \times \frac{x^3}{20}\,\mathrm{d}x \quad \left(= \int_1^3 \frac{x^5}{20}\,\mathrm{d}x\right)$	M1
	$= \left[\frac{x^6}{120}\right]_1^3$	A1
	$= \frac{729}{120} - \frac{1}{120} = \frac{91}{15}$	A1
		(3)
(b)	$\mathrm{Var}(E) = \text{"}\mathrm{E}(X^2)\text{"} - (2.42)^2$	
	$= \frac{91}{15} - (2.42)^2 = 0.21026...$	M1
	awrt 0.210	A1ft
		(2)
(ii)(a)	No smaller than Q_3, $S \sim \mathrm{B}(10, 0.75)$ $\mathrm{P}(S \ldots 7) = 1 - \mathrm{P}(S \,„\, 6)$ $= 1 - 0.22412...$ $= 0.77587...$ awrt 0.776 Alt: No larger than Q_3, $L \sim \mathrm{B}(10, 0.25)$ $\mathrm{P}(L \,„\, 3)$ $= 0.77587...$ (tables give 0.7759) awrt 0.776	B1 M1 A1
		(3)
(b)	$\mathrm{P}(S \ldots 5) = 1 - \mathrm{P}(S \,„\, 4)$ $= 1 - 0.019727...$ $= 0.98027...$ $\mathrm{P}(L \,„\, 5)$ $= 0.98027...$ (tables give 0.9803) awrt 0.980	M1 A1
		(2)
	Notes	**Total 10**

(i)(a)	**M1**	correct method stated or implied condone missing limits
	A1	$\frac{x^6}{120}$ correct **and** correct limits shown or used (which may be implied by final answer)
	A1	$\frac{91}{15}$ oe (provided $\frac{x^6}{120}$ oe seen). May be seen in (b).
(b)	**M1**	correct calculation ft their $\mathrm{E}(X^2)$ from (a)
	A1ft	awrt 0.210 accept $\frac{1577}{7500}$ Correct answer 2/2. Condone 0.21 with working seen ft if (a) is rounded to 6.07 leading to awrt 0.214
(ii)(a)	**B1**	$\mathrm{B}(10, 0.75)$ or $\mathrm{B}(10, 0.25)$ oe stated in either (ii)(a) or (ii)(b), or implied by a correct probability in (ii)(a) or (ii)(b)
	M1	correct probability statement for their $\mathrm{B}(10, p)$, where $p = 0.25$ or $p = 0.75$ or allow if $\mathrm{Po}(10p)$ used. Implied by correct answer.
	A1	awrt 0.776
(b)	**M1**	correct probability statement for their $\mathrm{B}(10, p)$, where $p = 0.25$ or $p = 0.75$ or allow if $\mathrm{Po}(10p)$ used. Implied by correct answer.
	A1	awrt 0.980 (condone 0.98 with correct working seen)

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Question Number	Scheme	Marks
5(a)	No of meteors in 20 mins, $M \sim \text{Po}(5)$ oe	B1
(i)	$\text{P}(M \geqslant 6) = 1 - \text{P}(M \leqslant 5)$	
	$= 1 - 0.6160 = 0.3840$	M1
	awrt 0.384	A1
(ii)	$\text{P}(M \leqslant 3)$	
	$= 0.2650$	
	awrt 0.265	A1
		(4)
(b)	$\text{H}_0 : \lambda = 15 \qquad \text{H}_1 : \lambda > 15$	B1
		(1)
(c)	For 30 mins use $X \sim \text{Po}(7.5) \qquad \text{P}(X \leqslant 12) = 0.9573$	M1
	Correct probability statement: $\text{P}(X \geqslant 13) = 0.0427$	A1
	Critical Region $X \geqslant 13$	B1
		(3)
(d)	Test statistic $x = 12$ is not in critical region oe (so insufficient evidence to reject H_0 / insignificant result)	M1
	No significant evidence that the number of **meteors** to be seen has **increased**/no significant evidence to support the **astronomy club's claim**	A1
		(2)
		Total 10

(a)	**B1**	Po(5) seen, used or implied by correct answer in (i) or (ii). Sight (to 3sf) of any of 0.265(0) (or 0.765(0), 0.4405 (or 0.5595), 0.616(0) (or 0.384(0)), 0.7622 (or 0.2378) implies this mark.
(i)	**M1**	For an attempt at calculating $1 - \text{P}(M \leqslant 5)$ with a Poisson distribution. Imp. by correct answer
	A1	awrt 0.384 (condone $\frac{48}{125}$)
(ii)	**A1**	awrt 0.265 (independent of the M mark in (i) so B1M0A0A1 is possible)
(b)	**B1**	written in terms of λ or μ only (accept 7.5 instead of 15 if consistently used for both)
(c)	**M1**	evidence of $\text{Po}(7.5)$ stated or used. Sight of any of 0.0203 or 0.9208 (or 0.0792), 0.9573 (or 0.0427), 0.9784 (or 0.0216), 0.9897 (or 0.0103) to 2sf with probability statement or 3sf on their own implies this mark.
	A1	correct probability statement $\text{P}(X \geqslant 13)$ oe and awrt 0.0427 oe (awrt 4.27%).
	B1	correct critical region $X \geqslant 13$ (or $X > 12$) **only**, with or without probability given and independent of their (b). Allow a different letter for X but do not allow CR.
(d)	**M1**	For a correct comparison ft their CR $X \ldots a$ oe (may be written as $\text{P}(X \ldots a)$) where $a \geqslant 13$ indicating 12 is not in the critical region. e.g. $12 < \text{"13"}$ so accept H_0 Alternatively compares e.g. $\text{P}(X \leqslant 12) = 0.0792 (> 0.05)$ or $\text{P}(X \leqslant 11) = 0.9208 < 0.95$ and indicates do not reject H_0. Do not ignore contradictory non-contextual statements. Allow if they have a 2-tail CR provided upper CR is $\text{P}(X \ldots a)$ oe where $a \geqslant 13$
	A1	Correct conclusion indep. of hypotheses and must be in context. Must mention **meteors** and **increase** OR the **club's claim** oe e.g. insufficient evidence to suggest the number of meteors is greater. Condone e.g. there are not more meteors / the number of meteors has not changed.

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Question Number	Scheme	Marks
6		
(a)	$200(1-p)$	B1
		(1)
(b)	$(z=)\pm\dfrac{179.5-200}{"\sqrt{200(1-p)}"}$	M1M1 A1ft
	$z=(\pm)1.87$	B1
	$\dfrac{179.5-200}{\sqrt{200(1-p)}}=-1.87$ $*\sqrt{200(1-p)}=\dfrac{-20.5}{-1.87}=10.962...*$	A1*cso
		(5)
(c)	$1-p=0.600889...$ or $200-200p=\dfrac{75076}{625}(=120.1216)\Rightarrow 200p=\dfrac{49924}{625}\ (=79.8784)$	M1
	$p=0.39911...$ awrt $p=0.40$	A1
		(2)
	Notes	**Total 8**

(a)	**B1**	$200(1-p)$ oe as variance. Must be seen in (a). isw if they subsequently square root to find sd or multiply out and make errors
(b)	**M1**	attempt at continuity correction, sight of 179.5 or 180.5 may be implied by 19.5 or 20.5 imp. by a correct equation.
	M1	standardisation using their Normal distribution $N(200, (a))$ (Note could use 220.5 for 179.5 and $z = 1.87$) implied by a correct equation. Condone use of 180 for this mark. Allow use of $200(1-p)$ in (b) if (a) is incorrect.
	A1ft	for correct standardisation, ft their variance. Must have scored M1M1.
	B1	awrt ± 1.87 calculator gives -1.8706
	A1*	cso for achieving awrt 10.963 following a correct equation i.e. when their standardised expression is equated to ± 1.87 the signs must be compatible otherwise A0* If using a calculator to find the z-value look for awrt 10.959
		$\dfrac{179.5-200}{\sqrt{200(1-p)}}=-1.87$ oe scores M1M1A1ftB1
(c)	**M1**	for rearranging the given answer to part (b) to $1-p=$ awrt 0.6 oe or $200p=$ awrt 80 oe using the correct order of operations. Implied by awrt 0.4. May also rearrange to $p=\dfrac{10.96^2-200}{-200}$ or equivalent which implies this mark.
	A1	awrt 0.40 , use of 10.96 gives 0.399392

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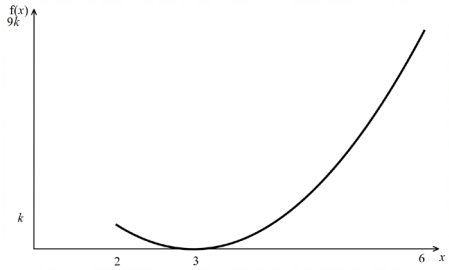
Question Number	Scheme	Marks
7 (a)	 Correct shape Fully correct including labels for 2, 3, 6, k and $9k$. Must be on the sketch	M1 A1 (2)
(b)	Mode = 6	B1 (1)
(c)(i)	$\int k(x-3)^2 \, dx = 1$	M1
	$k\int_2^6 x^2-6x+9 \, dx = k\left[\frac{1}{3}x^3-3x^2+9x\right]_2^6$ or $k\left[\frac{1}{3}(x-3)^3\right]_2^6$ Alt method $\Rightarrow k\left(\frac{1}{3}x^3-3x^2+9x\right)+c$	M1
	$18k-\frac{26k}{3}=1$ or $9k--\frac{k}{3}=1$ $k\left(\frac{1}{3}(2)^3-3(2)^2+9(2)\right)+c=0$ $\Rightarrow c=-\frac{26}{3}k$ $k\left(\frac{1}{3}(6)^3-3(6)^2+9(6)\right)-\frac{26}{3}k=1$	dM1
	e.g. $\frac{28k}{3}=1 \quad \therefore k=\frac{3}{28}$*	A1*
		(4)
(ii)	$\frac{3}{28}\int_2^{5.71} x^2-6x+9 \, dx = 0.7465...$ and $\frac{3}{28}\int_2^{5.72} x^2-6x+9 \, dx = 0.7544...$ $\frac{3}{28}\int_{5.71}^6 x^2-6x+9 \, dx = 0.25348...$ and $\frac{3}{28}\int_{5.72}^6 x^2-6x+9 \, dx = 0.24558...$	M1 dM1
	e.g. $0.7465\ldots < 0.75 < 0.7544\ldots$ therefore $5.71 < Q_3 < 5.72$ oe e.g. $0.24558\ldots < 0.25 < 0.25348\ldots$ therefore $5.71 < Q_3 < 5.72$ oe	A1
		(3)
Alt(ii)	$\frac{3}{28}\int_2^{5.71} x^2-6x+9 \, dx - 0.75 = -0.003...$ and $\frac{3}{28}\int_2^{5.72} x^2-6x+9 \, dx - 0.75 = 0.004...$ $\frac{3}{28}\int_{5.71}^6 x^2-6x+9 \, dx - 0.25 = 0.003...$ and $\frac{3}{28}\int_{5.72}^6 x^2-6x+9 \, dx - 0.25 = -0.004...$	M1 dM1
	e.g. there is a change of sign therefore Q_3 lies between 5.71 and 5.72 oe	A1
		(3)
		Total 10

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	Notes	
(a)	**M1**	for correct positive quadratic shape in first quadrant ignore labelling with a minimum point on the x-axis. End point on the lhs should be lower than the end point on rhs. Condone poor curvature but not straight lines provided the intention is clear
	A1	fully correct including the coordinates $(2, k)$ (accept $(2, \frac{3}{28})$) , $(3, 0)$ and $(6, 9k)$ (accept $(6, \frac{27}{28})$) shown on sketch. Labels on axes are sufficient.
(b)	**B1**	mode = 6 only
(c)(i)	**M1**	correct integral set equal to 1. May be seen or implied in later work. Does not require limits.
	M1	attempt to expand brackets and integrate with at least one x^{n+1} term. Ignore coefficients of terms. May attempt to integrate $(x-3)^2 \to (x-3)^3$. Does not require limits
	dM1	dep on both previous M marks for use of correct limits proceeding to a linear equation in k set equal to 1 or implied.
	A1*	cso including correct use of brackets. Must show some evidence of evaluation after substituting in limits before proceeding to $k = \frac{3}{28}$. e.g. $k\left(\frac{1}{3}(6-3)^3 - \frac{1}{3}(2-3)^3\right) = 1 \Rightarrow k = \frac{3}{28}$ is A0*
Alt(c)(i)	**M1**	correct integral set equal to 1. May be seen or implied in later work. Does not require limits.
	M1	attempt to expand brackets and integrate with at least one x^{n+1} term. Ignore coefficients of terms. May attempt to integrate $(x-3)^2 \to (x-3)^3$. Does not require limits.
	M1	for substituting $x = 2$ into their integrated expression and set equal to 0 to find c in terms of k $\left(-\frac{26k}{3}\right)$ Then substitutes in $x = 6$ and set equal to 1 achieves a linear equation in k. (or the opposite way round using $x = 6$ and setting equal to 1 to find c and then substituting $x = 2$ and setting equal to 0)
	A1*	cso including correct use of brackets. Must show some evidence of evaluation after substituting in $x = 6$ (or $x = 2$ if the other way round) before proceeding to $k = \frac{3}{28}$.
(ii)	**M1**	1 calculation attempted, ie attempting to evaluate 1 definite integral with the correct limits. Implied by awrt 0.747 (or allow 0.746) or awrt 0.754 or awrt 0.253 or awrt 0.246 (allow 0.245)
	dM1	dep on 1st M for 2 calculations attempted. Implied by both correct values to 3sf
	A1	for correct values awrt 0.747 (or allow 0.746) and awrt 0.754 (or awrt 0.253 and awrt 0.246 (allow 0.245)), comparisons and justification of Q_3. Must refer to the upper quartile oe. Not just e.g. x. Do not penalise mislabelling of their functions.
Alt(ii)	**M1**	1 calculation attempted, ie attempting to evaluate 1 definite integral with the correct limits and subtracting 0.75 or 0.25 as appropriate
	dM1	dep on 1st M for 2 calculations attempted (imp. by correct values rounded to 1sf or truncated)
	A1	for correct values (rounded or truncated), comparisons and justification of Q_3. Must refer to the upper quartile oe. Not just e.g. x. The comparisons with 0 may be done in their working. Do not penalise mislabelling of their functions.
		Note: May substitute 5.71 and 5.72 into $a^3 - 9a^2 + 27a - 47 = 0$ instead proceeding to values of $-0.0974...$ and $0.12364...$
(ii)	**SC M1dM1 A0**	Integrates, sets equal to 0.75 and solves with a justification of Q_3: $\frac{3}{28}\int_2^a x^2 - 6x + 9 \, dx = 0.75 \Rightarrow \frac{3}{28}\left[\frac{1}{3}x^3 - 3x^2 + 9x\right]_2^a = 0.75 \Rightarrow a = 5.714...$ $\left(= a^3 - 9a^2 + 27a - 47 = 0\right) \Rightarrow a =$ awrt 5.714 $5.71 < 5.714 < 5.72$ therefore $5.71 < Q_3 < 5.72$ oe

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