Question Number		Scheme	Marks	
1. (a)(i)	$X \sim B(50, 0.4)$		
	/ /	$P(X=26) = 0.9686 - 0.9427 \text{ or } {}^{50}C_{26} (0.4)^{26} (0.6)^{24}$	M1	
		awrt <u>0.0259</u>	A1	
			(2)	
	(ii)	$P(X \ge 26) = 1 - P(X \le 25)$	M1	
		= 1 - 0.9427 = awrt <u>0.0573</u>	A1	
			(2)	
((iii)	(From tables) $k = \underline{19}$	Bl	
(h)		$I = \mathbf{N}(240, 144)$	(1) M1A1	
(D)(I)	$J \sim N(240, 144)$	MIAI	
		$P(X \le 222) \sim P(J < 222.5) = P\left(Z < \frac{222.5 - 240}{\sqrt{222.5}}\right)$	M1M1	
		(144)		
		P(Z < -1.46) = 1 - 0.9279 = awrt 0.0721 - 0.0724	A1	
			(5)	
	(ii)	n is large (oe) and p is close to 0.5	B1	
			(1)	
			[11 marks]	
) (1)	Notes		
(a	ı)(i)	M1 Use of tables or ${}^{50}C_{26}(p)^{26}(1-p)^{24}$ with $0 allow alternative notations for$		
		$\Delta 1_{\text{out}} = 0.0250$ (correct answer scores 2 out of 2)		
	(ii)	All awriting or using $1 - P(X < 25)$		
	(11)	A 1 swit 0.0573 (calc 0.0573/37) (correct answer scores 2 out	t of 2	
	(iii)	At a wit 0.0575 (care 0.0575457) (correct answer scores 2 out of 2) B1 19 cao $k \le 19$ or $k \ge 19$ is B0		
	()			
ſb)(i)	1^{st} M1 For writing or using N(240) (May be seen in standardisation)		
(~)(-)	1^{st} A1 For writing or using N(240, 144) (May be seen in standardisation)		
		2^{nd} M1 use of continuity correction 222 ± 0.5		
		$(222 \text{ or } 222.5 \text{ or } 221.5 - their mean})$		
		3^{10} M1 ± if distribution not c	learly stated,	
		then the mean and sd must be correct in the standardisation to score the	nis mark	
		2^{nd} A1 awrt 0.0721 through to awrt 0.0724 (calc 0.0723743))		
		Answer in the range implies all previous marks unless clearly comes f	from wrong	
		method		
		[NB: Use of binomial distribution gives 0.0719]		
	(ii)	B1 both conditions required		
	()	for n is large allow in words e.g. 'sample is large'		
		allow 0.4 in place of p		
		condone ' $n > 30$ ' (or any number > 30)		
		Ignore comments about <i>np</i>		

Question Number	Scheme	Marks	
2. (a)	e.g. Population is small	B1	
		(1)	
(b)(i)	list/register/database of all members (of the leisure centre)	B1	
(ii)	A member (of the leisure centre)	B1	
		(2)	
(c)	C is the statistic as it is (a quantity) based only on <u>values</u> (oe) taken	B1	
	from the sample/it contains no unknown parameters/population	(1)	
	values		
		[4 marks]	
	Notes		
(a)	B1 any correct characteristic of the population that makes a census a practical		
(b)(i)	alternative to a sample (accessible, finite, well-defined) B1 idea of list (oe) and idea of all members (e.g. list of each member of the leisure centre))		
(ii)	B1 a single member		
	Condone members Also condone One of the members in the sample The opinion/view of one of the members is B0		
(c)	B1 choosing C (or clearly identifying C in words) only with a correct supporting reason which must include value (oe) and sample <u>or</u> no unknown parameters For values allow e.g. information, observations, calculations, function, numerical data, etc.		

NumberNumberNumberNumber3. (a) $\int_{2}^{1} \frac{1}{4} (x^2 - 8x + c) dx = 1$ M1 $1 = \frac{1}{48} [\frac{1}{3} - 4x^2 + cx]_{2}^{5}$ M1 $1 = \frac{1}{48} [\frac{5^3}{3} - 4(5^2) + 5c] - (\frac{2^3}{3} - 4(2^2) + 2c))$ or48 = 39 - 84 + 3c($\Rightarrow 3c = 93 \Rightarrow)c = 31^*$ A1cso*(b) $P(2 < X < 3) = \frac{1}{48} [\frac{x^3}{3} - 4x^2 + 31x]_{2}^{3}$ M1 $\frac{1}{48} (\frac{3^3}{3} - 4(3^2) + 31(3)) - (\frac{2^3}{3} - 4(2^2) + 31(2))) = \frac{13}{36}$ (-awrt 0.361)A1(c)Less than 3 since $\frac{n 13}{3n} > 0.25$ B1(d) $x = 4$ leads to the minimum/lowest value of $f(x) / f(x)$ is a positive quadraticB1(e)Considers $x = 2$ and $x = 5$ by e.g.B1(f)(g)Sketch of $f(x)$ from $x = 2$ to $x = 5$ A1(g)Sketch of $f(x)$ from $x = 2$ to $x = 5$ A1(g)NotesA1(h)NotesA1(h)A1(2)(h)Is defining up integral and equating to 1 (condome missing dx) limits not needed 2^{n4} M1 attempting to integrate $f(x)$ at least one term $x' \to x^{n1}$ (need not $b = 1$)Use of integration of $f(x)$ with $F(2) = 0$ and $F(5) = 1$ can score M1M1A1^n cost cost correct limits. There should be at least one line of working between scoring the 2^{n4} M1 attempting to integrate $f(x)$ at least one term $x' \to x^{n1}$ (need not $b = 1$)Use of integration of $f(x) x^n \to x^{n-1}$ with correct limits 2 and 3 (ft from their (a))(h)M1 for use of integration of $f(x) x^n \to x^{n-1}$ with correct limits 2 and 3 (ft from their (a))(h)M1 for use of integration of $f(x) x^n $	Question	Scheme	Marks	
3. (a) $\int_{\frac{1}{2}}^{\frac{1}{2}} \frac{1}{4\pi} \left(x^2 - 8x + c\right) dx = 1$ $1 = \frac{1}{48} \left[\frac{x^3}{3} - 4x^2 + cx\right]_{2}^{5}$ $1 = \frac{1}{48} \left[\frac{5^3}{3} - 4(5^2) + 5c\right] - \left(\frac{2^3}{3} - 4(2^2) + 2c\right)\right) \text{ or } 48 = 39 - 84 + 3c$ $(\Rightarrow 3c = 93 \Rightarrow)c = 31^{*}$ (b) $P(2 < X < 3) = \frac{1}{48} \left[\frac{x^3}{3} - 4x^2 + 31x\right]_{2}^{5}$ $\frac{1}{48} \left[\left(\frac{3^3}{3} - 4(3^2) + 31(3)\right) - \left(\frac{2^3}{3} - 4(2^2) + 31(2)\right)\right) = \frac{13}{36} \text{ (=awrt 0.361)}$ (c) Less than 3 since " $\frac{13}{36} > 0.25$ (d) $x = 4$ leads to the minimum/lowest value of $f(x) / f(x)$ is a positive quadratic quadratic c (c) Considers $x = 2$ and $x = 5$ by e.g. (1) B1 (1) B1 (1) B1 (1) Considers $x = 2$ and $x = 5$ by e.g. (1) Considers $x = 2$ and $x = 5$ by e.g. (2) M(1) (3) $x = 4$ leads to the minimum/lowest value of $f(x) / f(x)$ is a positive quadratic quadra	Number	Scheme		
$1 = \frac{1}{48} \left[\frac{x^3}{3} - 4x^2 + cx \right]_2^5$ $1 = \frac{1}{48} \left[\left(\frac{5^3}{3} - 4(5^2) + 5c \right) - \left(\frac{2^3}{3} - 4(2^2) + 2c \right) \right] \text{ or } 48 = 39 - 84 + 3c$ $(\Rightarrow 3c = 93 \Rightarrow)c = 31^*$ (b) $P(2 < X < 3) = \frac{1}{48} \left[\frac{x^3}{3} - 4x^2 + 31x \right]_2^3$ $\frac{1}{48} \left[\left(\frac{3^3}{3} - 4(3^2) + 31(3) \right) - \left(\frac{2^3}{3} - 4(2^2) + 31(2) \right) \right] = \frac{13}{36} (= \text{awrt } 0.361)$ (c) $Less than 3 since "\frac{13}{36} > 0.25$ (d) $x = 4 \text{ leads to the minimum/lowest value of } f(x) / f(x) is a positive quadratic $	3. (a)	$\int_{2}^{5} \frac{1}{48} \left(x^2 - 8x + c \right) dx = 1$	M1	
$ \begin{array}{c} 1 \\ 1 = \frac{1}{48} \left[\left(\frac{5^3}{3} - 4(5^2) + 5c \right) - \left(\frac{2^3}{3} - 4(2^2) + 2c \right) \right) \underbrace{\text{or}} 48 = 39 - 84 + 3c \\ (\Rightarrow 3c = 93 \Rightarrow)c = 31^* \\ (b) \\ P(2 < X < 3) = \frac{1}{48} \left[\frac{x^3}{3} - 4x^2 + 31x \right]_2^3 \\ \frac{1}{48} \left[\left(\frac{3^3}{3} - 4(3^2) + 31(3) \right) - \left(\frac{2^3}{3} - 4(2^2) + 31(2) \right) \right] = \frac{13}{36} (= \text{awrt } 0.361) \\ (c) \\ \text{Less than 3 since } \left[\frac{13}{36} \right] > 0.25 \\ (d) \\ x = 4 \text{ leads to the minimum/lowest value of } f(x) / f(x) \text{ is a positive quadratic } (1) \\ (e) \\ \text{Considers } x = 2 \text{ and } x = 5 \text{ by e.g.} \\ \cdot \\ f(2) = 0.39(583) [= \frac{6}{33}] \text{and } f(5) = 0.3 [= \frac{16}{34}] (\text{so } f(2) > f(5)) \\ \cdot \\ \text{Sketch of } f(x) \text{ from } x = 2 \text{ to } x = 5 \\ \cdot \\ x = 2 \text{ is further than } x = 4 (\text{then } x = 5) \\ \text{Mode is } x = 2 \\ \end{array} $		$1 = \frac{1}{48} \left[\frac{x^3}{3} - 4x^2 + cx \right]_{0}^{5}$	M1	
(\Rightarrow 3c = 93 \Rightarrow) c = 31* (\Rightarrow 3c = 93 \Rightarrow) c = 31* (3) P(2 < X < 3) = $\frac{1}{48} \left[\frac{x^3}{3} - 4x^2 + 31x \right]_2^3$ $\frac{1}{48} \left(\left(\frac{3^3}{3} - 4(3^2) + 31(3) \right) - \left(\frac{2^3}{3} - 4(2^2) + 31(2) \right) \right) = \frac{13}{36}$ (=awrt 0.361) (c) Less than 3 since $\frac{n \cdot 13}{36} > 0.25$ (d) x = 4 leads to the minimum/lowest value of f(x) / f(x) is a positive quadratic (e) Considers x = 2 and x = 5 by e.g. • f(2) = 0.39(583) [= $\frac{19}{48}$] and f(5) = 0.3 [= $\frac{16}{48}$] (so f(2) > f(5)) • Sketch of f(x) from x = 2 to x = 5 • x = 2 is further than x = 4 (then x = 5) Mode is x = 2 Notes (a) 1 st M1 setting up integral and equating to 1 (condone missing dx) limits not needed 2 nd M1 attempting to integrate f(x) at least one term x ⁿ $\rightarrow x^{n+1}$ (need not be = 1) Use of integration of f(x) with F(2) = 0 and F(5) = 1 can score M1M1 A1 [*] cso including use of correct limits. There should be at least one line of working between scoring the 2 nd M1 atterting up integral 2 nd M1 attempting to integrate A1cso use of correct limits to show that it integrates to 1 and concluding that c = 31 (b) M1 for use of integration of f(x) x ⁿ $\rightarrow x^{n+1}$ with correct limits 2 and 3 (ft from their (a)) A1 allow awrt 0.361 (correct answer scores 2 out of 2) (c) B1 less than 3 with correct reasoning. May use their part (b), but must be consistent with 'less than 3' If the lower quartile is found awrt 2.67, allow LQ/2.67 < 3 (d) B1 correct reason why the method does not give the correct mode. Allow a sketch of f(x). Also allow, c.g. 'Kei's method did not consider the end-points' (e) M1 considers end-points		$1 = \frac{1}{48} \left(\left(\frac{5^3}{3} - 4(5^2) + 5c \right) - \left(\frac{2^3}{3} - 4(2^2) + 2c \right) \right) \underline{\text{or}} 48 = 39 - 84 + 3c$		
(b) $P(2 < X < 3) = \frac{1}{48} \left[\frac{x^3}{3} - 4x^2 + 31x \right]_2^3$ $\frac{1}{48} \left(\left(\frac{3^3}{3} - 4(3^2) + 31(3) \right) - \left(\frac{2^3}{3} - 4(2^2) + 31(2) \right) \right) = \frac{13}{36} (= \text{awrt } 0.361)$ (c) Less than 3 since " $\frac{13}{36}$ " > 0.25 (d) $x = 4$ leads to the minimum/lowest value of $f(x) / f(x)$ is a positive quadratic (e) Considers $x = 2$ and $x = 5$ by e.g. (f(2) = 0.39(583) [= \frac{19}{8}] \text{ and } f(5) = 0.3 [= \frac{16}{8}] \text{ (so } f(2) > f(5)) (f(2) = 0.39(583) [= $\frac{19}{8}]$ and $f(5) = 0.3 [= \frac{16}{8}] \text{ (so } f(2) > f(5))$ (g) Sketch of $f(x)$ from $x = 2$ to $x = 5$ (g) $x = 2$ is further than $x = 4$ (then $x = 5$) Mode is $x = 2$ (g) [9 marks] (h) A1 ($(\Rightarrow 3c = 93 \Rightarrow)c = 31*$	A1cso* (3)	
$\frac{1}{48} \left(\left(\frac{3^3}{3} - 4(3^2) + 31(3)\right) - \left(\frac{2^3}{3} - 4(2^2) + 31(2)\right) \right) = \frac{13}{36} (=\operatorname{awrt} 0.361) \right) $ (c) Less than 3 since " $\frac{13}{36}$ " > 0.25 (1) (d) $x = 4$ leads to the minimum/lowest value of $f(x) / f(x)$ is a positive quadratic (1) (c) Considers $x = 2$ and $x = 5$ by e.g. (1) (c) Considers $x = 2$ and $x = 5$ by e.g. (1) (c) Sketch of $f(x)$ from $x = 2$ to $x = 5$ (1) (c) Sketch of $f(x)$ from $x = 2$ to $x = 5$ (2) y marks] (2) (2) y marks] (3) (4) (5) $y = \frac{13}{48} [(\operatorname{so} f(2) > f(5)] = \frac{14}{48} [(\operatorname{so} f(2) > f(2)] $	(b)	$P(2 < X < 3) = \frac{1}{48} \left[\frac{x^3}{3} - 4x^2 + 31x \right]_2^3$	M1	
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(c) Less that 5 since $\frac{36}{36} + \frac{36}{36}$ (1) (d) $x = 4$ leads to the minimum/lowest value of $f(x) / f(x)$ is a positive quadratic (e) Considers $x = 2$ and $x = 5$ by e.g. • $f(2) = 0.39(583) [= \frac{19}{48}]$ and $f(5) = 0.3 [= \frac{16}{48}]$ (so $f(2) > f(5)$) • Sketch of $f(x)$ from $x = 2$ to $x = 5$ • $x = 2$ is further than $x = 4$ (then $x = 5$) Mode is $x = 2$ (a) 1^{st} M1 setting up integral and equating to 1 (condone missing dx) limits not needed 2^{nd} M1 attempting to integrate $f(x)$ at least one term $x^n \to x^{n+1}$ (need not be = 1) Use of integration of $f(x)$ with $F(2) = 0$ and $F(5) = 1$ can score M1M1 A1* cso including use of correct limits. There should be at least one line of working between scoring the 2^{nd} M1 and arriving at the given answer. Allow a verification method 1 st M1 setting up integral 2^{nd} M1 attempting to integrate A1 cso use of correct limits to show that it integrates to 1 and concluding that $c = 31$ (b) M1 for use of integration of $f(x)$ $x^n \to x^{n+1}$ with correct limits 2 and 3 (ft from their (a)) A1 allow awrt 0.361 (correct answer scores 2 out of 2) (c) B1 less than 3 with correct reasoning. May use their part (b), but must be consistent with 'less than 3' If the lower quartile is found awrt 2.67, allow LQ/2.67 < 3 (d) B1 correct reason why the method does not give the correct mode. Allow a sketch of f(x). Also allow, e.g. 'Kei's method did not consider the end-points' (e) M1 considers end-points	(c)	Less than 3 since $\ \frac{13}{12}\ > 0.25$	B1	
(e) quadratic Considers $x = 2$ and $x = 5$ by e.g. • $f(2) = 0.39(583) [= \frac{19}{48}]$ and $f(5) = 0.3 [= \frac{16}{48}]$ (so $f(2) > f(5)$) • Sketch of $f(x)$ from $x = 2$ to $x = 5$ • $x = 2$ is further than $x = 4$ (then $x = 5$) Mode is $x = 2$ (a) 1^{st} M1 setting up integral and equating to 1 (condone missing dx) limits not needed 2^{nd} M1 attempting to integrate $f(x)$ at least one term $x^n \rightarrow x^{n+1}$ (need not be = 1) Use of integration of $f(x)$ with $F(2) = 0$ and $F(5) = 1$ can score M1M1 A1* cso including use of correct limits. There should be at least one line of working between scoring the 2^{nd} M1 and arriving at the given answer. Allow a verification method 1^{st} M1 setting up integrals to show that it integrates to 1 and concluding that $c = 31$ (b) M1 for use of integration of $f(x)$ $x^n \rightarrow x^{n+1}$ with correct limits 2 and 3 (ft from their (a) A1 allow awrt 0.361 (correct answer scores 2 out of 2) (c) B1 less than 3 with correct reasoning. May use their part (b), but must be consistent with 'less than 3' If the lower quartile is found awrt 2.67, allow LQ/2.67 < 3 (d) B1 correct reason why the method does not give the correct mode. Allow a sketch of f(x). Also allow, e.g. 'Kei's method did not consider the end-points' (e) M1 considers end-points	(c) (d)	36 x = 4 leads to the minimum/lowest value of f(x) / f(x) is a positive	(1) B1	
(e) Considers $x = 2$ and $x = 5$ by e.g. • $f(2) = 0.39(583)[=\frac{19}{48}]$ and $f(5) = 0.3[=\frac{16}{48}]$ (so $f(2) > f(5)$) • Sketch of $f(x)$ from $x = 2$ to $x = 5$ • $x = 2$ is further than $x = 4$ (then $x = 5$) Mode is $x = 2$ (2) 19 marks (a) 1^{st} M1 setting up integral and equating to 1 (condone missing dx) limits not needed 2^{nd} M1 attempting to integrate $f(x)$ at least one term $x^n \to x^{n+1}$ (need not be = 1) Use of integration of $f(x)$ with $F(2) = 0$ and $F(5) = 1$ can score M1M1 A1* cso including use of correct limits. There should be at least one line of working between scoring the 2^{nd} M1 and arriving at the given answer. Allow a verification method 1^{st} M1 setting up integral 2^{nd} M1 attempting to integrate A1 cso use of correct limits to show that it integrates to 1 and concluding that $c = 31$ (b) M1 for use of integration of $f(x)$ $x^n \to x^{n+1}$ with correct limits 2 and 3 (ft from their (a)) A1 allow awrt 0.361 (correct answer scores 2 out of 2) (c) B1 less than 3 with correct reasoning. May use their part (b), but must be consistent with 'less than 3' If the lower quartile is found awrt 2.67, allow LQ/2.67 < 3 (d) B1 correct reason why the method does not give the correct mode. Allow a sketch of f(x). Also allow, e.g. 'Kei's method did not consider the end-points' (e) M1 considers end-points		quadratic	(1)	
 Sketch of f(x) from x = 2 to x = 5 x = 2 is further than x = 4 (then x = 5) Mode is x = 2 Notes (a) 1st M1 setting up integral and equating to 1 (condone missing dx) limits not needed 2nd M1 attempting to integrate f(x) at least one term xⁿ → xⁿ⁺¹ (need not be = 1) Use of integration of f(x) with F(2) = 0 and F(5) = 1 can score M1M1 A1* cso including use of correct limits. There should be at least one line of working between scoring the 2nd M1 and arriving at the given answer. Allow a verification method 1st M1 setting up integral 2nd M1 attempting to integrate A1 cso use of correct limits to show that it integrates to 1 and concluding that c = 31 (b) M1 for use of integration of f(x) xⁿ → xⁿ⁺¹ with correct limits 2 and 3 (ft from their (a)) A1 allow awrt 0.361 (correct answer scores 2 out of 2) (c) B1 less than 3 with correct reasoning. May use their part (b), but must be consistent with 'less than 3' If the lower quartile is found awrt 2.67, allow LQ/2.67 < 3 (d) B1 correct reason why the method does not give the correct mode. Allow a sketch of f(x). Also allow, e.g. 'Kei's method did not consider the end-points' (e) M1 considers end-points 	(e)	Considers $x = 2$ and $x = 5$ by e.g. • $f(2) = 0.39(583)[=19]$ and $f(5) = 0.3[=16]$ (so $f(2) > f(5)$)	IVI 1	
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 (d) B1 correct reason why the method does not give the correct mode. Allow a sketch of f(x). Also allow, e.g. 'Kei's method did not consider the end-points' (e) M1 considers end-points 		May use their part (b), but must be consistent with 'less than 3' If the lower quartile is found exert 2.67, allow LO/2.67 < 3		
f(x). Also allow, e.g. 'Kei's method did not consider the end-points' (e) M1 considers end-points	(d)	11 the lower quartile is found awrt 2.07, allow $LQ/2.07 < 3$ B1 correct reason why the method does not give the correct mode. Allow a sketch of		
(e) M1 considers end-points	()	f(x). Also allow, e.g. 'Kei's method did not consider the end-points'		
A1 mode is 2 and Answer only scores MOAO. Must have some instification	(e)	M1 considers end-points	ion	

NumberB14. (a) p is smallB1(b) Let N = number of candles not suitable for sale(1) $N \sim B(125, 0.02)$ M1
4. (a) p is small (b) Let N = number of candles not suitable for sale $N \sim B(125, 0.02)$ M1
(b) Let N = number of candles not suitable for sale $N \sim B(125, 0.02)$ M1
$N \sim B(125, 0.02)$ M1
$\approx C \sim \text{Po}(2.5)$ A1
$P(C \leqslant 6)$ M1
= 0.9858 awrt 0.986 A1
$(2)(i) \qquad \qquad$
$ \begin{array}{c c} (c)(1) & H_0: p = 0.05 & H_1: p < 0.05 \\ \hline D & D(20, 0.05) \\ \hline \end{array} $
$D \sim B(30, 0.05)$ $P(D = 0) = 0.2146$ A1
$\begin{bmatrix} P(D-0) - 0.2140 \\ Do not reject H / not significant \end{bmatrix} M1$
The manufacturer's claim is not supported/There is not enough
evidence to suggest that the proportion(oe) of candle holders with
minor defects is less than 5%/ Charlie's claim is supported
(ii) Impossible to reject H (since $P(D=0) > 0.05$) B1
(ii) impossible to reject Π_0 (since $\Gamma(D=0) > 0.05$) [21 (1)
(d) 0.95^{50} [=0.0769] or X~B(50, 0.05), P(X = 0) (is still) > 0.05 M1
(so still not possible to reject H_0) hence Ashley's change does not A1
make the test appropriate. (2)
Notos [13 marks]
(a) B1 correct condition allow 'p is close to 0' allow ' $p < 0.1$ ' or any value less than
(b) 1^{st} M1 recognizing Dinemial distribution (may be implied by De(2.5))
(b) 1 M1 recognising Binomial distribution (may be implied by $Po(2.5)$) 1 st A1 correct distribution $Po(2.5)$
2^{nd} M1 writing or using P($C \le 6$) from Poisson distribution
2 nd A1 awrt 0.986 from correct distribution used (calc : 0.9858126)
[NB : Use of binomial gives 0.98678] Answer only 0.9858 or better scores 4
out of 4, but answer of 0.986 must see Po(2.5) to award full marks.
(c)(i) B1 correct hypotheses in terms of p or π
1^{st} M1 writing or using B(30, 0.05) (may be implied by 1^{st} A1)
1 st A1 awrt 0.215
2^{nd} M1 a correct ft statement consistent with their <i>p</i> -value and 0.05 No context
needed but do not allow contradicting non contextual comments.
2^{nd} A1 correct conclusion in context which must be not rejecting H ₀ .
Must use underlined words (oe) No hypotheses then A0
Condone e.g. '5% of candle holders have minor defects'
(ii) B1 correct reasoning which implies there is no critical region/ H_0 cannot be rejected
Sample size is too small on its own is B0.
(d) M1 for 0.95^{50} or for X~B(50, 0.05) and P(X=0) > 0.05
A1 test is (still) not appropriate with M1 scored

Question	Scheme	Marks		
5. (a)	$F(3) = 0 \rightarrow \frac{1}{2}(3^2 - 6(3) + a) = 0$	M1		
	$(3) = -\frac{1}{16}(3 - 0(3) + u) = 0$	A1		
	$F(10) = 1 \rightarrow \frac{1}{2}(100(10) - (5)10^2 + c) = 1$	N (1		
	c = -488	MI		
(b)		A1 (4)		
(0)	$\frac{1}{16} \left(5^2 - 6(5) + "9" \right) = \frac{1}{12} \left(5 + b \right) \qquad \frac{1}{12} \left(9 + b \right) = \frac{1}{12} \left(100(9) - 5(9^2) + "-488" \right)$	M1		
	b = -2	A1 (2)		
(c)	$P(6 < Y \leq 9) = F(9) - F(6)$	(2) M1		
	$=\frac{1}{12}(9+"-2")-\frac{1}{12}(6+"-2")$	M1		
	=1	A1 (2)		
	4	(3) D1		
(u)	$f(y) = \frac{1}{12}$	ы (1)		
(e)	$E(6Y-5) = [26.5+]^9 (6y-5)''\frac{1}{12}'' dy$	M1		
	$-[265+1]^{1}[(2y^{2}-5y)]^{9}$	dM1		
	$= 26.5 + \frac{1}{12} [(3y^2 - 5y)]_5$ = 26.5 + $\frac{1}{12} [(3(9^2) - 5(9)) - (3(5^2) - 5(5))]$	dM1		
		A1		
	$-\frac{1}{6}$	(4)		
	Notes	[Total 14]		
(a)	1 st M1 writing or use of $F(3) = 0$			
	$1^{\text{as}} \text{A1} a = 9 \text{ cao}$ 2^{nd}M1 writing or use of F(10) = 1			
(h)	$2^{nd} A1 c = -488 cao$ M1 use of E(5) = E(5) [= 1] or E(0) = E(0) [= 7] 1 ft their values from (c)			
	A1 $b = -2$ cao			
(c)	1^{st} M1 writing or using F(9) – F(6) (may be implied by 2^{nd} M1)			
	2^{nd} M1 substituting 9 and 6 into F(x) with their value of b			
	allow $\frac{1}{12}(100(9) + 5(9^2) + "-488") - \frac{1}{12}(6 + "-2")$ with their value of b and their value of c			
	A1 $\frac{1}{4}$ oe			
(d)	B1 $\frac{1}{12}$			
(e)	1 st M1 use of $\int_{-\infty}^{9} (6y - 5)'' \frac{1}{12}'' dy$ (ignore limits)			
	2 nd M1 (dep on 1 st M1) attempt to integrate $(6y - 5)''\frac{1}{12}''$ with at least one $y^n \rightarrow y^{n+1}$			
	3^{rd} M1 (dep on 1 st M1) 26.5 + $\int_{5}^{9} (6y-5)'' \frac{1}{12}'' dy$			
SC.	A1 awrt 38.8 Answer only or correct answer not using given information scores M0M1M1A1			
SC:		1 1 1		

Question Number	Scheme	Marks	
6. (a)	$P(17 < W < k) = P(W < k) - P(W < 17) = \frac{53}{60} - \left(1 - \frac{1}{5}\right) = \frac{1}{12}$	M1 A1 (2)	
(b)(i)	$\frac{(b-a)^2}{12} = 75$, $\frac{b-17}{b-a} = \frac{1}{5}$ or $\frac{17-a}{b-a} = \frac{4}{5}$	B1, B1	
	$\frac{(b-a)^2}{12} = 75 \to (b-a) = 30 \qquad \qquad \frac{b-17}{30} = \frac{1}{5}$	M1	
	b = 23 and $a = -7$	A1 (4)	
(ii)	$P(W < k) = \frac{k - ("-7")}{"23" - ("-7")} = \frac{53}{60} \text{ or } P(17 < W < k) = \frac{k - 17}{30} = \frac{1}{12} \text{ or } P(W > k) = \frac{"23" - k}{"23" - ("-7")} = \frac{7}{60}$	(4) M1	
	<i>k</i> = 19.5	A1 (2)	
(c)	$P(-5 < W < 5) = \frac{5 - (-5)}{"23" - ("-7")} = \frac{1}{3}$	M1A1ft (2)	
(d)	$E(W^2) = Var(W) + E(W)^2 = 75 + \left(\frac{"23"+"-7"}{2}\right)^2 = 139$	(2) M1 A1	
		[Total 12]	
(a)	$\frac{\text{Notes}}{M1 \text{ for writing or using } P(W \le k) - P(W \le 17) \text{ allow } \le \text{ or } \le 17}$		
(")	$\frac{1}{1} = \frac{1}{1} = \frac{1}$		
	Allow equivalent expressions e.g. $P(W > 17) - P(W > k) = \frac{1}{5} - \left(1 - \frac{1}{60}\right)$		
	A1 oe condone awrt 0.0833 condone $\frac{1}{12}$ coming from $\frac{13}{12} - 1$ or $\left -\frac{1}{12} \right $		
(b) (i)	1 st B1 correct equation for variance 2 nd B1 either correct probability equation Allow e.g. <i>k</i> in place of $(b - a)$ 1 st M1 eliminating $(b - a)$ which must appear in both equations. A1 both $b = 23$ and $a = -7$ correct answers imply all 4 marks		
(ii)	M1 probability expression using uniform distribution ft their values A1 $k = 19.5$ oe cao		
(c)	M1 for $10/(\text{their } b - \text{their } a)$		
	A1ft $\frac{1}{3}$ oe condone awrt 0.333 (Allow ft $\frac{10}{their(b-a)}$ as exact fraction or	evaluated to	
	3sf or better provided $a < -5$ and $b > 5$)		
(u)	MI use of $E(W^{2}) = Var(W) + (E(W))^{2}$ with values substitued for $Var(W)$ a ft their values of a and b allow any rearrangement. Must have a correct (ft) e	nd $E(W)$	
	value for $E(W)$		
	Also allow $\int_{-7"}^{23"} \frac{1}{23"-7"} w^2 dw$		
	A1 139 cao		

Question Number	Scheme		Ma	Marks	
7. (a)	$R \sim Po(8)$ P(4 \le R \le 8) = P(R \le 8) - P(R \le 3) = 0.5925 - 0.0424		B1 M1 A1		
(b)	$= 0.5501 = awrt \underline{0.550}$ $H \sim Po(4)$ $P(H \le 2) = 0.2381$ $Y \sim B(5, ``0.2381'')$ $P(Y = 2) = {}^{5}C_{2}("0.2381'')^{2}(1 - "0.2381'')^{3}$		B1 B1 M1 A1	(3)	
(c)	W = number sold in first fifteen minutes X = number sold in last forty five minutes	F = number of muffins sold in first 15 minutes		(3)	
	$P(W > X R = 4) = \frac{P(W = 4)P(X = 0) + P(W = 3)P(X = 1)}{P(R = 4)}$ $= \frac{\frac{e^{-2}2^{4}}{4!} \frac{e^{-6}6^{0}}{0!} + \frac{e^{-2}2^{3}}{3!} \frac{e^{-6}6^{1}}{1!}}{\frac{e^{-8}8^{4}}{1!}}$	$F \sim B(4, 0.25)$ P(F > 2) = P(F = 3) + P(F = 4) $={}^{4} C_{3}(0.25)^{3}(0.75) + 0.25^{4}$	M1 M1 M1		
	$\frac{e^{-8}}{4!} = \frac{13}{256}$	- (awrt 0.0508 or awrt 0.0509)	A1 [Tota	(4) Il 12]	
	Notes				
(a)	B1 writing or using Po(8) (may be implied by one correct probability from 0.5925, 0.0424 0.4530 or 0.09 M1 writing or using P($R \le 8$) – P($R \le 3$) A1 awrt 0.550 (calc: 0.55016) correct answer scores 3 out of 3			996)	
(b)	1 st B1 writing or using Po(4) 2 nd B1 awrt 0.238 1 st M1 choosing binomial distribution with $n = 5$ and their p 2 nd M1 ${}^{5}C_{2} p^{2}(1-p)^{3}$ with $0A1 awrt 0.251$				
(c)	1 st M1 attempt at either correct product $P(W = 4)P(X = 0)$ or $P(W = 3)P(X = 1)$				
	from $W \sim Po(2)$ and $X \sim Po(6)$ implied by awrt 0.0902×awrt 0.0025 or awrt 0.180×awrt 0.0149 or awrt 0.0029 2 nd M1 conditional probability with P($R = 4$) from $R \sim Po(8)$ on denominator				
	implied by awrt 0.0573 seen in the denominator of a probability expression				
	3 rd M1 complete expression for the required probability				
	implied (awrt 0.0902×awrt 0.0025+awrt 0.180×awrt 0.0149)/awr	t 0.0573 for 3 rd M1			
ALT	1^{st} M1 identifying B(4, 0.25)				
	2 nd M1 P($F = 3$) + P($F = 4$) from B(4, 0.25) 3 rd M1 4 $p^3q + p^4$ from B(4, 0.25)				