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Question Number		Scheme			
1 (a) (i)	$X \square B(14, 0.2)$				
	$\int \mathbf{P}(X =$	2) = $]^{14}C_2 \times 0.2^2 \times 0.8^{12}$		M1	
		= 0.2501	awrt 0.2501	A1	
(ii)	$X \square \mathbf{B}($	25,0.2)			
	P( <i>X</i> >	$3 = 1 - P(X_{,,} 3) = 1 - 0.2340$ or 1	-(0.0038 + 0.0236 + 0.0708 + 0.1358)	M1	
		= 0.7660	awrt 0.766	A1	
				(4)	
(b)(i)	[np=6]	$\Rightarrow$ ] $n = \frac{6}{0.2}$		M1	
		= 30		Al	
				(2)	
(ii)	$Y \square B(n, 0.2)$ we require $P(Y \ge 1) > 0.95$				
	$1 - P(Y = 0) > 0.95 \Longrightarrow P(Y = 0) < 0.05$				
	$\left[ {\left[ {^n C_0  imes 0.2^0 } \right]  imes 0.8^n < 0.05}  ight.$				
	$0.8^{14} = 0.04398[< 0.05] \qquad \qquad n > \frac{\ln 0.05}{\ln 0.8} \Longrightarrow n > 13.425$				
		n = 14			
		No	otes	Total 10	
(a) (i)	M1	For writing or using ${}^{14}C_2 \times 0.2^2 \times 0.8^{12}$	<sup>2</sup> (Allow 91 for ${}^{14}C_2$ )		
	A1	awrt 0.2501 NB 0.2501 with no wor	king scores M1A1		
(ii)	M1	For writing or using $1 - P(X_{,,} 3)$			
	A1 awrt 0.766 NB awrt 0.766 with no working scores M1A1				
(b)(i)	M1	For use of $np = 6$ e.g $0.2n = 6$ (Allow	v ≥)		
	A1	Сао			
(ii)	ii) M1 For writing or using $P(Y1) = 1 - P(Y = 0)$ (Allow $P(Y1) = 1 - P(Y, 0)$				
	M1	1 For $0.8^n < 0.05$ oe (Allow = or $\leq$ )			
	<b>dM1</b> Dependant on previous M1 For substitution of <i>n</i> (allow $0.8^{13} = 0.05497$ ) or rearranging to $n >$ (Allow = or			≥)	
		If using logs allow any base e.g. $n > $	$\log_{0.8} 0.05$		
	A1 Cao				

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Question Number		Scheme Marks					
2 (a)	[Mode =	4					
2 (u)				B1 (1)			
(b)	$\left[a\int_0^4 x^3 \mathrm{d} x\right]$	$x = \frac{1}{2} \Rightarrow \left] a \left[ \frac{x^4}{4} \right]_0^4 = \frac{1}{2}$ $\Rightarrow a = \frac{1}{128} *$					
	$64a = \frac{1}{2}$	$\Rightarrow a = \frac{1}{128} *$		A1*			
				(2)			
(c)	$0.5 \\ 0.5 \\ 0.5 \\ d \\ 1 \\ 2 \\ 2 \\ (d-4) = \frac{1}{2}  \text{or}  \frac{1}{2} \\ \frac{1}{2} \\ (d-4) + \int_{0}^{4} ax^{3} dx = 1$						
	d = 6			A1			
	<i>u</i> = 0			(2)			
(d)	$b = \frac{-\frac{1}{2}}{\frac{1}{6} - 4} \left[ = -\frac{1}{4} \right] \qquad \qquad 4b + c = 0.5 \text{ oe}$						
	$0 = -\frac{1}{4}$	$'\times'6'+c$ or $\frac{1}{2} = '-\frac{1}{4}'\times4+c$ $10b+2c = 0.5$ oe or $'6'b+c = 0$ oe					
		$b = -\frac{1}{4}$ and $c = \frac{3}{2}$ A1					
			(3)				
		1	Notes	Total 8			
(a)	<b>B</b> 1	Сао	Cao				
(b)	M1		For integrating the $1^{st}$ line of the pdf and setting = 0.5 Ignore limits				
	A1*	Answer is given so a correct solution must be seen with no errors. There must be at least one line of correct working from the M mark to the final answer.					
	3	Mark parts c and d together					
(c)	M1	For setting the area of the triangle $= 0.5$					
	A1	Cao					
(d)	M1	A correct method for finding b ft their d value or $4b+c=0.5$ oe (this may be seen any part of this question) Allow $4b+c=64a$					
	M1	M1 A correct method for finding c ft their b and d value or $10b+2c=0.5$ oe or $'d' \times b+c=0$ oe (these may be seen any part of this question) Allow db+c=0					
	A1 For both b and c correct NB $b = -0.25$ oe and $c = 1.5$ oe will score $3/3$						

Question				
Number		Scheme	Marks	
3 (a)(i)	3 + [0] +	-29 = 32*	B1*	
(ii)	3 + 15 + 29 = 47*			
			(2)	
	ſ	$\frac{1}{2}$ 32 t 47		
(b)	f(t) =	$ \frac{1}{15} 32,, t, 47  0 otherwise $	M1 A1	
	l	0 otherwise		
			(2)	
(c) (i)	[E(T) =]		B1	
		$(47-32)^2$	M1	
(ii)	$\left[ \operatorname{Var}(T) \right]$	$=$ $\int \frac{12}{12}$	M1	
	75	$=]\frac{(47-32)^{2}}{12}$ .75		
	$\frac{-}{4} = 18.$	./>	A1	
			(3)	
(1)	(40 22	1	M1	
(d)	(40-32	$\frac{1}{15}$	M1	
	$(40 - 32)$ $= \frac{8}{15}$		A1	
	15		AI	
			(2)	
		Notes	Total 9	
(a)(i)	B1*	For 3 + [0] + 29		
(ii)	B1*	For 3 + 15 + 29 Allow 32 + 15		
		For $f(t) = \frac{1}{15}$ 32, , t, 47 Allow use of < instead of one/both $\leq$ signs.		
(b)	M1	Allow the use of any letter for $f(t)$ and t (Condone inconsistent use of letters) but we r	nust have	
		f(t) and an inequality	nust nuve	
		Fully correct pdf $f(t) = \begin{cases} \frac{1}{15} & 32 , t , 42 \end{cases}$ Must be $f(t)$ and t. Condone $f(T)$ and T		
	A1	0 otherwise		
		Allow use of $<$ instead of one/both $\leq$ signs		
(a)(i)	B1	Allow equivalent for the 0 otherwise. For 39.5 oe		
(c)(i)	D1			
(ii)	M1	For use of $\operatorname{Var}(T) = \frac{\left(\beta - \alpha\right)^2}{12}$		
1		12 For 18.75 oe		
	Λ1			
	A1			
(d)	A1 M1	For use of $(40 - \alpha) \times \frac{1}{\beta - \alpha}$		
(d)				

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Question Number		Scheme					
4 (a)	$0.2 \times \pounds 10 + 0.3 \times \pounds 12 + 0.5 \times \pounds 15$					M1	
	$= [\pounds] 13.10$					A1	
	10 10 1		12 12 12	15 15 15			
(b)			12 12 15 (×3)			B1 B1	
			10 12 12 (×3)	10 15 15 (×3)			
	10 12 1	5 (×6)				(2)	
(-)	P(10) = 0	0.2	P(12) = 0.3	P(15) = 0.5		(2) B1	
(c)	· · ·		( )	P(13) = 0.3			
		can be 10, 12				B1	
	$\mathbf{P}(M=1)$	$0) = 0.2^3 + 0.2$	$2^2 \times 0.3 \times 3 + 0.2^2 \times 0.5$	$\times 3$ or $1 - 0.8^3 - 3 \times 0.$	$8^2 \times 0.2$	M1	
	P(M=1)	$2) = 0.3^3 + 0.3$	$v^{2} \times 0.5 \times 3 + 0.3^{2} \times 0.2$	$\times 3 + 0.2 \times 0.3 \times 0.5 \times 6$		M1	
	$P(M = 15) = 0.5^{3} + 0.5^{2} \times 0.3 \times 3 + 0.5^{2} \times 0.2 \times 3 \text{ or } 1 - 0.5^{3} - 3 \times 0.5^{2} \times 0.5$				<sup>2</sup> ×0.5	M1	
		М	10	12	15		
	P(2	M = m)	$\frac{13}{125} = 0.104$	$\frac{99}{250} = 0.396$	$\frac{1}{2} = 0.5$	A1	
						(6)	
			N	otes		Total 10	
(a)	M1	For 0.2×10+	For $0.2 \times 10 + 0.3 \times 12 + 0.5 \times 15$ May be implied by a correct answer				
	A1	Cao Allow 1	Cao Allow 13.1				
(b)	<b>B</b> 1		B1 for at least 5 possible combinations. Ignore repeats. May be seen in part c				
	B1	For all 10 possible combinations. Ignore repeats. May be seen in part c					
(c)	B1	Correct probabilities – may be seen in an equation or implied by a correct probability					
	B1		All 3 medians and no extras				
	M1		A correct method for one of the probabilities (May be implied by a correct probability)				
	M1	A correct method for two of the probabilities (May be implied by 2 correct probabilities)					
	M1	A correct method for all three probabilities (May be implied by 3 correct probabilities) or 3 probabilities that add to 1					
	A1			abilities must be attach	ed to the correct median		

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NumberB15 (a)Complaints received are independent or occurring at a constant rate or singlyB1(b)(i) $[P(X < 3 X ~ Po(6)) = ]0.0620$ awrt 0.062B1(ii) $[P(X6) = ]1 - P(X, , 5)$ or $1 - 0.4457 = 0.5543$ awrt 0.554M1A1(c) $H_0 : \lambda = 6$ $H_1 : \lambda > 6$ B1 $P(X12) = 1 - P(X, , 21) = [1 - 0.9799]$ or $P(X11) = 1 - P(X, , 20) = [1 - 0.9574]$ M1 $R$ eject $H_0/In$ the CR/SignificantM1There is sufficient evidence to suggest that the mean number of complaints receivedA1ftis greater than 6 per weakB1(d) $H_0 : \lambda = 6$ $H_1 : \lambda < 6$ $6$ week period is $Po(36) \Rightarrow N(36, 36)$ B1 $P(X, 26) \approx P(Y < 26.5) = P(Z < \frac{26.5 - 36}{6})$ or $\frac{x + 0.5 - 36}{\sqrt{36}} < -1.6449$ M1 M $[P(Z < -1.583)] = 0.0571(Calculator 0.05667) or x < 25.63A1awrt 0.057awrt 25.6Do not reject HavKor in the CR/Not significantThere is insufficient evidence to suggest that the mean number of complaintsreceived after the changes made is less than 6 per week10(a)B1A correct assumption. Must be in context so need 'complaints' and then independent/random orconstant rate or singly(b)(i)B1B1 avrt 0.062(ii)M1 For writing or using 1 - P(X, x) of x - 0.544(c)B1 Both hypotheses correct. Must be attached to H_0 and H_1 in terms of \lambda or \muM1 For vriting or using 1 - P(X, x) or 1 - P(X, 20)A1 For 0.0201 or CR11M1 A correct statement - no context meeded bu$	Question		Scheme	Mark	s	
(b)(i) $\begin{bmatrix} P(X < 3 X - Po(6)) = \end{bmatrix} 0.0620 & awrt 0.062 & B1 \\ \hline P(X6) = ]1 - P(X , 5) or 1 - 0.4457 = 0.5543 & awrt 0.554 & M1A1 \\ \hline P(X12) = 1 - P(X , 5) or 1 - 0.4457 = 0.5543 & awrt 0.554 & M1A1 \\ = 0.0201 & or CR11 & = 1 - P(X , 20) = [1 - 0.9794] & M1 \\ = 0.0201 & or CR11 & A1 \\ Reject H_0/In the CR/Significant & M1 \\ There is sufficient evidence to suggest that the mean number of complaints received A1ft is greater than 6 per week & B1 \\ 6 week period is Po(36) ⇒ N(36, 36) & B1 \\ 9 (Y, 26) ≈ P(Y < 26.5) = P(Z < \frac{26.5 - 36}{6}) & or \frac{X + 0.5 - 36}{\sqrt{36}} < -1.6449 & M1 \\ M1 \\ There is sufficient evidence to suggest that the mean number of complaints received M1 M. \\ \begin{bmatrix} P(Z < -1.583) \end{bmatrix} = 0.0571(Calculator 0.05667) or X < 25.63 A1 A1 A1 A1 A1 A2 A2 A2 A3 A3 A3 A3 A3 A3 A3 A4 A3 A3 A4 A4 A4 A4 A4 A4 A4 A4$	Number					
(ii) $\begin{bmatrix} P(X6) = ] 1 - P(X, s) \text{ or } 1 - 0.4457 - 0.5543 & awrt 0.554 & M1A1 \\ \hline P(X12) = 1 - P(X, 11) = [1 - 0.9799] \text{ or } P(X11) = 1 - P(X, 20) = [1 - 0.9574] & M1 \\ = 0.0201 & \text{or } CR11 & A1 \\ Reject H_0/In the CR/Significant & M1 \\ There is sufficient evidence to suggest that the mean number of complaints received a 11 ft of week week & A1ft of week period is P(36) \Rightarrow N(36, 36) & B1 \\ P(Y, 26) \approx P(Y < 26.5) = P\left(Z < \frac{26.5 - 36}{6}\right) & \text{or } \frac{x + 0.5 - 36}{\sqrt{36}} < -1.6449 & M1 & M1 \\ There is sufficient evidence to suggest that the mean number of complaints received A1ft B1 P(Y, 26) \approx P(Y < 26.5) = P\left(Z < \frac{26.5 - 36}{6}\right) & \text{or } x < 42.563 & A1 \\ P(Z < -1.583)\right] = 0.0571(Calculator 0.05667) & or x < 25.63 & A1 \\ Do not reject H_0/Nt in the CR/Ntot significant \\ There is insufficient evidence to suggest that the mean number of complaints received after the changes made is less than 6 per week & Notes Total \\ (a) B1 A correct assumption. Must be in context so need 'complaints' and then independent/random or constant rate or singly & M1 & GP(X, 20) \\ (b)(i) B1 awrt 0.052 & Notes Total \\ A correct assumption. Must be attached to H_0 and H_1 in terms of \lambda or \mu & M1 & For writing or using 1 - P(X, 20) P(X, 20) A1 For 0.0201 or CR11 M1 For writing or using 1 - P(X, 20) A1 For 0.0201 or CR11 M1 A correct statement – no context meeded but do not allow contradicting non contextual commen A1ft Correct conclusion in context with the words highlighted in bold Both hypotheses correct. Must be attached to H_0 and H_1 in terms of \lambda or \mu Allow use of 36 rather than 6 Pri working or using 1 - P(X, 20) A1 For writing or using 1 - P(X, 20) A1 For active tonclusion in context with the words highlighted in bold Both Mpotheses correct. Must be attached to H_0 and H_1 in terms of \lambda or \mu Allow use of 36 rather than 6 Pri working or using N(36, 36) B1 For writing or using N(36, 36) B1 For writing or using N($	5 (a)	Compl	aints received are independent or occurring at a constant rate or singly	1	(1)	
(c) $H_0: \lambda = 6$ $H_1: \lambda > 6$ $P(X12) = 1 - P(X_n, 21) = [1 - 0.9799]$ or $P(X11) = 1 - P(X_n, 20) = [1 - 0.9574]$ M1 = 0.0201 or CR11 A1 Reject $H_0'$ In the CR/Significant M1 There is sufficient evidence to suggest that the mean <b>number</b> of <b>complaints</b> received A1ft is <b>greater</b> than 6 per week B1 (d) $H_0: \lambda = 6$ $H_1: \lambda < 6$ B1 $P(Y, 26) \approx P(Y < 26.5) = P(Z < \frac{26.5 - 36}{6})$ or $\frac{x + 0.5 - 36}{\sqrt{36}} < -1.6449$ M1 M [P(Z < -1.583)] = 0.0571(Calculator 0.05667) or $x < 25.63$ A1 a wrt 0.057 $a wrt 25.6$ M1 $There is insufficient evidence to suggest that the mean number of complaints received after the changes made is less than 6 per week A1ft There is insufficient evidence to suggest that the mean number of complaints received after the changes made is less than 6 per week A1ft There is insufficient evidence to suggest that the mean number of complaints received after the changes made is less than 6 per week A1ft There is insufficient evidence to suggest that the mean number of complaints received after the changes made is less than 6 per week A1ft There is insufficient evidence to suggest that the mean number of complaints R = \frac{1}{00000000000000000000000000000000000$	(b)(i)	$\int P(X <$	$<3 X \sim Po(6)) = ]0.0620$ awrt 0.062			
P(X12) = 1-P(X, 21) = [1-0.9799] or P(X11) = 1-P(X, 20) = [1-0.9574]M1= 0.0201or CR11A1Reject Ha/In the CR/SignificantM1There is sufficient evidence to suggest that the mean <b>number</b> of <b>complaints</b> receivedA1fr(d)H <sub>0</sub> : $\lambda = 6$ H <sub>1</sub> : $\lambda < 6$ B16 week period is Po(36) $\Rightarrow$ N(36, 36)B1P(Y, 26) $\approx$ P(Y < 26.5) = P(Z < $\frac{26.5 - 36}{6}$ ) or $\frac{x + 0.5 - 36}{\sqrt{36}} < -1.6449$ M1 M.[P(Z < -1.583)] = 0.0571(Calculator 0.05667) or $x < 25.63$ A1 $awrt 0.057$ $awrt 25.6$ M1Do not reject Ha/Not in the CR/Not significantM1There is insufficient evidence to suggest that the mean <b>number</b> of <b>complaints</b> received after the changes made is <b>less</b> than 6 per week <b>ii</b> (a) <b>B1</b> A correct assumption. Must be in context so need 'complaints' and then independent/random or constant rate or singly(b)(i) <b>B1B1</b> For writing or using 1-P(X., 5) May be implied by awrt 0.554(a) <b>B1</b> A correct assumption. Must be attached to H <sub>0</sub> and H <sub>1</sub> in terms of $\lambda$ or $\mu$ (d) <b>B1</b> A correct statement - no context needed but do not allow contradicting non contextual comment(d) <b>B1</b> A correct statement - no context with the words highlighted in hold(d) <b>B1</b> Both hypotheses correct. Must be attached to H <sub>0</sub> and H <sub>1</sub> in terms of $\lambda$ or $\mu$ Allow use of 36 rather than 6(d) <b>B1</b> Both hypotheses correct. Must be attached to H <sub>0</sub> and H <sub>1</sub> in terms of $\lambda$ or $\mu$ Allow use	(ii)	$\left[ P(X \right] \right]$	6) = ]1 - P(X, 5)  or  1 - 0.4457 = 0.5543 awrt 0.554	M1A1		
P(X12) = 1-P(X, 21) = [1-0.9799] or P(X11) = 1-P(X, 20) = [1-0.9574]M1= 0.0201or CR11A1Reject Ha/In the CR/SignificantM1There is sufficient evidence to suggest that the mean <b>number</b> of <b>complaints</b> receivedA1fr(d)H <sub>0</sub> : $\lambda = 6$ H <sub>1</sub> : $\lambda < 6$ B16 week period is Po(36) $\Rightarrow$ N(36, 36)B1P(Y, 26) $\approx$ P(Y < 26.5) = P(Z < $\frac{26.5 - 36}{6}$ ) or $\frac{x + 0.5 - 36}{\sqrt{36}} < -1.6449$ M1 M.[P(Z < -1.583)] = 0.0571(Calculator 0.05667) or $x < 25.63$ A1 $awrt 0.057$ $awrt 25.6$ M1Do not reject Ha/Not in the CR/Not significantM1There is insufficient evidence to suggest that the mean <b>number</b> of <b>complaints</b> received after the changes made is <b>less</b> than 6 per week <b>ii</b> (a) <b>B1</b> A correct assumption. Must be in context so need 'complaints' and then independent/random or constant rate or singly(b)(i) <b>B1B1</b> For writing or using 1-P(X., 5) May be implied by awrt 0.554(a) <b>B1</b> A correct assumption. Must be attached to H <sub>0</sub> and H <sub>1</sub> in terms of $\lambda$ or $\mu$ (d) <b>B1</b> A correct statement - no context needed but do not allow contradicting non contextual comment(d) <b>B1</b> A correct statement - no context with the words highlighted in hold(d) <b>B1</b> Both hypotheses correct. Must be attached to H <sub>0</sub> and H <sub>1</sub> in terms of $\lambda$ or $\mu$ Allow use of 36 rather than 6(d) <b>B1</b> Both hypotheses correct. Must be attached to H <sub>0</sub> and H <sub>1</sub> in terms of $\lambda$ or $\mu$ Allow use				ĺ	(3)	
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	(c)	$H_0: \lambda$	$= 6 \qquad H_1: \lambda > 6$	B1		
Reject H_0/In the CR/SignificantM1There is sufficient evidence to suggest that the mean number of complaints received is greater than 6 per weekA1ft(d)H_0: $\lambda = 6$ H_1: $\lambda < 6$ B16week period is Po(36) $\Rightarrow$ N(36, 36)B1P(Y, 26) $\approx$ P(Y < 26.5) $=$ P $\left(Z < \frac{26.5 - 36}{6}\right)$ or $\frac{x + 0.5 - 36}{\sqrt{36}} < -1.6449$ M1 M $\left[P(Z < -1.583)\right] = 0.0571$ (Calculator 0.05667) or $x < 25.63$ awrt 0.057A1There is insufficient vidence to suggest that the mean number of complaints received after the changes made is less than 6 per weekM1M1There is insufficient vidence to suggest that the mean number of complaints received after the changes made is less than 6 per weekTotal(a)B1A correct assumption. Must be in context so need 'complaints' and then independent/random or constant rate or singly (b)(i)A correct assumption. Must be attached to H_0 and H_1 in terms of $\lambda$ or $\mu$ (b)B1awrt 0.554A1(c)B1Both hypotheses correct. Must be attached to H_0 and H_1 in terms of $\lambda$ or $\mu$ M1For writing or using $1 - P(X, 20)$ A1For 0.201 or CR11M1A correct statement – no context meaded but do not allow contradicting non contextual commen A1 for 0.201 or CR11M1A correct continuity correct. Must be attached to H_0 and H_1 in terms of $\lambda$ or $\mu$ Allow use of 36 rather than 6B1For writing or using $2.5.526/26.5$ , their mean and their standard deviation or standardising using $x - 0.5/x \times + 0.5$ , their mean and their standard deviation or standardising using $x - 0.5/x \times + 0.5$ , their mean and the		P(X	12) = 1 - P(X,, <b>2</b> 1) = [1 - 0.9799] or P(X11) = 1 - P(X,, <b>2</b> 0) = [1 - 0.9574]	M1		
There is sufficient evidence to suggest that the mean number of complaints received is greater than 6 per weekA1ft(d) $H_0: \lambda = 6$ $H_1: \lambda < 6$ B16 week period is $PO(36) \Rightarrow N(36, 36)$ B1 $P(Y, 26) \approx P(Y < 26.5) = P\left(Z < \frac{26.5 - 36}{6}\right)$ or $\frac{x + 0.5 - 36}{\sqrt{36}} < -1.6449$ M1 M $\left[P(Z < -1.583)\right] = 0.0571$ (Calculator 0.05667) or $x < 25.63$ awrt 0.057A1onto reject Ho/Not in the CR/Not significantThere is insufficient evidence to suggest that the mean number of complaints received after the changes made is less than 6 per weekNotesTotal(a)(b)(i)B1awrt 0.052Total(b)(i)B1awrt 0.052TotalAlftTotal(b)(i)B1awrt 0.554(c)B1Both hypotheses correct. Must be attached to $H_0$ and $H_1$ in terms of $\lambda$ or $\mu$ M1For writing or using $1 - P(X_n, 21)$ or $1 - P(X_n, 20)$ AlftCorrect conclusion in context meeded but do not allow contradicting non contextual commenAlft(d)B1Both hypotheses correct. Must be attached to $H_0$ and $H_1$ in terms of $\lambda$ or $\mu$ Allow use of 36 rather			= 0.0201 or CR11	A1		
is greater than 6 per week       A111         (d)       H <sub>0</sub> : λ = 6       H <sub>1</sub> : λ < 6		Reject	H <sub>0</sub> /In the CR/Significant	M1		
6 week period is $Po(36) \Rightarrow N(36, 36)$ B1 $P(Y, 26) \approx P(Y < 26.5) = P\left(Z < \frac{26.5 - 36}{6}\right)$ or $\frac{x + 0.5 - 36}{\sqrt{36}} < -1.6449$ M1 M $\left[P(Z < -1.583)\right] = 0.0571$ (Calculator $0.05667$ ) or $x < 25.63$ awrt $25.6$ A1Do not reject H <sub>0</sub> /Not in the CR/Not significantM1There is insufficient evidence to suggest that the mean <b>number</b> of <b>complaints</b> received after the changes made is <b>less</b> than 6 per weekA1(a)B1A correct assumption. Must be in context so need 'complaints' and then independent/random or constant rate or singlyTotal(b)(i)B1awrt $0.062$ $(ii)$ (ii)M1For writing or using $1-P(X, s)$ May be implied by awrt $0.554$ (c)B1Both hypotheses correct. Must be attached to H <sub>0</sub> and H <sub>1</sub> in terms of $\lambda$ or $\mu$ M1For writing or using $1-P(X, 21)$ or $1-P(X, 20)$ A1For o.0201 or CR11M1A correct tance then t - no context needed but do not allow contradicting non contextual commen A1ftA1ftCorrect conclusion in context with the words highlighted in bold(d)B1Both hypotheses correct. Must be attached to H <sub>0</sub> and H <sub>1</sub> in terms of $\lambda$ or $\mu$ Allow use of 36 rather than 6M1For standardising using $25.5/26/26.5$ , their mean and their standard deviation or standardising using $x - 0.5/x/x + 0.5$ , their mean and their standard deviation or standardising using $x - 0.5/x/x + 0.5$ , their mean and their standard deviation or standardising using $x - 0.5/x/x + 0.5$ , their mean and their standard deviation or standardising using $x - 0.5/x/x + 0.5$ , their mean and their standard deviation or standardising using $x - 0.5/x/x + 0.5$				A1ft		
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(d)B1Both hypotheses correct. Must be attached to $H_0$ and $H_1$ in terms of $\lambda$ or $\mu$ Allow use of 36 rather than 6B1For writing or using N(36, 36)M1For standardising using 25.5/26/26.5, their mean and their standard deviation or standardising using $x-0.5/x/x + 0.5$ , their mean and their standard deviation and setting equal to $-1.6449$ M1For a correct continuity correction written or used e.g. 26.5 or $x + 0.5$ A1awrt 0.057 (NB Poisson used gives $0.0512685$ and scores M0M0A0) or CR < awrt 25.6 (Allow $\leq$ )M1A correct statement – no context needed but do not allow contradicting non contextual comment Correct conclusion in context with the words in bold (Allow The mean <b>number</b> of <b>complaints</b>		M1	A correct statement - no context needed but do not allow contradicting non contextual	comment	ts	
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B1For writing or using N(36, 36)M1For standardising using $25.5/26/26.5$ , their mean and their standard deviation or standardising using $x-0.5/x/x + 0.5$ , their mean and their standard deviation and setting equal to $-1.6449$ M1For a correct continuity correction written or used e.g. $26.5$ or $x + 0.5$ A1awrt 0.057 (NB Poisson used gives $0.0512685$ and scores M0M0A0) or CR < awrt $25.6$ (Allow $\leq$ )M1A correct statement – no context needed but do not allow contradicting non contextual comment Correct conclusion in context with the words in bold (Allow The mean number of complaints)	(d)	B1		36 rather	•	
M1using $x-0.5/x/x + 0.5$ , their mean and their standard deviation and setting equal to $-1.6449$ M1For a correct continuity correction written or used e.g. 26.5 or $x + 0.5$ A1awrt 0.057 (NB Poisson used gives $0.0512685$ and scores M0M0A0) or CR < awrt 25.6 (Allow $\leq$ )M1A correct statement – no context needed but do not allow contradicting non contextual comment Correct conclusion in context with the words in bold (Allow The mean number of complaints)		B1				
M1For a correct continuity correction written or used e.g. $26.5$ or $x + 0.5$ A1awrt 0.057 (NB Poisson used gives $0.0512685$ and scores M0M0A0) or CR < awrt 25.6 (Allow $\leq$ )M1A correct statement – no context needed but do not allow contradicting non contextual commenA1ftCorrect conclusion in context with the words in bold (Allow The mean number of complaints)		M1		•		
A1       awrt 0.057 (NB Poisson used gives 0.0512685 and scores M0M0A0) or CR < awrt 25.6 (Allow ≤)		M1		+49		
A1       or CR < awrt 25.6 (Allow ≤)		awrt 0.057 (NB Poisson used gives 0.0512685 and scores M0M0A0)				
M1         A correct statement – no context needed but do not allow contradicting non contextual commen           A1ft         Correct conclusion in context with the words in bold (Allow The mean number of complaints)		A1				
		M1	A correct statement - no context needed but do not allow contradicting non contextual			
		A1ft	Correct conclusion in context with the words in bold (Allow The mean <b>number</b> of <b>constayed the same/not changed</b> oe)	nplaints l	has	

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Question		52_2023_				
Number		Scheme Mar				
6(a)	$\left[ P \right( Y$	$\left[P\left(Y < \frac{1}{4}k \mid Y < k\right) = \right] \frac{F\left(\frac{1}{4}k\right)}{F(k)} = \frac{\frac{1}{21}\left(\frac{k}{4}\right)^2}{\frac{1}{21}k^2} = \frac{1}{16} \text{ oe}$				
			(2)			
(b)		$= -\frac{1}{15}k^{2} + \frac{4}{5}k - \frac{7}{5} \qquad \frac{d}{dy}\left(\frac{1}{21}y^{2}\right) = \frac{2}{21}y \text{ or } \frac{d}{dy}\left(\frac{2}{15}\left(6y - \frac{y^{2}}{2}\right) - \frac{7}{5}\right) = \frac{2}{15}(6-y)$	M1			
	$\Rightarrow 4k$	$d^{2} - 28k + 49 = 0$ oe $\frac{d}{dy}\left(\frac{1}{21}y^{2}\right) = \frac{2}{21}y \& \frac{d}{dy}\left(\frac{2}{15}\left(6y - \frac{y^{2}}{2}\right) - \frac{7}{5}\right) = \frac{2}{15}(6-y)$	A1			
	$\Rightarrow$ (2	$(k-7)^2 = 0$ $\frac{2}{21}k = \frac{2}{15}(6-k)$	M1			
		$k = \frac{7}{2}$ oe	A1			
			(4)			
(c)	f( <i>y</i> )=	$\begin{cases} \frac{2}{21}y & 0, y, y', '3.5' \\ \frac{2}{15}(6-y) & '3.5' < y, 6 \\ [0] & [otherwise] \end{cases}$	M1 M1			
	$\mathrm{E}(Y)$ =	$= \frac{2}{21} \int_{0}^{3.5'} y^2 dy + \frac{2}{15} \int_{3.5'}^{6} (6y - y^2) dy \implies \frac{2}{21} \left[ \frac{y^3}{3} \right]_{0}^{3.5'} + \frac{2}{15} \left[ 3y^2 - \frac{y^3}{3} \right]_{3.5'}^{6}$	M1 M1			
	$\frac{2}{21}\left(\frac{34}{2}\right)$	$\left(\frac{43}{4}\right) + \frac{2}{15}\left(\frac{325}{24}\right) = \frac{19}{6} = 3.166$ awrt 3.17 dM1 dA1				
		(6)				
(-)	M1	Total 12				
(a)	M1	For a correct probability statement or a correct ratio of probabilities				
	A1	For $=\frac{1}{16}$ or 0.0625				
(b)	M1	For setting the two lines of the cdf = to each other or $\frac{2}{21}y$ or $\frac{2}{15}(6-y)$ (Implied by a correct 3TQ)				
	A1	For a correct 3TQ or $\frac{2}{21}y$ and $\frac{2}{15}(6-y)$				
	M1	For solving their 3TQ. If the 3TQ is not correct, then a correct method must be shown or setting their 2 lines of the $pdf = to$ each other				
	A1	k = 3.5 oe <b>NB</b> $k = 3.5$ with no incorrect working scores $4/4$				
(c)	M1	Attempting to differentiate 1 of the functions. May be seen in part (b) or in an attempt to find $E(Y)$				
	M1	Attempting to differentiate both with one correct. May be seen in part (b) or in an attempt to find $E(Y)$				
	M1	For writing or using $E(Y) = \int_0^{3.5} y f(y) dy + \int_{3.5}^6 y f(y) dy$ Ignore limits				
	M1					
	dM1	<b>dM1</b> Dependent on previous M1. For substitution of limits, must be 0 or 6 and ft their 3.5. May be implied by $\frac{49}{36}$ oe or $\frac{65}{36}$ oe or $\frac{19}{6}$ oe. If the integral is not correct, then we must see evidence of substitution.				
	<b>dA1</b> Dependent on previous M1. For $\frac{19}{6}$ or awrt 3.17					

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Question Number		Scheme	Marks			
7(a)	$\frac{97.5-2}{\sigma}$	$\frac{\mu}{\sigma} = 1.25$ $\frac{85.5 - \mu}{\sigma} = -0.75$	M1 M1 M1 M1 M1			
	$2\sigma = 12$		M1			
	$\sigma = 6 *$	$\left[\mu = 90\right]$	dA1*			
			(7)			
(b)	np = 90	0 and $np(1-p) = 36$	M1			
	1 - p =	0.4	M1			
	p = 0.6 and $n = 150$					
	(3)					
		Notes	Total 10			
		<b>NB</b> Condone use of <i>np</i> for $\mu$ and $\sqrt{np(1-p)}$ for $\sigma$				
(a)	M1	For standardising using 96.5/97/97.5 and = $z$ value, where $1 < z < 1.5$				
	M1	M1 For standardising using $85.5/86/86.5$ and $= z$ value, where $-1 < z < -0.5$				
	M1 For use of a correct continuity correction in either equation					
	M1 For a correct <i>z</i> value used in either equation					
	M1 An attempt at both equations with one fully correct					
	<b>M1</b>	For solving simultaneously eliminating $\mu$ or $\sigma$ As this is a show that question then w	orking must			
	be seen.					
	dA1	Dependent on all previous M marks being awarded $\sigma = 6*$				
(b)	M1	For $np = \mu$ and $np(1-p) = \sigma^2$ Follow through their $\mu$ (Condone $npq = \sigma^2$ )				
	M1 For solving simultaneously. May be implied by a correct value for <i>p</i> and <i>n</i>					
	A1	Both $p = 0.6$ and $n = 150$				