Question	Answer	Marks	Guidance
1(i)	$z = 2.326$	**B1**	
	$62.3 \pm z\frac{13.2}{\sqrt{200}}$	**M1**	Any z. Expression of correct form. Must be a 'z'
	60.1 to 64.5 (3 sfs)	**A1**	Must be an interval
		3	
1(ii)	Yes, because pop not (given to be) normal, or pop distribution unknown	**B1**	No contradictions
		1	

Question	Answer	Marks	Guidance
2	$\text{E}(X - 3Y) = 0.2$	**B1**	oe
	$\text{Var}(X - 3Y) = 12.1 + 9 \times 8.6$ (= 89.5)	**B1**	
	$\frac{0-0.2}{\sqrt{"89.5"}}$ (= –0.021)	**M1**	For area consistent with their working
	Φ('0.021')	**M1**	
	= 0.508 (3 sfs)	**A1**	
		5	

Question	Answer	Marks	Guidance
3	$H_0: \lambda = 32$ $H_1: \lambda < 32$	**B1**	Accept 'population mean' (μ)
	$X \sim N(32, 32)$	**B1**	seen or implied
	$\frac{21.5-32}{\sqrt{32}}$	**M1**	Standardise with their values. Allow with no or wrong cc
	$= -1.856$ cv of $z = -2.054$ (or -2.055 or -2.053)	**A1**	
	'1.856' < 2.054	**M1**	Valid comparison or comp ϕ("1.856") with 0.98 i.e. 0.9682 < 0.98 oe
	No evidence that fewer accidents at B than at A	**A1f**	No contradictions Note Use of CV method x = 20.38 M1 A1 comparison 21.5 > 20.38 M1 conc A1
		6	

Question	Answer	Marks	Guidance
4(i)	$\bar{x} = \frac{420}{50} = 8.4$	**B1**	
	$s^2 = \frac{50}{49}\left(\frac{27530}{50} - \left(\frac{420}{50}\right)^2\right)$	**M1**	Or $1/49(27530 - (420)^2/50)$
	$= 489.8(36....)$	**A1**	Must see ⩾ 4 sf
		3	

Question	Answer	Marks	Guidance
4(ii)	$\Phi^{-1}(0.9377) = 1.536$	**B1**	
	$\frac{5-'8.4'}{\sqrt{\frac{490}{n}}} = -1.536$	**M1**	Attempting to standardise – must have correct form
	$n = (\frac{1.536}{3.4})^2 \times 490$ (= 100.0048)	**M1**	Attempting numerical expression for n or √n (must have used a 'z' value) may be implied by answer
	$n = 100$	**A1**	No errors seen. Must be whole number
		4	

Question	Answer	Marks	Guidance
5(i)	$1 - e^{-1.8}(1 + 1.8)$	**M1**	Accept any λ. Accept 1–P(0,1,2)
	= 0.537 (3 sf)	**A1**	
		2	
5(ii)	$\lambda = 2.2$	**B1**	
	$e^{-2.2}(1 + 2.2 + \frac{2.2^2}{2!} + \frac{2.2^3}{3!} + \frac{2.2^4}{4!})$	**M1**	Attempt expr'n for P(X ⩽ 4),allow one end error, allow any λ
	= 0.928 (3 sf) or 0.927	**A1**	
		3	

Question	Answer	Marks	Guidance
5(iii)	$1 - e^{-1.8t} \geqslant 0.99$ or $1 - e^{-\lambda} \geqslant 0.99$	M1	Condone = signs/incorrect inequality signs
	$e^{-1.8t} \leqslant 0.01$ or $e^{-\lambda} \leqslant 0.01$ $-1.8t \leqslant \ln 0.01$	M1	Valid attempt take logs (must have single term on each side)
	$t \geqslant 2.56$ She must watch for at least 2.56 (hours)	A1	or 2 hours, 34 mins or better. No errors seen
		3	

Question	Answer	Marks	Guidance
6(i)	Test is for "difference" oe	B1	Test is not for 'increase' or 'decrease' oe No contradictions
		1	
6(ii)	0.05	B1	
	Conclude mean time is different when it is not	B1	oe, in context
		2	

Question	Answer	Marks	Guidance
6(iii)	Assume $\sigma = 6.4$	**B1**	
	H_0: pop mean = 91.4 H_1: pop mean ≠ 91.4	**B1**	Allow μ, but not 'mean'
	$\bar{x} = \frac{568.5}{6}$ (= 94.75)	**B1**	
	$\frac{'94.75'-91.4}{\frac{6.4}{\sqrt{6}}}$	**M1**	Must have √6
	= 1.282 cv of z = 1.96	**A1**	
	'1.282' < 1.96	**M1**	Valid comparison or comp ϕ("1.282") with 0.975 0.9(001) < 0.975 or 0.0999 (or 0.1) > 0.025 consistent use of one tail test can score M1 for comparison with 1.645oe but not A1ft oe. No contradictions. ft their z.
	No evidence mean time different	**A1 ft**	CV method x = 96.52 M1 A1 94.75 < 96.52 M1 Conc A1
		7	

Question	Answer	Marks	Guidance
7(i)	$\sqrt{2}\int_{\frac{\pi}{6}}^{\frac{\pi}{4}}\cos x\mathrm{d}x$ $= \sqrt{2}\,[\sin x]_{\frac{\pi}{6}}^{\frac{\pi}{4}}$	**M1**	Attempt integ f(*x*) with correct limits
	$= \frac{2-\sqrt{2}}{2}$ oe or 0.293 (3 sf)	**A1**	SC Final answer of 0.707 scores B1sc
		2	
7(ii)	$\sqrt{2}\int_0^m \cos x\mathrm{d}x = 0.5$	**M1**	Attempt to integ f(x) & = 0.5. Ignore limits. Condone missing √2
	$\sqrt{2}\,[\sin x]_0^m = 0.5$ $\sqrt{2}\,\sin m = 0.5$	**A1**	Correct integral and limits 0 to unknown & = 0.5 Condone missing √2
	$\sin m = \frac{1}{2\sqrt{2}}$ oe	**M1**	For rearranging their expression to the form sin*m*=… (sin*m* = 0.35355.... or 0.354) seen or implied
	$m = 0.361$ (3 sfs)	**A1**	No errors seen (Note 20.705 can score M1 A1 M1 A0)
		4	

Question	Answer	Marks	Guidance
7(iii)	$\sqrt{2}\int_0^{\frac{\pi}{4}} x\cos x\,dx$	M1	Attempt to integ $xf(x)$. Ignore limits. Condone missing √2
	$= \sqrt{2}\ \{[x(\sin x)]_0^{\frac{\pi}{4}} - \int_0^{\frac{\pi}{4}} \sin x\,dx\ \}$	M1	Attempt to integ by parts leading to expression of form $\pm x\sin x \pm \cos x$ with correct limits
	$= \sqrt{2}\ \{\frac{\pi}{4\sqrt{2}} - 0 - [-\cos x]_0^{\frac{\pi}{4}}\}$	A1	For $\sqrt{2}(x\sin x - (-\cos x))$ with correct limits
	$= \sqrt{2}\ \{\frac{\pi}{4\sqrt{2}} + \cos\frac{\pi}{4} - 1\}$ $= \frac{\pi}{4} + 1 - \sqrt{2}$ oe or 0.371 (3 sf)	A1	
		4	