Question	Answer	Marks	Guidance
1(a)(i)	Po(2.54)	**M1**	seen or implied Po(2540 × 0.001)
	$1 - e^{-2.54}(1 + 2.54)$	**M1**	any λ Allow 1 end error
	= 0.721 (3 sf)	**A1**	
		3	
1(a)(ii)	n large and p small (or np (= 2.54) < 5)	**B1**	$n > 50$, $p < 0.1$
		1	
1(b)	$\mu = 5.6$	**B1**	
	$\sigma = 2.37$ (3 sf)	**B1**	Accept $\sqrt{5.6}$
		2	

Question	Answer	Marks	Guidance
2(i)	$4820 \pm z \times \frac{1420}{\sqrt{125}}$	**M1**	Must be a z value
	$z = 2.326$	**B1**	Accept 2.326 - 2.329
	4524/4525 to 5115/5116 or 4520 to 5120 (3 sf)	**A1**	Must be an interval
		3	

Question	Answer	Marks	Guidance
2(ii)	$\overline{x} = 4840$	**B1**	or width = 280 or half width = 140
	$4840 + 1.96 \times \frac{1420}{\sqrt{n}} = 4980$ OE	**M1**	or $140 = 1.96 \times \frac{1420}{\sqrt{n}}$ OE
	$n = 395$	**A1**	CAO must be an integer
		3	

Question	Answer	Marks	Guidance
3(i)	$\overline{m} = \frac{98.2}{100} = 0.982$	**B1**	Accept either
	$s = \sqrt{\frac{100}{99}} \times \sqrt{\frac{104.52}{100} - 0.982^2}$ (= 0.28582) or var = 0.08169	**M1**	
	H_0: Pop mean mass = 1.01 H_1: Pop mean mass < 1.01	**B1**	not just 'mean', but allow just 'μ'
	$\pm\frac{0.982 - 1.01}{\frac{0.28582}{\sqrt{100}}}$	**M1**	$\pm\frac{0.982 - 1.01}{\frac{0.284387}{\sqrt{100}}}$ **M1**
	= −0.980 (3 sf) accept ±	**A1**	= –0.985 (3 sfs) accept ± **A1**
	Comp with $z = -1.645$ (or areas 0.1635 > 0.05)	**M1**	Valid comparison of z's or area's
	No evidence that (mean) mass is less than 1.01	**A1 FT**	Correct conclusion FT their z
		7	

Question	Answer	Marks	Guidance
3(ii)	Distr of X normal (so distr of $\overline{X}$ normal) Must state or imply No	**B1**	X/parent population
		1	

Question	Answer	Marks	Guidance
4(i)	$k\int_0^a \frac{1}{\sqrt{x}}dx = 1$	**M1**	Attempt int f(x) and = 1 ignore limits
	$(2k[x^{0.5}]_0^a = 1)$ $2ka^{0.5} = 1$ or $a = \frac{1}{4k^2}$	**A1**	OE; a correct eqn in k & a after sub limits
	$k\int_0^a \frac{x}{\sqrt{x}}dx = 3$	**M1**	Attempt int xf(x) and = 3
	e.g. $\frac{2}{3}ka^{1.5} = 3$ or $a^3 = \frac{81}{4k^2}$	**A1**	OE; a correct eqn in k and a after sub limits
	e.g. $a^2 = 81$ or e.g. $k^2 = \frac{81}{4\times9^3}$	**M1**	Attempt eliminate one letter
	$a = 9$	**A1**	Convincingly obtained
	e.g. $k = \frac{9}{54}$ $k = \frac{1}{6}$ AG	**A1**	
		7	

Question	Answer	Marks	Guidance
4(ii)	$\frac{1}{6}\int_0^m \frac{1}{\sqrt{x}}\,dx = 0.5$ OE	**M1**	Attempt int f(x), unknown limit and = 0.5
	$\frac{1}{3}m^{0.5} = 0.5$	**A1**	a correct equn in m after sub limits
	$m = 2.25$	**A1**	
		3	

Question	Answer	Marks	Guidance
5(i)	$E(X - Y) = 56-43$ (= 13)	**B1**	
	$Var(X - Y) = 6^2 + 5^2$ (= 61)	**M1**	
	$\frac{0-13}{\sqrt{'61'}}$ (= −1.664)	**M1**	Ignore any attempted cc/no SD/var mixes. var must be attempt at a combination
	$1 - \phi('-1.664') = \phi('1.664')$	**M1**	For area consistent with their working
	= 0.952 (3 sf)	**A1**	Similar scheme for use of $Y - X$
		5	

Question	Answer	Marks	Guidance
5(ii)	$E(M) = 56 + 1.5(43)$ (= 120.5)	**B1**	
	$Var(M) = 6^2 + 1.5^2 \times 5^2$ (= 92.25)	**M1**	
	$\frac{135-120.5}{\sqrt{'92.25'}}$ (= 1.510)	**M1**	Ignore any attempted cc/no SD/var mixes. var must be attempt at a combination
	$1 - \phi('1.510')$	**M1**	For area consistent with their working
	= 0.0655 or 0.0656 or 6.55% or 6.56% (3 sf) As final answer	**A1**	Allow 6.6% or 6.5% or 7% if correct working seen
		5	

Question	Answer	Marks	Guidance
6(i)	H_0: Pop mean no. defectives = 5.15 H_1: Pop mean no. defectives < 5.15	**B1**	or '= 1.03 (per day)' not just 'mean', but allow just 'λ' or 'μ'
	$P(X \leqslant 2)$	**M1**	Attempted. Any one term error/end error/incorrect λ/expression 1–…
	$= e^{-5.15}(1 + 5.15 + \frac{5.15^2}{2})$	**M1**	Correct expression attempted
	= 0.113	**A1**	
	Comp with 0.1	**M1**	Valid comparison
	No evidence to believe mean no. of defectives has decreased	**A1 FT**	Correct conclusion (FT their value) No contradictions
		6	

Question	Answer	Marks	Guidance
6(ii)	BOTH $P(X \leqslant 1) = e^{-5.15}(1 + 5.15)$ (= 0.0357) AND $P(X \leqslant 2) = = e^{-5.15}(1 + 5.15 + \frac{5.15^2}{2})$= (0.113)	**B1***	(Could be seen in **(i)**)
	Comp either with 0.1	**DB1**	One comparison with 0.01 (could be seen in **(i)**)
	P(Type I error) = 0.0357 (3 sf)	**B1**	
		3	
6(iii)	Actually mean = 1.03 but conclude that mean < 1.03	**B1**	Mean no. of defectives not reduced, but conclude that it is reduced.
		1	