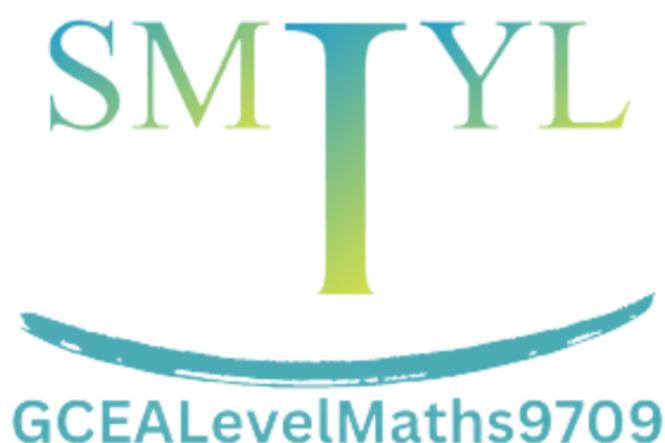


Probability and Statistics 2
October November 2024
Marking Scheme
CIE A Level Maths 9709



*This is not endorsed by Cambridge and is purely for practice purposes only.

Question	Answer	Marks	Guidance
1(a)	Calls are received at a constant mean rate (must say mean or rate)		Must be in context (Accept 32.1 as context).
	Calls are received at random	B1	Any one reason correctly stated
	Calls are received independently Calls are received singly	B1	A second reason correctly stated
			SC B1: both correct, not in context
		2	
1(b)(i)	$\lambda = \frac{2}{7} \times 32.2 [= 9.2]$	B1	
	$e^{-9.2} \left(\frac{9.2^4}{4!} + \frac{9.2^5}{5!} + \frac{9.2^6}{6!} \right)$ or $e^{-9.2} (298.50 + 549.23 + 842.16)$ or 0.03016 + 0.05549 + 0.08509	M1	Allow any λ . Allow end errors Expression must be seen
	= 0.171 (3sf)	A1	If M0 allow SC B1 for 0.171 no working seen
		3	
1(b)(ii)	$e^{-4.6} \times 4.6$ or $(1 - e^{-4.6}(4.6 + 1))$ or 0.0462 or 0.944 (3sf)	B1	
	$e^{-4.6} \times 4.6 \times (1 - e^{-4.6}(4.6 + 1))$	M1	M1 for product of two Poisson probabilities $P(1) \times (1 - P(0, 1))$ (no end errors accepted). Accept any λ .
	$\times 2$ or 0.04364×2	M1	M1 for <i>their</i> product of two Poisson probabilities (accept end errors) $\times 2$. Accept any λ .
	= 0.0873 (3sf)	A1	
		4	

Question	Answer	Marks	Guidance
1(c)	$N(220.8, 220.8)$	B1	SOI
	$\frac{230.5-220.8}{\sqrt{220.8}} [= 0.653]$	M1	Standardise with <i>their</i> values. Allow wrong or no cc. Must have $\sqrt{\quad}$
	$1 - \phi(\textit{their '0.653'})$	M1	For probability area consistent with <i>their</i> values
	$= 0.257$ (3sf)	A1	
		4	

Question	Answer	Marks	Guidance
2(a)	$\frac{4088}{73} \pm z \times \frac{9.2}{\sqrt{73}}$	M1	For expression of correct form. Any z (but $\phi(z)$).
	$z = 2.576$	B1	
	53.2 to 58.8 (3sf)	A1	Must be an interval
		3	
2(b)	$2.576 \times \frac{s}{\sqrt{100}} = 2.1$ or $2 \times 2.576 \times \frac{s}{\sqrt{100}} = 4.2$	M1	Equation of correct form (any z). Allow factor of 2 error (i.e first equation = 4.2)
	$s = 8.15$ (3sf) or $\frac{375}{46}$	A1	
		2	

Question	Answer	Marks	Guidance
3(a)	$E(X - Y) = 5000 - 4000 [= 1000]$	B1	OE, e.g. $(Y - X)$
	$Var(X - Y) = 400^2 + 350^2 [= 282500]$	M1	
	$\frac{0 - (\text{their}'1000')}{\sqrt{\text{their}'282500'}} [= -1.881]$	M1	For standardising with <i>their</i> E and Var
	$\phi(1.881)$	M1	For area consistent with <i>their</i> values
	$= 0.970$ (3sf)	A1	
		5	
3(b)	$E(\text{Total}) = 5000 \times 3 + 4000 \times 2.5 [= 25000]$	B1	
	$Var(\text{Total}) = 400^2 \times 3^2 + 350^2 \times 2.5^2$ $[= 2205625]$	M1	
	$\frac{25550 - \text{their}'25000'}{\sqrt{\text{their}'2205625'}} [= 0.370]$ or $\frac{24000 - \text{their}'25000'}{\sqrt{\text{their}'2205625'}} [= -0.673]$	M1	For one standardisation with <i>their</i> E and Var
	$\phi(\text{their}'0.370') + \phi(\text{their}'0.673') - 1 =$ $0.6443 + 0.7496 - 1$	M1	For area consistent with <i>their</i> values
	$= 0.394$ (3sf)	A1	
		5	

Question	Answer	Marks	Guidance
4(a)	$\text{Est}(\mu) = \frac{12100}{10} [= 1210]$	B1	
	$\text{Est}(\sigma^2) = \frac{10}{9} \left(\frac{15730000}{10} - "1210"'^2 \right)$ or $\frac{1}{9} \left(15730000 - \frac{12100'^2}{10} \right)$	M1	Attempt to find Σx^2 and substitute in correct formula. May be implied by correct answer. Biased 72900 scores M0
	121000	A1	
		3	
4(b)(i)	$H_0 : \mu = 1196$ $H_1 : \mu > 1196$	B1	Allow 'Population mean' but not just 'mean'
	$\frac{\frac{125000}{100} - 1196}{302 \div \sqrt{100}}$	M1	Standardising must have $\sqrt{100}$
	= 1.788	A1	
	1.788 > 1.645	M1	OE
	[Reject H_0] There is sufficient evidence (at 5% level) to suggest [mean] mass is greater than 1196	A1FT	OE FT <i>their</i> '1.788' in context, not definite, no contradictions.
		5	
4(b)(ii)	Not true. Large sample, [so sample mean is approx normally distributed]	B1	OE Allow 'Not true. Large sample' or 'Not true. n is large' or 'Not true. CLT used'
		1	

Question	Answer	Marks	Guidance
5	H_0 : Population mean no. of visits = 2.55 H_1 : Population mean no. of visits > 2.55	B1	Or "population mean no. of visits = 0.51 (per second)" oe Allow ' $\lambda = 2.55$ ' or ' $\mu = 2.55$ '
	$P(X \geq 6) = 1 - e^{-2.55} \left(1 + 2.55 + \frac{2.55^2}{2!} + \frac{2.55^3}{3!} + \frac{2.55^4}{4!} + \frac{2.55^5}{5!} \right)$ or $1 - e^{-2.55} (1 + 2.55 + 3.25125 + 2.76356 + 1.76177 + 0.89850)$ or $1 - (0.078082 + 0.19911 + 0.25386 + 0.21578 + 0.13756 + 0.070157)$	M1	Allow one error, e.g. extra term $e^{-2.55} \times \frac{2.55^6}{6!}$
	= 0.0454 (3sf)	A1	Allow 0.0455 SC B1 no working scores B1 instead of M1A1
	$0.0454 > 0.025$	M1	For valid comparison
	[Accept H_0] There is insufficient evidence [at 2.5% sig level] to suggest that mean no. of visits has increased	A1FT	In context, not definite e.g., not "Mean no. of visits has not increased" No contradictions
		5	

Question	Answer	Marks	Guidance
6(a)	$1 - p$ or $p - 0.5$	M1	SOI, e.g., on diagram
	$[P(1 < X < 2) =] 2p - 1$	A1	Clearly as final answer
		2	
6(b)(i)	$\int_{-1}^4 (a - b(x^2 - x))dx = 1$	M1	OE Attempt integral, with correct limits and RHS
	$\left[ax - b \left(\frac{x^3}{3} - \frac{3}{2}x^2 \right) \right]_{-1}^4 (= 1)$	A1	OE Correct Integration
	$4a - \frac{64}{3}b + 24b + a - \frac{1}{3}b - \frac{3}{2}b = 1$ leading to $30a + 5b = 6$ AG	A1	Correctly obtained. No errors seen
		3	
6(b)(ii)	$a - b(1 + 3) = 0$ or $a - b(16 - 12) = 0$ [hence $a - 4b = 0$]	*M1	Use $f(-1) = 0$ or $f(4) = 0$ Further attempts at integration M0
	Attempt to solve $30a + 5b = 6$ and <i>their</i> $a - 4b = 0$	DM1	
	$a = \frac{24}{125}$ or 0.192 $b = \frac{6}{125}$ or 0.048	A1	
		3	