CAMBRIDGE
INTERNATIONAL EXAMINATIONS

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GCE A AND AS LEVEL

MARK SCHEME

MAXIMUM MARK: 50

SYLLABUS/COMPONENT: 9709/07, 8719/07

MATHEMATICS AND HIGHER MATHEMATICS
Paper 7 (Probability and Statistics 2)

UNIVERSITY of CAMBRIDGE
Local Examinations Syndicate

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1 $\frac{1.9}{\sqrt{n}} \times 1.96 < 1$ $n > 13.9$ (13.87) $n = 14$	M1 A1 M1 A1 **[4]**	For equality or inequality involving width or equivalent and term in $1/\sqrt{n}$ and a z-value For correct inequality For solving a relevant equation For correct answer cwo
2 $\lambda = 4.5$ $P(X = 2, 3, 4) = e^{-4.5}\left(\frac{4.5^2}{2!} + \frac{4.5^3}{3!} + \frac{4.5^4}{4!}\right)$ $= 0.471$	M1 B1 M1 A1 A1 **[5]**	For using Poisson approximation any mean For correct mean used For calculating P(2, 3, 4) their mean For correct numerical expression For correct answer NB Use of Normal can score B1 M1 SR Correct Bin scores M1 A1 A1 only
3 SU ~ N(19,12) P(T-SU > 0) or P(T- S > 5) = $1 - \Phi\left(\frac{0-1}{\sqrt{21}}\right)$ $= \Phi(0.2182)$ $= 0.586$	B1 M1 M1 M1 A1 **[5]**	For correct mean and variance. Can be implied if using P(T-S>5) in next part For consideration of P(T – SU > 0) For summing their two variances For normalising and finding correct area from their values For correct answer
4 **(i)** $\lambda = \frac{20}{80} = 0.25$ $P(X \geq 3) = 1 - P(X \leq 2)$ $= 1 - e^{-0.25}(1 + 0.25 + \frac{0.25^2}{2})$ $= 0.00216$	B1 M1 M1 A1 **[4]**	For $\lambda = 0.25$ For calculating a relevant Poisson prob(any λ) For calculating expression for P $(X \geq 3)$ their λ For correct answer
(ii) $e^{\frac{-k}{80}} = 0.9$ $\frac{-k}{80} = -0.10536$ $k = 8.43$	M1 M1 M1 A1 **[4]**	For using λ = -t/80 in an expression for P(0) For equating their expression to 0.9 For solving the associated equation For correct answer cwo
5 **(i)** $P(\overline{X} > 1800) = 1 - \Phi\left(\frac{1800-1850}{117/\sqrt{26}}\right)$ $= \Phi(2.179)$ $= 0.985$	B1 M1 A1 **[3]**	For $117/\sqrt{26}$ (or equiv) For standardising and use of tables For correct answer cwo

(ii) H_0: $\mu = 1850$ H_1: $\mu \neq 1850$	B1	Both hypotheses correct
Test statistic = $\dfrac{1833-1850}{117/\sqrt{26}}$	M1	Standardising attempt including standard error
$= -0.7409$	A1	Correct test statistic (+/-)
Critical value $z = \pm 1.645$	M1	Comparing with $z = \pm 1.645$,+ with + or – with – (or equiv area comparison) ft 1 tail test z=1.282
Accept H_0, no significant change	A1ft	For correct conclusion on their test statistic and their *z*. No contradictions.
	[5]	
6 (i) (a) Rejecting H_0 when it is true **(b)** Accepting H_0 when it is false	B1 B1 **[2]**	Or equivalent
(ii) (a) P(NNNNN) under H_0 = $(0.94)^5$ = 0.7339 P(Type I error) = 1 – 0.7339 = 0.266	M1* A1 M1* A1ft dep*	For evaluating P(NNNNN) under H_0 For correct answer (could be implied) For identifying the Type I error outcome For correct **final** answer SR If M0M0 allow B1 for Bin(5,0.94)used
	[4]	
(b) P(NNNNN) under H_1 = $(0.7)^5$ = 0.168 P(Type II) error = 0.168	M1 M1 A1	For Bin(5,0.7) used For P(NNNNN) under H_1 For correct **final** answer
	[3]	
7 (i) $\int_0^\infty ke^{-3x}\,dx = 1$	M1	For attempting to integrate from 0 to ∞ and putting the integral = 1
$0 - \dfrac{-k}{3} = 1 \Rightarrow k = 3$	A1	For obtaining given answer correctly
	[2]	
(ii) $\int_0^{q1} 3e^{-3x}\,dx = 0.25$	M1	For equating $\int 3e^{-3x}\,dx$ to 0.25 (no limits needed)
$\left[-e^{-3x}\right]_0^{q1} = 0.25$ $-e^{-3q1} + 1 = 0.25$ $0.75 = e^{-3q1}$	M1	For attempting to integrate and substituting (sensible) limits and rearranging
$q_1 = 0.0959$	A1	For correct answer
	[3]	

(iii) Mean = $\int_0^\infty 3xe^{-3x}\,dx$	B1 M1	For correct statement for mean For attempting to integrate $3xe^{-3x}$ (no limits needed)
$= \left[-xe^{-3x}\right]_0^\infty - \int_0^\infty -e^{-3x}\,dx$	A1	For $-xe^{-3x}$ or $-xe^{-3x}/3$
$= \left[\frac{e^{-3x}}{-3}\right]_0^\infty$	M1	For attempt $\int -e^{-3x}\,dx$ (their integral)
	A1	For $0+\left[\frac{e^{-3x}}{-3}\right]_0^\infty$
= 0.333 or 1/3	A1	For correct answer
	[6]	