

NOVEMBER 2002

**GCE Advanced Level
GCE Advanced Subsidiary Level**

MARK SCHEME

MAXIMUM MARK : 50

SYLLABUS/COMPONENT : 9709 /7, 8719 /7

**MATHEMATICS
(Probability and Statistics 2)**

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1	$512 \pm 2.576 \times \sqrt{\frac{37.4}{120}}$ $49.8 < \mu < 52.6$	M1 B1 A1 3	$\bar{x} \pm z \frac{s}{\sqrt{n}}$ Calculation of correct form Using $z = 2.576$ Or equivalent statement
2	(i) $0.015n = 2.55$ $n = 170$ (ii) mean = $210 \times 0.015 (=3.15)$ $e^{-3.15} \left(1 + 3.15 + \frac{3.15^2}{2} \right)$ $P(0) + P(1) + P(2) =$ $= 0.390 \text{ or } 0.391$ SR use of Binomial scores B1 for final correct answer 0.389	M1 A1 2 B1 M1 A1 3	For equation linking n, p and mean For correct answer For new mean For evaluating Poisson $P(0) + P(1) + P(2) + [P(3)]$ For correct answer
3	(i) $z = \frac{64.3 - 65}{4.9/\sqrt{n}} = -1.807$ $n = 160$ (ii) $H_0: \mu = 65$ $H_1: \mu < 65$ Critical Value ± 1.645 Significant growth decrease	M1 M1 A1 3 B1 B1 M1 A1 4	For standardising equation = ± 1.807 with n or $\sqrt{n}$ Solving for n For correct answer CWO. For H_0 and H_1 For ± 1.645 (or ft ± 1.96 for two tail test) Comparing given statistic with their CV Correct conclusion
4	(i) $H_0: \lambda = 4.8$ $H_1: \lambda < 4.8$ Under H_0 $P(0) = e^{-4.8} (=0.00823)$ $P(1) = 0.0395$ $P(2) = 0.0948$ Critical region is $X = 0$ or 1 Not enough evidence to say road sign has decreased accidents SR If M0, M0 allow M1 for stating / showing $P(0) + P(1) < 10\%$ (ii) $P(\text{Type I error}) = P(0) + P(1)$ $= 0.0477$	B1 M1 M1 A1 A1 5 M1 A1 2	For both H_0 and H_1 For evaluating $P(0)$ and $P(1)$ and $P(2)$ For stating/showing that $P(0) + P(1) + P(2) > 10\%$ For critical region. Correct conclusion For identifying correct outcome For correct answer
5	(i) new mean = 5.6 $P(X+Y > 3) = 1 - \{P(0) + P(1) + P(2) + P(3)\}$ $e^{-5.6} \left(1 + 5.6 + \frac{5.6^2}{2!} + \frac{5.6^3}{3!} \right)$ $= 1 -$ $= 0.809$ (ii) $\bar{X} \sim N(2.5, \frac{2.5}{80})$ or equiv. method using totals $N(200, 200)$ $P(X < 2.4) = \Phi \left(\frac{2.4 - 2.5}{\sqrt{(2.5/80)}} \right) \text{ or } \Phi \left(\frac{192 - 200}{\sqrt{200}} \right)$ $= \Phi(-0.566)$ $= 1 - 0.7143 = 0.286$	B1 M1 A1 A1 4 M1 A1 M1 A1 4	For new mean For evaluating $1 -$ some Poisson probabilities For correct expression For correct answer For using normal distribution with mean $2.5 / 200$ For correct variance For standardising and using normal tables For correct answer

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6 (i) $k \int_{20}^{28} \frac{1}{x^2} dx = 1$ $k \left[\frac{-1}{x} \right]_{20}^{28} = 1$ $k \left[\frac{1}{20} - \frac{1}{28} \right] = 1 \Rightarrow k = 70$ (ii) $E(X) = k \int_{20}^{28} \frac{1}{x} dx = k[\ln x]$ $= 23.6, 23.5, 70 \ln 1.4, 70 \ln (7/5)$ (iii) $P(X < E(X)) = \int_{20}^{23.55} \frac{70}{x^2} dx$ $= 0.528$ (accept 0.534 from 23.6) (0.521 23.5) (iv) Greater Prob in (iii) is > 0.5	M1		For equating to 1 and attempt to integrate
	A1		Correct integration
	A1	3	For given answer correctly obtained (no decimals seen).
	M1		For attempt to evaluate $\int_{20}^{28} \frac{70}{x^2} dx$
	A1	3	For correct integration For correct answer
7 (i) $W \sim N(17.6, 0.133(2))$ $\Phi\left(\frac{18-17.6}{\sqrt{0.1332}}\right) (= 0.8633)$ $\Phi\left(\frac{17-17.6}{\sqrt{0.1332}}\right) = 1 - 0.9499 (= 0.0501)$ $0.8633 - 0.0501 = 0.813$ (ii) Wt diff $D \sim N(0, 0.0072)$ $1 - \Phi\left(\frac{0.05}{\sqrt{0.0072}}\right) = 1 - \Phi(0.589)$ $P(D > 0.05) = 0.278$ $P(D < 0.05) = 0.278$ $0.278 + 0.278 = 0.556$	M1		For attempt to evaluate $\int_{20}^{23.55} \frac{70}{x^2} dx$ between their limits (< 28)
	A1	2	For correct answer
	B1ft		For correct statement
	B1ft	2	For correct reason. Follow through from (iii) or calculating med. = 23.3
7 (i) $W \sim N(17.6, 0.133(2))$ $\Phi\left(\frac{18-17.6}{\sqrt{0.1332}}\right) (= 0.8633)$ $\Phi\left(\frac{17-17.6}{\sqrt{0.1332}}\right) = 1 - 0.9499 (= 0.0501)$ $0.8633 - 0.0501 = 0.813$ (ii) Wt diff $D \sim N(0, 0.0072)$ $1 - \Phi\left(\frac{0.05}{\sqrt{0.0072}}\right) = 1 - \Phi(0.589)$ $P(D > 0.05) = 0.278$ $P(D < 0.05) = 0.278$ $0.278 + 0.278 = 0.556$	B1		For correct mean
	B1		For correct variance
	M1		For standardising and using tables
	M1		For standardising and using tables
	A1	5	For correct answer
(ii) Wt diff $D \sim N(0, 0.0072)$ $1 - \Phi\left(\frac{0.05}{\sqrt{0.0072}}\right) = 1 - \Phi(0.589)$ $P(D > 0.05) = 0.278$ $P(D < 0.05) = 0.278$ $0.278 + 0.278 = 0.556$	B1		For correct mean and variance
	M1		For standardising and using tables
	A1		For 0.278 (could be implied)
	M1		For finding the other probability
	A1	5	For correct answer