CAMBRIDGE
INTERNATIONAL EXAMINATIONS

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)**

University of Cambridge
Local Examinations Syndicate

1 $512 \pm 2.576 \times \sqrt{\dfrac{37.4}{120}}$ $49.8 < \mu < 52.6$	M1 B1 A1 **3**	Calculation of correct form $\bar{x} \pm z \dfrac{s}{\sqrt{n}}$ Using $z = 2.576$ Or equivalent statement	
2 (i) $0.015n = 2.55$ $n = 170$ **(ii)** mean $= 210 \times 0.015 \; (=3.15)$ $e^{-3.15}\left(1 + 3.15 + \dfrac{3.15^2}{2}\right)$ $P(0) + P(1) + P(2) =$ $= 0.390$ 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) $z = \dfrac{64.3 - 65}{4.9 / \sqrt{n}} = -1.807$
      $n = 160$
 	
 (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(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 $= 5.6$
      $P(X+Y>3) = 1 - \{P(0)+P(1)+P(2)+P(3)\}$
      $= 1 - e^{-5.6}\left(1 + 5.6 + \dfrac{5.6^2}{2!} + \dfrac{5.6^3}{3!}\right)$
      $= 0.809$
 	
 (ii) $\bar{X} \sim N\left(2.5, \dfrac{2.5}{80}\right)$ or equiv. method using totals N(200, 200)
 	
 $P(X<2.4) = \Phi\left(\dfrac{2.4 - 2.5}{\sqrt{(2.5/80)}}\right)$ or $\Phi\left(\dfrac{192-200}{\sqrt{200}}\right)$
 $= \Phi(-0.566)$
 $= 1 - 0.7143 = 0.286$
	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	

6 (i) $k \int_{20}^{28} \frac{1}{x^2} dx = 1$ $k \left[\frac{-1}{x} \right] = 1$ $k \left[\frac{1}{20} - \frac{1}{28} \right] = 1 \quad \Rightarrow k = 70$	M1 A1 A1	3	For equating to 1 and attempt to integrate Correct integration For given answer correctly obtained (no decimals seen).
(ii) E(X) = $k \int_{20}^{28} \frac{1}{x} dx = k[\ln x]$ = 23.6, 23.5, 70ln 1.4, 70ln (7/5)	M1 A1 A1	3	For attempt to evaluate $\int_{20}^{28} \frac{70}{x} dx$ For correct integration For correct answer
(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)	M1 A1	2	For attempt to evaluate $\int \frac{70}{x^2} dx$ between their limits (<28) For correct answer
(iv) Greater Prob in (iii) is > 0.5	B1ft B1ft	2	For correct statement 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	B1 B1 M1 M1 A1	5	For correct mean For correct variance For standardising and using tables For standardising and using tables For correct answer
(ii) Wt diff $D \sim N(0, 0.0072)$ $P(D > 0.05) = 1 - \Phi \left(\frac{0.05}{\sqrt{0.0072}} \right) = 1 - \Phi(0.589)$ = 0.278 P(D <0.05) = 0.278 0.278 + 0.278 = 0.556	B1 M1 A1 M1 A1	5	For correct mean and variance For standardising and using tables For 0.278 (could be implied) For finding the other probability For correct answer