UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2009 question paper for the guidance of teachers

9709 MATHEMATICS

9709/71 Paper 71, maximum raw mark 50

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes must be read in conjunction with the question papers and the report on the examination.

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Mark Scheme Notes

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Penalties

1 $X \sim B(180, 0.02) \sim Po(3.6)$ $P(X < 4) = e^{-3.6}(1 + 3.6 + 3.6^2/2 + 3.6^3/6)$ $= 0.515$	B1 M1 A1 [3]	Poisson with mean 180×0.02 Poisson attempt with their allow end errors Correct answer SR_1 Use of Bin scores B1 only for ans 0.514 SR_2 Use of Normal scores B1 only for 0.479
2 $1.96 \times \frac{1.5}{\sqrt{n}} < \frac{1}{2}$ $n = 35$	B1 B1 M1 A1 [4]	$1.96 \times \frac{1.5}{\sqrt{n}}$ seen Confidence interval halved Solving an equation in their z, 1.5, n (2 and sq rt not needed) Correct answer (condone n 35)
3 (i) $P(\bar{w} > 51) = P\left(z > \frac{51 \quad 48.5}{12.4/\sqrt{5}}\right)$ $= 1 - \quad (0.451)$ $= 1 - 0.674$ $= 0.326$	M1 M1 A1 [3]	Standardising with 51 and mean 48.5 Standardising using 5 Correct answer
(ii) $z = 1.5$ or 1.499 $\frac{51.6 \quad 48.5}{(12.4/\sqrt{n})} = 1.5$ $\sqrt{n} = 6$ $n = 36$	B1 M1 M1 A1 [4]	1.5 or 1.499 seen Standardising must have $\sqrt{n}$ (no cc) Attempt to solve equation with $\sqrt{n}$, their z in correct answer
4 (i) $P(X > 4) = 1 - P(0, 1, 2, 3, 4)$ $= 1 - e^{1.8}\left(1 + 1.8 + \frac{1.8^2}{2} + \frac{1.8^3}{3!} + \frac{1.8^4}{4!}\right)$ $= 1 - 0.9635$ $= 0.036(4)$ This is < 0.05 and so X > 4 is in the critical region $P(4) = e^{1.8}\frac{1.8^4}{4!} = 0.0723$	M1 M1 A1 A1ft B1 [5]	Adding at least 3 relevant Poisson terms Poisson expression for P(X > 4) (oe implied by later working) Correct prob 0.036 (or 0.96 subject to later working) Correct comparison and statement identifying CR (ft their prob < 0.05) Verification that X = 4 is not in the cr region
(ii) P(Type II error) = P(X = 0, 1, 2, 3, 4) $= e^{2.3}\left(1 + 2.3 + \frac{2.3^2}{2} + \frac{2.3^3}{3!} + \frac{2.3^4}{4!}\right)$ $= 0.916$	B1 M1 A1 [3]	Correct region Poisson expression P(0, 1, 2, 3, 4) Correct answer

5	(i) $\int_0^{\pi/4} k\cos x\,dx = 1$	M1	Equating to 1 and attempt to integrate with limits
	$[k\sin x]_0^{\pi/4} = 1$		
	$k\sin(\pi/4) = 1 \qquad k/\sqrt{2} = 1$		
	$k = \sqrt{2}$ AG	A1 [2]	Correct answer legit obtained (no decimals seen)
	(ii) $\int_{0.4}^{\pi/4} k\cos x\,dx = [k\sin x]_{0.4}^{\pi/4}$	M1	Attempt to integrate from 0.4 to $\pi/4$ o.e.
	$= 1 - k\sin(0.4)$		
	$= 0.449$	A1 [2]	Correct answer
	(iii) $\int_0^{Q3} k\cos x\,dx = 0.75$	M1	Equation with integral on one side and 0.75 on the other o.e.
	$[k\sin x]_0^{Q3} = 0.75$	M1	Attempt to solve their integral for Q3
	$k\sin Q3 - 0 = 0.75$		
	$Q3 = 0.559$	A1 [3]	Correct answer
	(iv) ${}^5C_3 \times (0.25)^3 \times (0.75)^2$	M1	Binomial expression involving ${}^5C_3$, 0.25 and 0.75
	$= 0.0879$ (45/512)	A1 [2]	Correct answer
6	(i) $\bar{x} = 14.8$ (890/60 oe)	B1	Correct answer
	$s^2 = \frac{1}{59}\left(13780 - \frac{890^2}{60}\right)$	M1	Substituting in formula from book, o.e.
	$= 9.80$	A1 [3]	Correct answer
	(ii) H_0: $\mu = 15.2$		
	H_1: $\mu < 15.2$	B1	Correct H_1 and H_0
	P(Type I error) = 0.1 (10%)	B1	Correct answer
	Say the photographer has fewer discards when she doesn't	B1ft [3]	o.e. must be related to question. No contradictions. ft their H_1
	(iii) Test statistic $z = \frac{14.83 - 15.2}{\sqrt{\frac{9.802}{60}}}$	M1	Standardising must have $\sqrt{60}$
	$= -0.915$	A1	Correct z (–0.91 to 0.92) or correct area 0.18
	CV $z = \pm 1.282$	M1	Valid comparison with correct CV must be + with + or – with – and consistent with their H_1 oe comparison of areas
	Not enough evidence to support photographer's claim.	A1ft [4]	Correct conclusion ft their z and their CV No contradictions

7	(i)	$3C \sim N(990, 5.2^2 \times 3)$ $(= N(990, 81.12))$	B1	Correct mean for both 3 cans cola and 2 bottles water
		$2W \sim N(1000, 7.1^2 \times 2 (= N(1000, 100.82))$	B1	Correct variance for both 3 cans cola and 2 bottles water
		$3C - 2W \sim N(-10, 181.94)$	M1	Correct method for mean and variance for 3C – 2W or vice versa
		$P((3C - 2W) < 0) = \frac{0 \quad (\ 10)}{\sqrt{181.94}}$	M1	Standardising and using tables, need the sq root and area > 0.5
		$= \quad (0.741)$		
		$= 0.771$	A1 [5]	Correct answer
	(ii)	new drink $\sim N(910, 2 \times 5.2^2 + 0.5^2 \times 7.1^2)$	B1	Correct mean for new drink
		$\sim N(910, 66.68)$	B1	Correct variance for new drink
		$P(ND > 900) = 1 - P \quad z < \frac{900 \quad 910}{\sqrt{66.68}}$	M1	Standardising with sq rt and using tables
		$= 1 - P(z < -1.225)$		
		$= \quad (1.225)$		
		$= 0.8897\ (0.890)$	A1 [4]	Correct answer