Edexcel GCE
Statistics S2
Gold Level G2
(Mark Scheme)

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Question Number	Scheme	Marks
1.		
(a)	(1, 1, 1), (5, 5, 5), (1, 5, 5), (1, 5, 1) (1,1,1); (5,5,5); (1, 5, 5); (5, 1, 5); (5, 5, 1) (5, 1, 1); (1, 5, 1); (1, 1, 5)	B1 B1 **(2)**
(b)	r : 0 and 4 $P(R = 0) = \frac{9}{27}$ or $\frac{1}{3}$ $P(R = 4) = \frac{18}{27}$ or $\frac{2}{3}$	B1 M1d A1 **(3)** **[5]**

2.	**(a)**	$X \sim B(25,0.5)$ may be implied by calculations in part a or b	M1
		$P(X \leq 7) = 0.0216$	
		$P(X \geq 18) = 0.0216$	
		CR $X \leq 7$; $\cup$ $X \geq 18$	A1,A1 (3)
	(b)	P(rejecting H_0) = 0.0216 + 0.0216	M1
		= 0.0432 awrt 0.0432/0.0433	A1 (2) **Total 5**

Question Number	Scheme	Marks
3	One tail test Method 1 $H_o : \lambda = 5$ ($\lambda = 2.5$) may use λ or μ $H_1 : \lambda > 5$ ($\lambda > 2.5$) $X \sim$ Po (2.5) may be implied $P(X \geq 7) = 1 - P(X \leq 6)$ | [$P(X \geq 5) = 1 - 0.8912 = 0.1088$] att $P(X \geq 7)$ | $P(X \geq 6)$ $= 1 - 0.9858$ | $P(X \geq 6) = 1 - 0.9580 = 0.0420$ $= 0.0142$ | CR $X \geq 6$ awrt 0.0142 $0.0142 < 0.05$ | $7 \geq 6$ or 7 is in critical region or 7 is significant (Reject H_0.) There is significant evidence at the 5% significance level that the factory is polluting the river with bacteria. **or** The scientists claim is justified	B1 B1 M1 M1 A1 M1 B1 (7) Total 7
	Method 2 $H_o : \lambda = 5$ ($\lambda = 2.5$) may use λ or μ $H_1 : \lambda > 5$ ($\lambda > 2.5$) $X \sim$ Po (2.5) may be implied $P(X < 7)$ | [$P(X < 5) = 0.8912$] att $P(X < 7)$ | $P(X < 6)$ | $P(X < 6) = 0.9580$ $= 0.9858$ | CR $X \geq 6$ wrt 0.986 $0.9858 > 0.95$ | $7 \geq 6$ or 7 is in critical region or 7 is significant (Reject H_0.) There is significant evidence at the 5% significance level that the factory is polluting the river with bacteria. **or** The scientists claim is justified	B1 B1 M1 M1 A1 M1 B1 (7)

Two tail test
Method 1

$H_o : \lambda = 5$ ($\lambda = 2.5$) may use λ or μ B1
$H_1 : \lambda \neq 5$ ($\lambda \neq 2.5$) B0

$X \sim Po(2.5)$ M1

$P(X \geq 7) = 1 - P(X \leq 6)$ | $[P(X \geq 6) = 1 - 0.9580 = 0.0420]$ att $P(X \geq 7)$ $P(X \geq 7)$ M1
$= 1 - 0.9858$ | $P(X \geq 7) = 1 - 0.9858 = 0.0142$

$= 0.0142$ | CR $X \geq 7$ awrt 0.0142 A1

$0.0142 < 0.025$ | $7 \geq 7$ or 7 is in critical region or 7 is significant M1

(Reject H_0.) There is significant evidence at the 5% significance level that the factory is polluting the river with bacteria. B1
or
The scientists claim is justified (7)

Method 2
$H_o : \lambda = 5$ ($\lambda = 2.5$) may use λ or μ B1
$H_1 : \lambda \neq 5$ ($\lambda \neq 2.5$) B0

$X \sim Po(2.5)$ M1

$P(X < 7)$ | $[P(X < 6) = 0.9580]$ att $P(X < 7)$ $P(X < 7)$
$P(X < 7) = 0.9858$

$= 0.9858$ | CR $X \geq 7$ awrt 0.986 M1A1

$0.9858 > 0.975$ | $7 \geq 7$ or 7 is in critical region or 7 is significant M1

(Reject H_0.) There is significant evidence at the 5% significance level that the factory is polluting the river with bacteria. B1
or
The scientists claim is justified (7)

Question Number		Scheme	Marks
4.	**(a)**	$X \sim B(20, 0.3)$	M1
		$P(X \leq 2) = 0.0355$	A1
		$P(X \leq 9) = 0.9520$ so $P(X \geq 10) = 0.0480$	A1
		Therefore the critical region is $\{X \leq 2\} \cup \{X \geq 10\}$	A1 A1 (5)
	(b)	$0.0355 + 0.0480 = 0.0835$ awrt (0.083 or 0.084)	B1 (1)
	(c)	11 is in the critical region	B1ft
		there is evidence of a change/ increase in the proportion/number of customers buying single tins	B1ft (2)
			(8 marks)

5.	**(a)**	$\frac{9.5-7}{10-7}$	M1
		$= \frac{5}{6}$ awrt 0.833	A1
			(2)
	(b)	$P(\text{Longest} > 9.5) = 1 - P(\text{all} < 9.5) = 1 - \left(\frac{5}{6}\right)^3$	M1
		$= \frac{91}{216}$ or 0.421	A1
			(2)
	(c)	$P(\text{a stick} < 7.6) = \frac{0.6}{3} = 0.2$	B1
		Let Y = number of sticks (out of 6) <7.6 then $Y \sim B(6, 0.2)$	M1
		$P(Y > 4) = 1 - P(Y \leq 4)$	M1
		$= 1 - 0.9984$	
		$= 0.0016$ or $\frac{1}{625}$	A1
			(4)
			8

Question Number		Scheme	Marks
6.	**(a)**	Connecting occurs at random/independently, singly or at a constant rate	B1 (1)
	(b)	Po (8)	B1
	(i)	P(X = 0) = 0.0003	M1A1
	(ii)	P(X $\geq$ 4) = 1 – P(X $\leq$ 3) = 1 – 0.0424 = 0.9576	M1 A1 (5)
	(c)	H0 : $\lambda = 4$ (48) H1 : $\lambda > 4$ (48) N(48,48)	B1 M1 A1
		Method 1 $P(X \geq 59.5) = P\left(Z \geq \frac{59.5-48}{\sqrt{48}}\right)$ = P ($Z \geq 1.66$) = 1 – 0.9515 = 0.0485	Method 2 $\frac{x-0.5-48}{\sqrt{48}} = 1.6449$ $x = 59.9$
			M1 M1 A1 A1
		0.0485 < 0.05 Reject H_0. Significant. 60 lies in the Critical region The number of failed connections at the first attempt has increased.	M1 A1 ft (9) **[15]**

Question Number		Scheme	Marks
7.	**(a)**	The set of values of the test statistic for which the null hypothesis is rejected in a hypothesis test.	B1 B1 (2)
	(b)	X~B(30,0.3) $P(X \leq 3) = 0.0093$ $P(X \leq 2) = 0.0021$ $P(X \geq 16) = 1 - 0.9936 = 0.0064$ $P(X \geq 17) = 1 - 0.9979 = 0.0021$ Critical region is $(0 \leq)x \leq 2$ or $16 \leq x (\leq 30)$	M1 A1 A1 A1A1 (5)
	(c)	Actual significance level 0.0021+0.0064=0.0085 or 0.85%	B1 (1)
	(d)	15 (it) is not in the critical region not significant No significant evidence of a change in $p = 0.3$ accept H_0, (reject H_1) $P(x \geq 15) = 0.0169$	Bft 2, 1, 0 (2) **Total [10]**

Question Number	Scheme	Marks
8.	$\cap$ shape which does not go below the x-axis [condone missing patios]	B1
(a)	Graph must end at the points (1,0) and (5,0) and the points labelled at 1 and 5	B1 (2)
(b)	E(X) = 3 (by symmetry)	B1 (1)
(c)	$\left[E(X^2)\right] = \int x^2 \mathrm{f}(x)\mathrm{d}x = \frac{3}{32}\int \left(6x^3 - x^4 - 5x^2\right)\mathrm{d}x$	M1
	$= \frac{3}{32}\left[\frac{6x^4}{4} - \frac{x^5}{5} - \frac{5x^3}{3}\right]_1^5$	A1
	$= \frac{3}{32}\left(\left[\frac{6\times 625}{4} - 625 - \frac{625}{3}\right] - \left[\frac{6}{4} - \frac{1}{5} - \frac{5}{3}\right]\right) = 9.8$ **(*)**	M1 A1 cso (4)
(d)	s.d. = $\sqrt{9.8 - \mathrm{E}(X)^2}$,	M1
	= 0.8944… **awrt 0.894**	A1 (2)
(e)	F(1) = 0 $\Rightarrow \frac{1}{32}\left(a - 15 + 9 - 1\right) = 0$, leading to $\underline{a = 7}$	M1 A1 (2)
(f)	F(2.29) = 0.2449…, F(2.31) = 0.2515…	M1 A1
	Since F(q_1) = 0.25 and these values are either side of 0.25 then 2.29< q_1 < 2.31	A1 (3)
(g)	Since the distribution is symmetric q_3 =5-1.3 = $\underline{3.7}$ cao	B1 (1)
(h)	We know P(q_1=2.3 < X < 3.7= q_3) = 0.5	
	so $k\sigma = 0.7$	M1
	so $k = \frac{0.7}{0.894...} = 0.7826..$ = **awrt 0.78**	A1 (2)
		17

Statistics for S2 Practice Paper Gold 2

				Mean average scored by candidates achieving grade:							
Qu	**Max Score**	**Modal score**	**Mean %**	**ALL**	**A***	**A**	**B**	**C**	**D**	**E**	**U**
1	5		62.4	3.12	4.01	3.62	2.55	2.03	1.66	1.31	0.85
2	5		67.2	3.36	4.38	4.07	3.54	2.98	2.35	1.65	0.82
3	7		64.9	4.54		5.90	5.08	3.90	2.77	1.80	0.76
4	8		62.4	4.99		6.45	5.18	4.25	3.27	2.18	1.14
5	8		59.5	4.76	6.80	6.07	4.88	3.93	2.92	1.84	0.99
6	15		70.2	10.53	13.77	12.86	11.06	9.10	6.63	4.69	2.36
7	10		64.5	6.45		6.64	5.50	4.26	2.76	1.58	0.79
8	17		56.2	9.56	14.37	12.56	9.54	7.32	5.53	3.61	2.38
	75		**63.1**	**47.31**		**58.17**	**47.33**	**37.77**	**27.89**	**18.66**	**10.09**