General Certificate of Education
Advanced Level Examination

MATHEMATICS A

Statistics 2

Paper A

MARKING GUIDE

This guide is intended to be as helpful as possible to teachers by providing concise solutions and indicating how marks should be awarded. There are obviously alternative methods that would also gain full marks.

Method marks (M) are awarded for knowing and using a method.

Accuracy marks (A) can only be awarded when a correct method has been used.

(B) marks are independent of method marks.

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S2 Paper A – Marking Guide

1.	*(a)*	P $(X > 5) = 1 - \text{F}(5) = 1 - \frac{1}{64}(80 - 25) = \frac{9}{64}$	M1 A1	
	(b)	$\text{f}(x) = \text{F}'(x) = \frac{1}{64}(16 - 2x)$	M1 A1	
		$\therefore \text{f}(x) = \begin{cases} \frac{1}{32}(8 - x), & 0 \le x \le 8, \\ 0, & \text{otherwise.} \end{cases}$	A1	**(5)**
2.	*(a)*	let $\text{P}(X = 0) = x$		
		$\therefore\ x + 0.8x + (0.8)^2x + (0.8)^3x + \ldots = 1$	M1 A1	
		$\frac{x}{1 - 0.8} = 1 \quad \therefore x = 0.2$	M1 A1	
	(b)	geometric dist. [Geo(0.2)]	B1	
	(c)	$\text{E}(X) = \frac{1}{0.2} = 5, \quad \text{Var}(X) = \frac{0.8}{0.2^2} = 20$	B2	**(7)**
3.	*(a)*	let X = no. out of 30 who visit advertiser's site $\therefore X \sim \text{B}(30, \frac{1}{40})$	B1	
		$\text{P}(X \le 1) = (\frac{39}{40})^{30} + 30(\frac{1}{40})(\frac{39}{40})^{29}$	M1 A1	
		$= 0.828$ (3sf)	A1	
	(b)	let Y = no. out of 200 who visit advertiser's site $\therefore Y \sim \text{B}(200, \frac{1}{40})$		
		using Po approx. $Y \approx\sim \text{Po}(5)$	M1 A1	
		$\text{P}(Y > 10) = 1 - \text{P}(Y \le 10)$	M1	
		$\approx 1 - 0.9863 = 0.0137$ (3sf)	A1	**(8)**
4.	*(a)*	let F = time on French and E = time on English		
		let $A = F + E \ \therefore A \sim \text{N}(55 + 90, 10^2 + 18^2) = \sim \text{N}(145, 424)$	M1 A1	
		$\text{P}(A > 120) = \text{P}(Z > \frac{120 - 145}{\sqrt{424}})$	M1	
		$= \text{P}(Z > {}^-1.21) = 0.88686 = 0.887$ (3sf)	A1	
	(b)	$\text{P}(E > 2F) = \text{P}(E - 2F > 0)$	M1	
		let $B = E - 2F \ \therefore B \sim \text{N}(90 - 2\times55, 18^2 + 4\times10^2) = \sim \text{N}({}^-20, 724)$	M1 A1	
		$\text{P}(B > 0) = \text{P}(Z > \frac{0 + 20}{\sqrt{724}}) = \text{P}(Z > 0.74) = 1 - 0.77035 = 0.230$ (3sf)	M1 A1	**(9)**

5.	expected freq. males/watched = $\frac{36\times40}{80}$ = 18, males/stranded = $\frac{16\times40}{80}$ = 8	M1 A1
	giving expected freqs 18 8 14 18 8 14	A1
	H_0 : no difference in preference of males and females H_1 : difference in preference of males and females	B1

O	E	$(O-E)$	$\frac{(O-E)^2}{E}$
21	18	3	0.5
6	8	$^-2$	0.5
13	14	$^-1$	0.0714
15	18	$^-3$	0.5
10	8	2	0.5
15	14	1	0.0714

$\therefore\ \Sigma \frac{(O-E)^2}{E} = 2.143$	M1 A2	
$\nu = 2,\ \chi^2_{\text{crit}}(10\%) = 4.605$	M1 A1	
$2.143 < 4.605\ \ \therefore$ not significant		
there is no evidence of a difference in preference of males and females	A1	**(10)**

6.	*(a)*	Poisson with $\lambda = 4$	B1	
	(b)	e.g. more people shopping $\therefore$ probably sell more so λ higher	B1	
	(c)	(i) let X = no. of sales per hour $\therefore X \sim \text{Po}(4)$ $\text{P}(X > 4) = 1 - \text{P}(X \le 4) = 1 - 0.6288 = 0.371$ (3sf)	M1 A1	
		(ii) let Y = no. of sales per half-hour $\therefore Y \sim \text{Po}(2)$	M1	
		$\text{P}(Y = 0) = 0.1353 = 0.135$ (3sf)	A1	
	(d)	$H_0 : \lambda = 4 \quad H_1 : \lambda > 4$	B1	
		$\text{P}(X \ge 9) = 1 - \text{P}(X \le 8) = 1 - 0.9786 = 0.0214$	M1 A1	
		less than 5% $\therefore$ significant, evidence of increase	A1	**(10)**

7.	H_0 : B(16, 0.1) is a suitable model H_1 : B(16, 0.1) is not a suitable model	B1
	$\text{P}(0) = (0.9)^{16} = 0.1853$ $\text{P}(1) = 16(0.1)(0.9)^{15} = 0.3294$ $\text{P}(2) = \frac{16\times15}{2}(0.1)^2(0.9)^{14} = 0.2745$ $\text{P}(3) = \frac{16\times15\times14}{3\times2}(0.1)^3(0.9)^{13} = 0.1423$	M1 A1
	$\text{P}(4) = \frac{16\times15\times14\times13}{4\times3\times2}(0.1)^4(0.9)^{12} = 0.0514$	
	$\times$ 50 to give exp. freqs then freq of ≥ 5 = (50 – sum of others)	M1
	$\therefore$ exp. freqs are 9.27, 16.47, 13.73, 7.12, 2.57, 0.84	A1
	combining groups ≥ 3	M1

O	E	$(O-E)$	$\frac{(O-E)^2}{E}$
4	9.27	$^-5.27$	2.9960
12	16.47	$^-4.47$	1.2132
18	13.73	4.27	1.3280
16	10.53	5.47	2.8415

$\therefore \Sigma \frac{(O-E)^2}{E} = 8.379$	M1 A1	
$\nu = 4 - 1 = 3,\ \chi^2_{\text{crit}}(5\%) = 7.815$	M1 A1	
$8.379 > 7.815\ \ \therefore$ reject H_0		
B(16, 0.1) is not a suitable model	A1	**(11)**

Total **(60)**

Performance Record – S2 Paper A

Question no.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	Total
Topic(s)	c.d.f., p.d.f.	geometric	binomial, Po approx.	linear comb. of Normal r.v.	conting. table	Poisson, hyp. test	goodness of fit, binomial	
Marks	5	7	8	9	10	10	11	60
Student								