STATISTICS 2 (A) TEST PAPER 3 : ANSWERS AND MARK SCHEME

1.	(a)	The set of all items considered	B1	
	(b)	The individual elements of the population	B1	
	(c)	e.g. A list of customers from a holiday company	B1	
	(d)	e.g. A list from the local social services office.	B1	4
2	(a)	$k = \frac{1}{10}$, so $F(x) = 0\ (x < 5)$, $F(x) = \frac{x-5}{10}\ (5 \le x \le 15)$	B1 B1 M1 A1	
		$F(x) = 1\ (x > 15)$.	B1	
	(b)	$P(X < 8) = F(8) = \frac{3}{10}$	B1	6
3	(a)	$X \sim B(20, p)$ $H_0 : p = \frac{1}{2}, H_1 : p \ne \frac{1}{2}$	B1 B1	
		Assuming H_0, $P(X \ge 16 \text{ or } X \le 4) = 0{\cdot}0059 \times 2 = 0{\cdot}0118$	M1 M1 A1	
		$> 1\%$, so do not reject H_0 at 1% level.	A1	
	(b)	For significance at 0·1% level, would need $X \le 2$ or $X \ge 18$	B1 B1	8
4	(a)	$X \sim B(5, p)$	B1	
		$P(X \ge 3) = \binom{5}{5}p^5(1-p)^0 + \binom{5}{4}p^4(1-p)^1 + \binom{5}{3}p^3(1-p)^2$	M1 A1 A1	
		$= p^5 + 5p^4 - 5p^5 + 10p^3(1 - 2p + p^2)$	A1	
		$= 6p^5 - 15p^4 + 10p^3 = p^3(6p^2 - 15p + 10)$	M1 A1	
	(b)	Put $p = 0.6$ to get $P(X \ge 3) = 0{\cdot}683$	M1 A1	9
5.	(a)	No. of left-handed is $B(10, 0{\cdot}32)$ $P(X = 0) = 0{\cdot}68^{10} = 0{\cdot}0211$	M1 M1 A1	
	(b)	$P(X = 1) = 10 \times 0{\cdot}68^9 \times 0{\cdot}32 = 0{\cdot}0995$	M1 A1	
		$P(X \ge 2) = 1 - 0{\cdot}0211 - 0{\cdot}0995 = 0{\cdot}879$	M1 A1	
	(c)	Now no. of left-handed is $B(35, 0{\cdot}32) \approx N(11{\cdot}2, 7{\cdot}616)$	M1 A1	
		$P(5 < X < 15) = P(5{\cdot}5 < X < 14{\cdot}5) = P(-2{\cdot}07 < Z < 1{\cdot}20)$	M1 A1 A1	
		$= 0{\cdot}8849 - 0{\cdot}0193 = 0{\cdot}866$	M1 A1	
		Continuity correction, going from discrete to continuous variable	B1	15
6.	(a)	Poisson : $Po(1{\cdot}5)$	B1 B1	
	(b)	$P(X \ge 4) = 1 - P(X \le 3) = 1 - 0{\cdot}9344 = 0{\cdot}0656$	M1 A1 A1	
	(c)	Counts in 5 minutes are $Po(7{\cdot}5)$, so $P(X \le 3) = 0{\cdot}0591$	B1 M1 A1	
	(d)	Mean = 84/50 = 1·68 Var. = $226/50 - 1{\cdot}68^2 = 1{\cdot}698$	B1 M1 A1	
		Mean $\approx$ variance; this supports Poisson model, but mean > 1·5	B1	
	(e)	With mean = 1·68, $P(X = 2) = e^{-1{\cdot}68}(1{\cdot}68^2/2!) = 0{\cdot}263$	M1 M1 A1	15
7.	(a)	When $F(t) = 0.5$, $t^2(3t^2 - 16t + 24) = 8$	M1	
		When $t = 0{\cdot}77$, L.H.S. = $7{\cdot}98 \approx 8$	M1 A1	
	(b)	$F(1{\cdot}2) = 0{\cdot}8208$ $F(1{\cdot}5) = 0{\cdot}9492$	B1 B1	
		P(Wait 1·5 | wait 1·2) = $(1 - 0{\cdot}9492) \div (1 - 0{\cdot}8208) = 0{\cdot}283$	M1 A1 A1	
	(c)	$f(t) = \frac{1}{16}(12t^3 - 48t^2 + 48t)$ $(0 \le t \le 2)$, $f(t) = 0$ otherwise	M1 A1 A1	
		Graph sketched	B1	
	(d)	Mode is at max. point, where $f'(t) = 0$ $36t^2 - 96t + 48 = 0$	M1 A1	
		$12(3t - 2)(t - 2) = 0$ Mode is $t = \frac{2}{3}$ ($6\frac{2}{3}$ minutes)	M1 A1 A1	
	(e)	Unlikely to be no delays above 20 minutes	B1	18