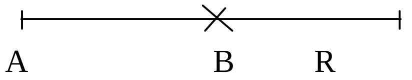
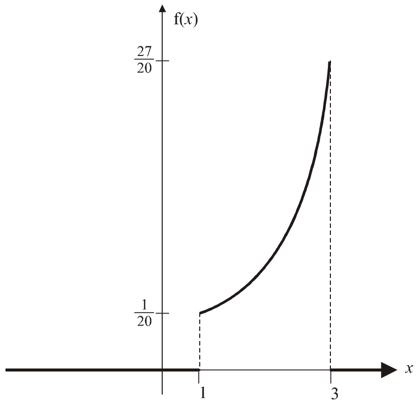
Question Number	Scheme	Marks
1. (*a*)	<u>Advantage</u>: eg quicker/cheaper	B1
	<u>Disadvantage</u>: eg doesn't give the full picture	B1 (2)
(*b*)	The register of pupils attending	B1 (1)
(*c*)	The individual pupils	B1 (1)
		(4 marks)
2. (*a*)	 $X \sim \text{U}[0,12]$	B1, B1 (2)
(*b*)	$\text{P}(X \le x) = \int_0^x \frac{1}{12}\,\text{d}t = \underline{\frac{x}{12}}$ $\quad \therefore \text{F}(x) = \begin{cases} 0, & x < 0 \\ \frac{x}{12}, & 0 \le x \le 12 \\ 1 & x > 12 \end{cases}$	M1 A1 B1 ft (centre) B1 (ends) (4)
(*c*)	$\text{P}(X < 4) = \frac{4}{12} = \frac{1}{3}$	B1 ft (1)
		(7 marks)
3. (*a*)	$\text{P(SC)} = \frac{3}{4}$; $\text{P(HC)} = \frac{1}{4}$ either	B1
	Let X represent the number of HC chocolates	
	$\therefore X \sim \text{B}(20; 0.25)$ can be implied	B1
	$\text{P}(X = 10) = 0.9961 - 0.9861 = 0.0100$ awrt 0.010	B1 (3)
(*b*)	$\text{P}(X < 5) = \text{P}(X \le 4)$	M1
	$= 0.4148$ awrt 0.415	A1 (2)
(*c*)	Expected number $= np = 100 \times 0.25 = 25$	M1 A1 (2)
		(7marks)

Question Number		Scheme	Marks	
4.	(*a*)	$\bar{x} = \dfrac{0\times37+1\times65+2\times60+\ldots+5\times12}{37+65+60+\ldots+12} = \dfrac{500}{250} = 2$	M1 A1cso	(2)
	(*b*)	$\text{var} = \dfrac{\sum x^2}{250} - 2^2 = \dfrac{1478}{250} - 4 = 1.912$ (or $s^2 = 1.9196\ldots$)	M1 A1	(2)
	(*c*)	For a Poisson distribution the mean must equal the variance;		
		parts (a) and (b) are very close, so a Poisson might be a suitable model.	B1	(1)
	(*d*)	H_0: $\mu = 2$; H_1: $\mu < 2$	B1 B1	
		X = number of errors over 4 pages. Under H_0 $X \sim P_0(8)$;	M1	
		$P(X \leq 3) = 0.0424$	M1 A1	
		This is less than 5% so a significant result and there is evidence that the secretary has improved.	A1 ft	(6)
				(11 marks)
5.	(a)	$H_0 : p = 0.30$ $H_1 : p < 30$	B1 B1	
		X = number ordering vegetarian meal $X \sim B(20, 0.30)$ under H_0		
		$P(X \leq 3) = 0.1071 > 5\%$	M1, A1	
		$\therefore$ Not significant i.e. no reason to suspect proportion is lower	A1 ft	(5)
	(b)	$H_0 : p = 0.10$ $H_1 : p \neq 0.10$	B1 B1	
		Y = number ordering vegetarian meal $Y \sim B(100, 0.10) \Rightarrow Y \approx P_0(10)$	M1	
		Need a, b such that $P(Y \leq a) \approx 0.025$ and $P(Y \geq b) \approx 0.025$		
		From tables: $P(Y \leq 4) = 0.0293$ and $P(Y \leq 16) = 0.9730$	M1 A1	
		$\Rightarrow P(Y \geq 17 = 0.0270$	A1	
		$\therefore Y \leq 4$ and $Y \geq 17$		(6)
	(c)	Significance level is $0.0270 + 0.0293 = \underline{0.0563}$ (5.6%)	B1 ft	(1)
				(12 marks)

Question Number	Scheme	Marks
6. (a)	X = number of sheep per square $\quad X \sim \text{P}_0\,(2.25)$	B1 (1)
(b)	$\text{P}(X = 0) = \text{e}^{-2.25} = 0.105399\ldots$ $\quad$ awrt <u>0.105</u>	B1 (1)
(c)	P (X > 2) 1 – P ($X \le 2$), $=1-\ \text{e}^{-2.25}\left[1 + 2.25 + \frac{(2.25)^2}{2!}\right]$	M1, M1 A1
	$1 - 0.60933\ldots = 0.39066$ $\quad$ awrt <u>0.391</u>	A1 (4)
(d)	Sheep would tend to cluster – no longer randomly scattered	B1 (1)
(e)	$Y \sim \text{P}_0\,(20) \Rightarrow$ normal approx, $\mu = 20$, $\sigma = \sqrt{20}$	M1, A1
	P (Y < 15) = P ($Y \le 14.5$), $= \text{P}\left(Z \le \frac{14.5 - 20}{\sqrt{20}}\right)$ $\quad \pm\,\frac{1}{2}$	M1, M1
	$= \text{P}\,(\text{Z} \le -1.2298\ldots)$	A1
	$= 1 - 0.8907 = 0.1093$ $\quad$ AWRT <u>0.109</u>	M1 A1 (7)
		(14 marks)

Question Number	Scheme	Marks
7. (*a*)		B1, B1 B1 (3) $\left(\frac{1}{20}, \frac{27}{20}\right)$
(*b*)	$\mathrm{E}(X) = \int_1^3 \frac{1}{20} x^4 \mathrm{d}x = \left[\frac{x^5}{100}\right]_1^3 = \frac{242}{100} = \underline{2.42}$	M1 [M1] A1 (3)
(*c*)	$\sigma^2 = \int_1^3 \frac{1}{20} x^5 \mathrm{d}x - \mu^2 = \left[\frac{x^6}{120}\right]_1^3 - \mu^2 = \frac{728}{120} - (2.42)^2 = 0.21026$	M1 [M1]
	$\therefore$ σ = 0.459	A1 cso (3)
(*d*)	$\mathrm{P}(X \le x) = \int_1^x \frac{1}{20} t^3 \mathrm{d}t = \left[\frac{t^4}{80}\right]_1^x = \frac{x^4}{80} - \frac{1}{80}$	M1 $[M1]_1^x$ A1 cso
	$\mathrm{F}(x) = \begin{cases} 0 & x \le 1 \\ \frac{1}{80}\left(x^4 - 1\right) & 1 < x < 3 \\ 1 & x \ge 3 \end{cases}$	B1 ft, centre B1 ends (5)
(*e*)	$\mathrm{F}(p) = 0.25 \Rightarrow \frac{1}{80}\left(p^4 - 1\right) = \frac{1}{4} \therefore p^4 = 21 \Rightarrow p = 2.14\ldots$	M1 A1
	$\mathrm{F}(q) = 0.75 \Rightarrow \frac{1}{80}\left(q^4 - 1\right) = \frac{3}{4} \therefore q^4 = 61 \Rightarrow q = 2.79\ldots$	A1
	IQR=$\underline{0.65}$	A1 ft (4)
(*f*)	$\mathrm{IQR} \approx \frac{4}{3} \times 0.459 = \underline{0.612}$,	B1
	Sensible comment, e.g. reasonable approximation or slight underestimate	B1 (2)
		(20 marks)