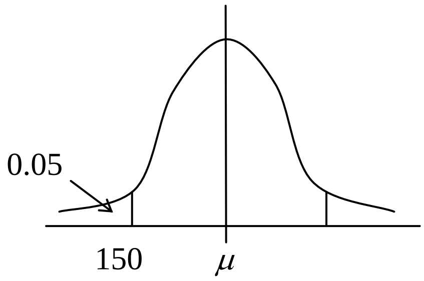
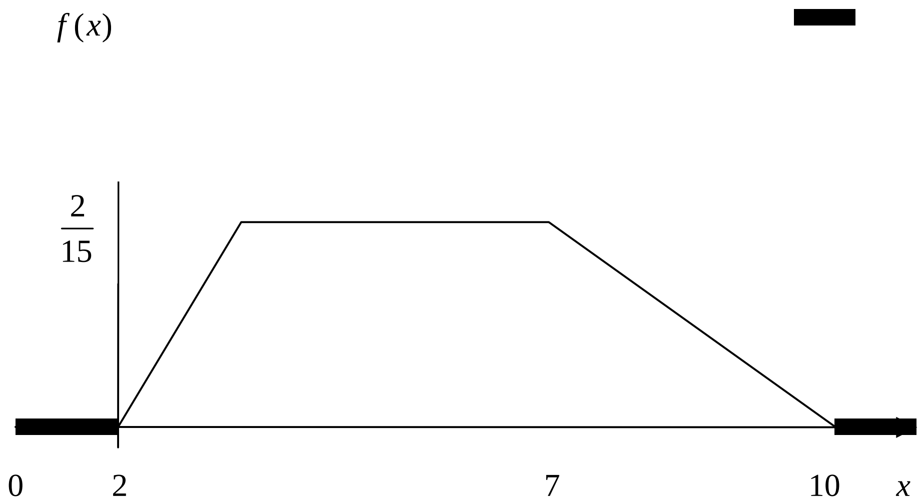
Question Number	Scheme	Marks
1. (*a*)	Survey is less time consuming.	B1
(*b*)	It is easier/quicker to analyse the results	B1 **(2)**
(*c*)	List of members	B1 **(1)**
(*d*)	The members	B1 **(1)**
		(4 marks)
2. (*a*)	Y is the random variable consisting of any function of the X_i that involves no other quantities.	B1 B1 **(2)**
(*b*)	$Y = \bar{X} = \frac{\sum X}{n}$	B1 **(1)**
(*c*)	When all possible samples are taken and the values of Y found then the values form a probability distribution (known as the sampling distribution of Y)	B1 B1 **(2)**
		(5 marks)
3. (*a*)	$\mathrm{E}(R) = \frac{\alpha+\beta}{2} = 3, \Rightarrow \alpha+\beta = 6$	M1 A1
(*b*)	$\mathrm{Var}(R) = \frac{(\beta-\alpha)^2}{12} = \frac{25}{3}, \Rightarrow (\beta-\alpha)^2 = 100$	M1 A1
	$\alpha = -2, \beta = 8$	M1 A1 A1 **(7)**
	$\mathrm{P(R} < 6.6) = \frac{1}{10} \times 8.6 = 0.86$	M1 A1 **(2)**
		(9 marks)
4. (*a*)	$\mathrm{H_0} : \rho = 0.20,\ \mathrm{H_1} : \rho < 0.20$	B1 B1
	X = number buying single packets, $X \sim \mathrm{B}(25, 0.20)$	
	$\mathrm{P}(X \le 2) = 0.0982$	M1 A1
	0.0982 > 5%, so not significant (comparison)	M1
	No reason to suspect the percentage who bought crisps in single packets that day was lower than usual (context)	A1 ft **(2)**
	$\mathrm{H_0} : \rho = 0.03,\ \mathrm{H_1} : \rho \ne 0.03$	B1 B1
	Y = number buying bumper packs, $Y \sim \mathrm{B}(300, 0.03) \Rightarrow Y \sim \mathrm{Po}(9)$	M1
	$\mathrm{P}(Y \le 3) = 0.0212$ and $\mathrm{P}(Y \le 15) = 0.9780 \Rightarrow \mathrm{P}(Y \ge 16) = 0.0220$	M1 A1
	Critical region $Y \le 3$ and $Y \ge 16$	A1 **(6)**
	Significance level = 0.0212 + 0.0220 = 0.0432	B1 ft **(1)**
		(13 marks)

Question Number	Scheme	Marks
5. (*a*)	$L \sim N(\mu, 0.3^2)$, $P(L < 150) = 0.05 \Rightarrow P\left(Z < \dfrac{150-\mu}{0.3}\right) = 0.05$	
	 $\Rightarrow \dfrac{150-\mu}{0.3} =, \ -1.6449$	M1 A1, B1
	$\mu = 150.49347 = 150.5$	A1 **(4)**
(*b*)	*X* represents number less than 150cm. $X \sim B(10, 0.05)$	B1
	$P(X \leq 2) = 0.9885$	M1 A1 **(3)**
(*c*)	Normal approximation $\mu = 500 \times 0.05 = 25$, $\sigma^2 = 23.75$ or 25	B1, B1
	$P(X < 35) \approx P(Z < \dfrac{34.5-25}{\sqrt{23.75 \text{ or } 25}})$ ± 0.5, standardise	M1, M1
	$\approx P(Z < 1.95 \text{ or } 1.9)$	A1
	≈ 0.9744 or 0.9713	A1 **(6)**
		(13 marks)
6. (*a*)	*X* represents number of faults per 25 m $\Rightarrow X \sim Po(1.5)$	B1
	$P(X = 4) = 0.0471$	B1 **(2)**
(*b*)	*Y* represents number of faults per 100 m $\Rightarrow Y \sim Po(6.0)$	B1
	$P(Y < 6) = P(Y \leq 5) = 0.4457$	B1
	R represents number of 100 m balls containing fewer than 6 faults	
	$R \sim B(3, 0.4457)$	M1 A1
	$P(R = 1) = C_1^3 \times 0.4457 \times (1 - 0.4457)^2 = 0.41082$ accept 0.411	M1 A1 **(6)**
(*c*)	*S* represents number of faults in a 500 m ball $\Rightarrow S \sim Po(30)$	B1
	$P(23 \leq S \leq 33) \approx P(\dfrac{22.5\text{-}30}{\sqrt{30}} \leq Z \leq \dfrac{33.5\text{-}30}{\sqrt{30}})$ ± 0.5, standardise	M1, M1 A1
	$\approx P(-1.37 \leq Z \leq 0.64)$	A1
	≈ 0.6536	A1 **(6)**
		(14 marks)

Question Number	Scheme	Marks
7. (*a*)		B1 (labels) B1 (graph) B1 (axes)
(*b*)	(i) $F(x)=\int_0^x \frac{x}{15}dx=\frac{x^2}{30}$ for $0 \le x \le 2$	B1
	$F(x)=\frac{12}{15}+\int_7^x (\frac{4}{9}-\frac{2x}{45})dx=\frac{4x}{9}-\frac{x^2}{45}-\frac{11}{9}$ for $7 \le x \le 10$	B1 M1 A1
	(ii) $F(x)=\frac{2}{15}+\int_2^x \frac{2}{15}dx=\frac{2x}{15}-\frac{2}{15}$ for $2 \le x \le 7$	B1 M1 A1
	(iii) $F(x)=0, x<0, F(x)=1, x>10$	B1 **(8)**
(*c*)	$\mathrm{P}(X \le 8.2)=F(8.2)=0.928$	M1 A1 **(2)**
(*d*)	$E(X)=\int_0^2 \frac{x^2}{15}dx+\int_2^7 \frac{2x}{15}dx+\int_7^{10}(\frac{4x}{9}-\frac{2x^2}{45})dx$	M1 A1
	$=\left[\frac{x^3}{45}\right]_0^2+\left[\frac{x^2}{15}\right]_2^7+\left[\frac{2x^2}{9}-\frac{2x^3}{125}\right]_7^{10}=4.78$	A1 A1 **(4)**
		(17 marks)