Qn no.	Scheme		Marks
1(a)	A list of (all) the members of the population		**B1**
			(1)
(b)	A random variable that is a function of a random sample		**B1**
	that contains no unknown parameters		**B1**
			(2)
			(Total 3 marks)
2(a)	$\text{P}(X < 2.7) = \frac{3.7}{5} = 0.74$	0.74	**B1**
			(1)
(b)	$\text{E}(X) = \frac{4-1}{2} = 1.5$	Require minus or complete attempt at integration, 1.5	**M1A1**
			(2)
(c)	$\text{Var}(X) = \frac{1}{12}(4+1)^2 = \frac{25}{12} = 2.08\dot{3}$	Require plus, $\frac{25}{12}$ *or* $2\frac{1}{12}$ *or* $2.08\dot{3}$ *or* 2.08	**M1A1**
			(2)
			(Total 5 marks)
3	$\text{H}_0 : p = 0.25,\ \text{H}_1 : p > 0.25$	1 tailed	**B1B1**
	Under H_0, $X \sim \text{Bin}(25, 0.25)$	Implied by probability	**B1**
	$\text{P}(X \geq 10) = 1 - \text{P}(X \leq 9) = 0.0713 > 0.05$	Correct inequality, 0.0713	**M1A1**
	Do not reject H_0, there is insufficient evidence to support Brad's claim.	DNR, context	**A1A1**
			(7)
			(Total 7 marks)
4(a)	Fixed no of trials/ independent trials/ success & failure/ Probab of success is constant	any 2	**B1B1**
			(2)
(b)	X is rv 'no of defective components $X \sim \text{Bin}(20, 0.1)$	$\text{Bin}(20, 0.1)$	**B1**
			(1)
(c)	$\text{P}(X = 0) = 0.1216$	=0, 0.1216	**M1A1**
			(2)
(d)	$\text{P}(X > 6) = 1 - \text{P}(X \leq 6) = 1 - 0.9976 = 0.0024$	Strict inequality & 1- with 6s, 0.0024	**M1A1**
			(2)
(e)	$\text{E}(X) = 20 \text{x} 0.1 = 2$	2	**B1**
	$\text{Var}(X) = 20 \text{x} 0.1 \text{x} 0.9 = 1.8$	1.8	**B1**
			(2)
(f)	$X \sim \text{Bin}(100, 0.1)$	Implied by approx used	**B1**
	$X \sim \text{P}(10)$		**B1**
	$\text{P}(X > 15) = 1 - \text{P}(X \leq 15) = 1 - 0.9513 = 0.0487$	Strict inequality and 1- with 15, 0.0487	**M1A1**
	(OR $X \sim \text{N}(10, 9)$, *P(X > 15.5) = 1-P(Z<1.83)=0.0336 (0.0334) with 15.5*		*B1**M1A1*****)**
	(OR $X \sim \text{N}(10, 10)$, *P(X > 15.5) = 1-P(Z<1.74)=0.0409 (0.0410) with 15.5*		*B1**M1A1*****)**
			(4)
			(Total 13 marks)

Qn no.	Scheme	Marks
5 (a)	A range of values of a test statistic such that if a value of the test statistic obtained from a particular sample lies in the critical region, then the null hypothesis is rejected (or equivalent).	B1B1
		(2)
(b)	P(X < 2) =P(X =0) + P(X=1) — both	M1
	$= e^{-\frac{1}{7}} + \frac{e^{-\frac{1}{7}}}{7}$ — both	A1
	=0.990717599… =0.9907 to 4 sf — awrt 0.991	A1
		(3)
(c)	$X \sim \text{P}(14\times\frac{1}{7}) = \text{P}(2)$	B1
	$\text{P}(X \le 4) = 0.9473$ — Correct inequality, 0.9473	M1A1
		(3)
(d)	$\text{H}_0 : \lambda = 4,\ \text{H}_1 : \lambda < 4$ — Accept μ & $\text{H}_0 : \lambda = \frac{1}{7},\ \text{H}_1 : \lambda < \frac{1}{7}$	B1B1
	$X \sim \text{P}(4)$ — Implied	B1
	$\text{P}(X \le 1) = 0.0916 > 0.05$, — Inequality 0.0916	M1A1
	So insufficient evidence to reject null hypothesis	A1
	Number of breakdowns has not significantly decreased	A1
		(7)
		(Total 15 marks)
6 (a)	No of defects in carpet area a sq m is distributed $\text{Po}(0.05a)$ — Poisson, 0.05a	B1B1
	Defects occur at a constant rate, independent, singly, randomly — Any 1	B1
		(3)
(b)	$X \sim \text{P}(30\times 0.05) = \text{P}(1.5)$ — P(1.5)	B1
	$\text{P}(X = 2) = \frac{e^{-1.5}\times 1.5^2}{2} = 0.2510$ — Tables or calc 0.251(0)	M1A1
		(3)
(c)	$\text{P}(X > 5) = 1 - \text{P}(X \le 5) = 1 - 0.9955 = 0.0045$ — Strict inequality, 1-0.9955, 0.0045	M1M1A1
		(3)
(d)	$X \sim \text{P}(17.75)$ — Implied	B1
	$X \sim \text{N}(17.75, 17.75)$ — Normal, 17.75	B1
	$\text{P}(X \ge 22) = \text{P}\left(Z > \frac{21.5 - 17.75}{\sqrt{17.75}}\right)$ — Standardise, accept 22 or ± 0.5	M1M1
	$= \text{P}(Z > 0.89)$ — awrt 0.89	A1
	=0.1867 — 0.1867,	A1
		(6)
		(Total 15 marks)

Qn no.	Scheme	Marks
7(a)	$\mathrm{E}(X)=\int_0^1 \frac{1}{3}x\,\mathrm{d}x+\int_1^2 \frac{8x^4}{45}\,\mathrm{d}x$ — $\int x\mathrm{f}(x)\mathrm{d}x$, 2 terms added	**M1M1**
	$=\left[\frac{1}{6}x^2\right]_0^1+\left[\frac{8x^5}{225}\right]_1^2$ — Expressions, limits	**A1A1**
	$=1.26\dot{8}=1.27$ to 3 sf or $\frac{571}{450}$ or $1\frac{121}{450}$ — awrt1.27	**A1**
		(5)
(b)	$\mathrm{F}(x_0)=\int_0^{x_0}\frac{1}{3}\mathrm{d}x=\frac{1}{3}x_0$ for $0\le x<1$ — variable upper limit on $\int \mathrm{f}(x)\mathrm{d}x$, $\frac{1}{3}x_0$	**M1A1**
	$\mathrm{F}(x_0)=\frac{1}{3}+\int_1^{x_0}\frac{8x^3}{45}\mathrm{d}x$ for $1\le x\le 2$ — their fraction + v.u.l on $\int \mathrm{f}(x)\mathrm{d}x$ &2 terms	**M1**
	$=\frac{1}{3}+\left[\frac{8x^4}{180}\right]_1^{x_0}$ — $\frac{8x^4}{180}$	**A1**
	$=\frac{1}{45}\left(2x_0^4+13\right)$	**A1**
	$\mathrm{F}(x)=\begin{cases}0 & x<0\\ \frac{1}{3}x & 0\le x<1\\ \frac{1}{45}\left(2x^4+13\right) & 1\le x\le 2\\ 1 & x>2\end{cases}$ — middle pair, ends	**B1,B1**
		(7)
(c)	$\mathrm{F}(m)=0.5$	
	$\frac{1}{45}\left(2x^4+13\right)=\frac{1}{2}$ — Their function=0.5	**M1A1ft**
	$m^4=4.75$	
	$m=1.48$ to 3 sf — awrt1.48	**A1**
		(3)
(d)	mean<median	**B1**
	Negative Skew — dep	**B1**
		(2)
		(Total 17 marks)