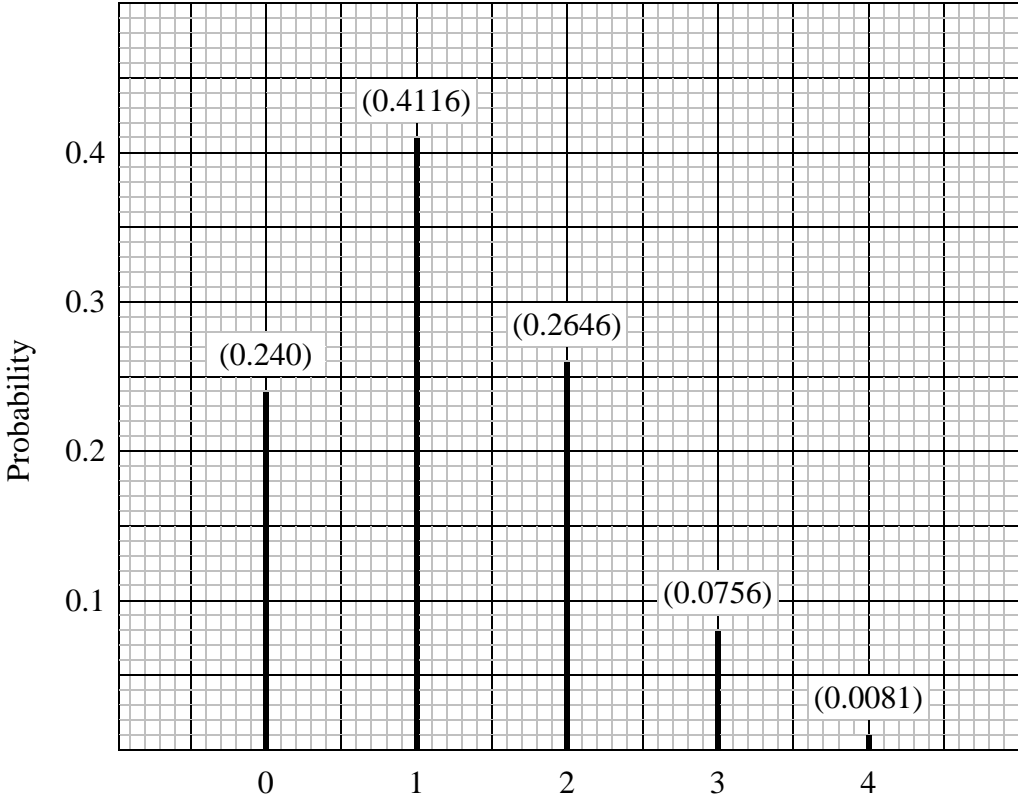


Question number	Mark scheme	Marks
1.	(a) A random variable; that is, a function involving no unknown quantities	B1; B1 (2)
	(b) If all possible samples are taken; then their values will form a probability distribution called the sampling distribution	B1; B1 (2) (4 marks)
2.	(a) λ is large or $\lambda > 10$	B1 (1)
	(b) $Y \sim N(30, 30)$	B1
	$P(Y > 28) = 1 - P(Y \leq 28.5)$	M1 A1
	$= 1 - P\left(Z \leq \frac{28.5 - 30}{\sqrt{30}}\right)$	M1 A1
	$= 1 - P(Z \leq -0.273)$ $= 0.607$	A1 (6) (7 marks)

(ft = follow through mark; (*) indicates final line is given on the paper)

Question number	Mark scheme	Marks
3.	<p>(a) $X \sim B(4, 0.3)$</p> <p>(b)</p>  <p>All probabilities correct</p> <p>Scales and labels</p> <p>Correct diagram</p> <p>(c) 1 resident</p> <p>(d) $E(X) = np = 1.2$</p> <p>$\text{Var}(X) = np(1 - p)$</p> <p>$= 4 \times 0.3 \times 0.7$</p> <p>$= 0.84$</p>	<p>B1 B1 (2)</p> <p>B1</p> <p>B1</p> <p>B1 (3)</p> <p>B1 (1)</p> <p>B1</p> <p>M1</p> <p>A1 (3)</p> <p>(9 marks)</p>

(ft = follow through mark; (*) indicates final line is given on the paper)

Question number	Mark scheme	Marks
4.	<p>(a) <i>Fixed number of independent trials</i> 2 outcomes Probability of success <i>constant</i></p> <p>(b) $P(X = 5) = \frac{2}{7}$; $P(X \neq 5) = \frac{5}{7}$ implied $P(5 \text{ on sixth throw}) = \left(\frac{5}{7}\right)^2 \times \left(\frac{2}{7}\right)$ $= 0.0531$</p> <p>(c) $P(\text{exactly 3 fives in first eight throws}) = \binom{8}{3} \left(\frac{2}{7}\right)^3 \left(\frac{5}{7}\right)^5$ $= 0.243$</p>	<p>B1 B1 B1 B1 (4) may be B1; B1 ft $p^n(1-p)$ M1 A1 ft A1 (5) use of nC_r needed M1 A1 ft A1 (3) (12 marks)</p>
5.	<p>(a) $f(x) = \begin{cases} 0.05 & 180 \leq x \leq 200 \\ 0 & \text{otherwise} \end{cases}$</p> <p>$f(x)$ ↑ 0.05 180 200 x</p> <p>(b)(i) $P(X \leq 183) = 3 \times 0.05$ $= 0.15$</p> <p>(ii) $P(X = 183) = 0$</p> <p>(c) $\text{IQR} = 10$</p> <p>(d) $0.05(200 - x); = 0.05(x - 180) \times 2$ $200 - x = 2x - 360$ $x = 186\frac{2}{3}$</p> <p>(e) $\frac{1}{3}$ of all cups of lemonade dispensed contains $186\frac{2}{3}$ ml or less (or $\frac{2}{3}$ of all cups of lemonade dispensed contains $186\frac{2}{3}$ ml or more)</p>	<p>B1 B1 labels 3 parts B1 B1 (4) M1 A1 B1 (3) B1 (1) M1; A1 A1 (3) B1 B1 ft (2) (13 marks)</p>

(ft = follow through mark; (*) indicates final line is given on the paper)

Question number	Mark scheme	Marks
6.	(a) Po(1) Each patient seen singly <i>or</i> patients with disease seen randomly <i>or</i> seen constant rate of once per week <i>or</i> each patient assumed independent of the next	B1 B1 B1 (3)
	(b) $X \sim \text{Po}(4)$ may be implied $P(X > 3) = 1 - P(X \leq 3)$ $= 1 - 0.4335$ $= 0.5665$	B1 M1 A1 A1 (4)
	(c) $H_0: \lambda = 6$ $H_1: \lambda < 6$ $P(X \leq 2) = 0.0620 \quad \alpha = 0.05 \Rightarrow \text{critical region } X \leq 1$ $0.0620 > 0.05 \quad 2 \text{ not in critical region}$ The number of patients with the disease seen by the doctor has not been reduced	B1 B1 M1 A1 M1 A1 (6)
	(d) This does not support the model as the disease will occur in outbreaks; the patients seen by the doctor are unlikely to be independent of each other/don't occur singly	B1; B1 (2)
		(15 marks)

(ft = follow through mark; (*) indicates final line is given on the paper)

Question number	Mark scheme	Marks
7.	(a) $\int_{-1}^0 k(x^2 + 2x + 1) \, dx = 1$	limits needed and =1 M1
	$\left[k \left(\frac{x^3}{3} + x^2 + x \right) \right]_{-1}^0 = 1$	attempt at integration M1 A1
	$k = 3 \quad (*)$	A1 (4)
	(b) $E(X) = \int_{-1}^0 x.f(x) \, dx$	M1
	$= \int_{-1}^0 (3x^3 + 6x^2 + 3x) \, dx$	limits needed A1
	$= \left[\frac{3x^4}{4} + 2x^3 + \frac{3x^2}{2} \right]_{-1}^0$	integration and substituting limits M1
	$= -\frac{1}{4}$	A1 (4)
	(c) $\int_{-1}^{x_0} (3x^3 + 6x^2 + 3x) \, dx = \left[x^3 + 3x^2 + 3x \right]_{-1}^{x_0}$	M1
	$= x_0 + 3x_0^2 + 3x_0 + 1$	A1
	$F(x) = \begin{cases} 0 & x < -1 \\ x^3 + 3x^2 + 3x + 1 & -1 \leq x \leq 0 \\ 1 & x > 0 \end{cases}$	B1 B1 (4)
	(d) $P(-0.3 < X < 0.3) = F(0.3) - F(-0.3)$	M1
	$= 1 - 0.343$	A1
	$= 0.657$	A1 (3)
		(15 marks)

(ft = follow through mark; (*) indicates final line is given on the paper)