1	$\lambda = \frac{1}{30}$ $1 - e^{-\frac{1}{30}}$ $= 0.0328$ (3 s.f.)	B1 M1 M1 A1 [4]	o.e $1 - P(X = 0)$ by Poisson, any λ allow 1 end error $1 - P(X = 0)$ by Poisson, correct λ no end errors S.R. Binomial with final answer 0.0328 B2 Correct answer, no working scores B2
2	$z = 2.576$ $2 \times z \times \frac{0.17}{\sqrt{n}} = 0.2$ oe $n = (\frac{2 \times 0.17 \times 2.576}{0.2})^2$ oe (= 19.2) Smallest n is 20	B1 M1 M1 A1 [4]	Seen (accept 2.574 to 2.579) Allow without '2 ×' OR with incorrect z Attempt to arrange equ of correct form (with correct z and '2×' into the form n= or $\sqrt{n}$ =
3 (i)	est (μ) = 2866 or 2870 (3 s.f.) est (σ^2) = $\frac{1}{49}(410900000 - \frac{143300^2}{50})$ (= 4126.53) = 4130 (3 sf)	B1 M1 A1 [3]	Accept 143300/50 o.e. Correct subst in correct formula
(ii)	H_0: Pop mean (or μ) = 2850 H_1: Pop mean (or μ) ≠ 2850 $\dfrac{\frac{143300}{50} - 2850}{\frac{\sqrt{'4126.53'}}{\sqrt{50}}}$ = 1.761 '1.761' < 1.96 No evidence mean distance changed	B1 M1 A1 M1 A1f [5]	Both. Not just 'mean' Allow '4126.53' without $\sqrt{\ }$, but must have all $\sqrt{50}$ Or correct c.v. (2867.81) for alt method For valid comparison of z values, areas or c.v. Dep 1.96; ft their 1.761 If H_1: $\mu > 2850$ and c.f. 1.645, max B0M1A1M1A0 (c.v. for 1 tail test 2864.94)
4 (i)	$\lambda = 2.8$ $e^{-2.8}(1 + 2.8 + \frac{2.8^2}{2})$ = 0.469 (3 s.f.) or 0.47(0)	B1 M1 A1 [3]	seen any λ allow one end error As final answer
(ii)	$e^{-0.7n} \geqslant 0.99$ or $e^{-\lambda} \geqslant 0.99$ $-0.7n \geqslant \ln 0.99$ or $-\lambda \geqslant \ln 0.99$ $n \leqslant 0.01436$ or $\lambda \leqslant 0.01005$ '0.01436' × 150 or '0.01005' × 150 ÷ 0.7 Max period is 2.15 mins (3 sf)	M1 M1 A1 M1 A1 [5]	Allow '=' throughout Attempt ln both sides Can be implied. Accept 3 s.f. Note $e^{-(0.7/150)n} \geqslant 0.99$ scores 1st and 3rd M1 T & I leading to ans 2.2 mins, SC: B2

5 (i)	$\int_0^2 k(x-2)^2\,dx = 1$ $\left(\left[\frac{k(x-2)^3}{3}\right]_0^2 = 1\right)$ $k\,[0-(-\frac{8}{3})] = 1$ $k = \frac{3}{8}$ **AG**	M1 A1 [2]	Attempt to integrate f(x) with correct limits and = 1 Must see this line or better, e.g. $k \times \frac{8}{3} = 1$
(ii)	$\frac{3}{8}\int_d^2 (x-2)^2\,dx = 0.2$ $\left(\frac{3}{8}\left[\frac{(x-2)^3}{3}\right]_d^2 = 0.2\right)$ $\frac{3}{8}\left[0-\frac{(d-2)^3}{3}\right] = 0.2$ oe $((d-2)^3 = -1.6)$ $d = 0.83(0)$ (3 s.f.)	M1 M1 A1 [3]	$\int$f(x)dx with limits d and 2 or 0 and d, and = 0.2 or =0.8 Condone missing 'k' Reasonable attempt to integrate from a correct expression, with limits substituted to give expression in d^3. Condone missing 'k'
(iii)	$\frac{3}{8}\int_0^2 x(x-2)^2\,dx$ $(= \frac{3}{8}\int_0^2 x^3 - 4x^2 + 4x\,dx)$ $= \frac{3}{8}\left[\frac{x^4}{4} - \frac{4x^3}{3} + 2x^2\right]_0^2$ $= \frac{1}{2}$	M1 A1 A1 [3]	Attempt integ xf(x); ignore limits, condone missing k $\left(\frac{3}{8}\left[x \times \frac{(x-2)^3}{3} - \int \frac{(x-2)^3}{3}\,dx\right]_0^2\right)$ $= \frac{3}{8}\left[x \times \frac{(x-2)^3}{3} - \frac{(x-2)^4}{12}\right]_0^2$ Correct integration & limits, condone missing k
6 (i)	P(Type I) = 1 - P($\geq$ 4 assuming p = 0.7) $1-({}^6C_4 \times 0.7^4 \times 0.3^2 + {}^6C_5 \times 0.7^5 \times 0.3 + 0.7^6)$ (= 1 – 0.744) = 0.256 (3 s.f.)	M1 M1 A1 [3]	or P($\leq$ 3 assuming p = 0.7) May be implied ${}^6C_3 \times 0.7^3 \times 0.3^3 + {}^6C_2 \times 0.7^2 \times 0.3^4 + {}^6C_1 \times 0.7 \times 0.3^5 + 0.3^6$ Allow one end error = 0.256 (3 s.f.) SR if zero scored allow B1 for use of B(6, 0.7) in any two or more terms
(ii)	P(Type II) = P($\geqslant$ 4 assuming p = 0.35) $= {}^6C_4 \times 0.35^4 \times 0.65^2 + {}^6C_5 \times 0.35^5 \times 0.65 + 0.35^6$ = 0.117	M1 M1 A1 [3]	May be implied Allow one end error SR if zero scored allow B1 for use of B(6, 0.35) in any two or more terms
(iii)	Type 1 They will reject Luigi's belief, although it might be true.	B1 B1 [2]	 In context

7 (i)	N(10.61, 0.1017) $\frac{11-'10.61'}{\sqrt{'0.1017'}}$ (= 1.223) Φ('1.223') = 0.889 (3 s.f.)	B1 M1 M1 A1 [4]	o.e. Stated or implied (accept in un-simplified form) Allow without √ For attempt to find correct area consistent with their working
(ii)	P(K – 1.2A > 0) Var = 0.0576 + 1.2^2 × 0.0441 (= 0.121104) N(–0.324, 0.121104) $\frac{0-(-0.324)}{\sqrt{'0.121104'}}$ (= 0.931) 1 – Φ('0.931') = 0.176 (3 s.f.)	M1 B1 B1 M1 M1 A1 [6]	Or similar stated or implied o.e. May be implied (accept in un-simplified form) Allow without √ For attempt to find correct area consistent with their working