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1	$(0.7 + 1.0) \times 2$ $= 3.4$ $e^{-3.4}(1 + 3.4 + 3.4^2 \div 2)$ $= 0.34(0)$ Alternative Method By Combinations		M1 A1 M1 A1 M2 A1 A1 [4]	Attempt combined mean Poisson P(0, 1, 2), any λ (Allow one end error) At least 4 correct $\lambda = 1.4, \lambda = 2$ All 6 correct combinations Correct answer
[Total: 4]				
2	(i)	$\frac{18 \times (1 - \frac{18}{70})}{70}$ (= 0.00272886.. $z = 1.645$ $\frac{18}{70} \pm z \times \sqrt{0.00272886}$ 0.171 to 0.343	M1 B1 M1 A1 [4]	Seen
	(ii)	Var (or sd) estimated or $N \sim B$ used	B1 [1]	
[Total: 5]				
3	(i)	$0.85^{30} + 30 \times 0.85^{29} \times 0.15 + {}^{30}C_2 \times 0.85^{28} \times 0.15^2$ $= 0.151$ > 0.04 No evidence decrease or Accept no decrease	M1 A1 M1 A1√ [4]	Allow just $0.85^{30} + 30 \times 0.85^{29} \times 0.15$ (Or critical region $X = 0$, or $X = 2$ Not in CR) Comp with 0.04 (can be implied by diagram) Correct Conclusion (ft) Use of $P(X = 2)$ only: max M0A0M1A1
	(ii)	(a) Not rejected H_0 (b) Has been decrease or π (or p) < 0.15	B1 [1] B1 [1]	Both independent marks Must be in context
[Total: 6]				
4	(i)	Po(4) $1 - e^{-4}(1 + 4 + \frac{4^2}{2!} + \frac{4^3}{3!})$ $= 1 - 0.43347..$ $= 0.567$ or 0.566	M1 A1 M1 A1 [4]	Use of Poisson, any mean Correct mean Allow one end error SC1: $\frac{3.5-4}{\sqrt{3.9984}}$ B1 SC2: Correct Bin method M1 ans 0.567 or 0.566 A1
	(ii)	$\lambda = \frac{n}{2500}$ $e^{-\frac{n}{2500}} < 0.01$ $-\frac{n}{2500} < \ln 0.01$ $n > 11512.9...$ Smallest $n = 11513$	$(\frac{2499}{2500})^n$ $(\frac{2499}{2500})^n < 0.01$ $n \times \ln(\frac{2499}{2500}) < \ln 0.01$ $n > 11510.6...$ Smallest $n = 11511$ A1 [3]	B1 M1 Correct exp'n < 0.01 . Allow ' = ' Allow by trial
[Total: 7]				

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5	(i)	$E(T) = 234, \text{Var}(T) = 15^2 + 8^2 = 289$ $\frac{200-234}{\sqrt{289}} \quad (= -2.000)$ $\Phi(“-2.000”) = 1 - \Phi(“2.000”)$ $1 - 0.9772$ 2.28%	B1 M1 M1 A1 [4]		
	(ii)	Require $P(D > 0)$ where $D = X - 4Y$ $E(D) (= 184 - 4 \times 50) = -16$ $\text{Var}(D) (= 15^2 + 4^2 \times 8^2) = 1249$ $\frac{0-(-16)}{\sqrt{1249}} \quad (= 0.453)$ $1 - \Phi(“0.453”)$ $(= 1 - 0.6747)$ $= 0.325$	B1 B1 M1 M1 A1 [5]	For -16 or $+16$ or $\pm (184 - 4 \times 50)$ For 1249 or $15^2 + 4^2 \times 8^2$	
[Total: 9]					
6	(i)	$-k \int_2^3 (x^2 - 5x + 6)dx = 1$ $(-k(\frac{3^3}{3} - 5 \times \frac{3^2}{2} + 6 \times 3 - [\frac{2^3}{3} - 5 \times \frac{2^2}{2} + 6 \times 2]) = 1)$ $-k \times (-\frac{1}{6}) = 1$ or $k \times \frac{1}{6} = 1$ $(k = 6 \quad \mathbf{AG})$	M1 A1 [2]	Integ = 1; ignore limits Correctly obtain $-\frac{1}{6}$ or $\frac{1}{6}$ CWO No rounded decimals	$-6 \int_2^3 (x^2 - 5x + 6)dx$ ignore limits Correctly obtain 1
	(ii)	$E(X) = 2.5$ $-6 \int_2^3 (x^4 - 5x^3 + 6x^2)dx \quad (= -6 \times (-1.05))$ $-“2.5”^2$ $= 0.05$	B1 M1* Dep M1* A1 [4]	Condone 25000 Integ $x^2 f(x)$; ignore limits Subtr μ^2 , ISW	
	(iii)	$-6 \int_2^{2.2} (x^2 - 5x + 6)dx \quad (= 0.104)$ $1 - (1 - “0.104”)^4$ $= 0.355/0.356$	M1 M1 A1 [3]	Integ with limits 2, 2.2 or 2.2, 3 Or equivalent	
[Total: 9]					

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7	(i)	$\text{Var}(\bar{X}) = \frac{121}{200}$ or SD of $\bar{X} = \frac{11}{\sqrt{200}}$ $(\pm) \frac{354 - 352}{\frac{11}{\sqrt{200}}} (= \pm 2.571)$ $1 - \Phi("2.571")$ $(= 1 - 0.9949)$ $= 0.0051$	M1 A1 M1 A1 [4]	Or with cc attempted. Allow no $\sqrt{\quad}$ Must include 200 or $\sqrt{200}$ 2.57(1) or correct expression
	(ii)	(No) n is large, $\bar{X}$ (appr) norm distr or CLT applies	B1 B1 [2]	“No” must be seen or implied, but gains no marks by itself $n \geq 30$ (SR Both statements correct, but wrong or no conclusion scores B1)
	(iii)	H_0 : Pop mean = 352 H_1 : Pop mean $\neq$ 352 $\pm \frac{356 - 352}{\frac{11}{\sqrt{50}}} \pm (= 2.57(1))$ Comp with $z = \pm 1.96$ (signs consistent) Evidence that pop mean has changed	B1 M1 A1 B1 $\sqrt{\quad}$ [4]	Allow ' μ ' but not just 'mean' Must have $\sqrt{50}$ Correct statement or 2.57(1) Correct comparison, and correct conclusion, follow through one tail test
[Total: 10]				