1	$N(-35,\ 60^2 + 4 \times 28^2)$ ⋮ $N(35,\ 60^2 + 4 \times 28^2)$	B1 B1	for $\pm(175 - 2 \times 105)$ or ± 35 for $60^2 + 4 \times 28^2$ or 6736
	$\frac{0-(-35)}{\sqrt{'6736'}}$ (= 0.426) ⋮ $\frac{0-35}{\sqrt{'6736'}}$ (= –0.426)	M1	For standardising with their mean and variance. Allow without √
	$1 - \Phi$("0.426") = 0.335 (3 sf)	M1 A1 5	For use of tables and finding area consistent with working
		Total: 5	
2 (i)	(Bin) with $n > 50$ and mean (or np) < 5 Po(1.5)	B1 B1	Accept n 'large', p 'small' Poisson with correct mean stated or implied
	$1 - e^{-1.5}$	M1	Poisson $1 - P(X = 0)$; allow incorrect λ; allow 1 end error
	= 0.777 (3 sf)	A1 4	SR If zero scored use of Bin leading to 0.778 / 0.779 scores B1
(ii)	3.5 $e^{-3.5}\left(\frac{3.5^4}{4!} + \frac{3.5^5}{5!} + \frac{3.5^6}{6!}\right)$	B1 M1	Correct mean stated or implied Poisson $P(X = 4, 5, 6)$; allow incorrect λ; allow 1 end error
	= 0.398 (3 sf)	A1 3	
		Total: 7	
3 (a)	$\int_0^{0.5} (1.5t - 0.75t^2)\,dt$ o.e.	M1	Attempt int f(t)
	$= \left[0.75t^2 - 0.25t^3\right]_0^{0.5}$ o.e.	A1	Correct integration and limits
	$= \frac{5}{32}$ or 0.156 (3 sf)	A1 3	
(b) (i)	$\frac{1}{2}\pi a^2 = 1$ or $\pi a^2 = 2$ oe	M1	Attempt to find the area and equate to 1
	$a = \sqrt{\frac{2}{\pi}}$ or 0.798 (3 sf)	A1 2	
(ii)	0	B1 1	
(iii)	Symmetry stated, seen or implied 0.8	M1 A1 2	Could be a diagram As final answer
		Total: 8	
4 (i)	$\text{Var}(P_s) = \dfrac{\frac{33}{150} \times \frac{150-33}{150}}{150}$ (= 0.001144)	M1	
	$z = 2.576$	B1	Seen. Accept 2.574 to 2.579
	$\frac{33}{150} \pm z\sqrt{'0.001144'}$	M1	Expression of correct form. Any z
	= 0.133 to 0.307 (3 sf)	A1 4	Must be an interval

(ii)	$\frac{19035}{150}$ (= 126.9 =127(3sf)) $\frac{150}{149}\left(\frac{4054716}{150}-\left(\frac{19035}{150}\right)^2\right)$ o.e. = 11001.17 or 11000(3 sf)	B1 M1 A1 3	 For use of a correct formula
(iii)	4-digit nos. each digit 0-9 Ignore nos > 9526 Ignore repeats	B1 B1 B1 3	Some valid way of generating 4 digit random nos from valid method from valid method SR If zero score, full explanation of method for drawing numbers out of a hat can score B1. NB Systematic sampling follows the scheme with first B1 for some way of generating a random starting point.
		Total: 10	
5 (i)	$\frac{4.8}{\sqrt{40}}$ $\frac{50.3-49.5}{\frac{4.8}{\sqrt{40}}}$ (= 1.054) 1 – Φ('1.054') = 0.146 (3 sf)	B1 M1 M1 A1 4	or $\frac{4.8^2}{40}$. Accept 4.8√40 or 4.8² × 40 for totals method For standardising with their SD Accept ± Accept totals method. No mixed methods For use of tables and finding area consistent with their working
(ii) (a)	Looking for decrease	B1 1	
(b)	H_0: Pop mean time spent (or μ) = 49.5 H_1: Pop mean time spent (or μ) < 49.5 $\frac{\frac{1920}{40}-49.5}{\frac{4.8}{\sqrt{40}}}$ (= –1.976) '1.976' > 1.555 (or '–1.976' < –1.555) There is evidence that mean time has decreased.	B1 M1 M1 A1 4	Not just "mean time spent" For standardising. Allow ÷ $\frac{4.8}{40}$ Accept totals method; CV method. No mixed methods For valid comparison (area comparison 0.024 < 0.06) CWO. No contradictions in conclusions
(c)	Population normally distr so No	B1 1	Both needed
		Total: 10	

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6 (i)	$\lambda = 4.65$ $e^{-4.65} \times \frac{4.65^4}{4!}$ $= 0.186$ (3 sf)	B1 M1 A1 3	 Poisson P($X = 4$) with any λ
(ii)	$\lambda = 3.875$ $= e^{-3.875}\left(1 + 3.875 + \frac{3.875^2}{2!}\right) = 0.257$ (3 sf)	B1 M1 A1 3	P($X = 0, 1, 2$) Attempted, any λ As final answer
(iii)	$\lambda = 1.5$ $1 - e^{-1.5}\left(1 + 1.5 + \frac{1.5^2}{2!}\right)$ $= 0.191$ (3 sf)	B1 M1 A1 3	 1 – P($X = 0, 1, 2$) Attempted, any λ As final answer
(iv)	He will reject H_0.	B1 1	
		Total: 10	