1	$(\frac{m}{2})^2$ $(\frac{m}{2})^2 = \frac{1}{2}$ $m = \sqrt{2}$ or 1.41 (3 sfs)	M1 M1 A1 [3]	$y = \frac{1}{2}x$ (attempt at linear equ with c = 0) $\int_0^m (\frac{1}{2}x)\mathrm{d}x = \frac{1}{2}$ (Note: $\pm\sqrt{2}$ as final answer scores A0)
2	H_0: Pop mean = 24.0 H_1: Pop mean > 24.0 $\frac{25-24}{\frac{4.8}{\sqrt{150}}}$ = 2.55(2) Comp z = 2.054 or 2.055 Evidence that Hiergro has incr hts	B1 M1 A1 M1 A1ft [5]	Allow 'μ' but not just 'mean' Standardise, with $\sqrt{150}$. Ignore cc. Accept sd/var mixes. OR find x_{crit} For correct z or area or x_{crit} Valid comparison (z values/areas/x values) Correct conclusion No contradictions (Note 2 tail test can score B0 M1 A1 M1 (z = 2.326) A1ft)
3	**(i)** Mean = 500 + 3 × 142 = 926 (cents) SD = 3 × 35 = 105 (cents)	B1 M1 A1 [3]	 Or 9×35^2 seen Accept $\sqrt{11025}$
	(ii) Mean = 6 × '926' = 5556 (cents) $6 \times$ '105'^{2} (= 66150) (SD = $\sqrt{66150}$) = 257 (cents) (3 sf)	B1ft M1 A1 [3]	 or SD = $\sqrt{6} \times$ '105'. ft their (i) Accept $\sqrt{66150}$
4	**(i)** $P(X \leqslant 1) = (0.75)^{20} + 20(0.75)^{19}(0.25)$ = 0.0243 $P(X \leqslant 2) = (0.75)^{20} + 20(0.75)^{19}(0.25) + {}^{20}C_2(0.75)^{18}(0.25)^2$ = 0.0913 or 0.0912 Critical region is 0 or 1 pkt contain gift or < 2 pkts contain gift oe	M1 A1 M1 A1 A1 [5]	Attempt correct expression Attempt correct expression OR Find P(2) = 0.0669 or 0.0670 dep M1M1 & their $P(X \leqslant 1) < 0.05 <$ their $P(X \leqslant 2)$ (S.R. Use of Normal: $N(5.3.75^2)$ used B1 $-1.645 = (x + 0.5 - 5)/\sqrt{3.75}$ M1 $x < 1.31$ A1 (3/5))
	(ii) P(Type I) = 0.0243 (3 sfs)	B1ft [1]	ft their $P(X \leqslant 1)$ dep < 0.05 ft Normal
	(iii) 2 is outside rej reg No evidence to reject claim	M1 A1ft [2]	or $P(X \leqslant 2) > 0.05$ No contradictions

5	**(i)** $\int_3^5 \frac{k}{x-1}\,dx = 1$	M1	Attempt integ f(x) & '= 1' ignore limits
	$[k\ln(x-1)]_3^5 = 1$	A1	Correctly integrated; ignore limits
	$k(\ln 4 - \ln 2) = 1$	M1	Subst of limits 3, 5
	$k\ln 2 = 1$	A1 [4]	
	($k = \frac{1}{\ln 2}$ **AG**)		No errors seen. No decimals seen
	(ii) $\frac{1}{\ln 2}\int_3^x \frac{1}{x-1}dx = 0.75$	M1*	Attempt integ f(x), unknown limit, & '= 0.75'or '= 0.25'
	$\frac{1}{\ln 2}[\ln(x-1)]_3^x = 0.75$		
	$\frac{1}{\ln 2}(\ln(x-1) - \ln 2) = 0.75$	A1	
	$\ln(x-1) = (0.75 \times \ln 2 + \ln 2)$		oe. Fully correct equn after subst limits
	$\ln(x-1) = 1.75 \times \ln 2$		
	$x - 1 = 2^{1.75}$ or $x - 1 = 3.36$	M1 dep*	
	$x = 4.36$ (3 sfs)	A1 [4]	oe. Correct manipulation of logs to find x
6	**(i)** Excludes children Excludes people without phones More than one person in some houses Some ex-directory	B1 [1]	or other implying directory excludes some people
	(ii) $\text{Var}(p) = \frac{\frac{38}{200}(1-\frac{38}{200})}{200}$ (= 0.0007695)	M1	
	$z = 2.576$	B1	Seen
	$\frac{38}{200} \pm z\sqrt{\frac{\frac{38}{200}(1-\frac{38}{200})}{200}}$	M1	For correct form of CI
	0.119 to 0.261 (3 sfs)	A1 [4]	Accept 0.262 Must be an interval
	(iii) $z \times$ '$\sqrt{0.0007695}$' = 0.05	M1	$z \times$ (their sd of p) = 0.05. Allow = 0.1
	$z = 1.802$	A1	
	Φ('1.802') (= 0.9642)	M1	Attempt Φ(their z) and find $2\Phi - 1$
	('0.9642' – (1 – '0.9642') = 0.9284)		
	$x = 93$ (2 sfs)	A1 [4]	
7	**(i)** $\lambda = 4.8$	B1	
	$E^{-4.8}(1 + 4.8 + \frac{4.8^2}{2!} + \frac{4.8^3}{3!})$	M1	P(R = 0, 1, 2 or 3), their λ allow one end error
	= 0.294 (3 sfs)	A1 [3]	

(ii)	$e^{-\lambda} \times \frac{\lambda^4}{4!} = \frac{16}{3} e^{-\lambda} \times \frac{\lambda^2}{2!}$ or without $e^{-\lambda}$	M1		$\lambda = 1.6n$ seen or implied	B1
	$\frac{\lambda^2}{12} = \frac{16}{3}$ or better	A1		$e^{-1.6n} \times \frac{(1.6n)^4}{4!} = \frac{16}{3} e^{1.6n} \times \frac{(1.6n)^2}{2!}$	M1
	$(\lambda = 8)$			$\frac{(1.6n)^2}{12} = \frac{16}{3}$ or better	A1
	$\lambda = 1.6n$ seen or implied	B1		$(1.6n = 8)$	
	$n =$ '8' ÷ 1.6				
	$= 5$	A1	[4]	$n = 5$	A1
(iii)	$T \sim N(64, 64)$	B1		May be implied	
	$\frac{75.5 - 64}{\sqrt{64}}$ (= 1.4375)	M1		Allow with wrong or no cc. No sd/var mixes	
	$1 - \Phi$('1.4375') (= 1 – 0.9247)	M1		Finding correct area consistent with their working	
	$= 0.0753$ to 0.0754	A1	[4]		