Note: "(3 sfs)" means "answer which rounds to ... to 3 sfs". If correct ans seen to ≥ 3sfs, ISW for later rounding. Penalise < 3 sfs only once in paper

1	$z = 2.326$ $494 \pm z \times \frac{23}{\sqrt{150}}$ = 490 to 498 (3 sfs)	B1 M1 A1 [3]	seen Any z
2	$(0.75 \times 54.8 + 0.25 \times 82.4 =) 61.7$ $0.75^2 \times 16.0^2 + 0.25^2 \times 4.8^2$ (= 145.44) sd = 12.1 (3 sfs)	B1 M1 A1 [3]	 No need for √ for M1
3	H_0: $p = 0.15$ H_1: $p > 0.15$ $(N(300 \times 0.15, 300 \times 0.15 \times 0.85))$ $= N(45, 38.25)$ $\frac{59.5-'45'}{\sqrt{'38.25'}}$ (= 2.345) Allow wrong or no cc $z = 1.96$ 2.345>1.96 Evidence prop is higher for new plan	B1 B1 M1 M1 A1 [5]	or H_0: Approval rate same for new as for old H_1: Approval rate for new > for old $(N(0.15, \frac{0.15\times0.85}{300}))$ $= N(0.15, 0.000425)$ or $\frac{\frac{59}{300}+\frac{0.5}{300}-'0.15'}{\sqrt{'0.000425'}}$ (= 2.345) Allow wrong or no cc comparison (or area comparison) cwo
4 **(i)**	$\int_0^1 \frac{k}{(x+1)^2}\,dx = 1$ $-\left[\frac{k}{(x+1)}\right]_0^1 = 1$ $-k\left(\frac{1}{2}-1\right) = 1$ ($k = 2$ **AG**)	M1 A1 [2]	Any attempt integ f(x) & = 1. Ignore limits oe, with limits inserted correctly
(ii)	$\int_0^a \frac{2}{(x+1)^2}\,dx = \frac{1}{5}$ $-\left[\frac{2}{(x+1)}\right]_0^a = \frac{1}{5}$ $-\left(\frac{2}{a+1}-2\right) = \frac{1}{5}$ $a = \frac{1}{9}$	M1 A1 A1 [3]	Attempt integ f(x) & = $\frac{1}{5}$ (oe), ignore limits oe, with correct limits inserted correctly
(iii)	Area below $x = 0.5$ is greater than 0.5 $m < 0.5$	B1 B1dep [2]	oe, eg More area at left hand end

5	**(i) (a)**	$P(X \geq 3) = 1 - e^{-3.2}\left(1 + 3.2 + \frac{3.2^2}{2!}\right)$ $= 0.62(0)$ (3 sf)	M1 A1 [2]	Allow one end error
	(b)	$P(X = 3) = e^{-3.2}\left(\frac{3.2^3}{3}\right)$ (= 0.22262) $\left(\frac{P(X=3 \cap X \geq 3)}{P(X \geq 3)} = \frac{P(X=3)}{P(X \geq 3)}\right)$ $= \frac{'0.22262'}{'0.62010'}$ = 0.359 (3 sf)	M1 M1 A1 [3]	May be implied $\frac{\text{Their } P(X=3)}{\text{Their } P(X \geq 3)}$
	(ii) (a)	(Approx) normal with mean 3.2 variance = $\frac{3.2}{120}$ or $\frac{2}{75}$ or 0.0267 (3 sfs) oe	B1 B1 [2]	 or sd = $\sqrt{\frac{3.2}{120}}$ or 0.163 (3 sfs) oe
	(b)	$\frac{3.3-3.2}{\sqrt{\frac{3.2}{120}}}$ (= 0.612) Φ ("0.612") = 0.730 (3 sfs)	M1 M1 A1 [3]	Allow with cc attempted Accept 0.73
6	**(i)**	$\bar{x} = 1.96$ $(\Sigma x^2 f = 254)$ $S^2 = \frac{50}{49} x \left(\frac{254}{50} - 1.96^2\right)$ = $\frac{1548}{1225}$ or 1.2637	B1 M1 A1 [3]	 Correct sub in S^2 formula
	(ii)	H_0: Pop mean = 1.66 H_1: Pop mean ≠ 1.66 $\frac{1.96-1.66}{\sqrt{\frac{1.2637}{50}}}$ = 1.887 $z = 1.96$ 1.887<1.96 No evidence that mean has changed	B1 M1 A1 M1 $A1_{ft}$ [5]	In context	H_0: Pop mean = 1.66 H_1: Pop mean > 1.66 B0 $\frac{1.96-1.66}{\sqrt{\frac{1.2637}{50}}}$ M1 = 1.887 A1 $z = 1.645$ M1 Evidence mean has changed $A1_{ft}$
	(iii)	No because H_0 not rejected	B1f [1]	If H_0 rejected in (ii): Yes because H_0 rejected
	(iv)	State mean not changed when it has –1.96 < test stat < 1.96	B1 B1 [2]	In context	State mean not increased when it has B1 test stat < 1.645 B1

7	**(i)**	$\lambda = 5$ $1 - e^{-5}\left(1 + 5 + \frac{5^2}{2!}\right)$ $= 0.875$	B1 M1 A1 [3]	Any λ. Allow one end error
	(ii)	$X \sim \text{N}(120, 120)$ $\frac{109.5-120}{\sqrt{120}}$ $(= -0.9585)$ $1 - \Phi(\text{“}0.9585\text{”})$ $(= 1 - 0.8312)$ $\text{“}0.1688\text{”}^2$ $= 0.0285$ to 0.0286	B1 M1 M1 A1 [4]	May be implied Allow with wrong or no cc or no √
	(iii)	$\lambda = 15 \times \frac{5}{60} + 0.5$ $= 1.75$ $e^{-1.75}\left(\frac{1.75^3}{3!} + \frac{1.75^4}{4!} + \frac{1.75^5}{5!}\right)$ $= 0.247$ (3 sfs)	M1 A1 M1 A1 [4]	Any λ. Allow one end error