Question	Answer	Marks	Guidance
1(i)	0.0842 (3 sf)	**B1**	
		1	
1(ii)	$e^{-5} \text{ x } \frac{5^n}{n!} = e^{-5} \text{ x } \frac{5^{n+1}}{(n+1)!}$	**B1**	or $\frac{5^n}{n!} = \frac{5^{n+1}}{(n+1)!}$ or better ISW
		1	
1(iii)	$1 = \frac{5}{n+1}$ $n = 4$	**B1**	
		1	

Question	Answer	Marks	Guidance
2(i)	Normal with mean 372	**B1**	
	sd = $\frac{54}{\sqrt{36}}$	**M1**	or variance = $\frac{54^2}{36}$ M1
	(= 9)	**A1**	(= 81) A1
		3	
2(ii)	Pop normal	**B1**	Allow X is normal
		1	

Question	Answer	Marks	Guidance
3(i)	Est(μ) = 1.85	**B1**	
	Est(σ^2) = $\frac{50}{49}\left(\frac{175.25}{50} - '1.85'^2\right)$	**M1**	Allow $\sqrt{\frac{50}{49}\left(\frac{175.25}{150} - '1.85'^2\right)}$ or 0.0290 for M1
	= 0.0842 (3 sf) or $\frac{33}{392}$	**A1**	Cao If $\frac{50}{49}$ omitted (giving var = 0.0825 or sd = 0.287) M0A0
		3	
3(ii)	H_0: Pop mean time = 1.9 (h) H_1: Pop mean time < 1.9 (h)	**B1**	Allow 'μ' but not just 'mean'
	$\pm\frac{1.85-1.9}{\sqrt{\frac{'0.0842'}{50}}}$	**M1**	$\pm\frac{1.85-1.9}{\frac{'0.290'}{\sqrt{50}}}$ Accept totals method (92.5–95) / $\sqrt{4.21}$
	= –1.22	**A1**	= –1.22
	comp z = –1.645	**M1**	Or other valid comparison 0.888 or 0.889 < 0.95 OR 0.111 or 0.112>0.05
	No evidence that mean time < 1.9 h	**A1**	**FT** their z. Correct conclusion. No contradictions If $\frac{50}{49}$ not used in (1): var = 0.8225, sd = 0.907, cr = 1.17 can score all marks in **(ii)** Note- 2 tail test can score B0 M1 A1 M1 (comparison with 1.96) A0 (no ft) max3/5
		5	

Question	Answer	Marks	Guidance
4	Use of $1.5X_1 - X_2$ or similar	**B1**	
	$E(1.5X_1 - X_2) = 1.5(110) - 110$ (= 55)	**B1**	or $E(X_1 - 1.5X_2) = 110 - 1.5(110)$ (= –55)
	$Var(1.5X_1 - X_2) = 1.5^2 \times 1050 + 1050$ (or 3412.5)	**M1**	Correct expression or result
	$\frac{0-55}{\sqrt{'3412.5'}}$ or $\frac{0-(-55)}{\sqrt{'3412.5'}}$ (= ± 0.942)	**M1**	Their '55'. Allow incorrect var (dep > 0 and ≠ 1050)
	$1 - \Phi$('0.942')	**M1**	Area consistent with their working
	= 0.173	**A1**	
	Ans 0.346 (3 sf)	**B1**	**FT** double their prob (must be <1)
		7	

Question	Answer	Marks	Guidance
5(i)	$H_0: p = 0.1$ $H_1: p < 0.1$	**B1**	
		1	
5(ii)	B(40, 0.1) stated or implied by use of	**B1**	e.g. by ${}^{40}C_x$ or $0.9^p \times 0.1^q$ $(p + q = 40)$
	$0.9^{40} + 40 \times 0.9^{39} \times 0.1$	**M1**	Correct working (if seen). If working not seen, M1 may be implied by 0.0805
	= 0.0805	**A1**	
		3	

Question	Answer	Marks	Guidance
5(iii)	$z = 1.645$	**B1**	seen
	$\frac{6}{80} \pm z\sqrt{\frac{\frac{6}{80}\times\frac{(80-6)}{80}}{80}}$	**M1**	Formula of correct form. Must be a 'z'
	= 0.0266 to 0.123 (3 sfs)	**A1**	Allow 0.03 to 0.12 or better Must be an interval
		3	
5(iv)	10% (or manufacturer's claim) is within CI Hence no reason to question claim	**B1**	**FT** Allow '10% is within CI, accept claim' oe Must include both parts. No contradictions. **FT** their CI Note if CI is centred on 0.1 allow ft 0.075 is within CI, accept claim
		1	

Question	Answer	Marks	Guidance
6(i)	$a\int_1^b \frac{1}{x^2}dx = 1$	**M1**	Attempt int f(x) and = 1, ignore limits
	$a\left[-\frac{1}{x}\right]_1^b = 1$	**A1**	correct integ and limits = 1
	$a[1 - \frac{1}{b}] = 1$ or $a\times\frac{b-1}{b} = 1$ $b = \frac{a}{a-1}$ **AG**	**A1**	No errors seen
		3	

Question	Answer	Marks	Guidance
6(ii)	$a\int_1^{\frac{3}{2}} \frac{1}{x^2}dx = \frac{1}{2}$ $a\left[-\frac{1}{x}\right]_1^{\frac{3}{2}} = \frac{1}{2}$	M1	Attempt int f(x) with limits 1 to $\frac{3}{2}$ and = $\frac{1}{2}$
	$a\left[1 - \frac{2}{3}\right] = \frac{1}{2}$	A1	oe correct equn in *a*
	$a = \frac{3}{2}$, $b = 3$	A1	Both
		3	
6(iii)	$\frac{3}{2}\int_1^3 \frac{1}{x}dx$	M1	Attempt int xf(x), ignore limits – condone missing a
	$= \frac{3}{2}\ [\ln x]_1^3$	A1	**FT** Correct integ and *their* limits 1 to b – condone missing a
	$= \frac{3}{2}\ln 3$ or 1.65 (3 sf)	A1	**FT** *their a* and *b* (valid *b* i.e. >1)
		3	

Question	Answer	Marks	Guidance
7(i)	Max no. of passengers plane can take oe	B1	oe e.g. No of passengers who bought tickets
		1	

Question	Answer	Marks	Guidance
7(ii)	$\lambda = 3.2$	B1	
	$e^{-3.2}(\frac{3.2^3}{3!} + \frac{3.2^4}{4!} + \frac{3.2^5}{5!})$	M1	Any λ. Allow one end error
	= 0.5146 = 0.515 (3 sfs)	A1	SR Use of Bin(640,0.005) scores B1 (only) for 0.516
		3	
7(iii)	$n > 50$	B1	Accept n is large
	$np = 1.6$, which is < 5 or p=0.005 which is <0.1	B1	Allow $np = 3.2$
		2	
7(iv)	H_0: Pop mean (for 5 days) = 8 H_1: Pop mean (for 5 days) < 8	B1	or Pop mean (for 1 day) = 1.6 Pop mean (for 1 day) < 1.6 Allow λ or μ but not just 'mean'
	$e^{-8}(1 + 8 + \frac{8^2}{2!})$	M1	Any λ ($\neq$ 1.6) No end errors. Accept use of Bin(1600,0.005) P(0,1,2)=0.0136
	= 0.0138	A1	
	Comp 0.025	M1	Valid comparison
	Evidence that mean no. failing to arrive has decreased	A1	**FT** their '0.0138' or '0.0136'. No contradictions
		5	