Question	Scheme	Marks
	SC Normal approximation may achieve 2 out of 4 B1 for the mean 114 1st A1 on epen B1 for either probability 0.0713 or 0.0708 2nd A1 on epen	
Question	**Scheme**	**Marks**
7(a)	$f(x) = \frac{1}{3125}(100x^3 - 20x^4)$ or $\frac{4}{125}x^3 - \frac{4}{625}x^4$	M1
	$f'(x) = \frac{1}{3125}(300x^2 - 80x^3) = 0$ or $\frac{12}{125}x^2 - \frac{16}{625}x^3$	M1A1
	$x = 3.75$	A1
		(4)
(b)	F(3.95) = 0.7166… F(4.05) = 0.7576…	M1A1
	F(3.95) < 0.75 < F(4.05), therefore the **upper quartile** (oe) is **4.0** to 1 decimal place.	A1
		(3)
(c)	$H_0 : p = 0.25$ $H_1 : p < 0.25$	B1
	$Y \sim B(25, 0.25)$ **and** P($Y \leq 3$) = 0.0962 | or P($Y \leq 2$) = awrt 0.0321 CR $Y \leq 2$	M1 A1
	Do not reject H_0 / not significant	dM1
	There is <u>not</u> enough evidence to suggest that the model <u>overestimates</u> the <u>proportion</u> of <u>queuing</u> more than 4 minutes/<u>Olivia's belief</u> is <u>not supported</u>.	A1cso
	SC If H_1 written using > 0.25 and they then go on to use P($Y \geq 3$) = 0.9679 allow B0M1A0dM0A0. If they go on to use P($Y \leq 3$) or P($Y \geq 4$) mark as original scheme	
	Notes	**Total [12]**
(a)	1st M1 for attempting to finding f(x) (at least one $x^n \to x^{n-1}$). May be implied. Condone missing 1/3125 2nd M1 for attempting to find $f'(x)$ and equating it to 0 Condone missing 1/3125 1st A1 correct differentiation ie $\frac{1}{3125}(300x^2 - 80x^3)$ Condone missing 1/3125 2nd A1 3.75oe only	
(b)	M1 for attempting F(3.95) and F(4.05) or a suitable tighter interval (need to check they give values either side of 0.75) 1st A1 for both awrt 0.72 and awrt 0.76 **NB** check answers and accuracy if other numbers used. 2nd A1 for comparison with "their 0.75" and correct conclusion. Must have bold in conclusion $Q_3 = 4.0$ is enough. **NB** other methods possible – will need to check	M1 for setting up $\frac{1}{3125}(25x^4 - 4x^5) = 0.75$ 1st A1 for x = 4.03118 (4.03 or better) 2nd A1 for conclusion. Must have bold in conclusion and a value for x of 4.03 or better
(c)	B1 both hypotheses correct p or π 1st M1 for writing or using P($Y \leq 3$) or P($Y \geq 4$) and writing or using B(25, p) may be implied Only award for P($Y \leq 2$) = awrt 0.0321 if CR has been given. 1st A1 for awrt 0.0962 or correct CR: $Y \leq 2$ or 0.9038 > 0.95 2nd dM1 Dependent on the 1st M1. For a correct statement i.e. not significant/do not reject H_0 Follow through their probability and their H_1	

Question	Scheme	Marks
	Do not allow non-contextual conflicting statements 2nd A1cso fully correct solution and correct contextual statement Allow equivalent words to proportion eg fraction but do not allow number Allow equivalent words for supported eg true. Allow her for Olivia	

(b) Other methods seen. Answers are for using 3.95 and 4.05. Allow 2 sf

$F(x) - 0.75 = 0$

awrt -0.033 and awrt +0.0076

$(F(x) - 0.75) * 3125 * 4 = 0$

awrt +95.3 and awrt -416/416.5

$(F(x) - 0.75) * 3125 = 0$

awrt -104.12 and awrt +23.8

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