

Qu 4	Scheme	Marks	AO
(a)	(i) 0.153588... awrt <u>0.154</u>	B1	3.4
	(ii) $P(X \leq 14) - P(X \leq 11)$ with at least 1 from $P(X \leq 14) = 0.97707... ; P(X \leq 11) = 0.797603...$ $= 0.17947... awrt 0.179$	M1	2.1
		A1	1.1b
		(3)	
(b)	$H_0 : p = 0.12 \quad H_1 : p < 0.12$ [D = no. of defective items in sample] $D \sim B(60, 0.12)$ [$P(D, 3)$] = 0.06013.. awrt <u>0.060</u> or [$P(D, 2)$] = awrt 0.0196 with reference to CR [so CR: $D, 2$] [0.06... > 5% not significant, do not reject H_0] <u>Insufficient</u> evidence that <u>proportion</u> of defective <u>items</u> has <u>decreased</u>	B1	2.5
		M1	2.1
		A1	1.1b
		A1	2.2b
(c)	<u>“0.06...”</u>	(4)	
		B1ft	1.2
		(1)	
		(8 marks)	
Notes			
(a)(i)	B1 for awrt 0.154		
(ii)	M1 for correct expression for $P(X \leq 14) - P(X \leq 11)$ [o.e.] with at least one correct probability substituted (2sf truncated or rounded) <u>or</u> correct calculation $0.97707... - 0.797603...$ (2sf truncated or rounded)		
ALT	<u>or</u> $P(X = 12) + P(X = 13) + P(X = 14)$ with at least one from $27C12(0.35)^{12}(0.65)^{15}$ $= 0.09176... + 27C13(0.35)^{13}(0.65)^{14} = 0.05701... + 27C14(0.35)^{14}(0.65)^{13} = 0.03069...$ with at least one correct probability calculation or value seen (2sf truncated or rounded)		
	A1 for awrt 0.179 allow 0.1795 correct answers scores 2 out of 2		
(b)	B1 for both hypotheses correct in terms of p or π M1 for sight or correct use of $B(60, 0.12)$ (implied by awrt 0.0601 or awrt 0.0405 or awrt 0.0196) 1 st A1 for final answer awrt 0.060 (allow 0.06 if $P(D, 3)$ is seen with $B(60, 0.12)$) or for critical region approach awrt 0.0196 with statement of CR or reference to CR NB: $P(D, 2) =$ awrt 0.0196 on its own scores A0 here as it is treated as a p -value but can score B1ft in part (c) 2 nd A1 (dep on M1A1 but independent of hypotheses) for a correct inference in context. Must NOT reject H_0 (if stated) and mention underlined words o.e. condone e.g. ‘ <u>proportion</u> of defective <u>items</u> is still 0.12/hasn’t changed’ allow e.g. ‘no’ for insufficient allow proportion/probability/percentage but not number allow e.g. ‘is less than 0.12’ for decreased 2 nd A0 for contradictory statements e.g. 'reject H_0 so no decrease in proportion of defective items’		
SC	A two-tailed test may score maximum in (b) B0M1A1A1 but must be 2×their p -value to 3 sf to score in part (c). Correct ft is 0.120 or better (do not accept 0.12 for the SC).		
(c)	B1ft for 0.06 or better allow as a percentage <u>or</u> ft their final (p -value) answer from part (b) to 1sf [provided it is a probability] NB: using a critical region approach in (b) scores B0ft if they state their CR probability as the p -value		