Question Number	Scheme	Marks
4. (a)	H_0: $p = 0.35$ H_1: $p > 0.35$	B1
	Probability route: $P(X \geq 11) = 1 - P(X \leq 10)$ [$= 1 - 0.9468$] $= 0.0532$ | CR route: $P(X \leq 11) = 0.9804$, $P(X \geq 12) = 0.0196$, CR: $X \geq 12$	M1 A1
	Do not Reject H_0 or not significant or 11 does not lie in the CR	dM1
	Hadi's belief is not supported or the proportion of customers paying by credit card is not greater than 35%.	A1cso
		(5)
(b)	$X \sim B(20, 0.35)$	
	[$E(X) =$] 7	B1
	S.D. $= \sqrt{20 \times 0.35 \times 0.65}$ [$= \sqrt{4.55} = 2.133\ldots$]	B1
	"7" + 2 × "2.133…" | 11 – "7" < 2 × 2.133… | $\frac{11-"7"}{\sqrt{"4.55"}}$ | 11 – 2 × "2.133…"	M1
	11 < 11.266 | 4 < 4.266 | 1.875 < 2 | 6.734 < 7	A1cso
		(4)
		[9 marks]

	Notes
(a)	B1 both hypotheses correct (may use p or π). Must have H_0 and H_1 1st M1 for writing or using $1 - P(X \leq 10)$ or if leading to a CR allow $P(X \leq 11)$ = awrt 0.980 (condone 0.98) or $P(X \geq 12)$ = awrt 0.0196 (may be implied by awrt 0.0532 or correct CR) A1 for 0.0532 or CR: $X \geq 12$ oe **NB** M1 A1 for $0.9468 < 0.95$ 2nd M1 Dependent on the 1st M1. For a correct statement i.e. not significant/accept H_0/Not in CR Follow through their probability/CR and their H_1 . Must have a Critical region not just a critical value Do not allow non-contextual conflicting statements. May be implied by a correct contextual statement on its own 2nd A1cso fully correct solution and correct contextual statement. Underlined words required and in a correct statement. eg Allow Hadi is wrong or Hadi's claim is not supported The (proportion/percentage/number/rate/probability) paying by credit card (is not greater/is 35%(0.35)/ remains the same) or there is insufficient evidence that the proportion of customers who pay by credit card has increased
(b)	1st B1 $E(X) = 7$ 2nd B1 for a correct expression for standard deviation M1 for using 'mean' + 2 × 'standard deviation' or 11- "their mean" < 2 × 'standard deviation' or $\frac{11-"\text{their } E(X)"}{"\text{Their sd}"}$ If $E(X)$ and sd not given then allow $5 < E(X) < 10$ and $0 < sd < 5$ A1cso for comparison with 11 or 4 or 2 allow awrt (11.3 or 4.27 or 1.88 or 6.43) oe and no errors seen