

Qu	Scheme	Marks	AO
4. (a)	$[R = \text{no. of red beads in Aliya's bracelet}] \quad R \sim B(18, 0.14)$	B1 (1)	3.3
(b)(i)	$P(R = 1) = 0.19403\dots$ awrt 0.194	B1	1.1b
(ii)	$P(R \geq 4) = 1 - P(R \leq 3) = 1 - [0.76184\dots]$ $= 0.2381588\dots$ awrt 0.238	M1 A1 (3)	3.4 1.1b
(c)	Requires $p = 0.14$ to be constant so need a large number of beads in the sack to ensure that removing 18 beads does not appreciably affect this probability, then it could be suitable.	B1 (1)	3.5b
(d)	$H_0 : p = 0.14 \quad H_1 : p \neq 0.14$ $[X = \text{number of red beads in the sample}] \quad X \sim B(75, 0.14)$ $P(X \leq 4) = 0.01506\dots$ or if $B(75, 0.14)$ seen awrt 0.02 { $0.02 < 0.025$ so significant <u>or</u> reject H_0 } There is evidence that the proportion of red beads has changed	B1 M1 A1 A1 (4)	2.5 3.3 3.4 2.2b
(e)	$p\text{-value is } 2 \times "0.01506\dots" = 0.030123\dots = \text{awrt } 0.03$	B1ft (1)	1.1b
(10 marks)			
Notes			
(a)	B1 for $B(18, 0.14)$ accept in words e.g. <u>binomial</u> with $n = 18$ and $p = 0.14$		
(b)(i)	B1 for awrt 0.194		
(ii)	M1 for interpreting “at least 4” Need $1 - P(R \leq 3)$ <u>and</u> $1 - p$ [$0 < p < 1$] $P(R = 3) = 0.233\dots$ OK A1 for awrt 0.238		
(c)	B1 for mention of <u>large number of beads</u> and need for <u>$p = 0.14$ to be constant</u> for it to be suitable. Do NOT accept e.g. “events are independent”		
(d)	B1 for both hypotheses correct with use of p or π M1 for selecting a suitable model: sight or correct use of $B(75, 0.14)$ May be implied by sight of 0.015 or better <u>or</u> $[P(X > 4) =] 0.9849\dots$ i.e. 0.985 or better 1 st A1 for use of the correct model awrt 0.015 (accept awrt 0.02 following a correct expression) Allow 1 st A1 for awrt 0.985 <u>only if</u> correct comparison with 0.975 is seen. Sight of $B(75, 0.14)$ and $P(X \leq 4) = \text{awrt } 0.02$ scores M1A1 <u>No sight</u> of $B(75, 0.14)$ <u>but</u> sight of awrt 0.015 scores M1(\Rightarrow)A1[Condone $P(X = 4) = \dots$] 2 nd A1 (dep on M1A1) for a correct conclusion in context mentioning “proportion”, “red” and “changed” If there is a statement about H_0 or significance it must be compatible. NB May see CR i.e. $X \leq 4$ (mark when prob seen) and $X \geq 18$ (prob = 0.01406..) Ignore upper limit NB for information $P(X = 4) = 0.0104\dots$ and can only score M1A0A0 if $B(75, 0.14)$ seen		
(e)	B1ft for awrt 0.03 Allow ft of their probability in (d) provided at least 3sf used NB an answer of 0.02 in (d) leading to 0.04 in (e) is B0		
SC	Use of CR will give significance level of $0.01506\dots + 0.01406\dots = 0.029\dots$ score B1 no ft		