

## STEP II, 2003, Q14

- 14 The probability of throwing a 6 with a biased die is  $p$ . It is known that  $p$  is equal to one or other of the numbers  $A$  and  $B$  where  $0 < A < B < 1$ . Accordingly the following statistical test of the hypothesis  $H_0 : p = B$  against the alternative hypothesis  $H_1 : p = A$  is performed.

The die is thrown repeatedly until a 6 is obtained. Then if  $X$  is the total number of throws,  $H_0$  is accepted if  $X \leq M$ , where  $M$  is a given positive integer; otherwise  $H_1$  is accepted. Let  $\alpha$  be the probability that  $H_1$  is accepted if  $H_0$  is true, and let  $\beta$  be the probability that  $H_0$  is accepted if  $H_1$  is true.

Show that  $\beta = 1 - \alpha^K$ , where  $K$  is independent of  $M$  and is to be determined in terms of  $A$  and  $B$ . Sketch the graph of  $\beta$  against  $\alpha$ .



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