

## STEP II, 2004, Q13

- 13 A bag contains  $b$  balls,  $r$  of them red and the rest white. In a game the player must remove balls one at a time from the bag (without replacement). She may remove as many balls as she wishes, but if she removes any red ball, she loses and gets no reward at all. If she does not remove a red ball, she is rewarded with £1 for each white ball she has removed.

If she removes  $n$  white balls on her first  $n$  draws, calculate her expected gain on the next draw and show that it is zero if  $n = \frac{b-r}{r+1}$ .

Hence, or otherwise, show that she will maximise her expected total reward if she aims to remove  $n$  balls, where

$$n = \text{the integer part of } \frac{b-r}{r+1} + 1.$$

With this value of  $n$ , show that in the case  $r = 1$  and  $b$  even, her expected total reward is  $\mathcal{L}\frac{1}{4}b$ , and find her expected total reward in the case  $r = 1$  and  $b$  odd.



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