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Exercise for February 25, 2006

November 1981 Course 110 Examination, Problem No. 41

An urn contains n black balls and n white balls. Three balls are chosen from the urn at random and without replacement. What is the value of n if the probability is $\frac{1}{12}$ that all three balls are white?

- A. 4 B. 5 C. 8 D. 10 E. 12

Solution.

There are $2n$ balls total, of which n are white and n are black. If 3 balls are chosen from the urn without replacement, the probability that all three are white is

$$\frac{\binom{n}{0} \cdot \binom{n}{3}}{\binom{2n}{3}} = \frac{n!}{0! \cdot n!} \cdot \frac{n!}{3! \cdot (n-3)!} = \frac{(n-2) \cdot (n-1) \cdot n}{(2n-2) \cdot (2n-1) \cdot 2n} = \frac{n-2}{4 \cdot (2n-1)},$$

and we know that this is equal to $\frac{1}{12}$, so that

$$\frac{n-2}{4 \cdot (2n-1)} = \frac{1}{12}.$$

This implies that $n = 5$.

Answer B.

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