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Bonus Problem

The first student to give all the right answers will get five bonus points in the second test.

Imagine an urn with n balls, identical in every respect except for being numbered from 1 to n so they can be distinguished. You draw the balls from the urn, one at a time, with replacement and a vigorous shaking after each draw. Clearly, after the nth draw you are certain to draw a ball that you draw earlier. Derive a formula for the average number of draws before a ball is drawn for the second time, and evaluate it for the cases of n=10, n=100, n=10,000, and n=100,000 balls. To be clear about the "before" in the last sentence, a drawing sequence of 3, 5, **9**, 8, 1, 7, 6, **9** would be recorded as requiring seven draws before the first repeat occurs (ball #9).