

The Algebra Symposium: Bouncing Balls

This file is <http://www2.math.uic.edu/~jlewis/as/asbounce.pdf>

From **Calculus**, Hughes–Hallett, *et al.*:

1. A ball is dropped from a height of 10 feet and bounces. Each bounce is $\frac{3}{4}$ of the height of the bounce before. Thus after the ball hits the floor for the first time, the ball rises to a height of $10 \left(\frac{3}{4}\right) = 7.5$ feet, and after it hits the floor for the second time, the ball rises to a height of $7.5 \left(\frac{3}{4}\right) = 10 \left(\frac{3}{4}\right)^2 = 5.625$ feet.
 - (a) Find an expression for the height to which the ball rises after it hits the floor for the n^{th} time.
 - (b) Find an expression for the total vertical distance the ball has traveled when it hits the floor for the first, second, third, and fourth times.
 - (c) Find an expression for the total vertical distance the ball has traveled when it hits the floor for the n^{th} time. Express your answer in a closed form.

Hint

$$1 + r + r^2 + \dots + r^n = \frac{1 - r^{n+1}}{1 - r}.$$

2. You might think that the ball [in the previous problem] keeps bouncing forever since it takes infinitely many bounces.

Is this true?

Some references from a Google Search for `bounce ratio`:

Zeno and the Bouncing Ball:

<http://www.sas.org/e-bulletin/2002-09-20/handsOnPhys/body.html>

The Bounce of the Ball:

http://wings.avkids.com/Curriculums/Tennis/bounce_summary.html

Note that the COR (Coefficient of Restitution) is not the same as the bounce ratio.