Billiard balls and mathematics.

Here we have an interesting connection between fundamental mathematics and billiard balls.

Consider a sequence of tests with a "system" consisting of a perfectly smooth billiard table, with a perfectly reflecting wall at the left hand end of the table (i.e. if a billiard ball hits the wall it bounces back without loss of speed), and a pair of perfectly elastic billiard balls with masses m and n X m, where n = 1, 100, 10,000, ... (i.e. $n = 100^{i-1}$, i = 1,2,3....). Since the balls and wall are perfectly elastic, both linear momentum and energy will be conserved in all collisions.

We place the balls, with that of mass m nearest to the wall and stationary and that of mass n X m stationary to the right. We strike the right hand ball so that it hits the left hand ball. They collide and, due to conservation of linear momentum, the left hand ball will move to the left and hit the wall, whereupon it will come back and hit the right hand ball again. Sooner or later, the two balls will both be moving to the right, with the right hand ball moving faster than the left hand ball, and, once that occurs, they will never collide again. We count the total number of collisions, C, including with the wall, for each value of n. The results are thus:

n=1, C = 3

n=100, C = 31

n=10,000, C = 314

n=1,000,000, C = 3142

Can you see a pattern emerging?

The explanation for this astonishing result is complicated but, if you are interested, you can see it here:

https://arxiv.org/abs/1712.06698#:~:text=In%20Galperin%20billiards%2C%20two%20balls,masses%20of%20the%20two%20particles.