Pi from Balls

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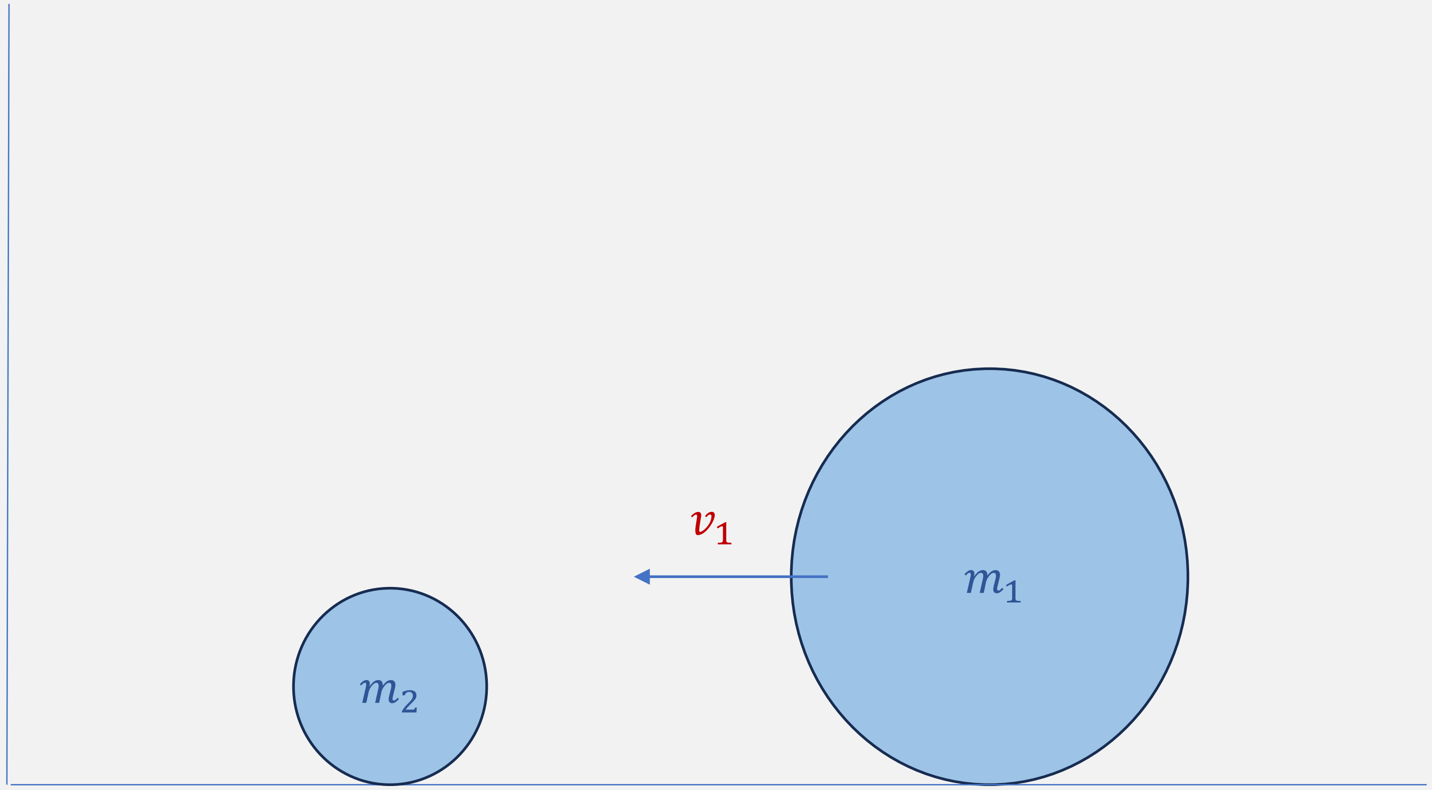
Ways To Compute Pi

- Archimedes Method
- Leibniz’s formula for Pi
- Monte Carlo Method
- Buffon’s Needle

Collision of Billiard Balls/Blocks

- A very interesting and unexpected way of computing pi is from the collision of two billiard balls.

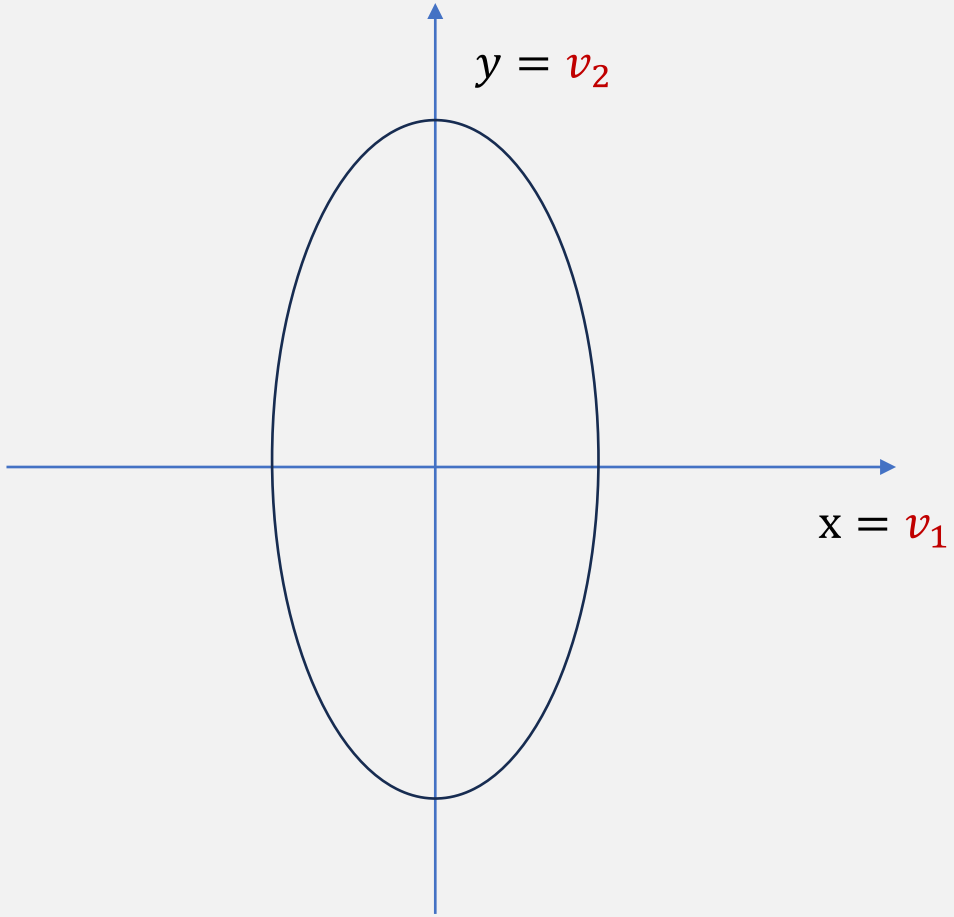


Simulation

- Here’s a link to simulation that replicates the billiard ball experiment.
- https://blocks.ktj.st/

Why does this happen?

- $\frac{1}{2}m_1(v_1)^2 + \frac{1}{2}m_2(v_2)^2 = C_1$
- $m_1v_1 + m_2v_2 = C_2$

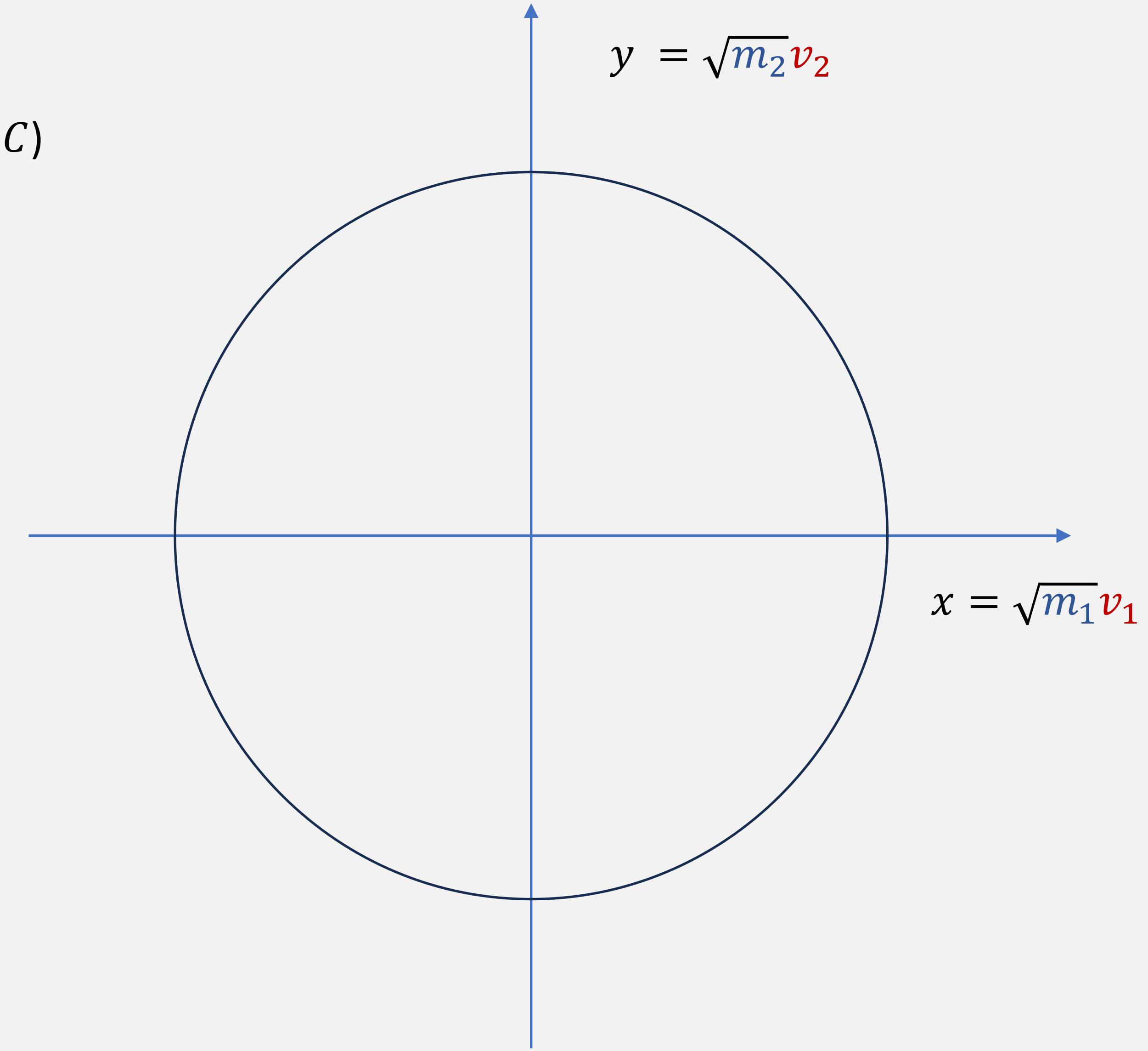


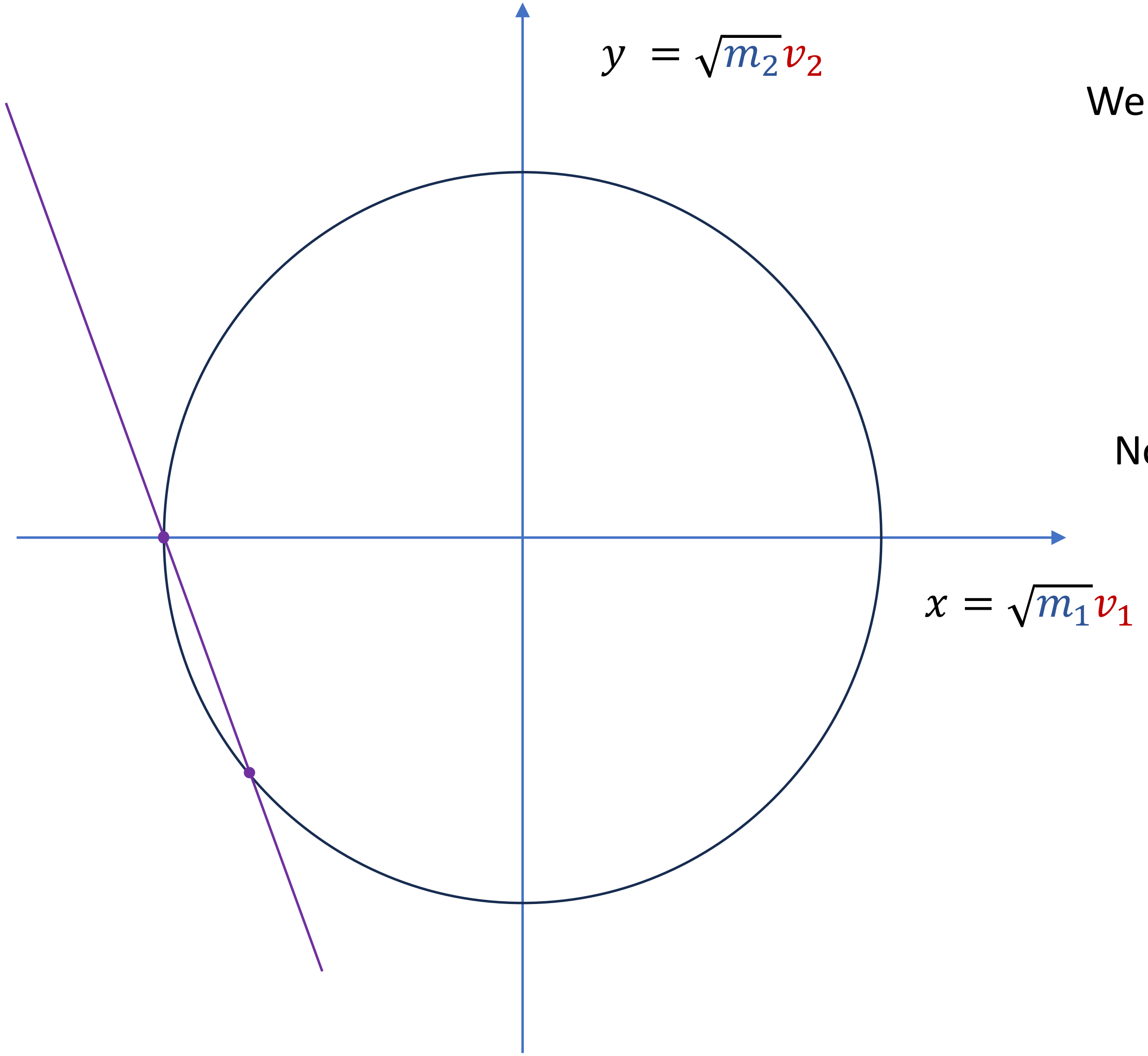
How do we get our graph looking like a circle?$(x^2 + y^2 = C)$

$$\frac{1}{2}m_1(v_1)^2 + \frac{1}{2}m_2(v_2)^2 = C_1$$

$$\frac{1}{2}(\sqrt{m_1}v_1)^2 + \frac{1}{2}(\sqrt{m_2}v_2)^2 = C_1$$

$$x = \sqrt{m_1}v_1,\ y = \sqrt{m_2}v_2$$





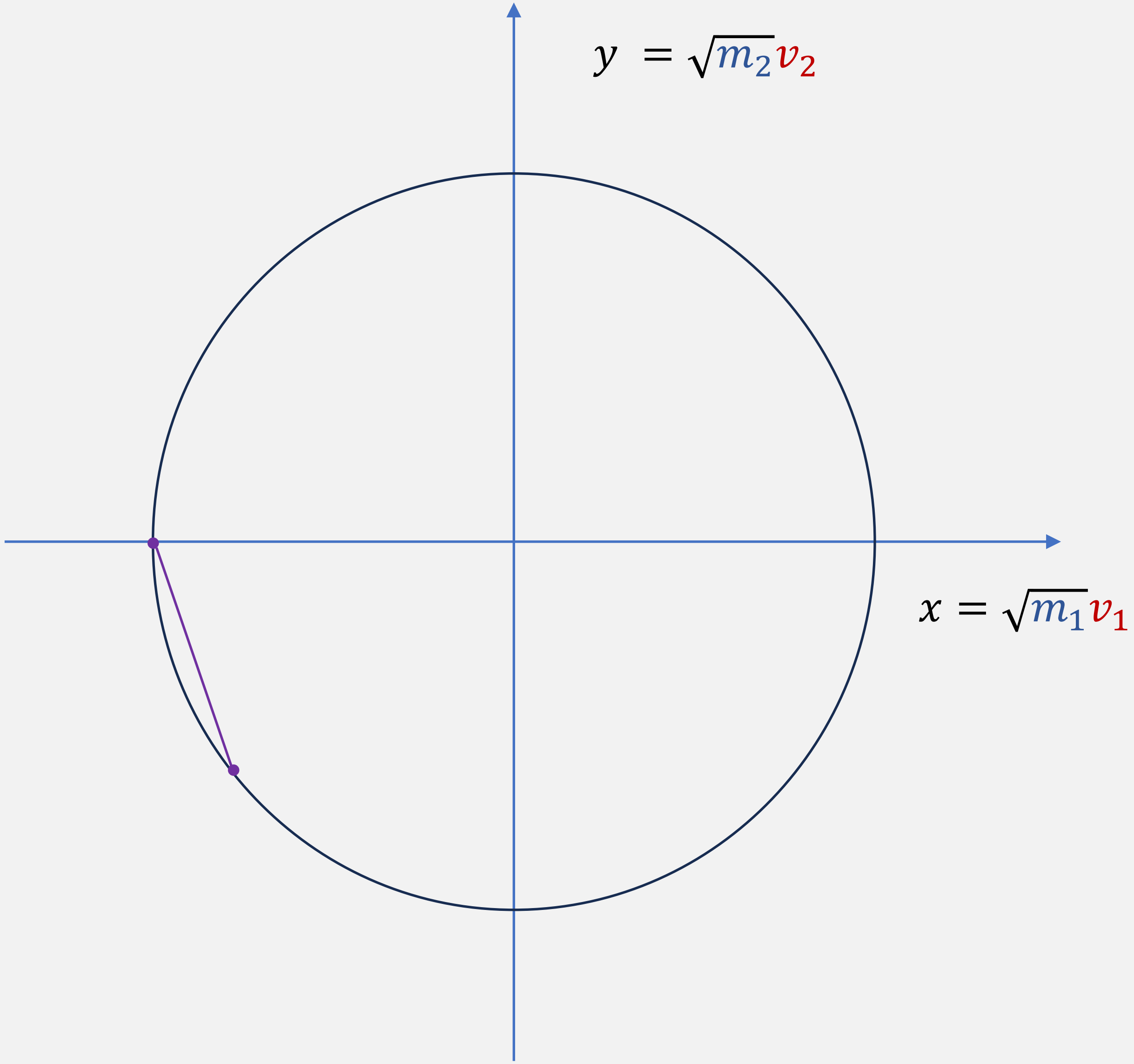
We can plug our x and y into our equation and get the following.

$$\sqrt{m_1}x + \sqrt{m_2}y = C_2$$

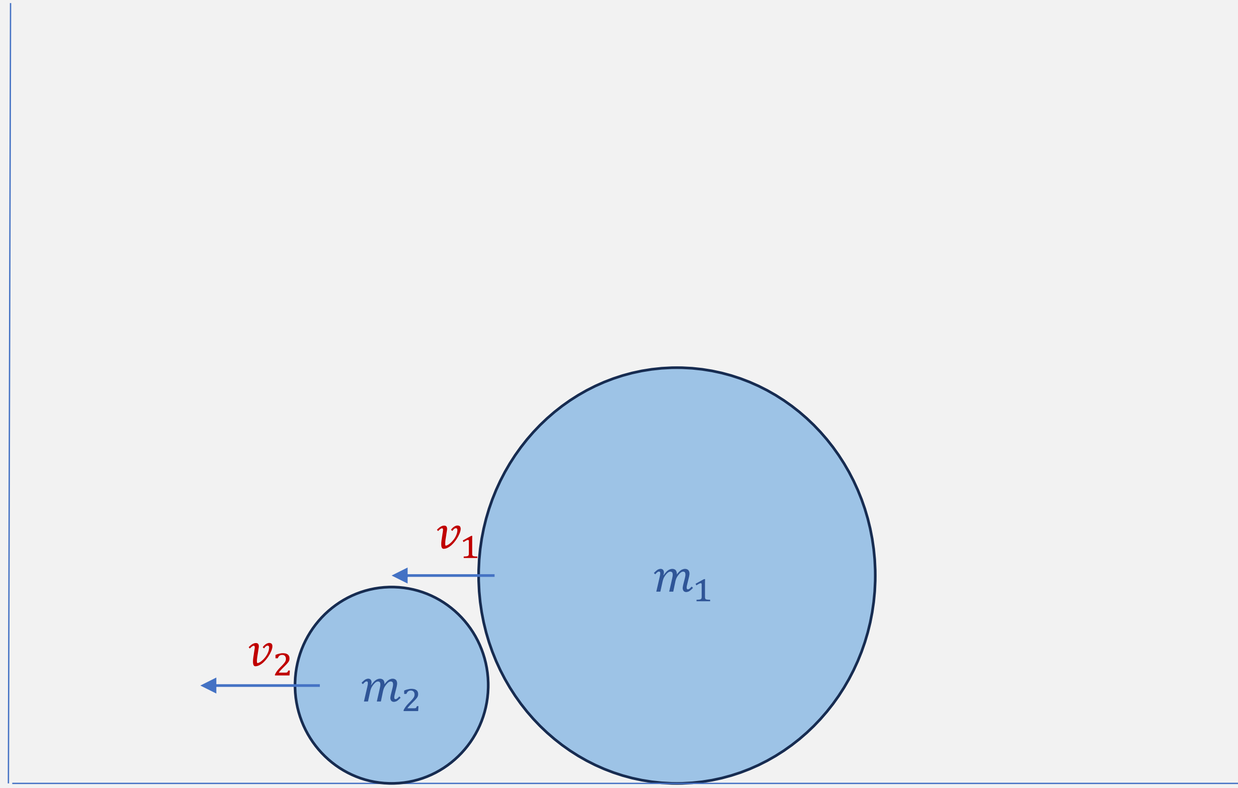
Now we can put it into point slope form in order to find slope,

$$y = -\frac{\sqrt{m_1}}{\sqrt{m_2}}x + C_2$$

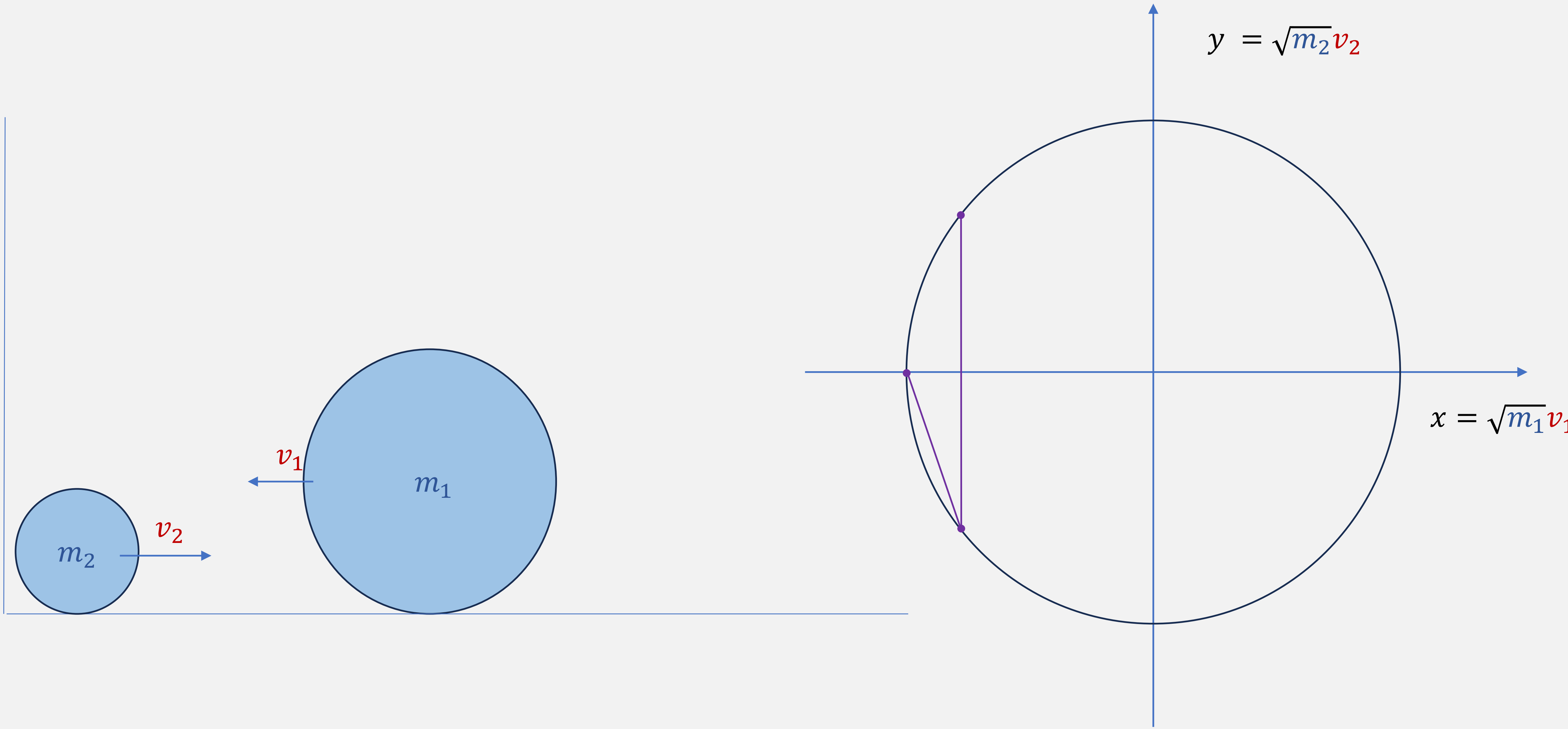
$$slope = -\frac{\sqrt{m_1}}{\sqrt{m_2}}$$



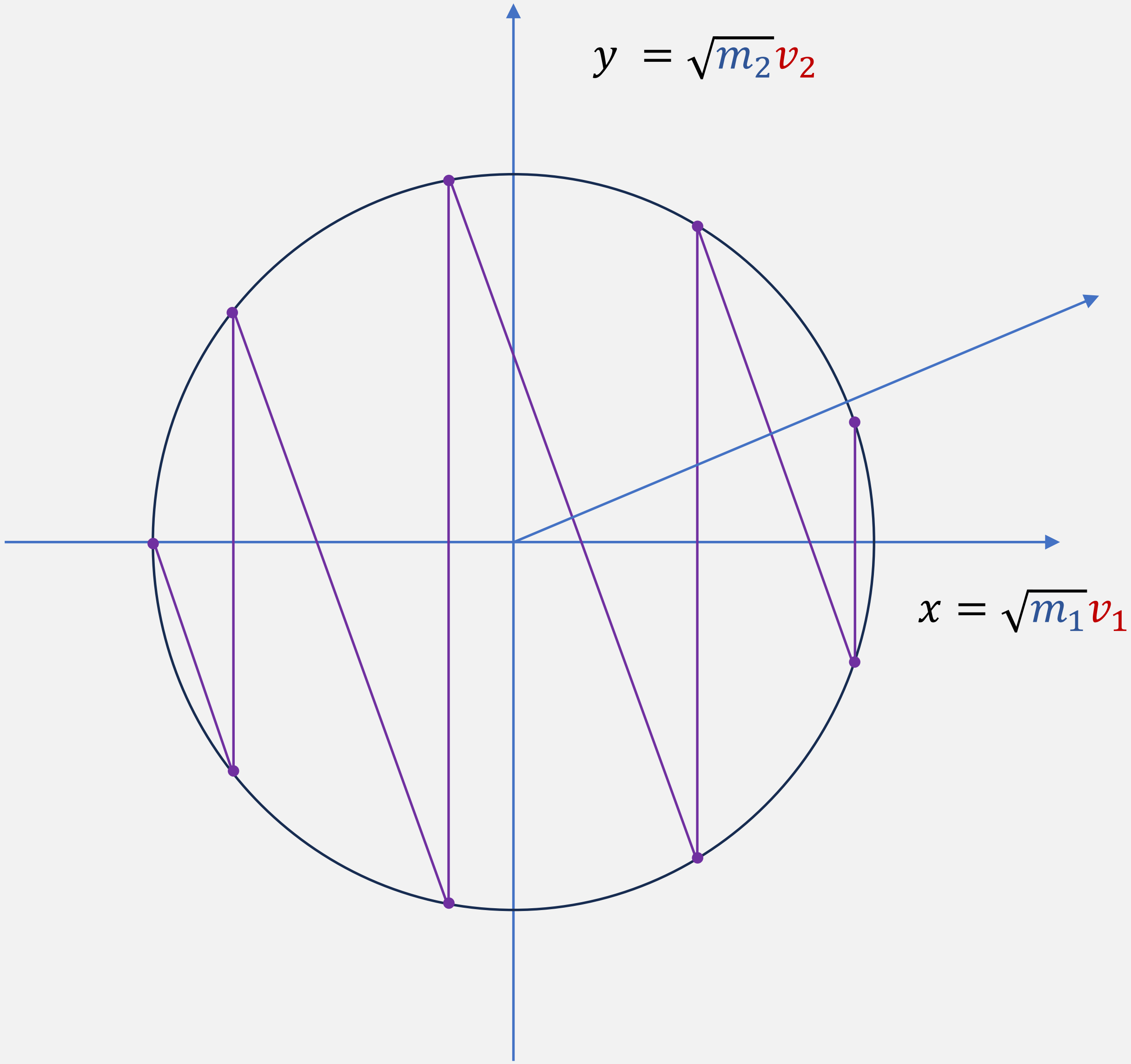
$y = \sqrt{m_2} v_2$
$x = \sqrt{m_1} v_1$



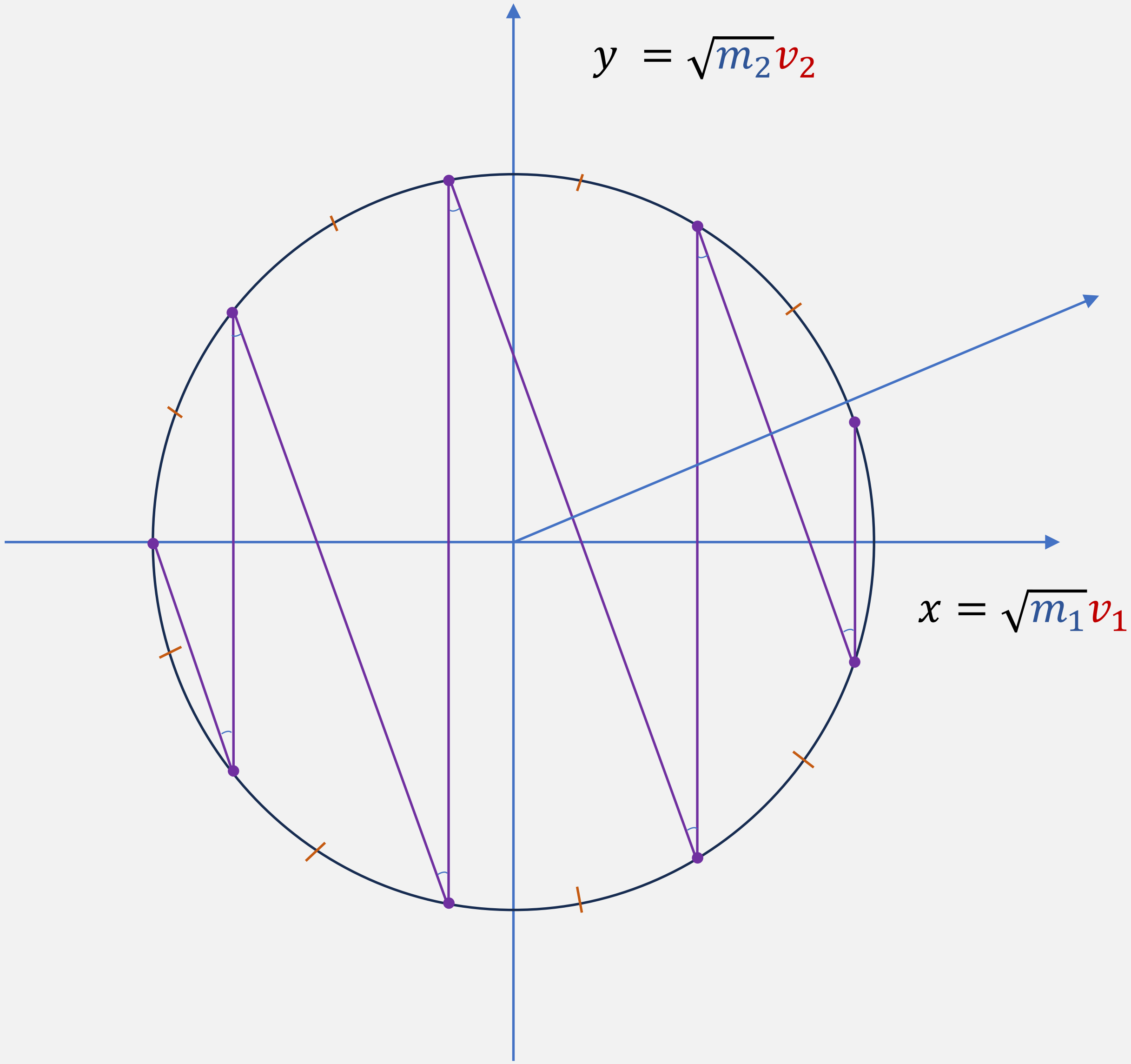
v_1
m_1
v_2
m_2



m_2
v_2
v_1
m_1
$y = \sqrt{m_2}v_2$
$x = \sqrt{m_1}v_1$

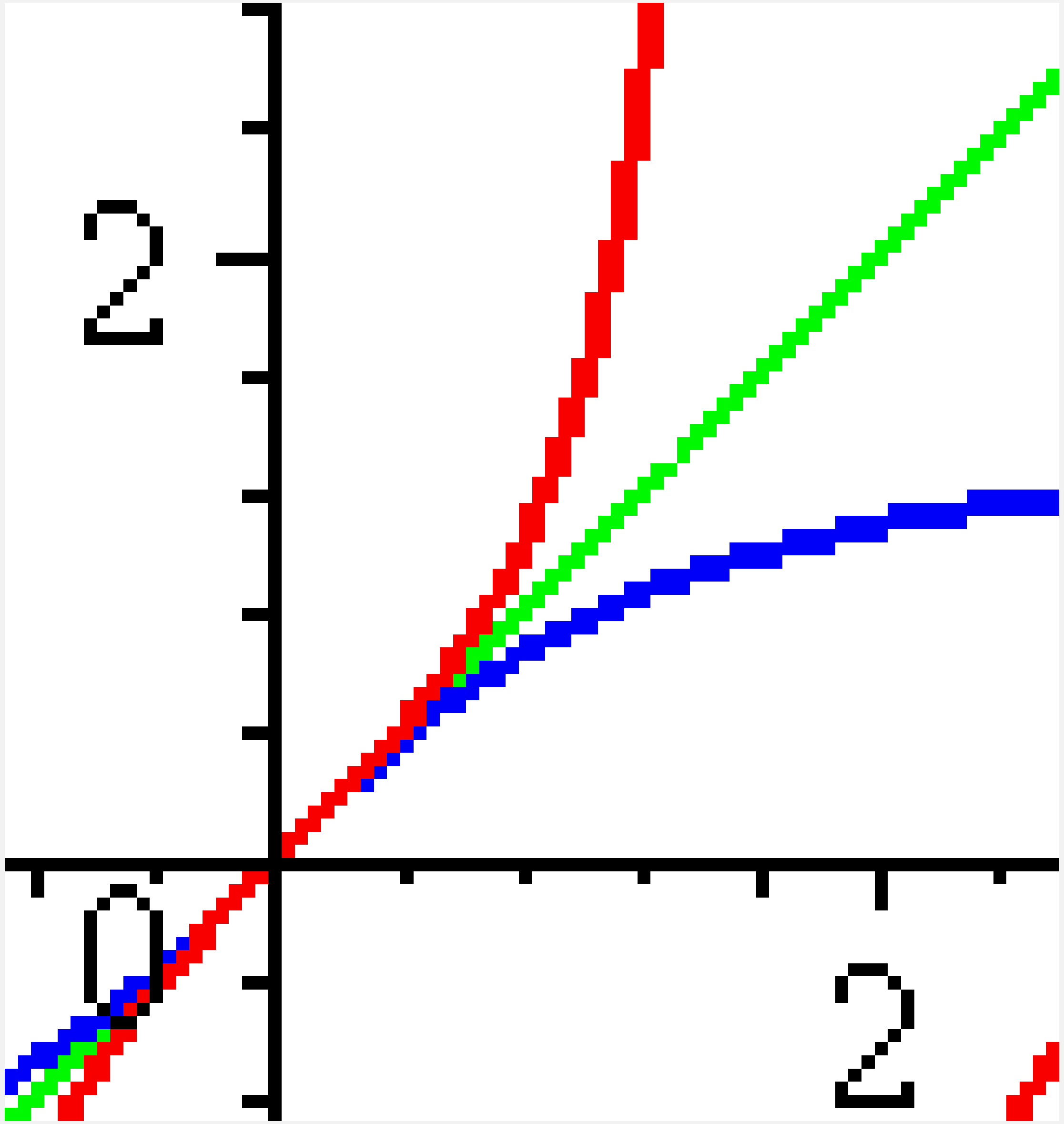


What can we say about these arcs?



We now know that n is the greatest possible integer such that $2\theta \cdot n \leq 2\pi$ where n is the number of collisions that occur. We can divide by 2 and get the inequality:

$$n \cdot 2\theta \leq 2\pi$$



2
0
2