April 2, Week 11

Today: Chapter 9, Rotation

Homework #8:
Mastering Physics: 8 problems from chapter 8
Written Question: 8.101
Due today at 11:59pm

Exam #4: Friday, April 6

Review Session: Thursday, April 5, 7:30PM in Regener 114

Practice Problems for chapters 5, 6, 7, and 8 available on Mastering Physics
Practice Exam on Website.

Rotation

Rotational Motion - Spinning or rolling of rigid bodies.

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Circular Objects:

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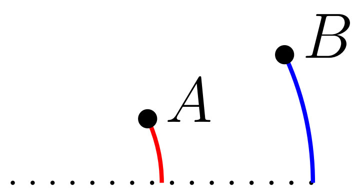
Follow two points, A and B



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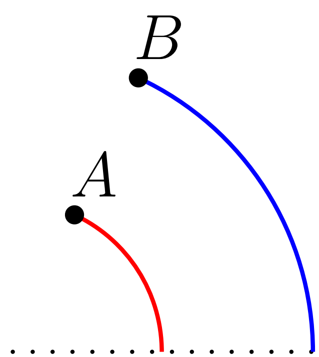

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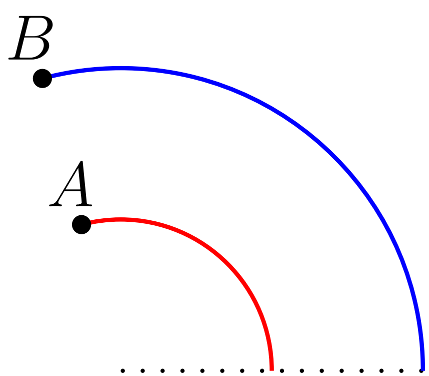

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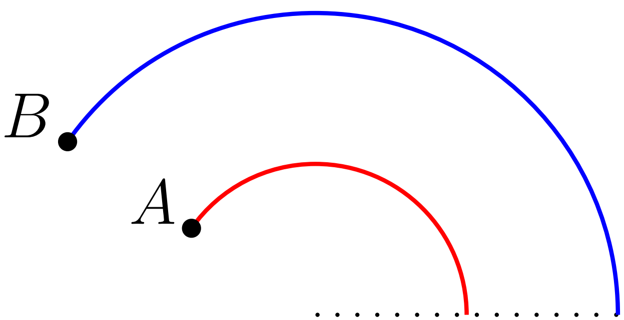

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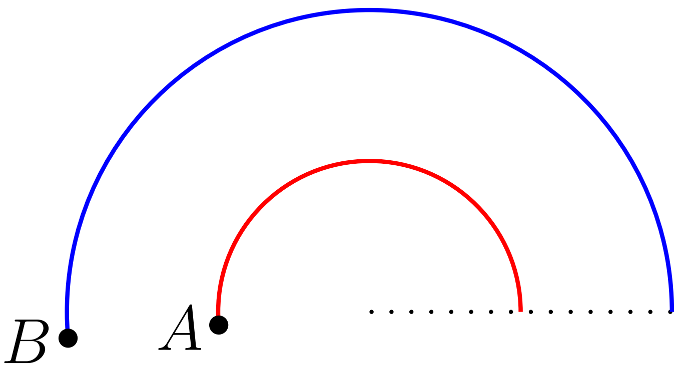

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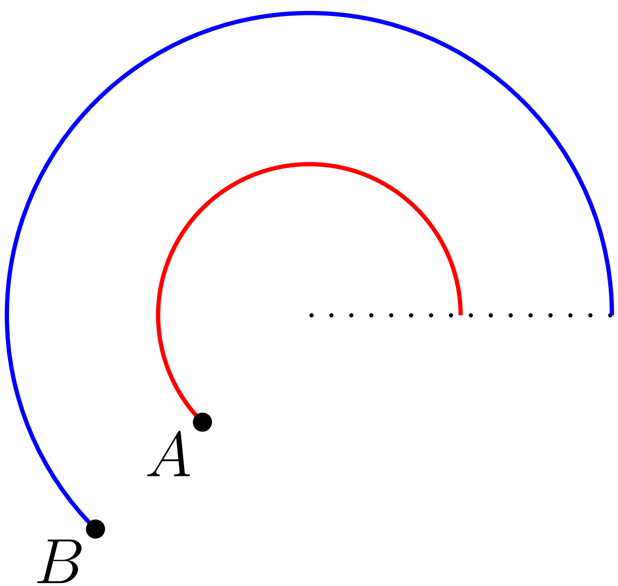

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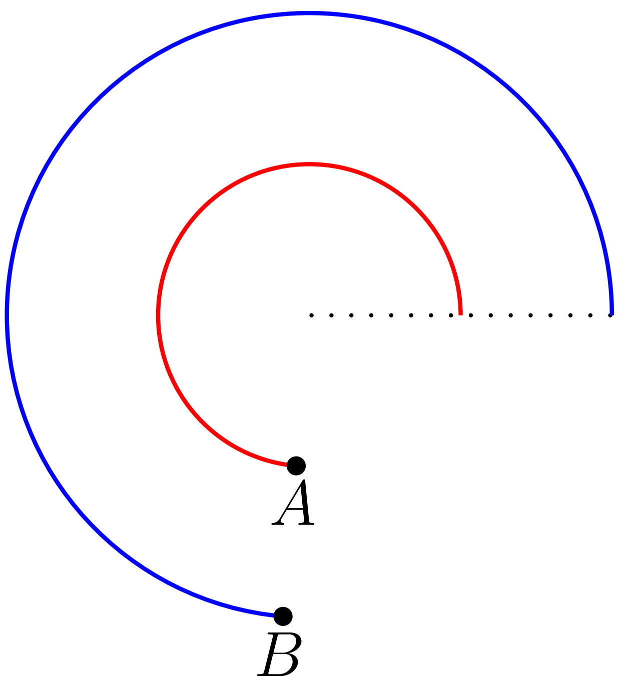

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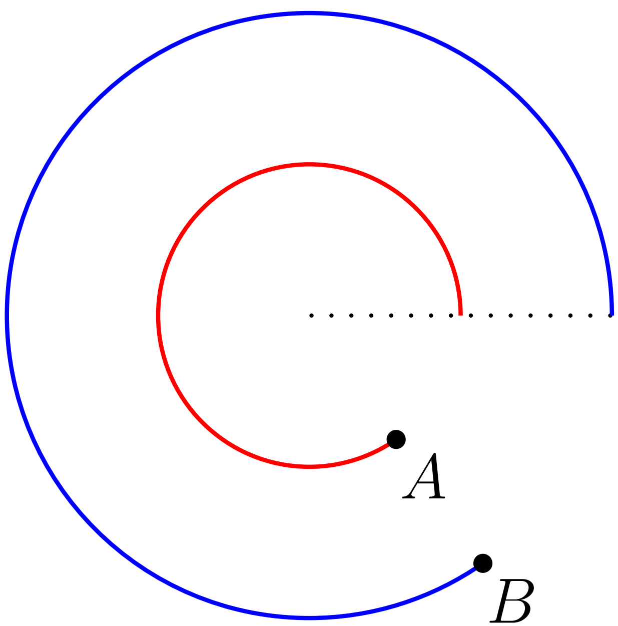

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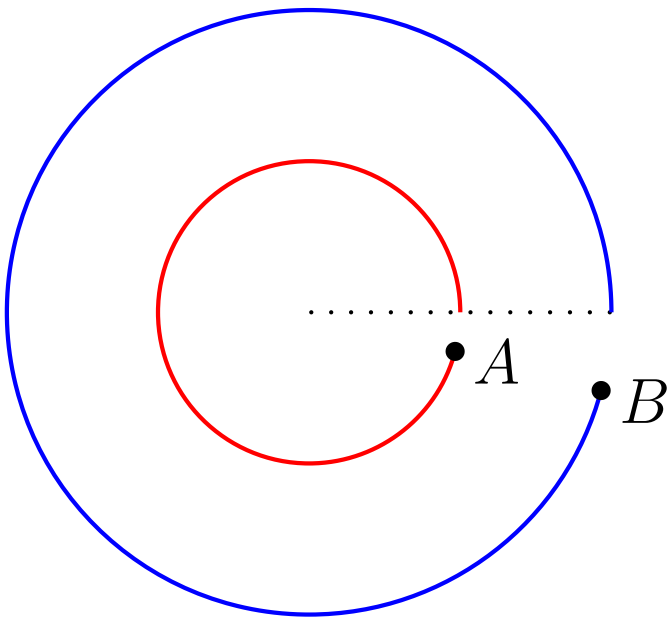

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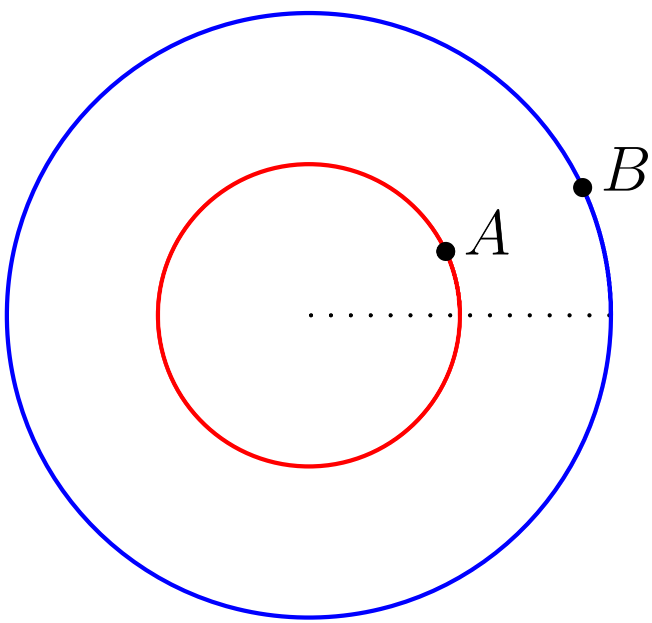

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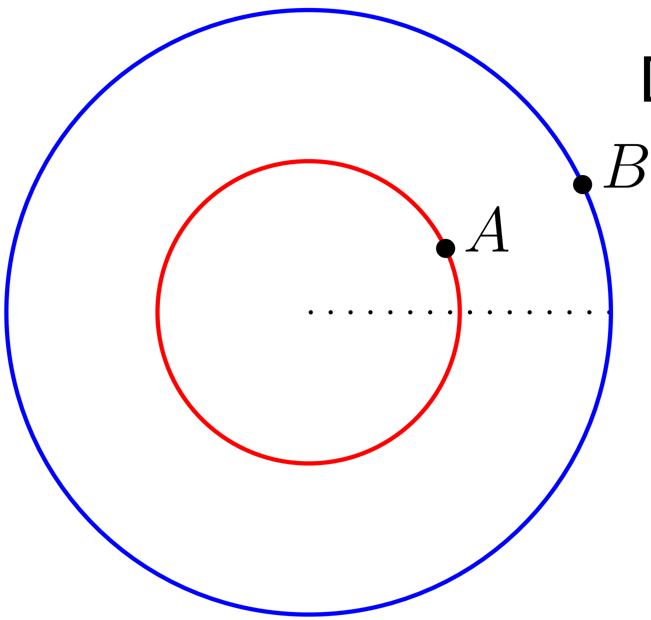

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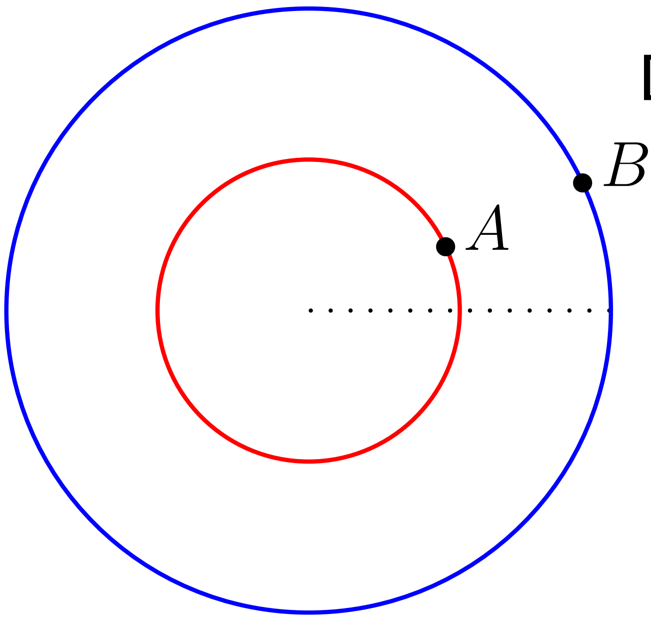

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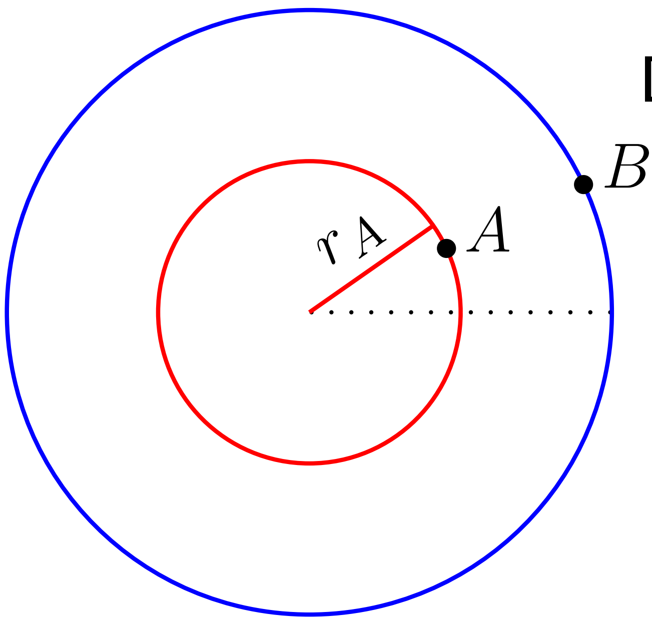

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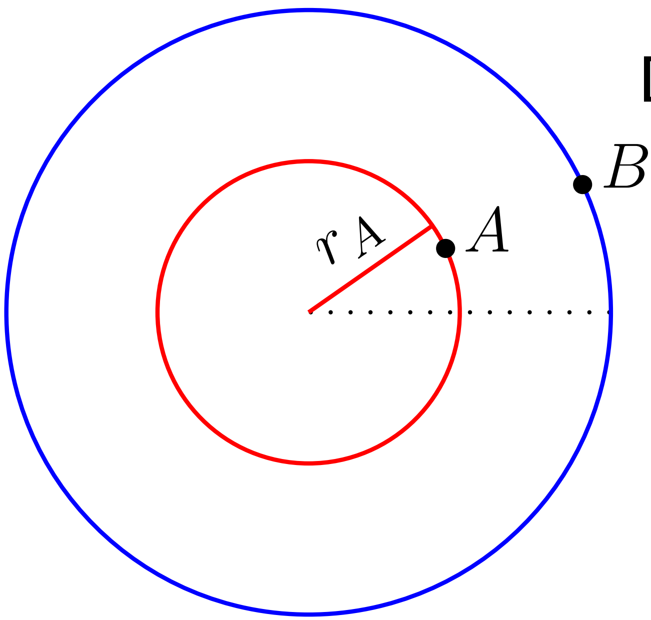

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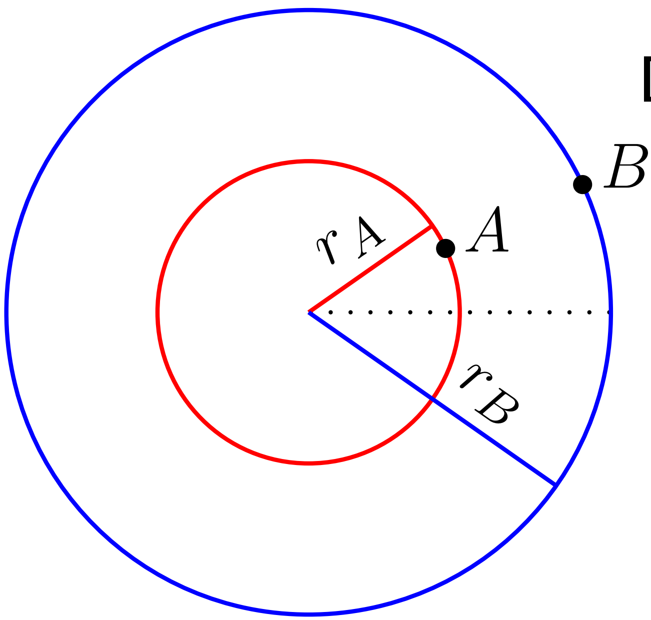

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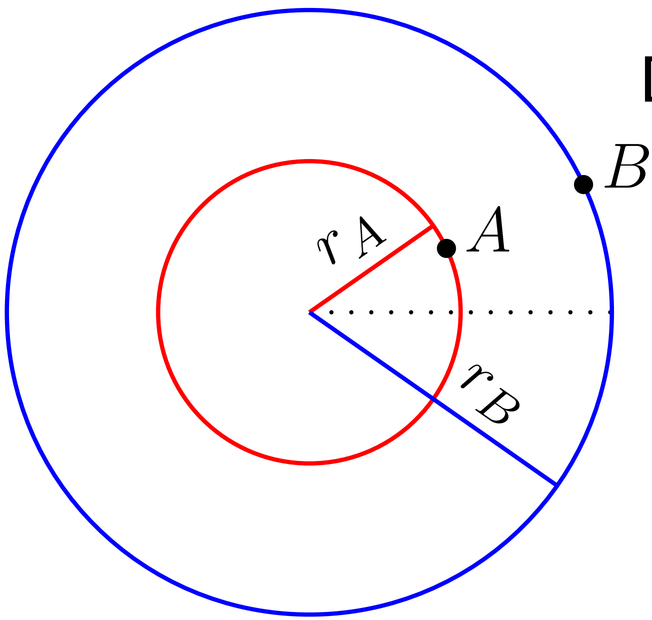

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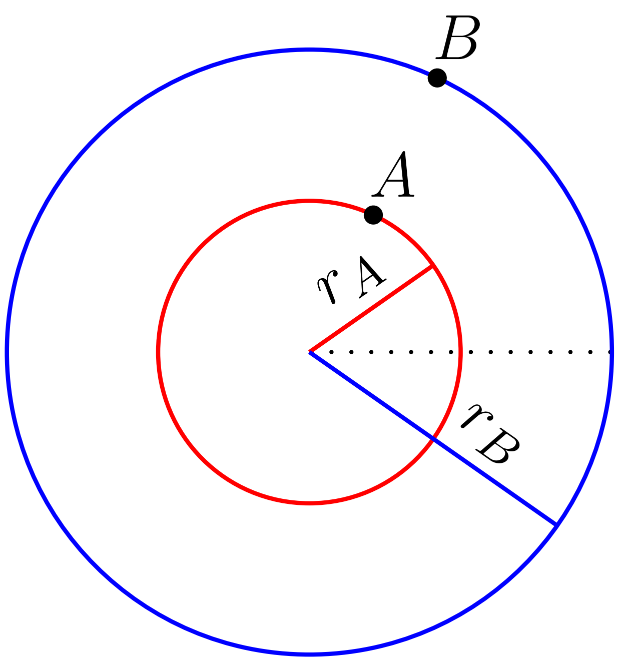

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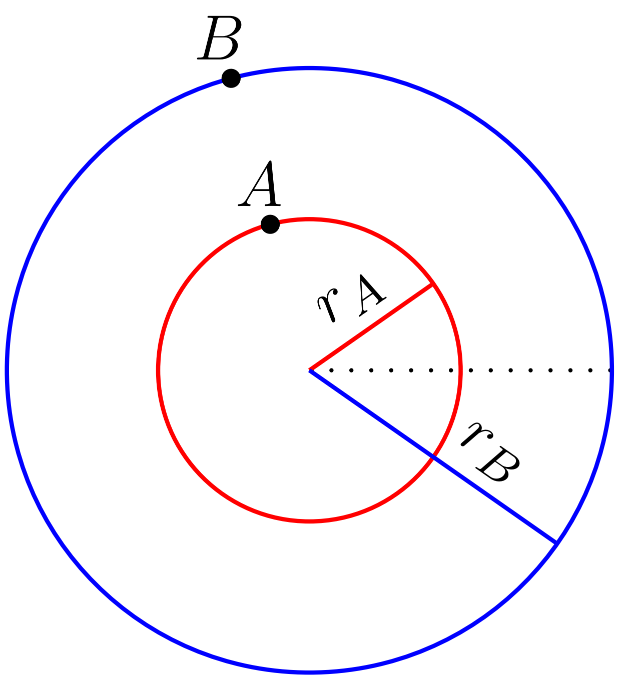

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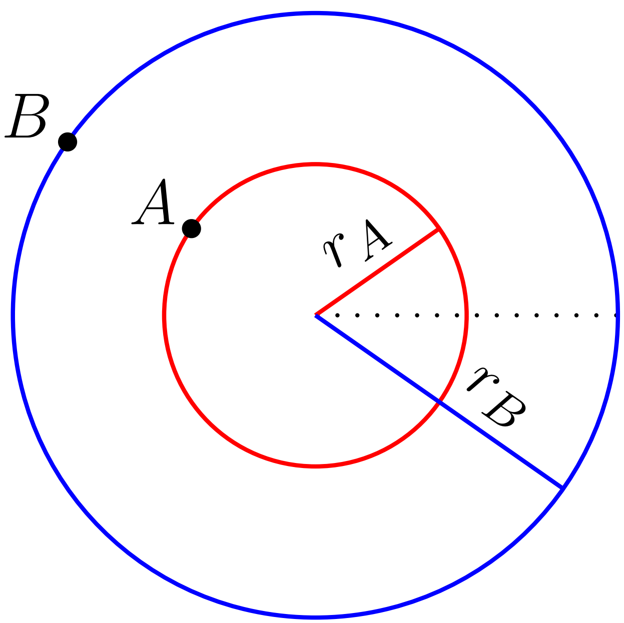

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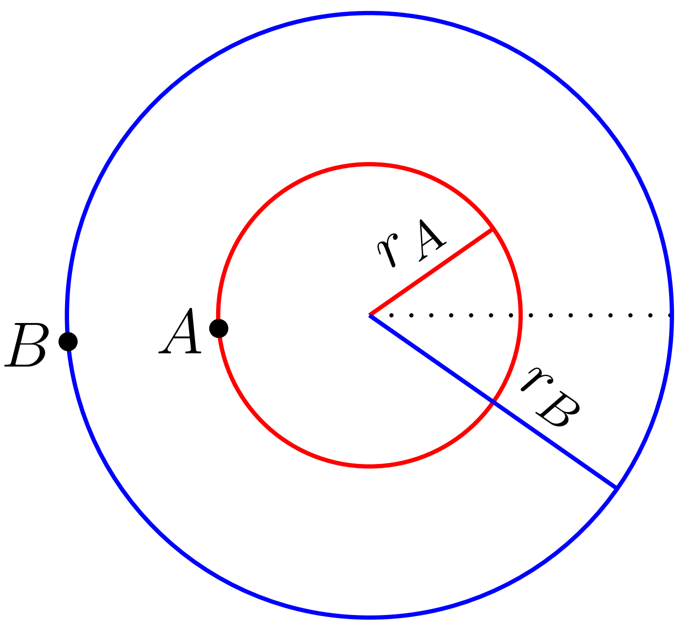

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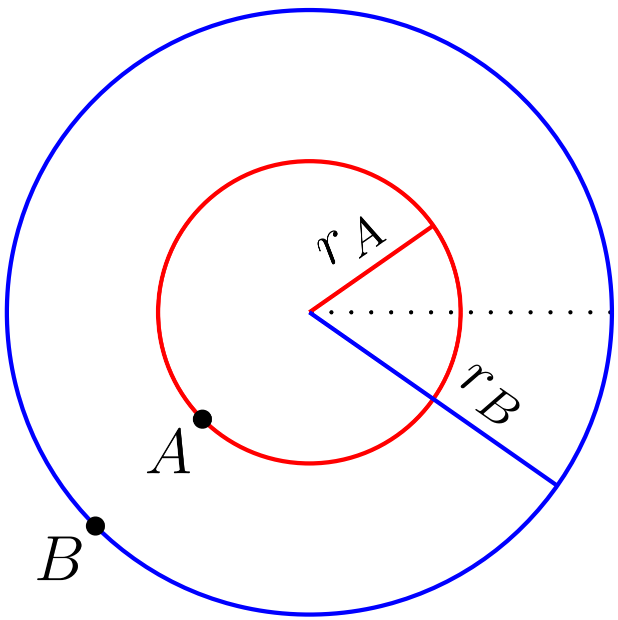

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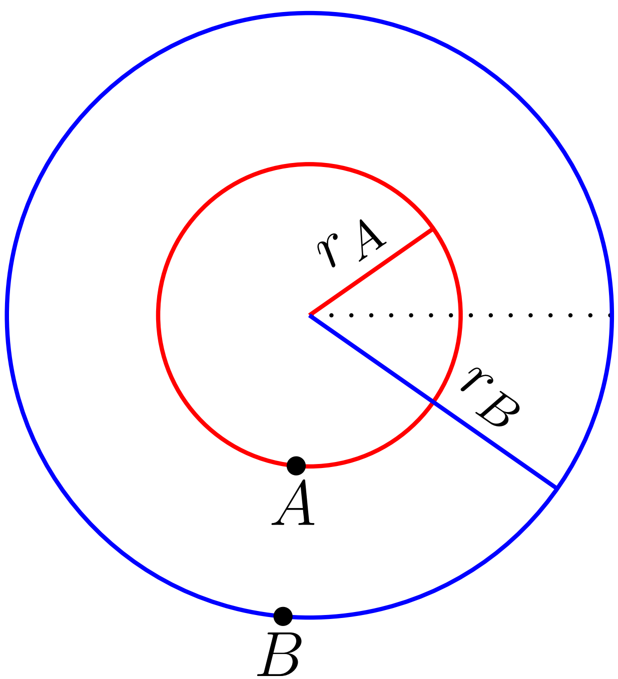

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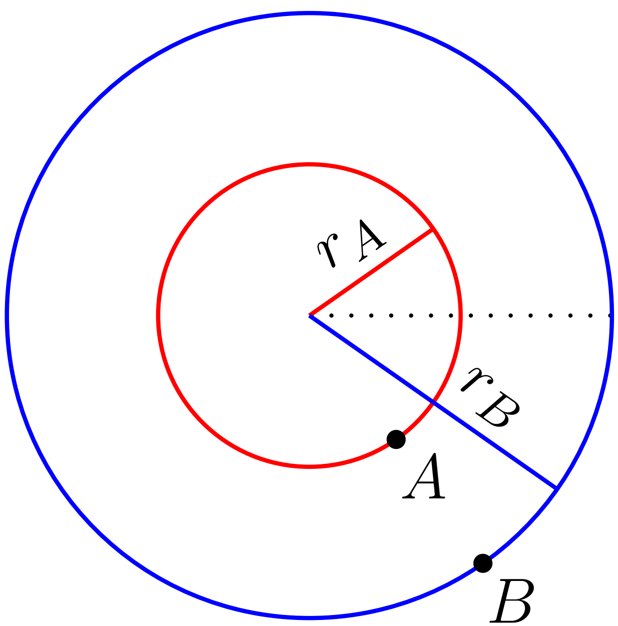

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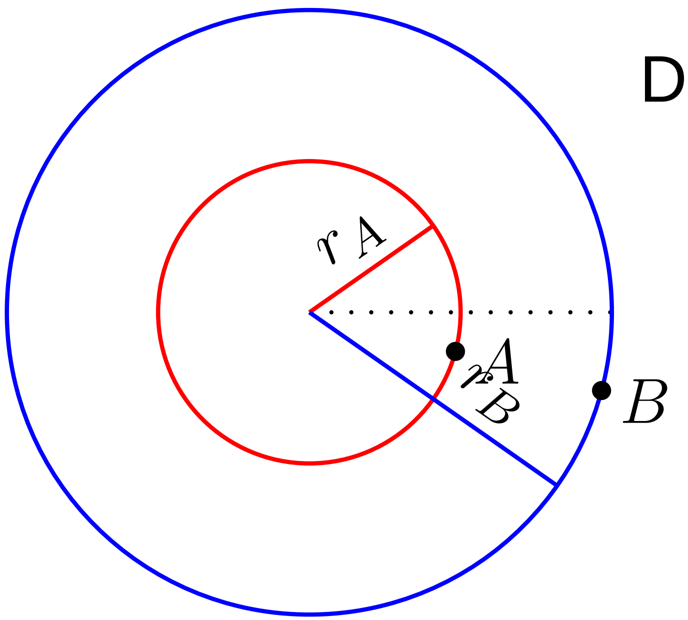

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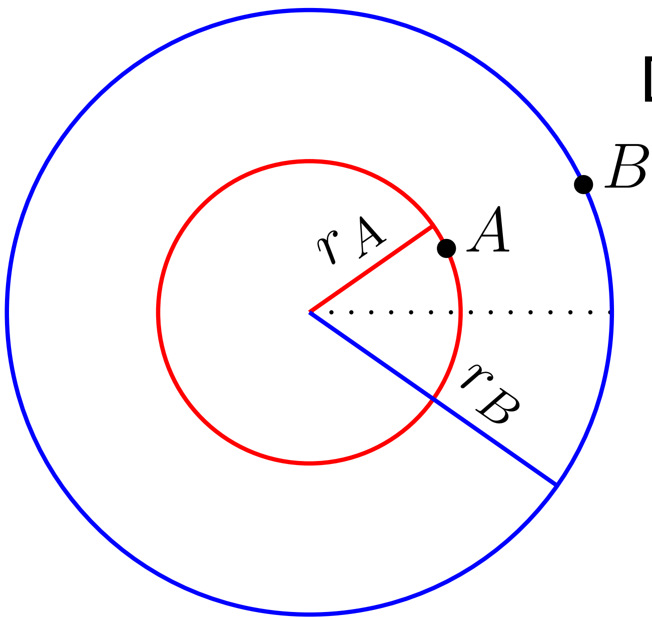

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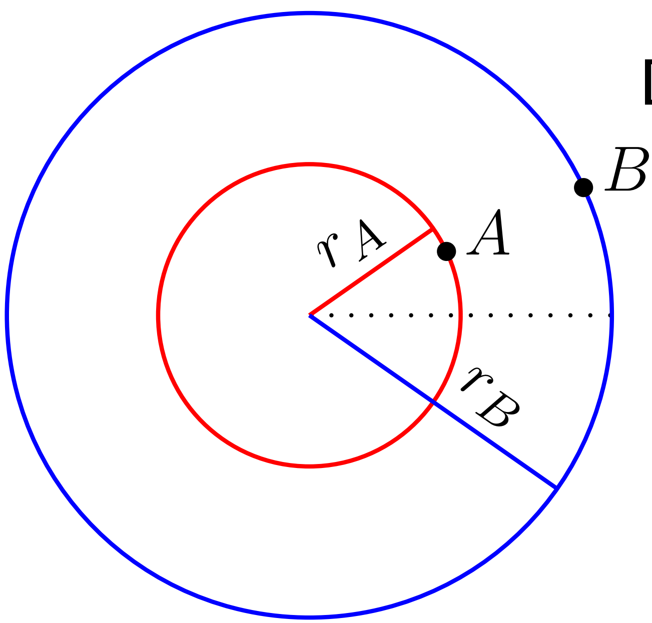

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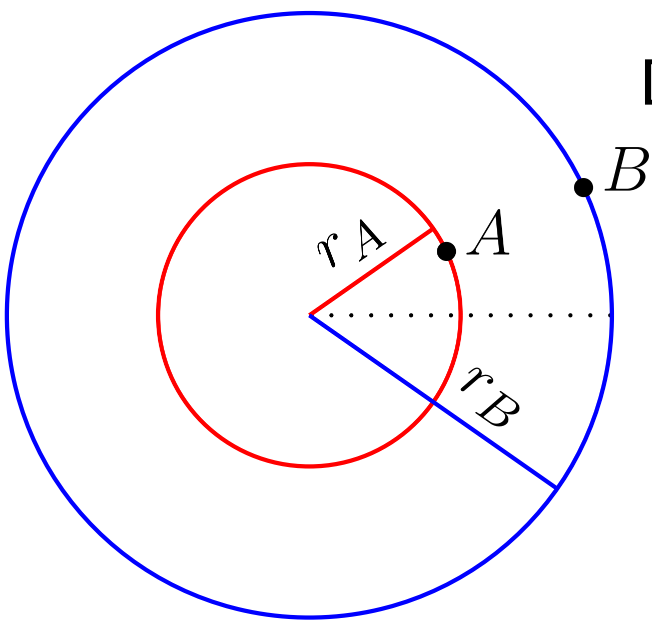

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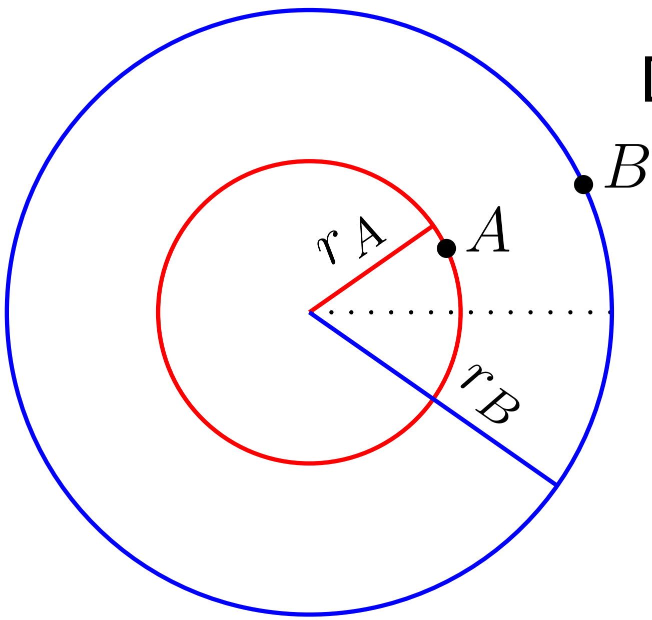

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A spinning object has infinitely many speeds

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While A and B travel different distances, they are always at the same angle.

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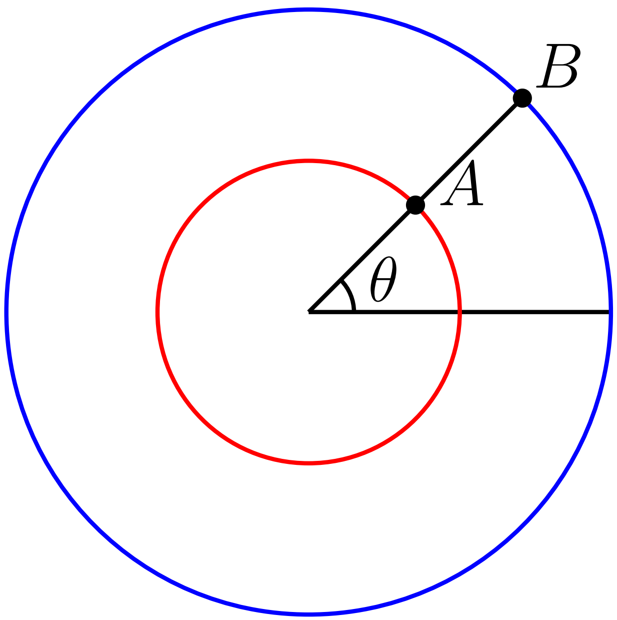

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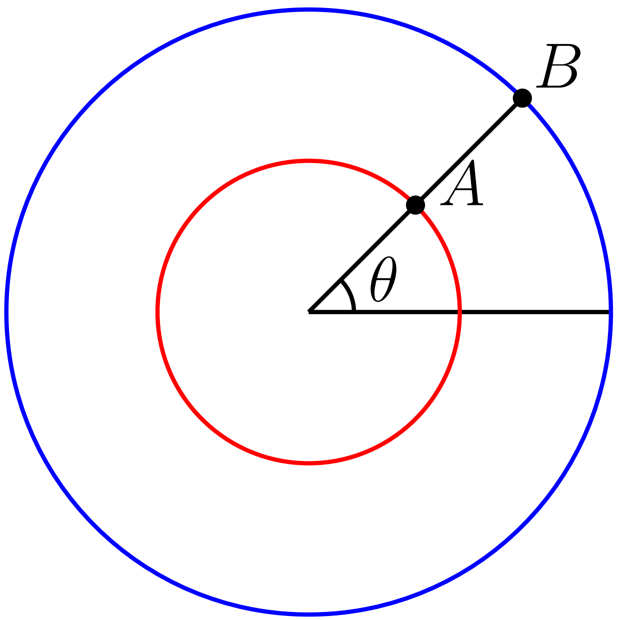

All points rotate through the same angle

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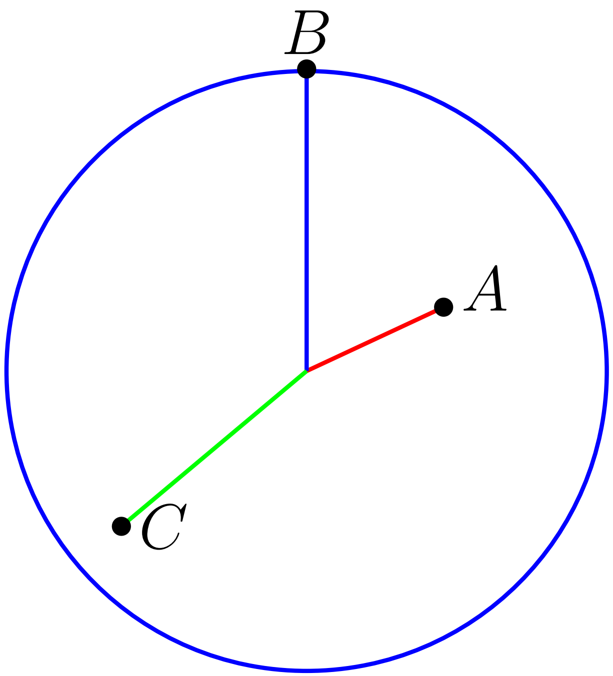

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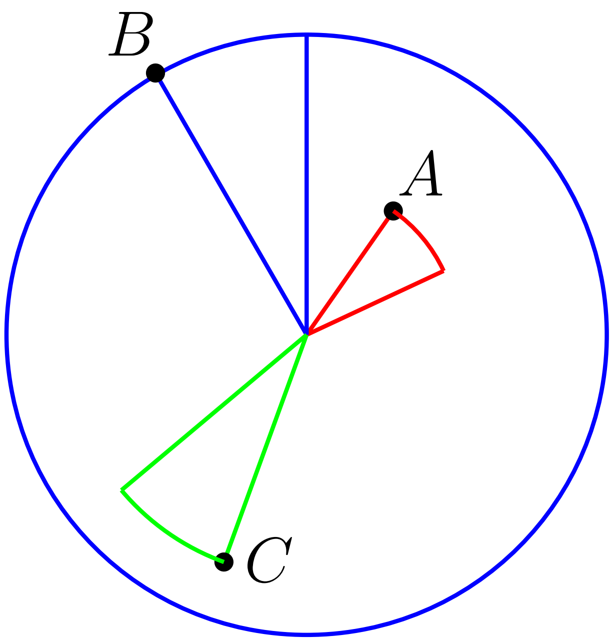

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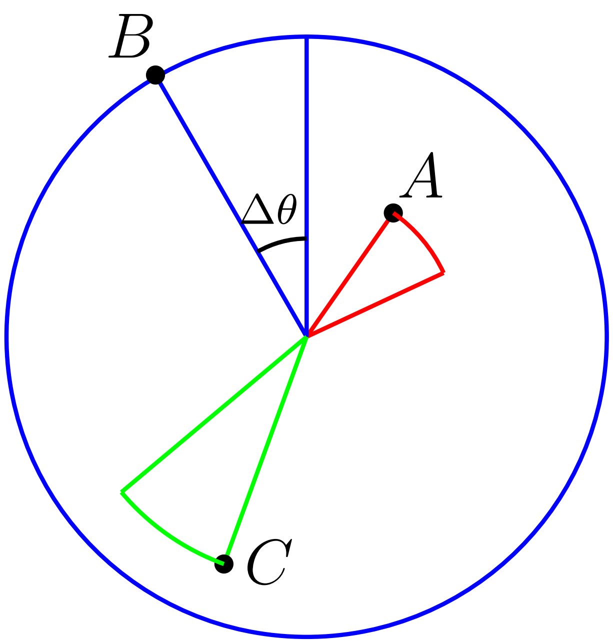

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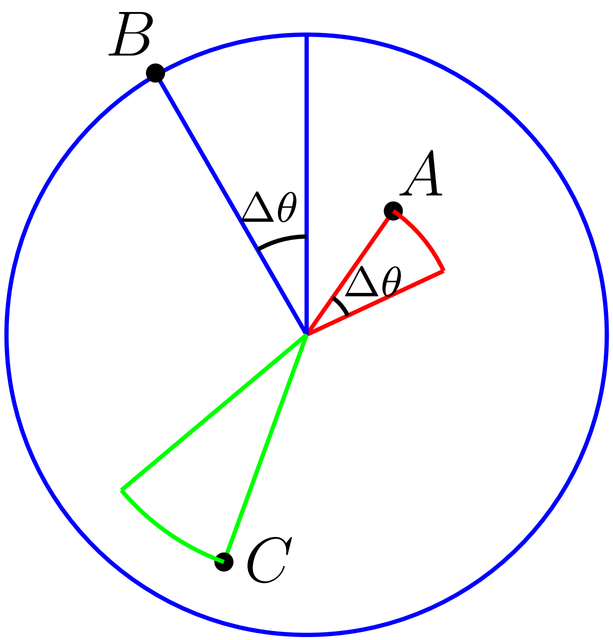

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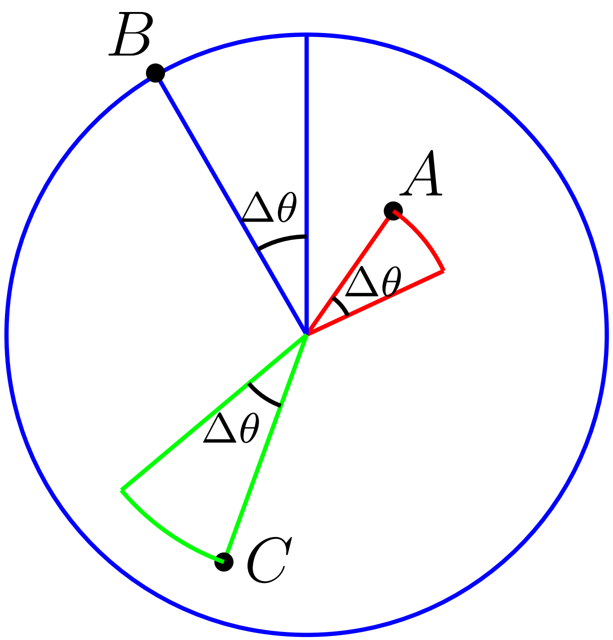

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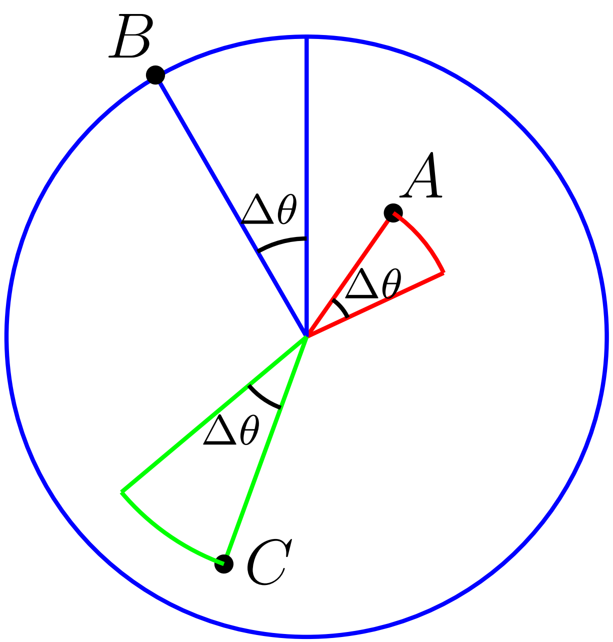

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We must distinguish

linear motion = distance/time

from angular motion = angle/time

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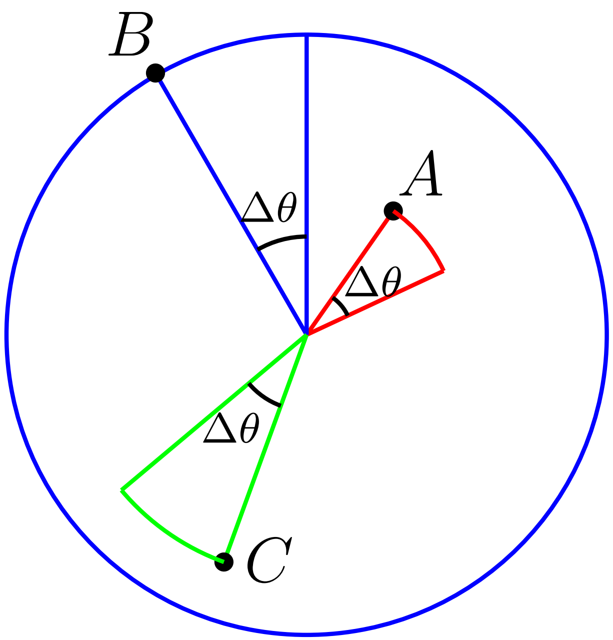

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linear motion = distance/time
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A rotating object has infinitely many linear speeds but only one angular speed

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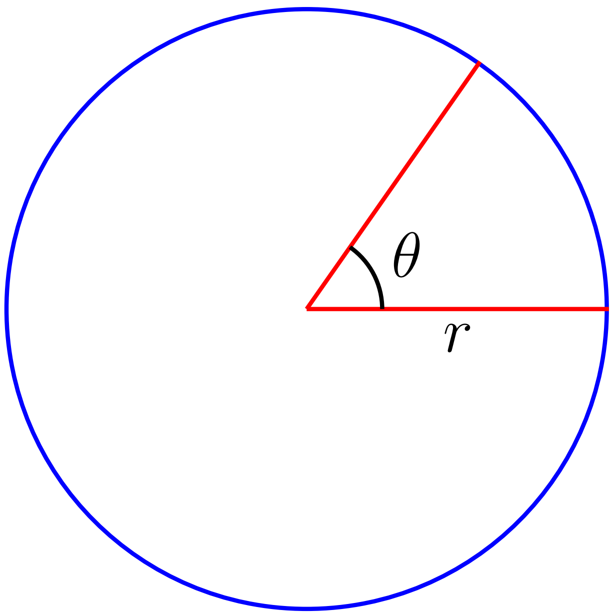

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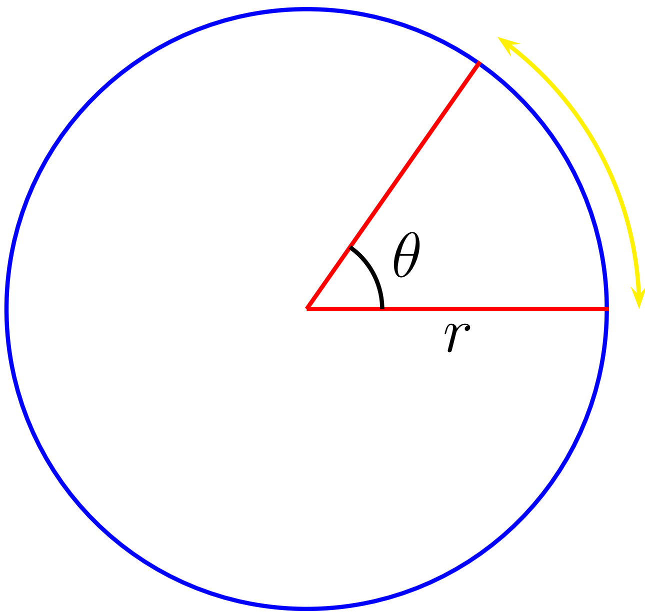

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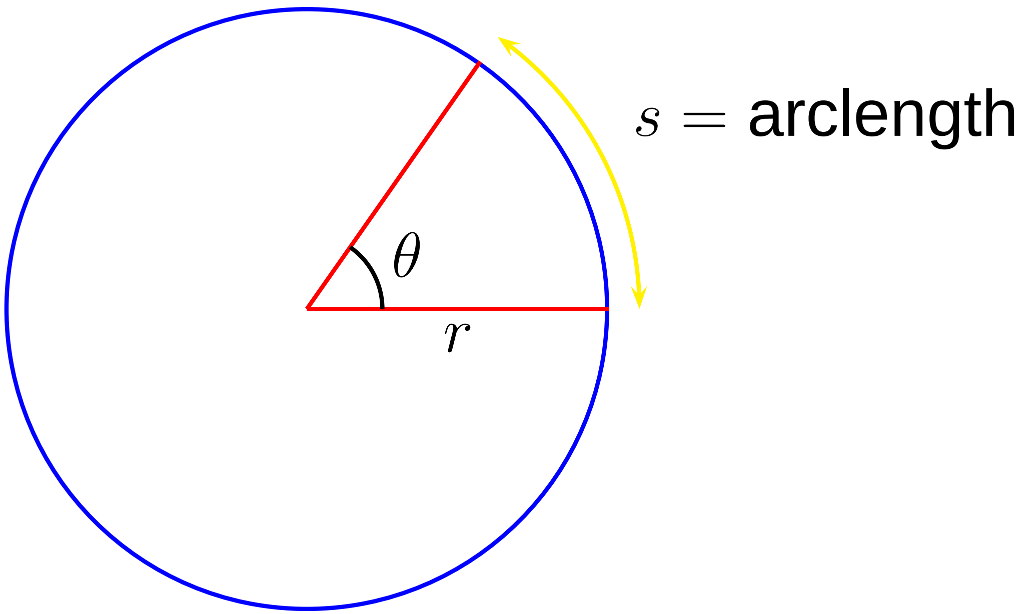

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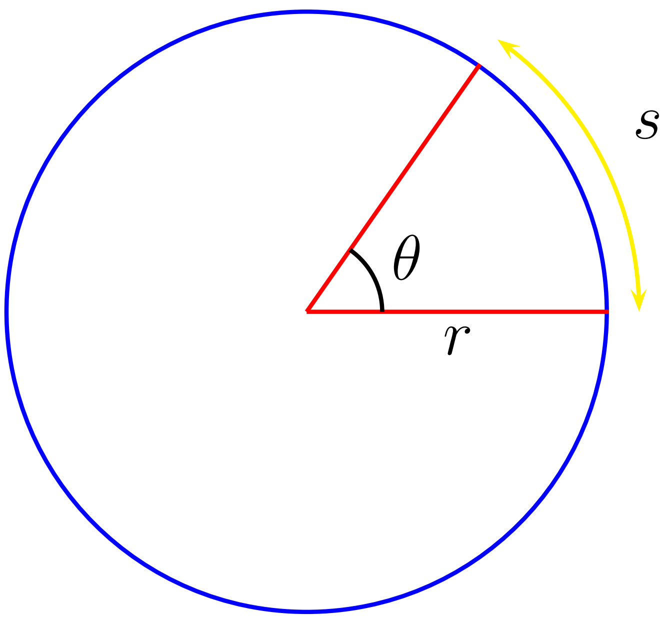

$s =$ arclength

When θ is in radians, $\boxed{s = r\theta}$

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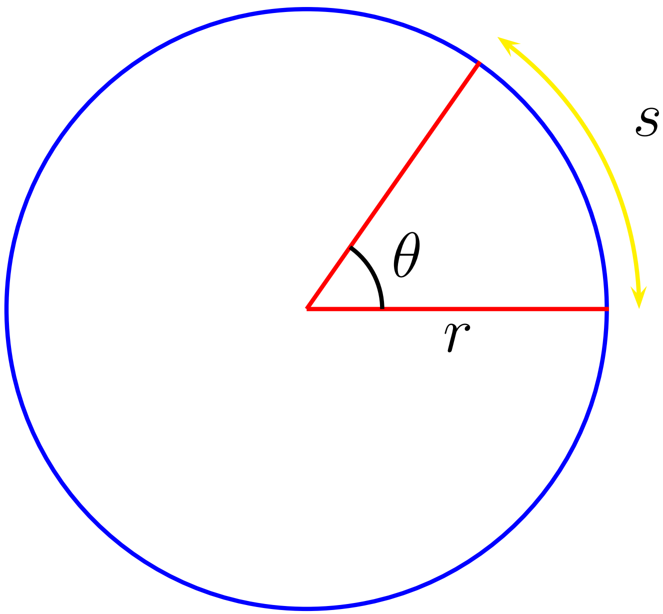

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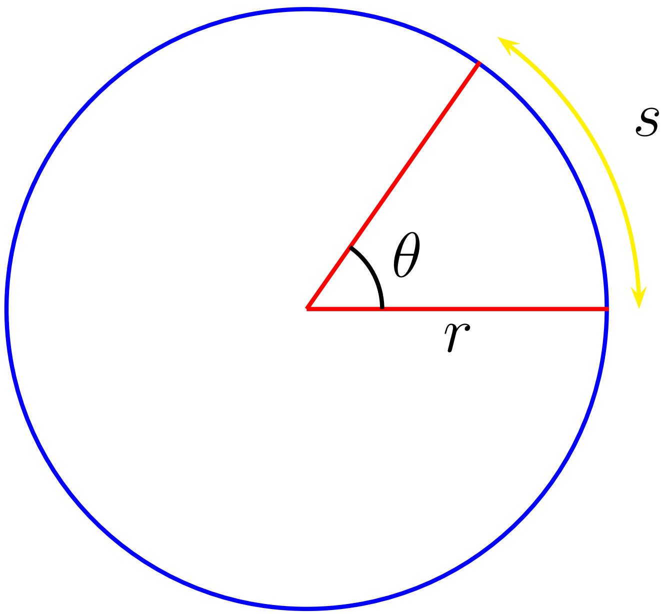

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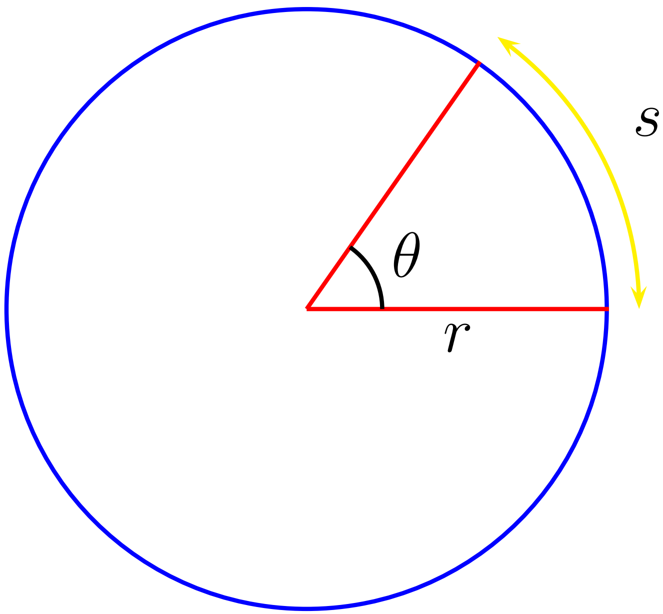

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"rad" is a way specify an angular quantity

Angular Velocity

The rate at which an objects spins is given by its angular speed, ω.

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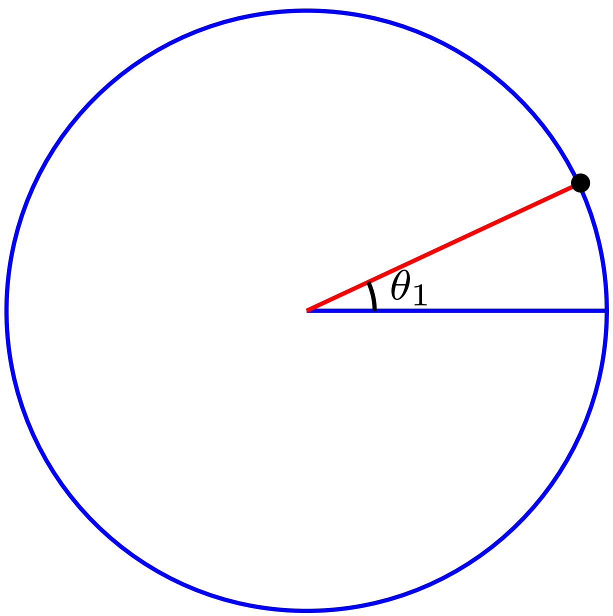

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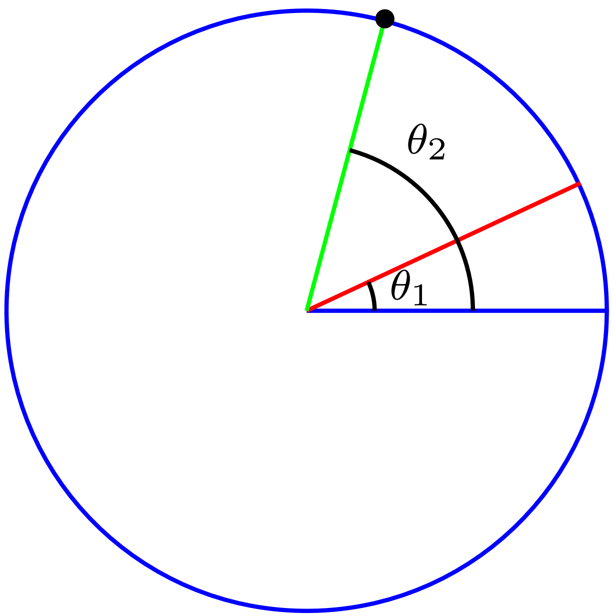

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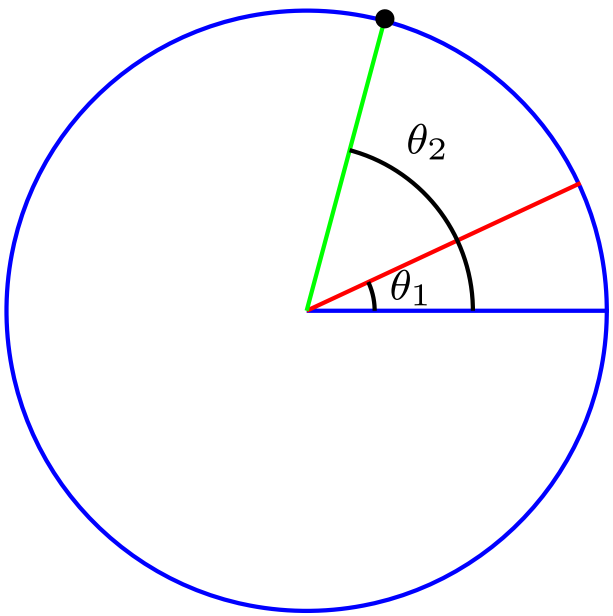

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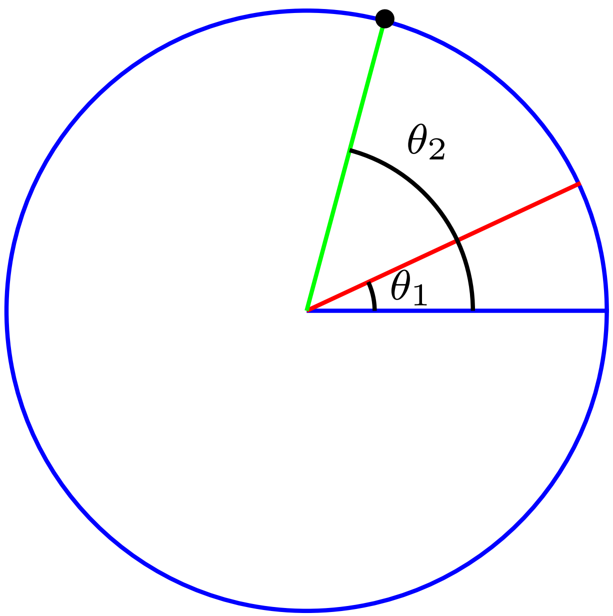

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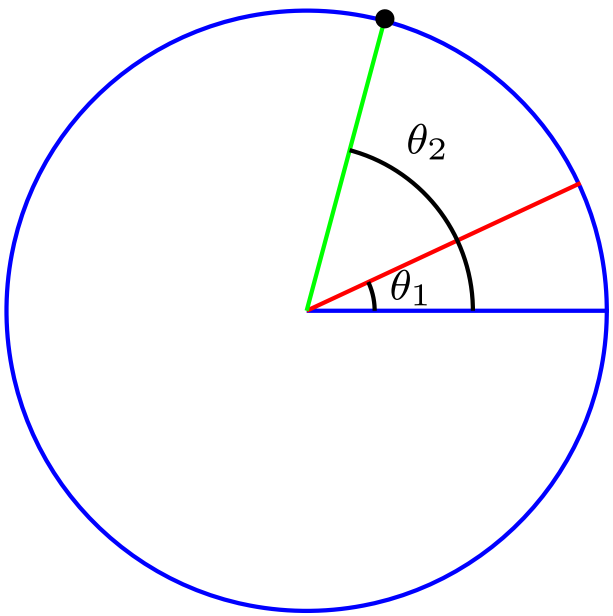

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$$\omega = \lim_{\Delta t \to 0} \frac{\Delta\theta}{\Delta t} = \frac{d\theta}{dt}$$

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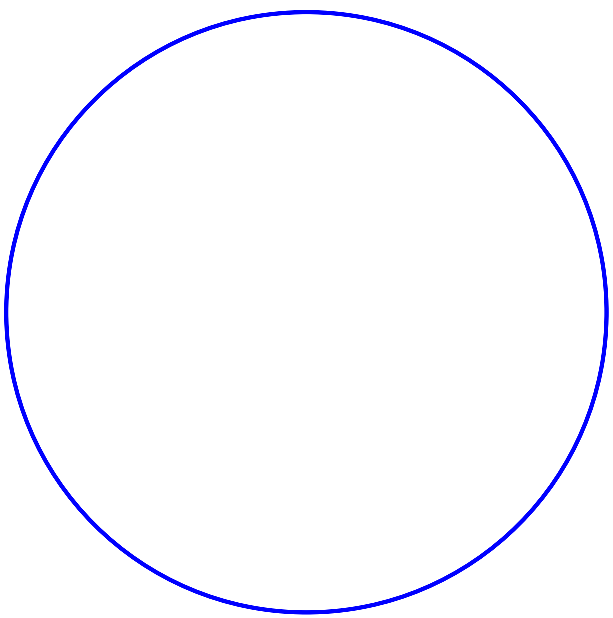

Perpendicular to motion
$\Rightarrow 90^\circ$ to all $\vec{\mathbf{v}}$

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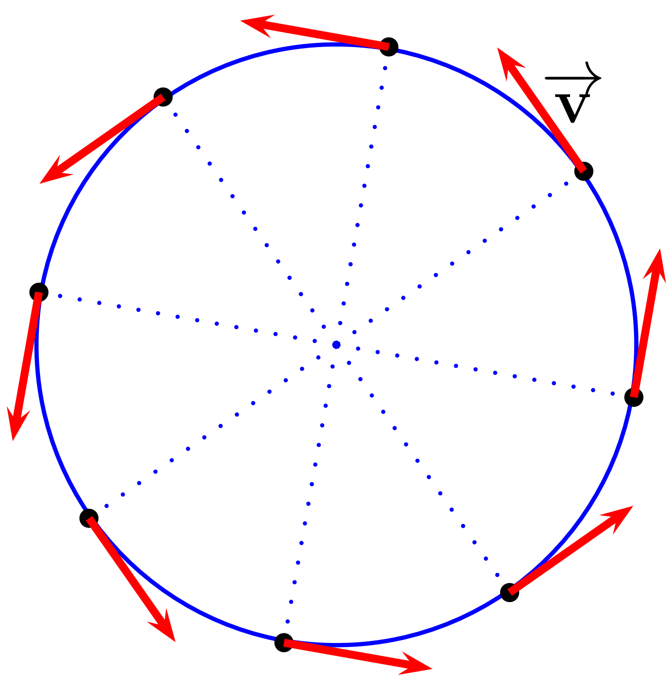

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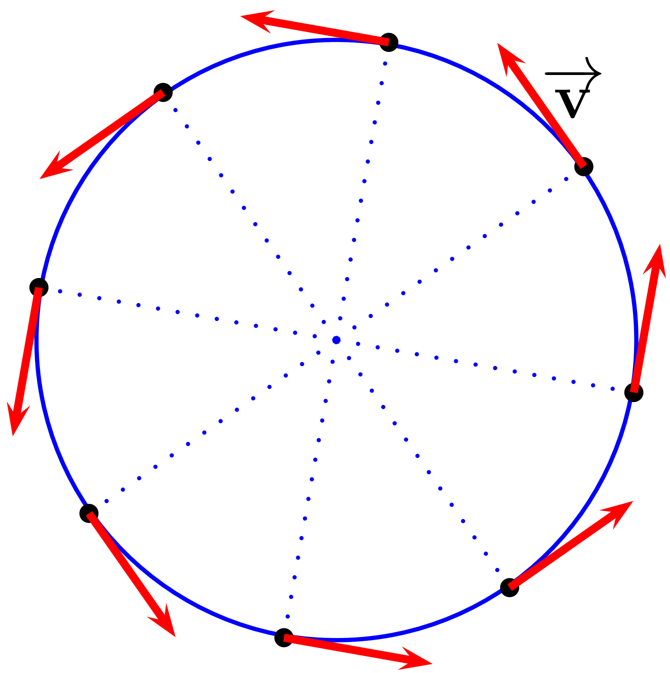

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The rotational axis is along the z-axis, *i.e.*, into and out of the page

Rotational Axis II

Any rotation has an axis.

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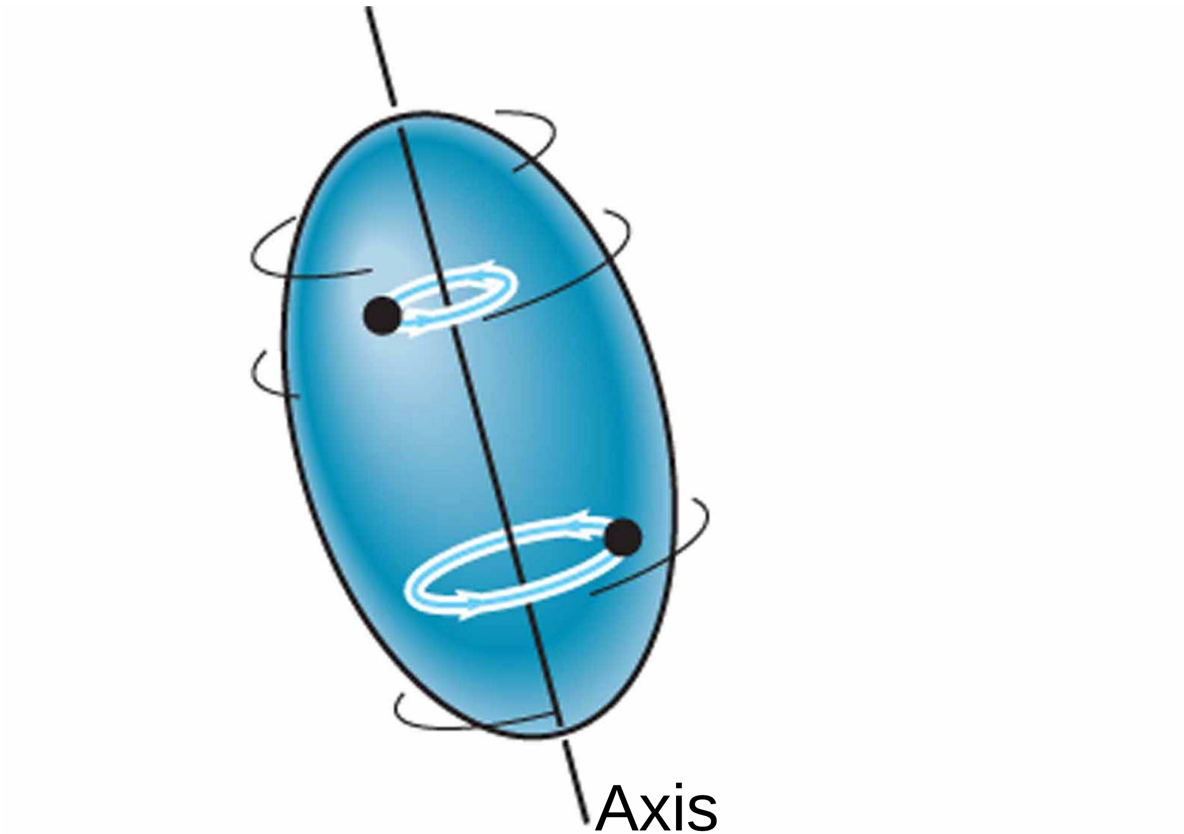

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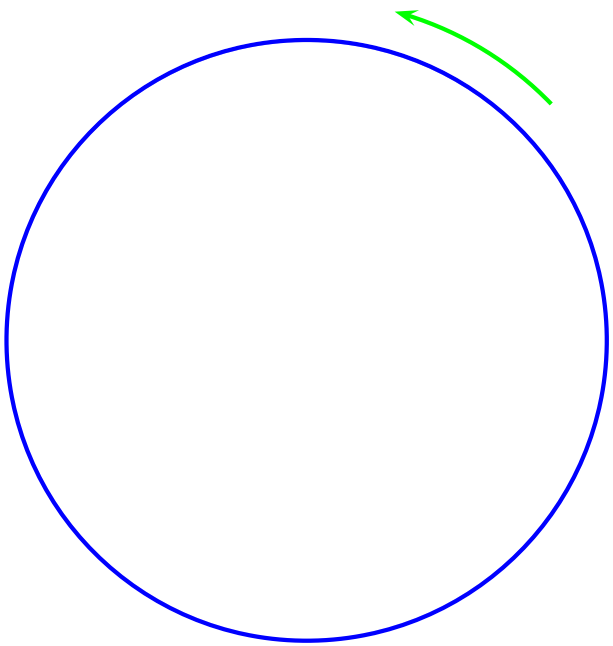

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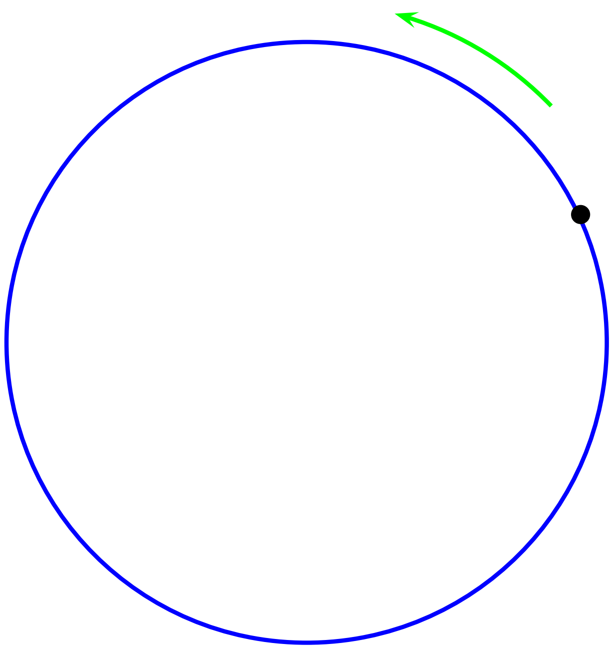

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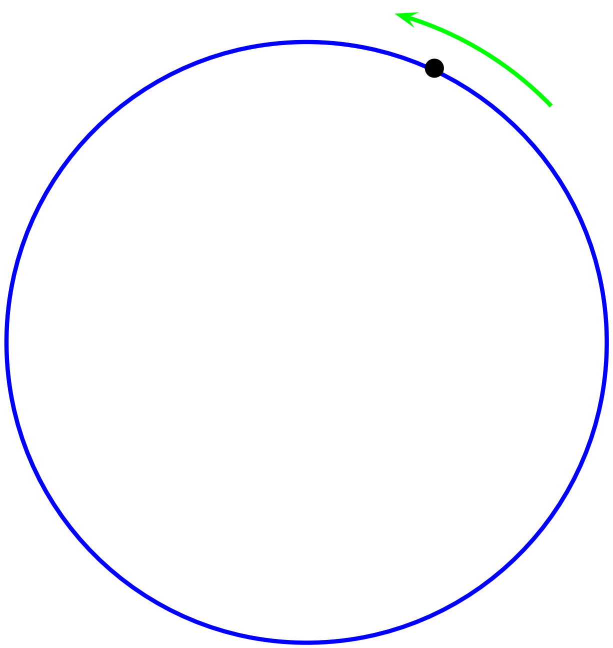

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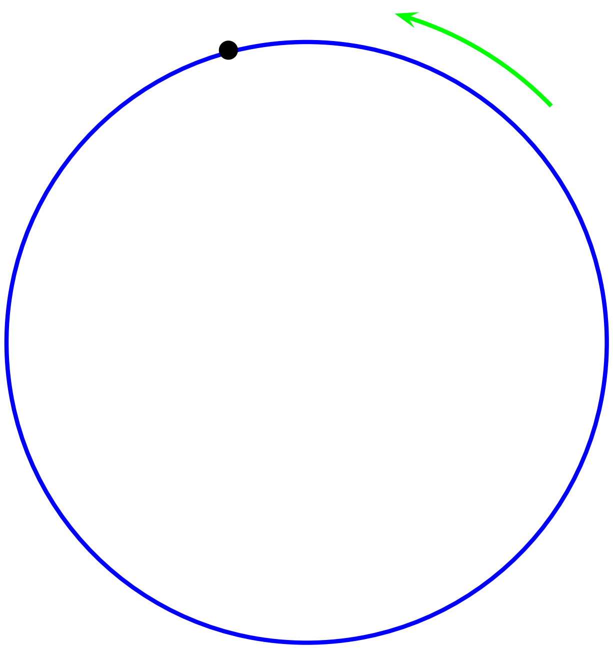

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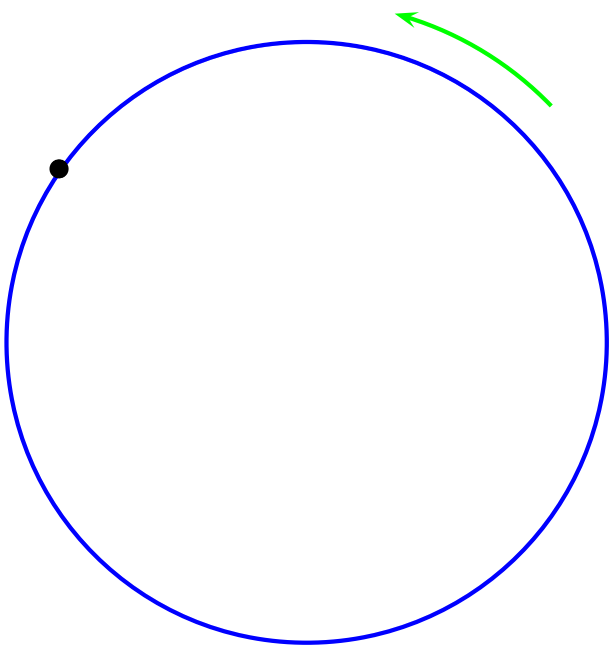

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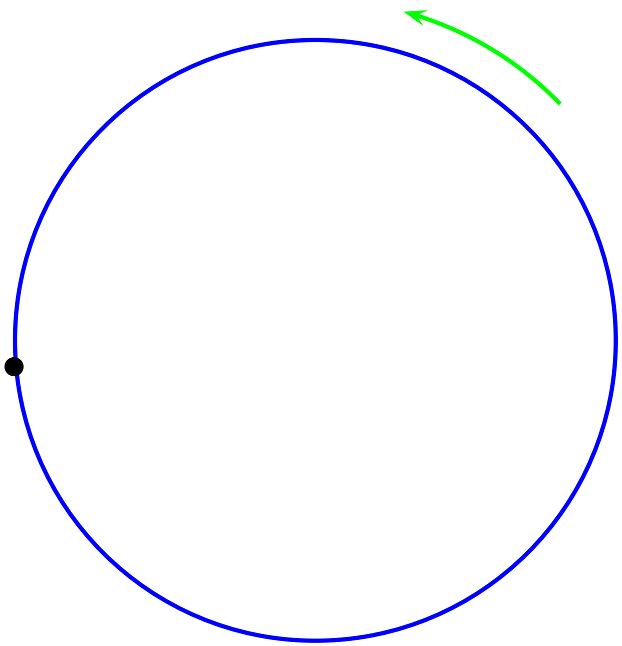

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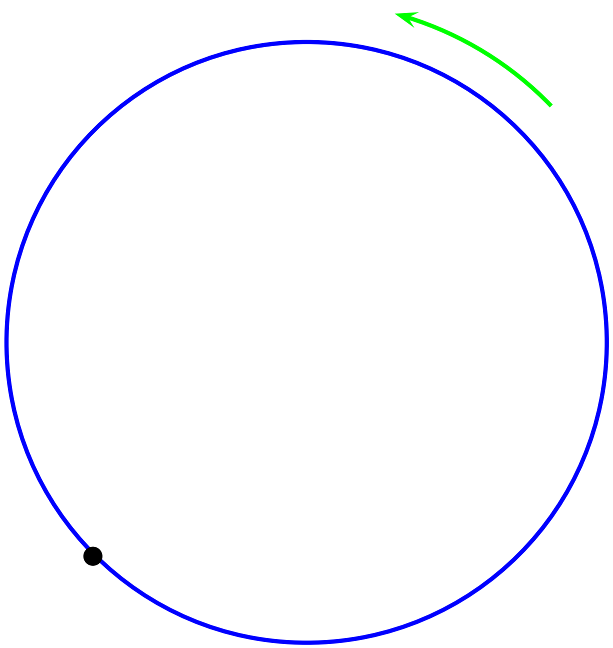

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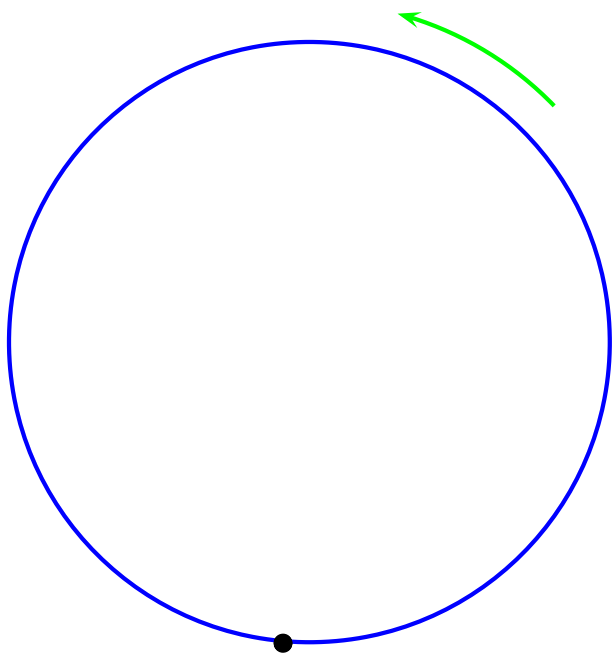

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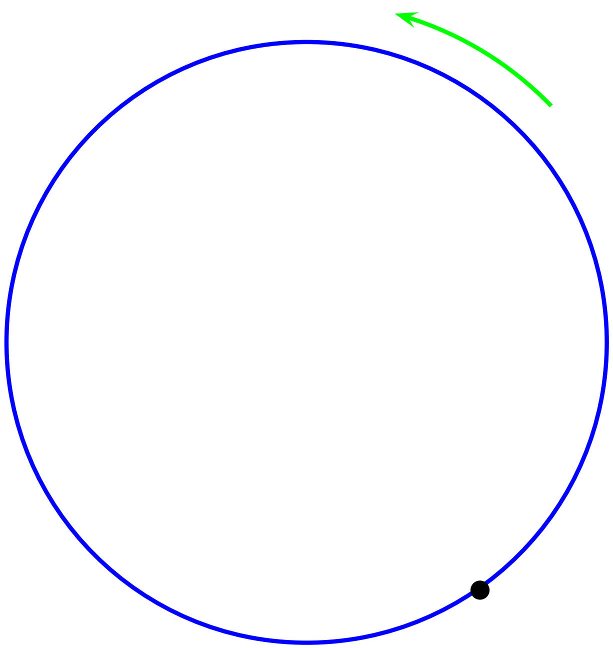

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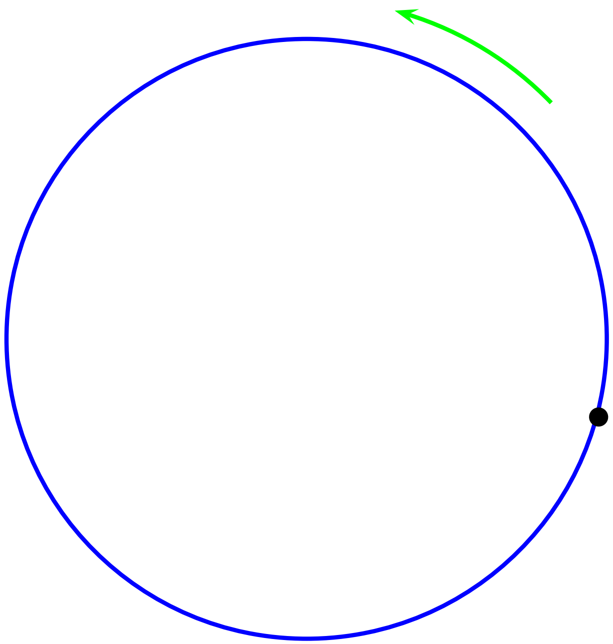

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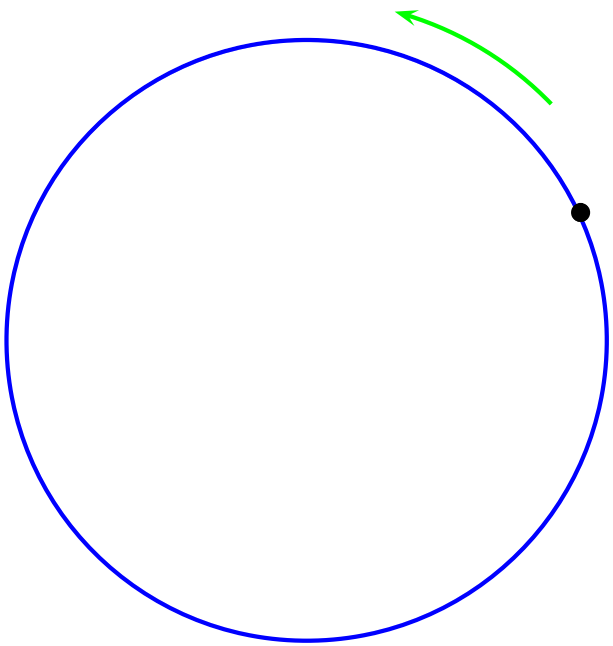

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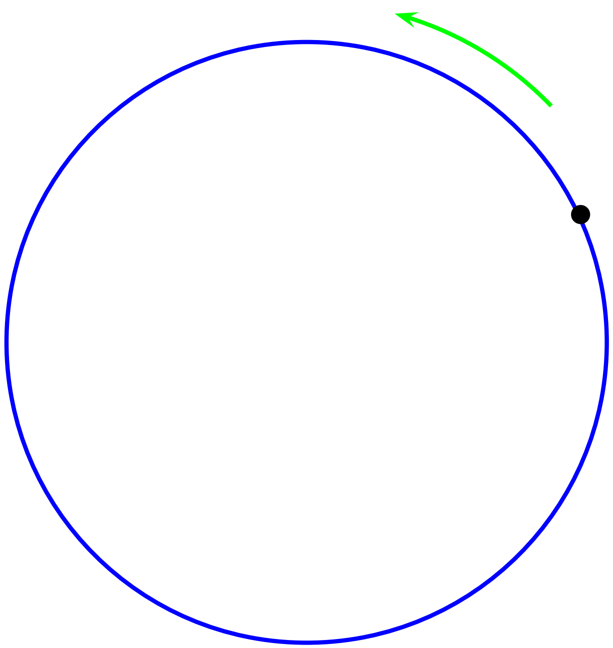

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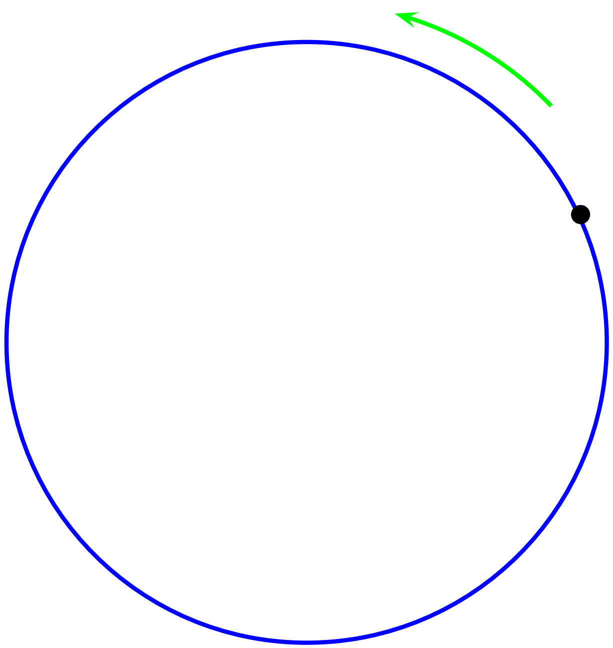

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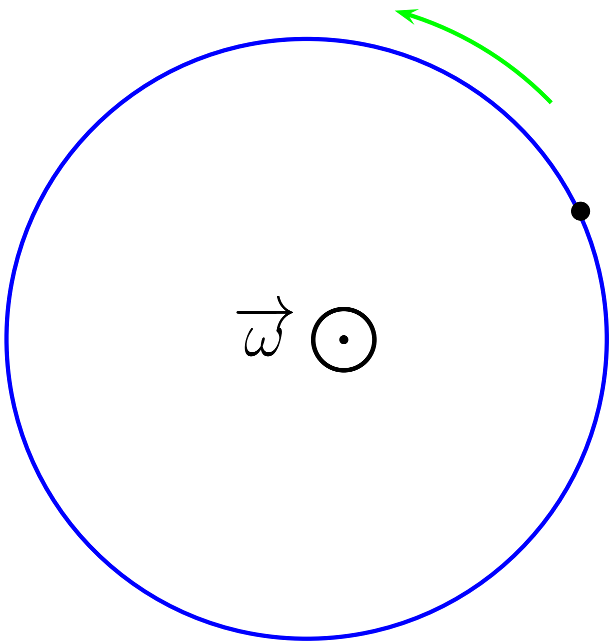

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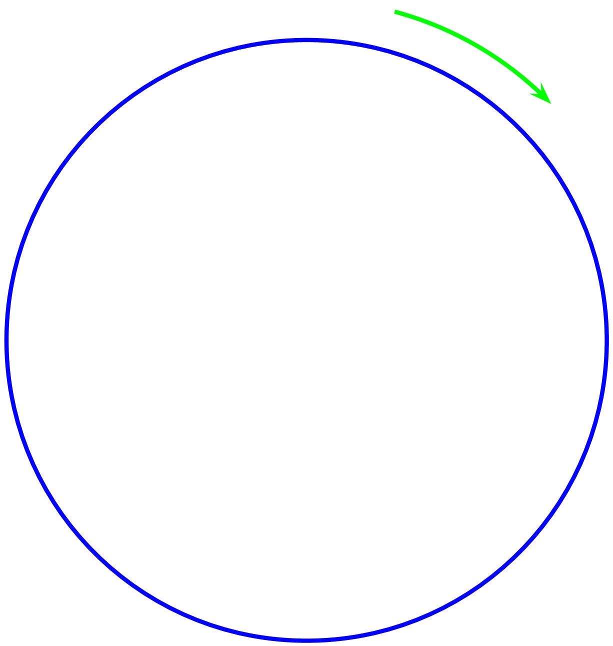

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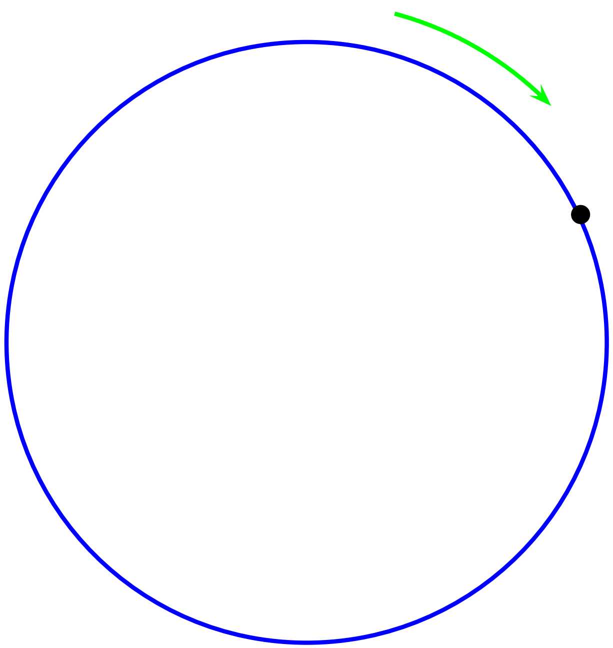

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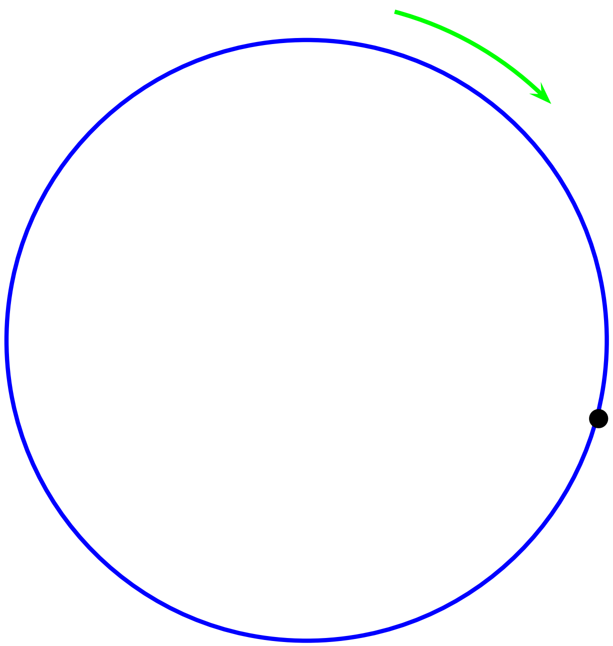

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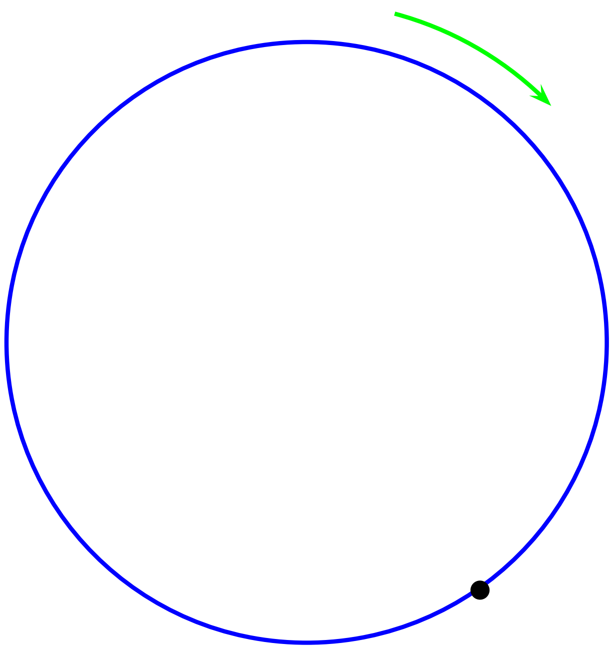

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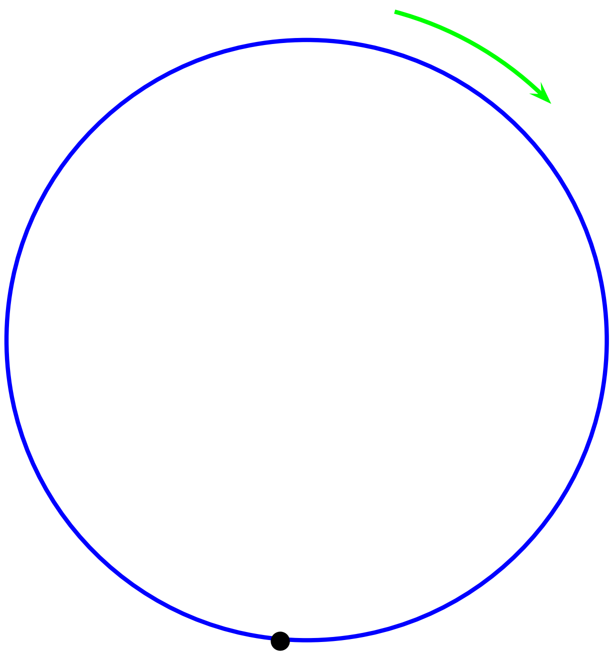

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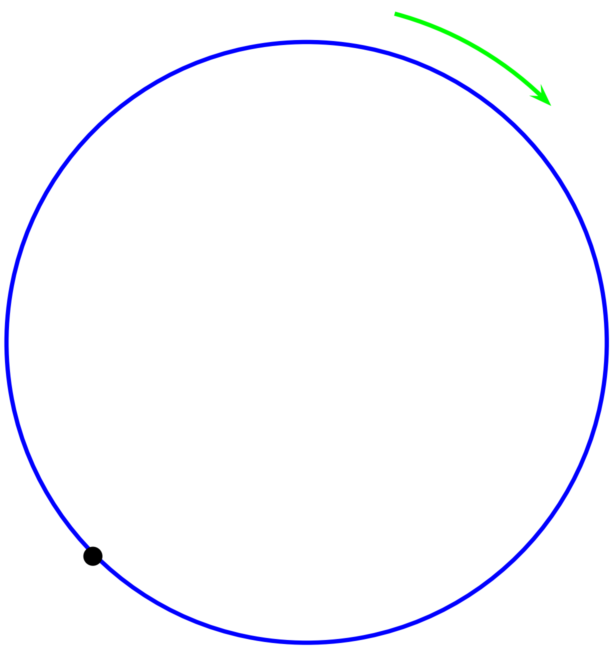

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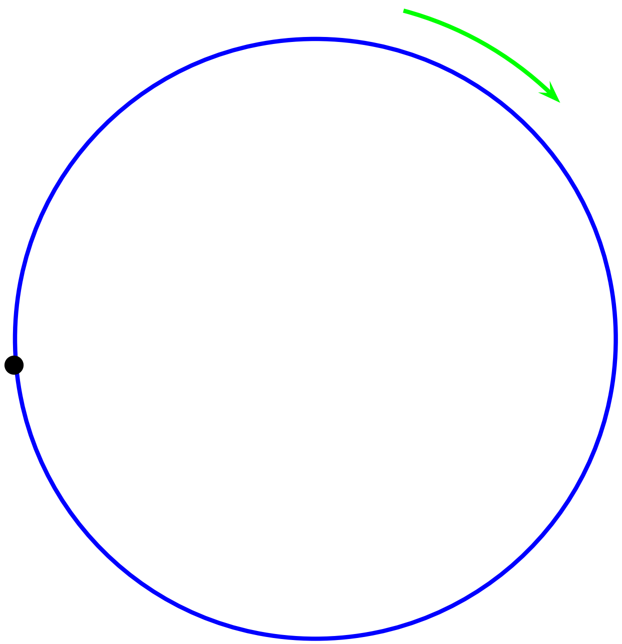

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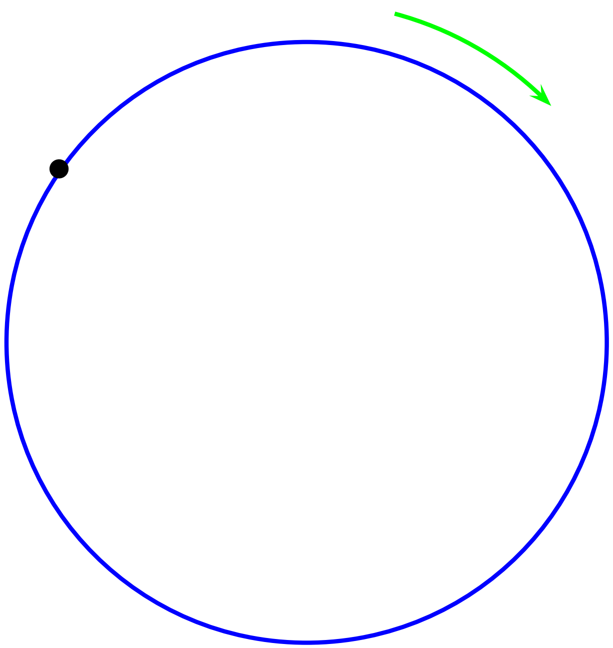

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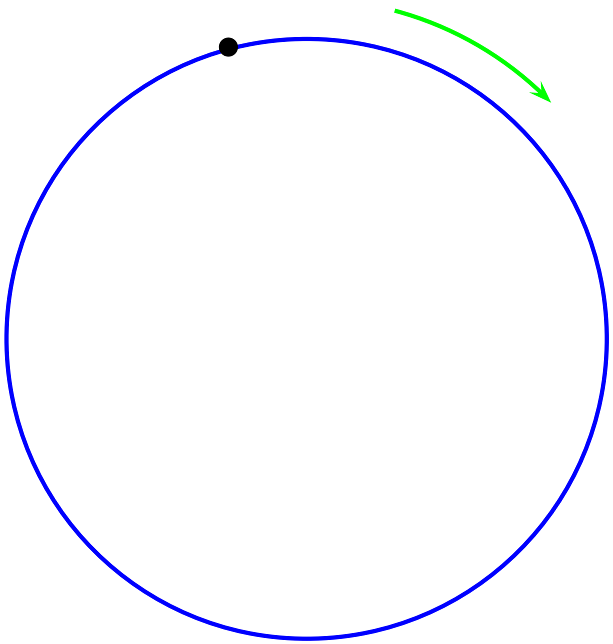

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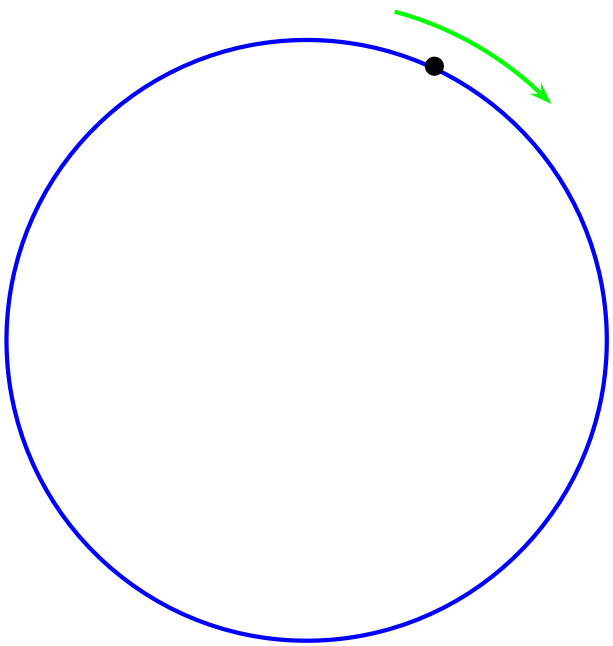

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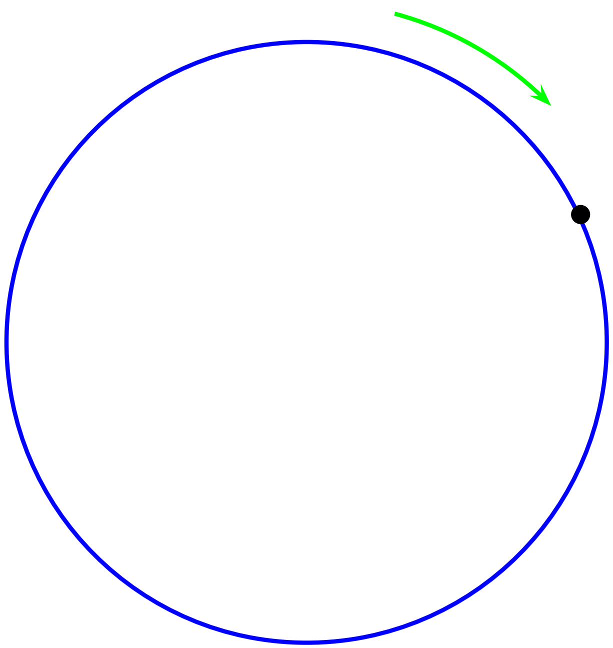

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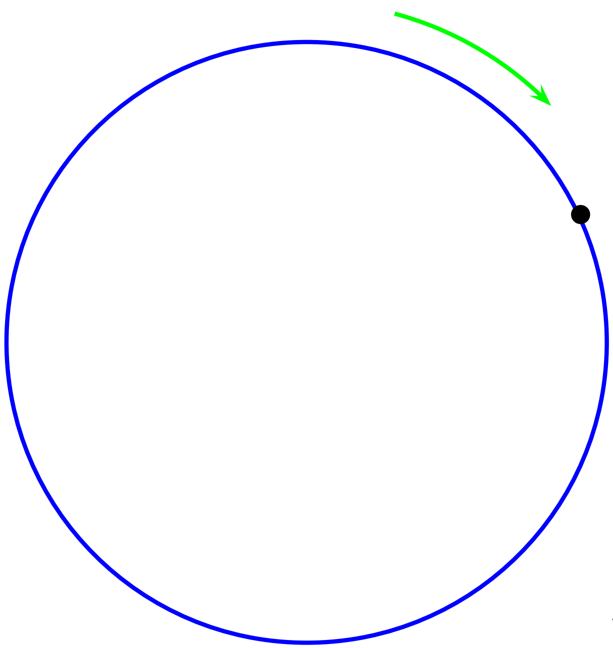

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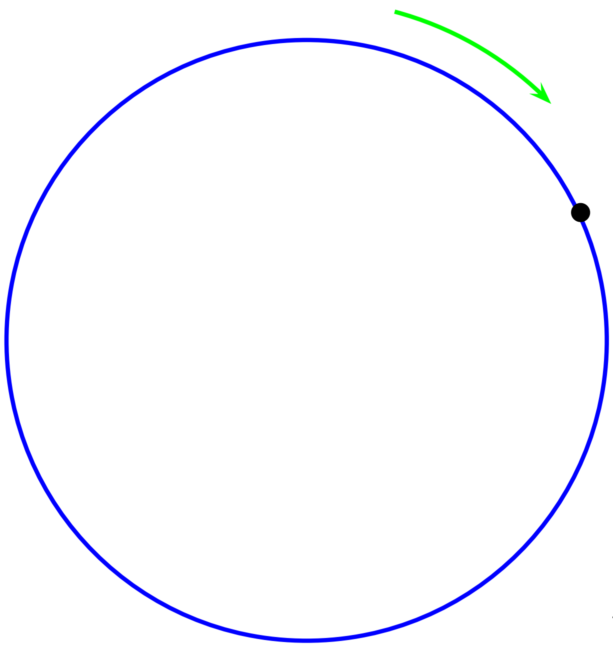

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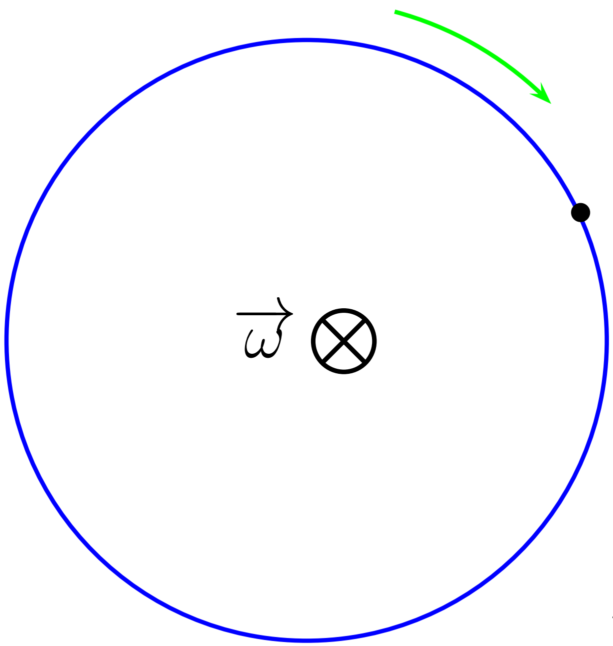

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For a spinning wheel held horizontal, spinning counter-clockwise when looked at from above, what direction is the angular velocity?

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(a) Up

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(c) Towards the board

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