

April 1, Week 11

Today: Chapter 8, Conservation of Momentum

Homework Assignment #8 - Due Monday, April 8

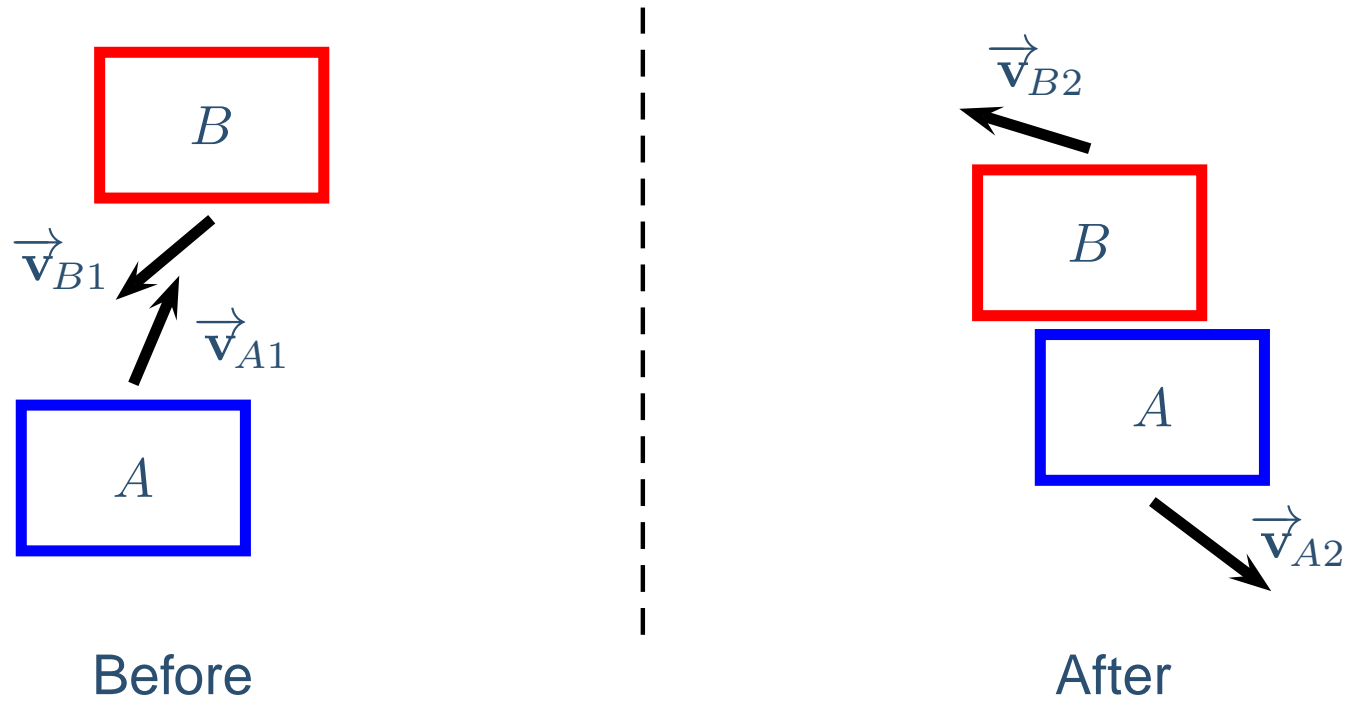
Mastering Physics: 8 problems from chapter 8

Written Questions: 8.101

Homework Assignment #9 - Due Friday, April 12.

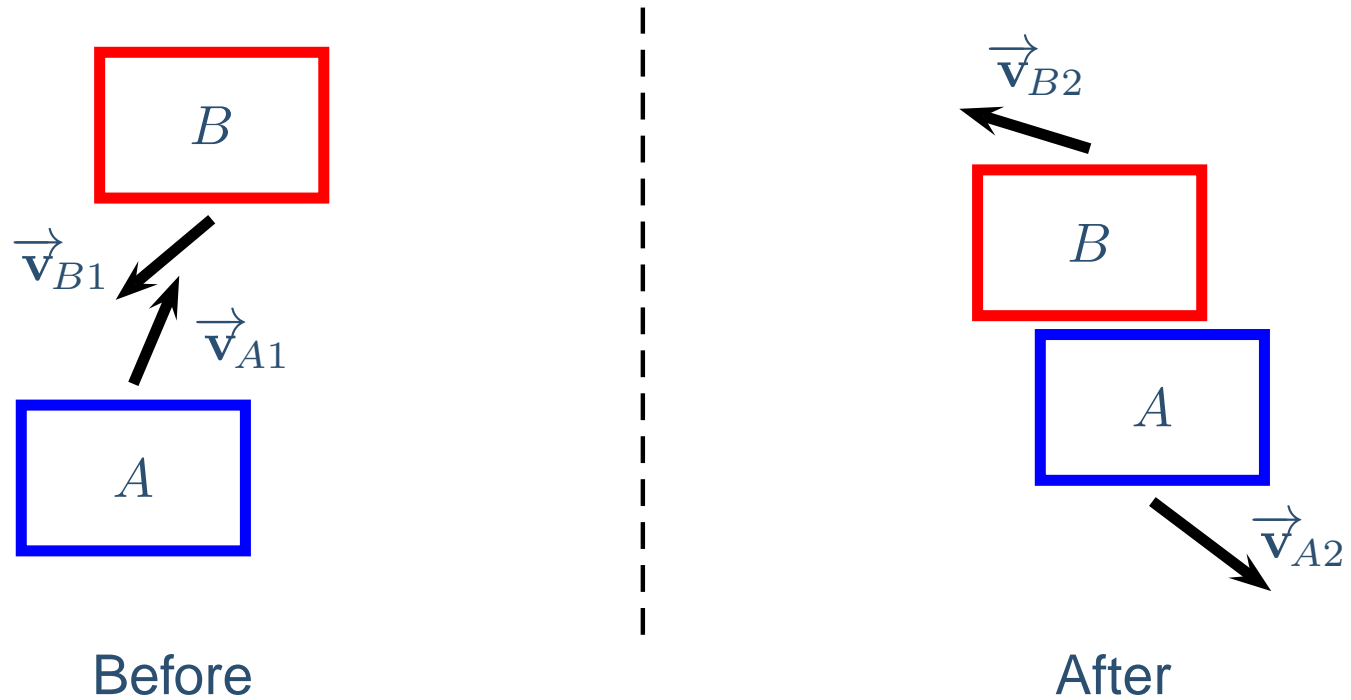
Exam #3 on Wednesday. Practice Exam available on webpage. Review session: Tuesday, April 2, 5:15-7:00 PM. Room 114 of Regener Hall.

Using Conservation of Momentum II



$$M_A \vec{v}_{A1} + M_B \vec{v}_{B1} = M_A \vec{v}_{A2} + M_B \vec{v}_{B2}$$

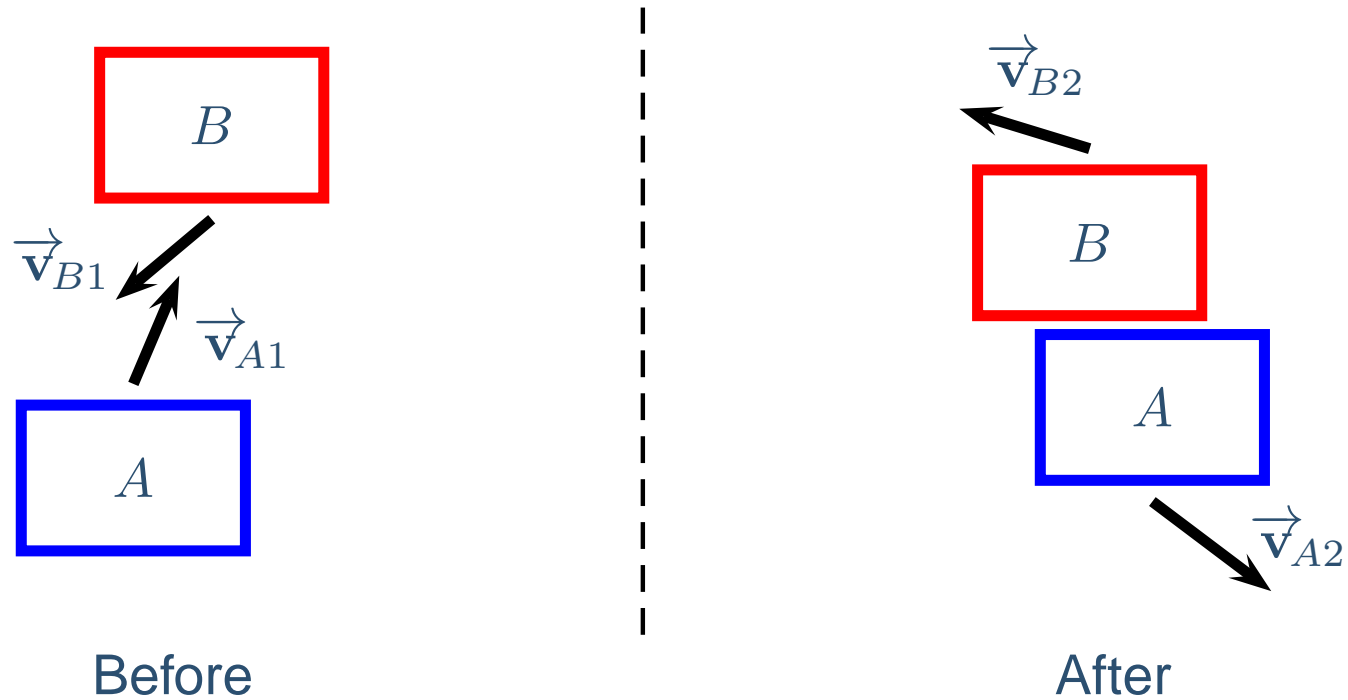
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Component Form:

Using Conservation of Momentum II

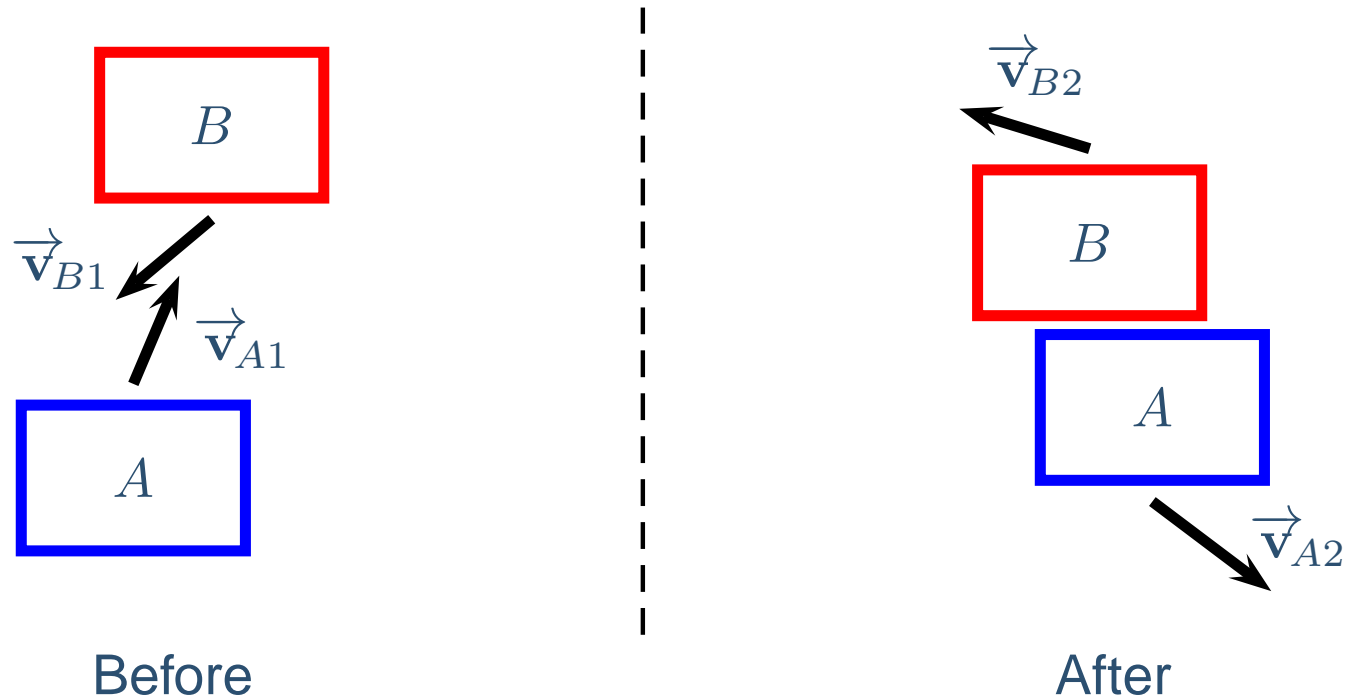


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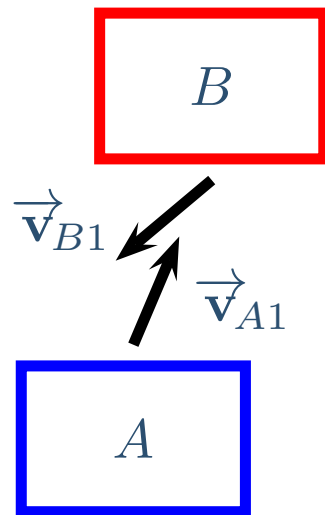
Collisions may not conserve kinetic energy because they produce heat and/or the objects change shape upon collision.

Perfectly Inelastic Collisions

When the colliding objects stick together, the collision is called perfectly inelastic or a plastic collision.

Perfectly Inelastic Collisions

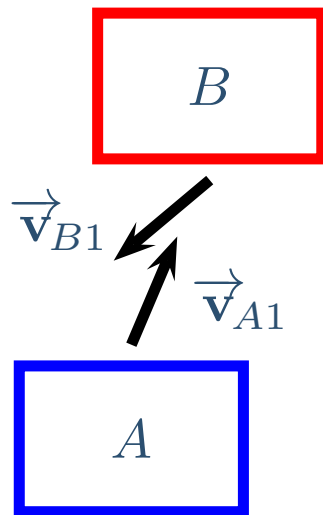
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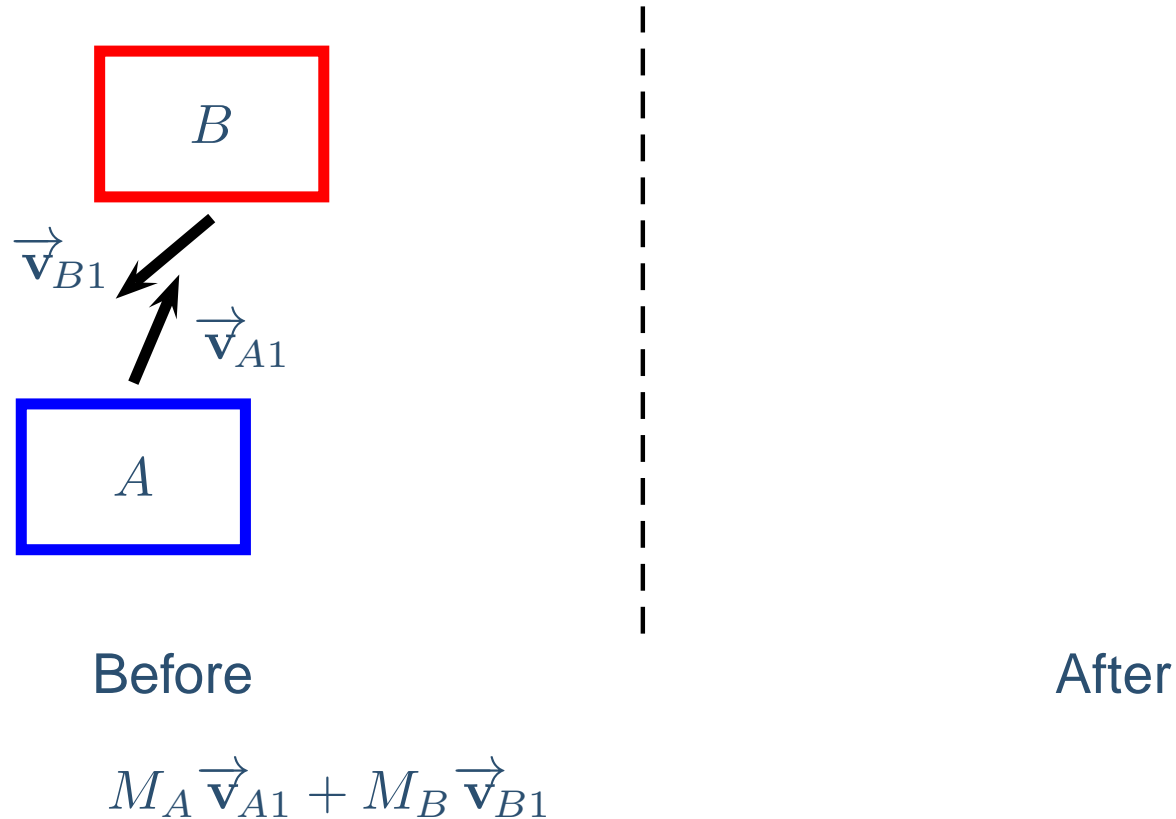


Before

$$M_A \vec{v}_{A1} + M_B \vec{v}_{B1}$$

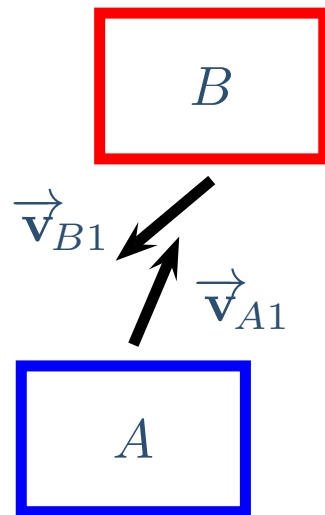
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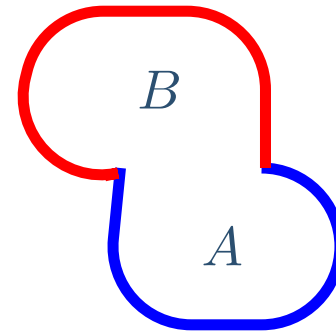
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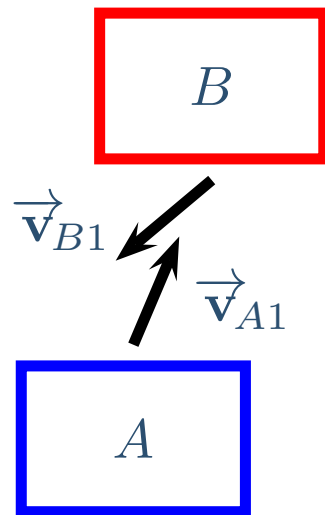
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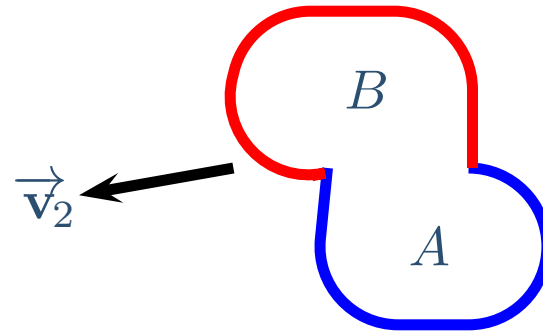
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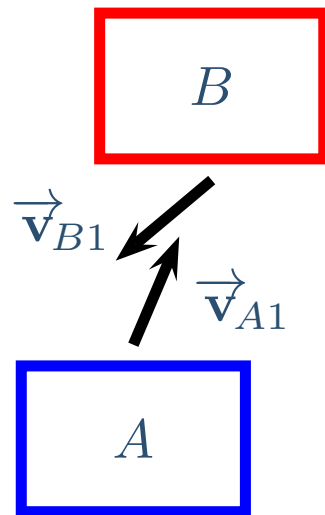
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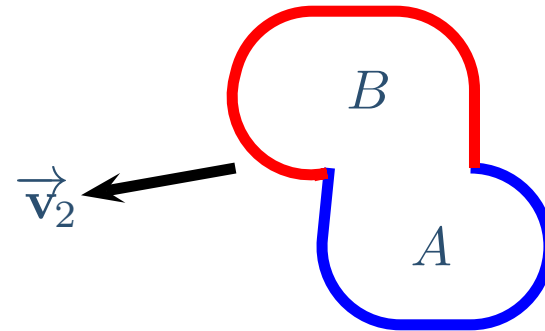
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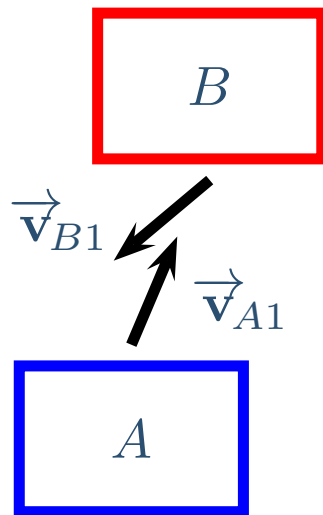


After

$$(M_A + M_B) \vec{v}_2$$

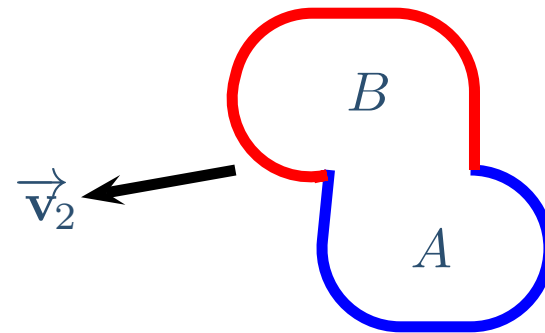
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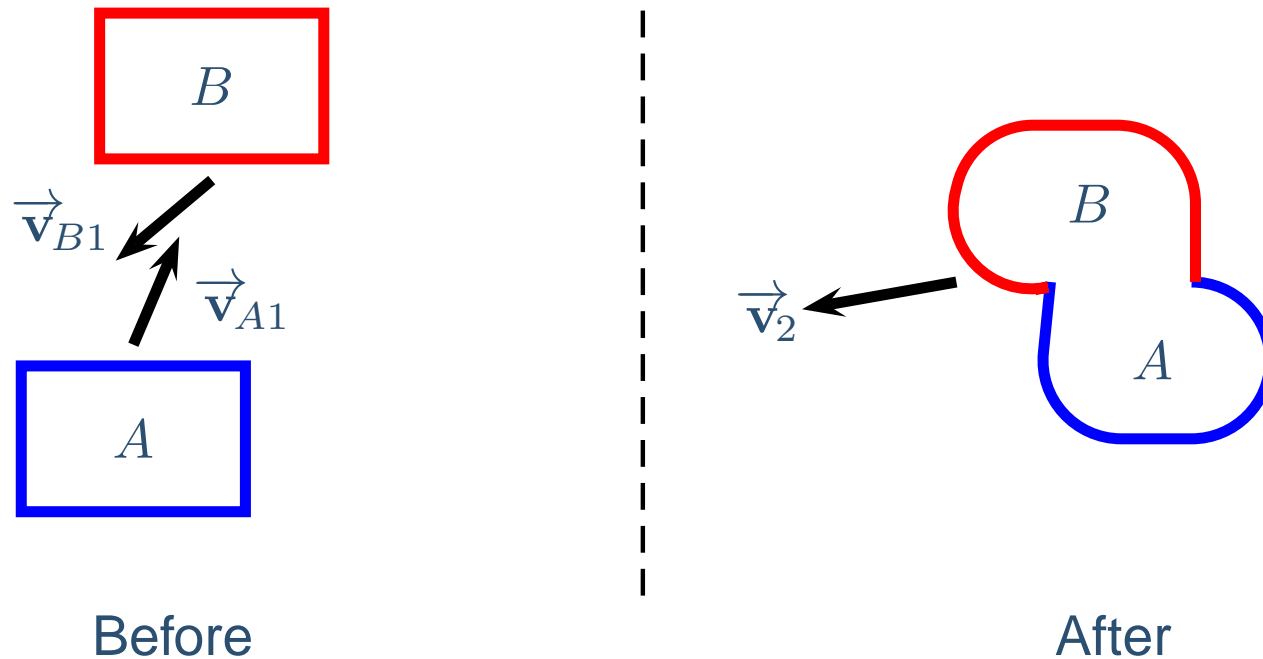
$$M_A \vec{v}_{A1} + M_B \vec{v}_{B1} = (M_A + M_B) \vec{v}_2$$



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$$M_A \vec{v}_{A1} + M_B \vec{v}_{B1} = (M_A + M_B) \vec{v}_2$$

Components: $M_A (v_{A1})_x + M_B (v_{B1})_x = (M_A + M_B) (v_2)_x$
 $M_A (v_{A1})_y + M_B (v_{B1})_y = (M_A + M_B) (v_2)_y$

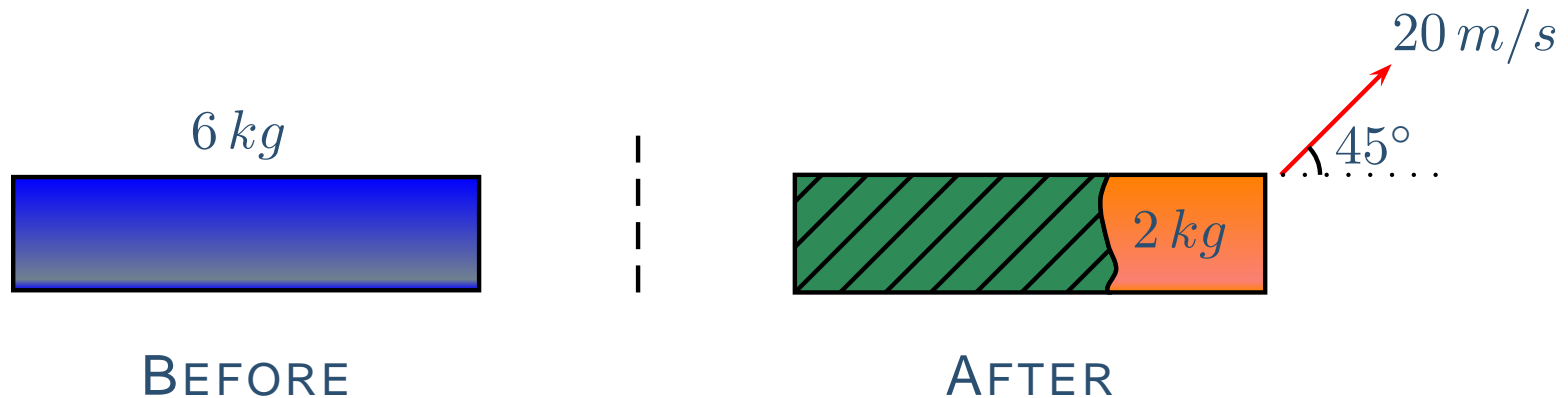
2D Conservation Exercise

A 6 kg box-shaped firecracker explodes into two unequal pieces. If the first piece of mass 2 kg has velocity 20 m/s at 45° , what speed and direction must the other piece have?



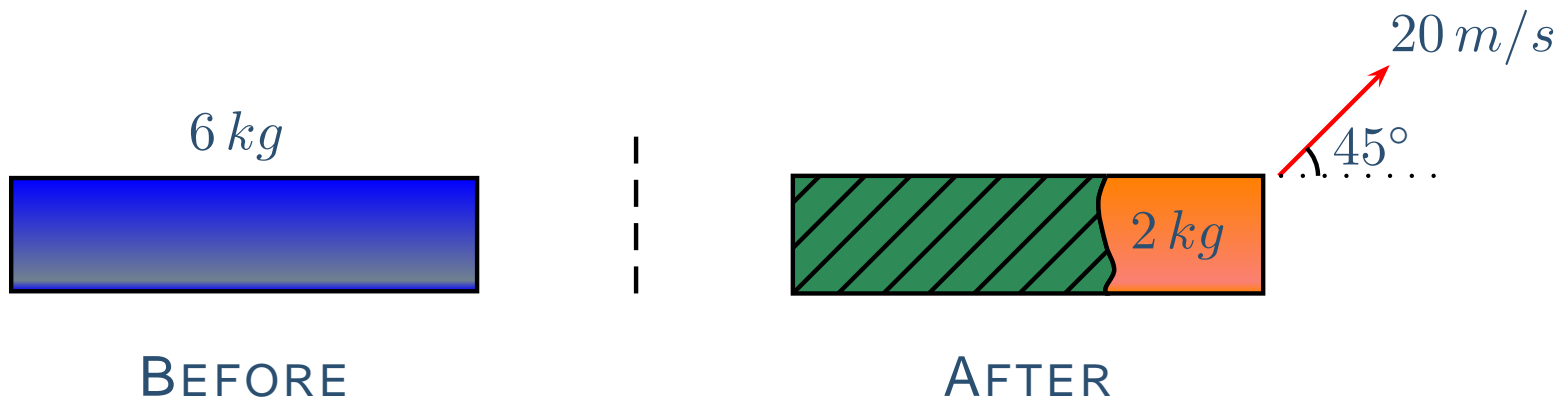
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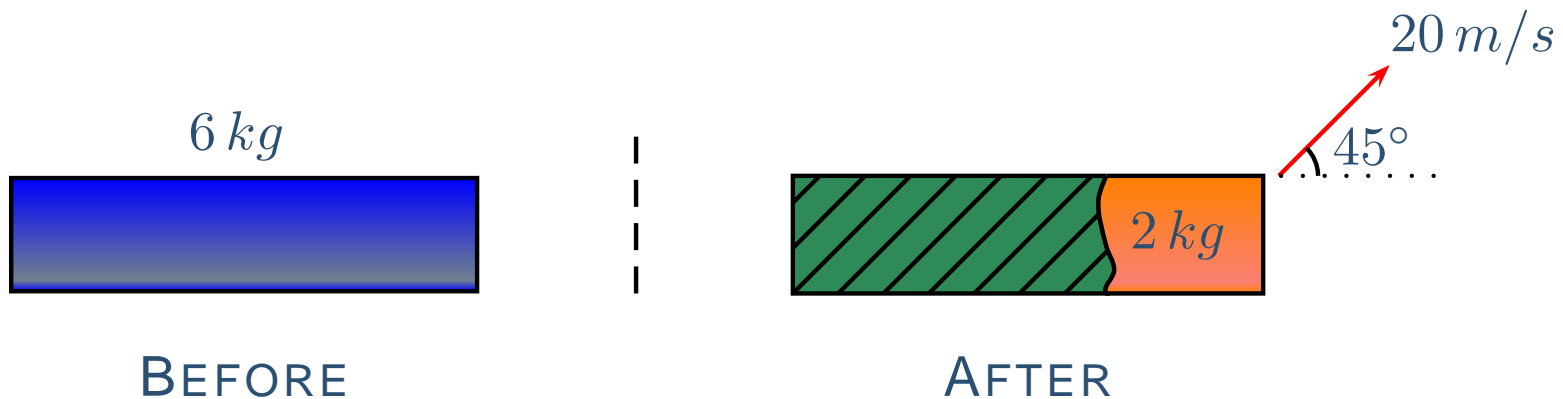
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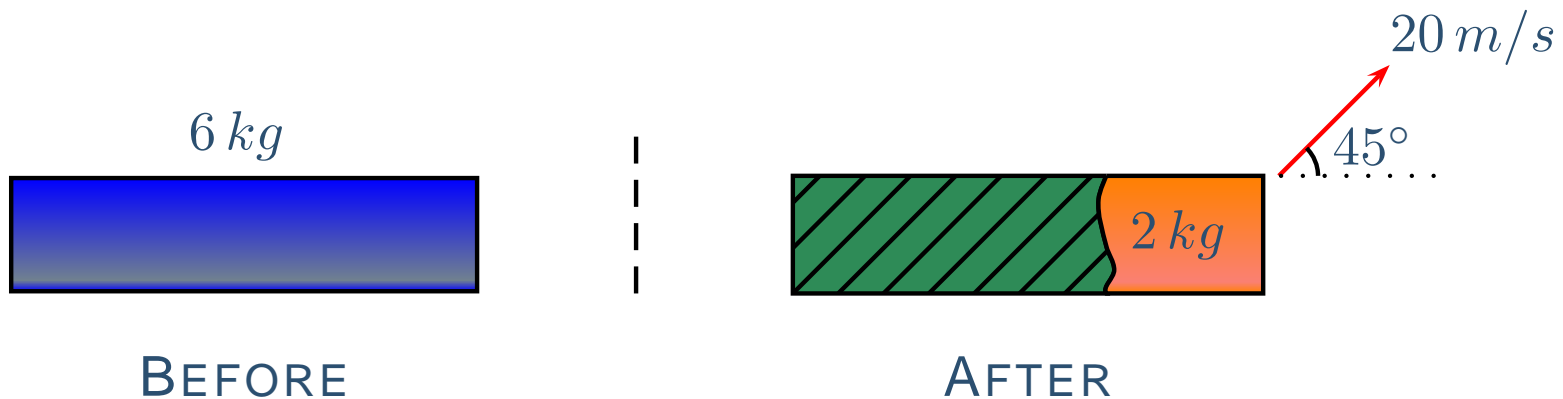


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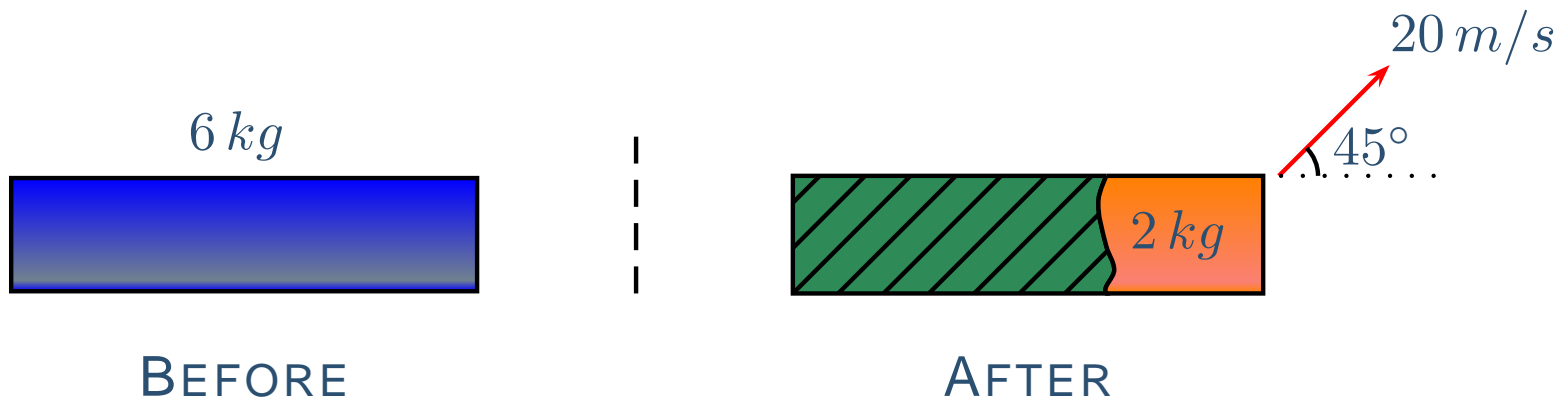
(a) 10 m/s at 225°

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(c) 40 m/s at 225°

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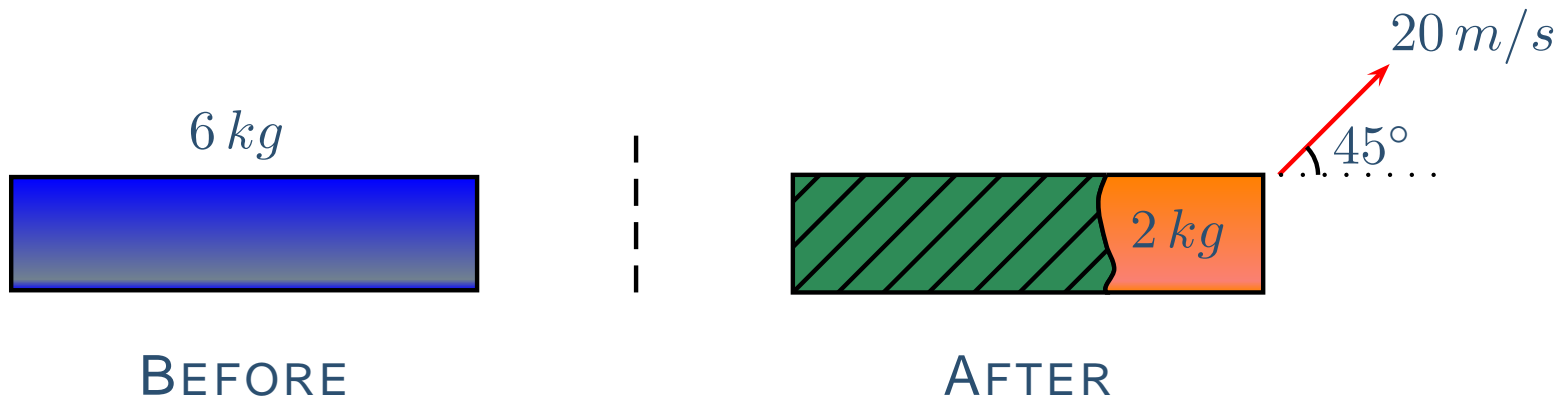
(b) 20 m/s at 225°

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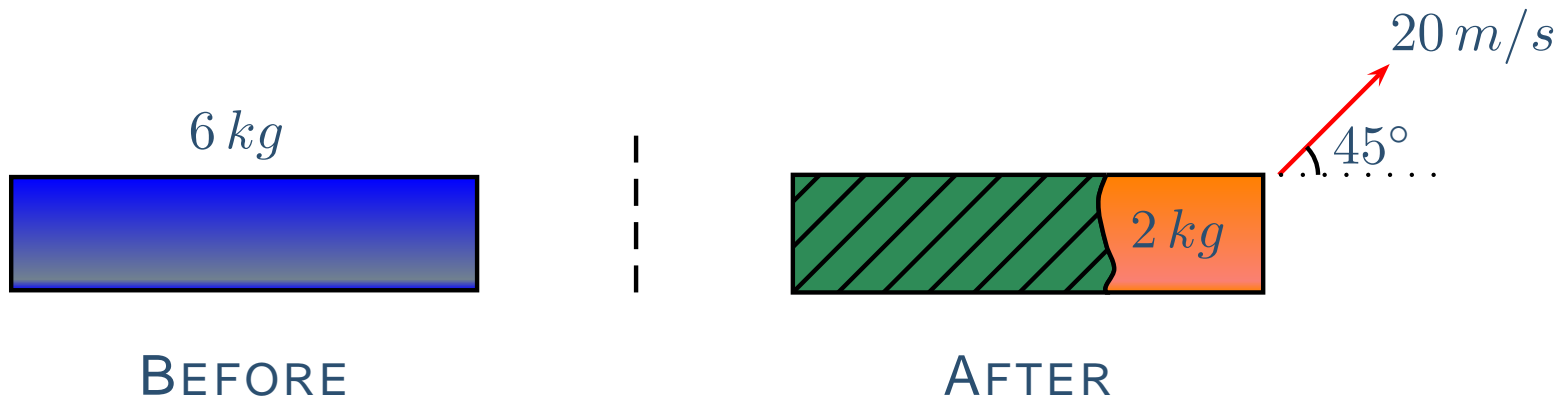
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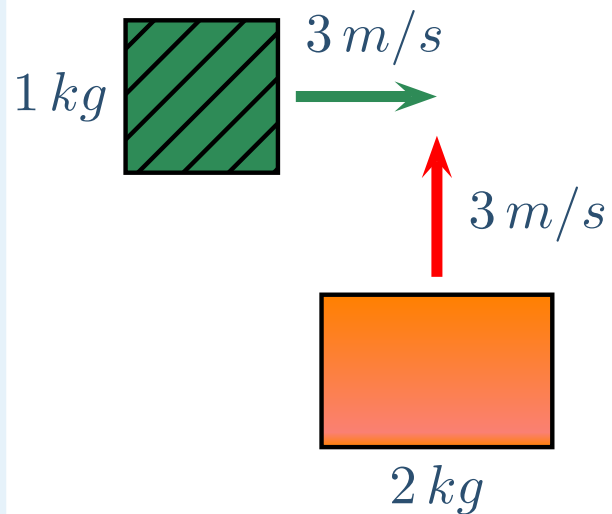
(d) 10 m/s at 135°

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$$0 = M_A \vec{v}_{A2} + M_B \vec{v}_{B2} \Rightarrow \vec{v}_{B2} = - \left(\frac{M_A}{M_B} \right) \vec{v}_{A2} = - \left(\frac{2}{4} \right) \vec{v}_{Af}$$

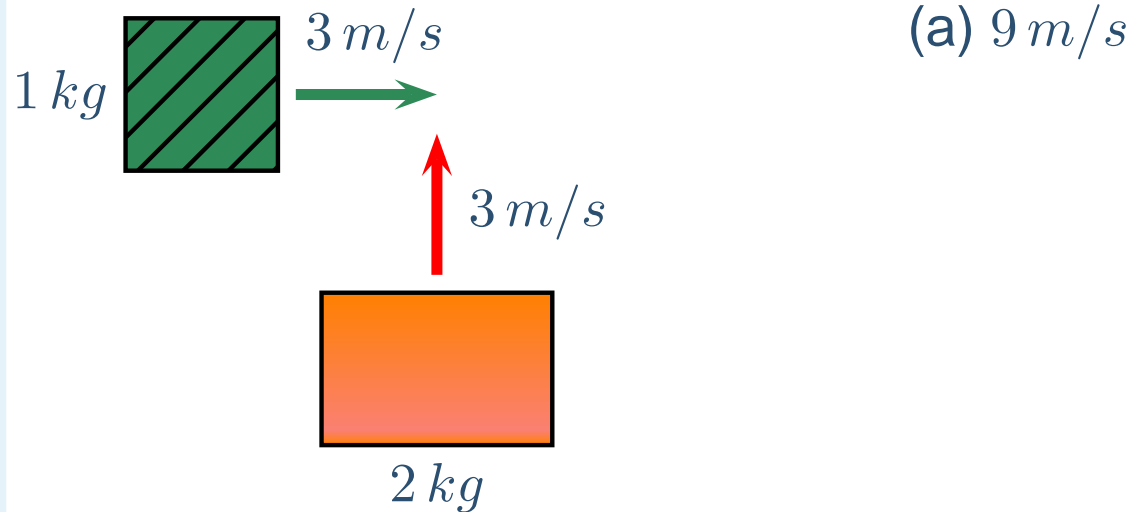
2D Exercise II

A block with $M_A = 1 \text{ kg}$ and velocity 3 m/s to the right has a perfectly inelastic collision with $M_B = 2 \text{ kg}$ that has velocity 3 m/s up. How fast must the masses be going the instant after their collision?



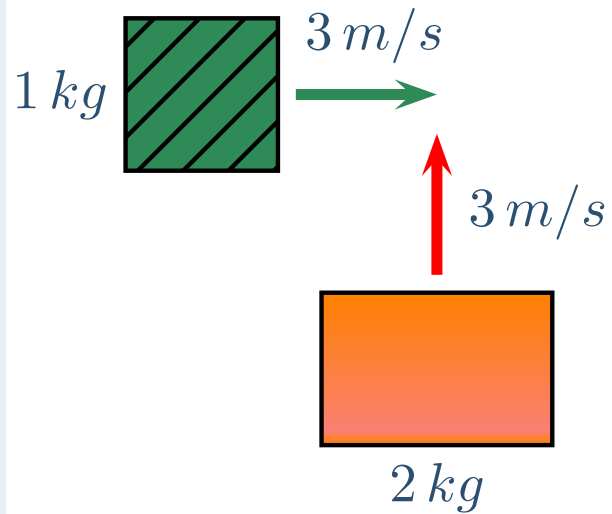
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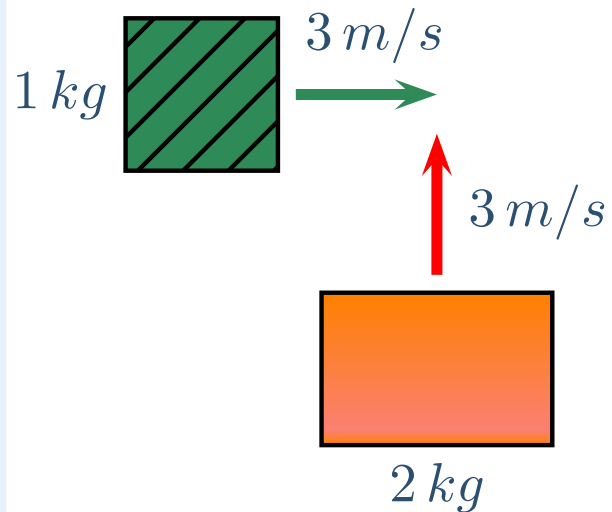


(a) 9 m/s

(b) $\sqrt{45} \text{ m/s} = 6.7 \text{ m/s}$

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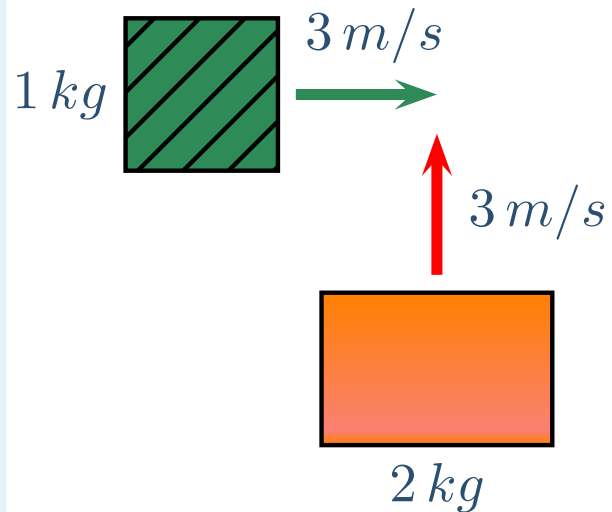
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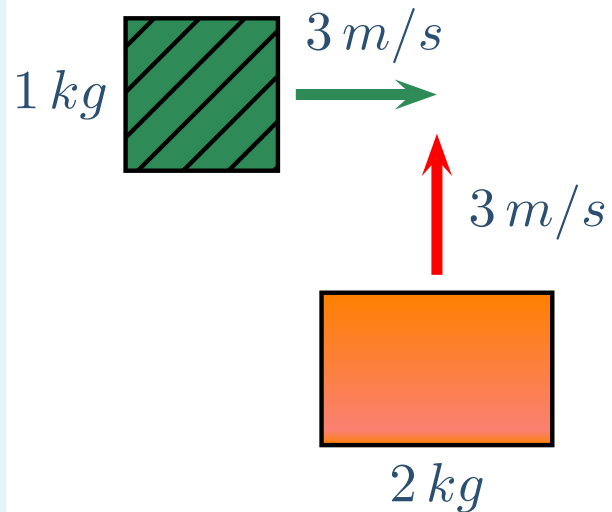
(b) $\sqrt{45} \text{ m/s} = 6.7 \text{ m/s}$

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(d) $\sqrt{5} \text{ m/s} = 2.236 \text{ m/s}$

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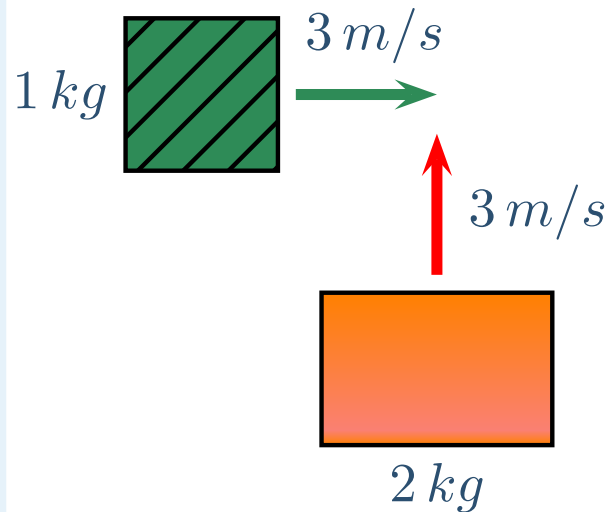
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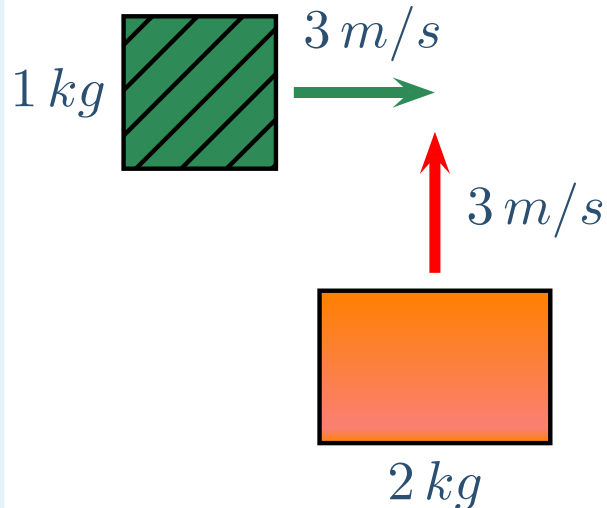
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$$M_A (v_{A1})_x + M_B (v_{B1})_x = (M_A + M_B) (v_2)_x$$

$$(1 \text{ kg})(3 \text{ m/s}) = (3 \text{ kg})(v_2)_x$$

$$\Rightarrow (v_2)_x = 1 \text{ m/s}$$

$$M_A (v_{A1})_y + M_B (v_{B1})_y = (M_A + M_B) (v_2)_y$$

$$(2 \text{ kg})(3 \text{ m/s}) = (3 \text{ kg})(v_2)_y$$

$$\Rightarrow (v_2)_y = 2 \text{ m/s}$$

$$v_2 = \sqrt{(v_2)_x^2 + (v_2)_y^2}$$

Rotation

Rotational Motion - Spinning or rolling of rigid bodies.

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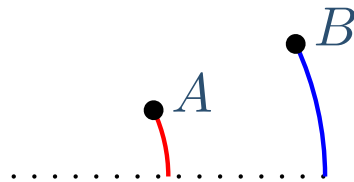
Circular Objects:

Rotation

Rotational Motion - Spinning or rolling of rigid bodies.

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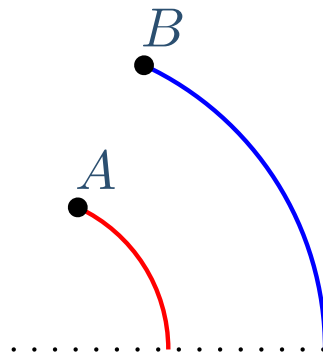
Follow two points, A and B



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Rotational Motion - Spinning or rolling of rigid bodies.

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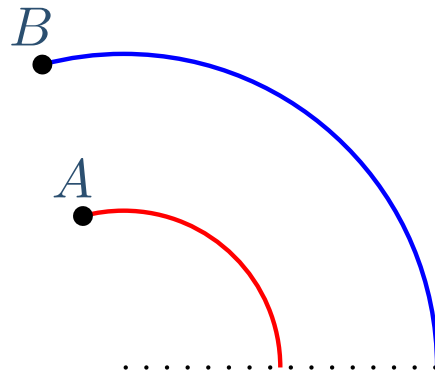


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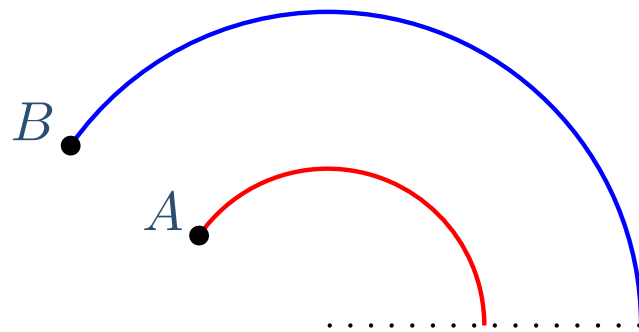


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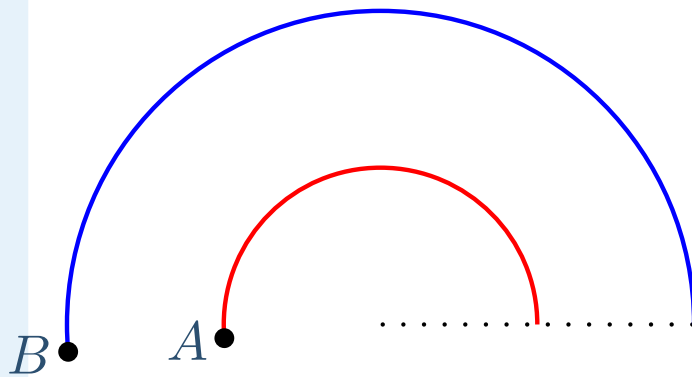
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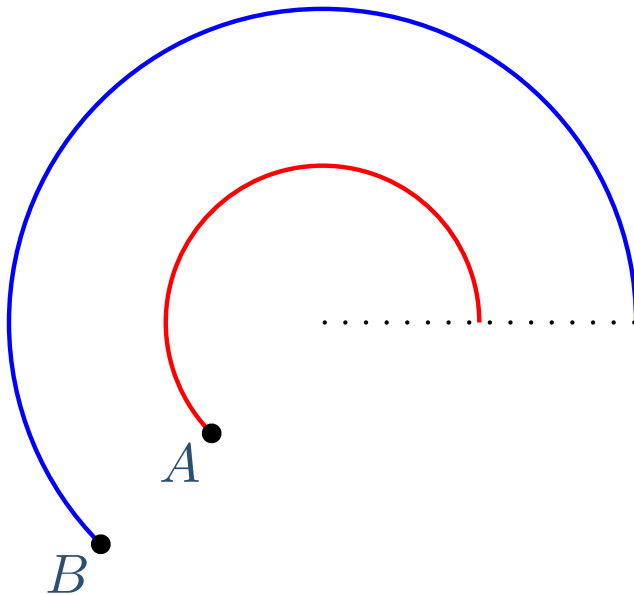


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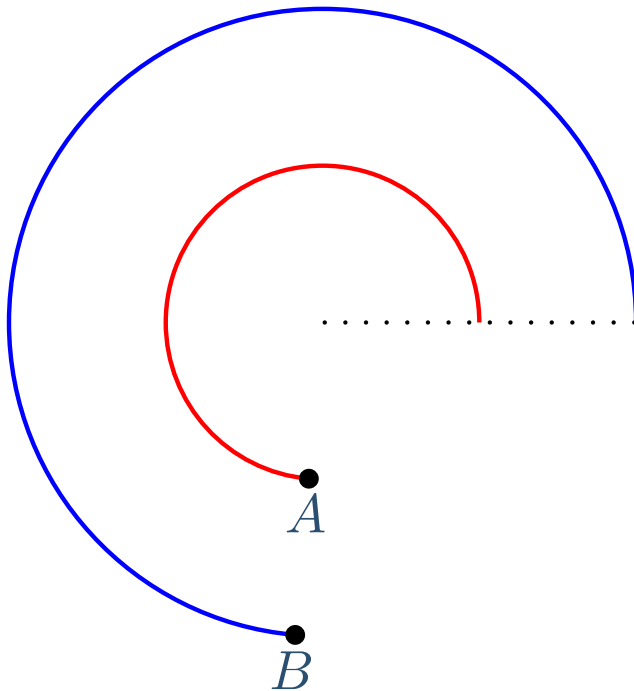


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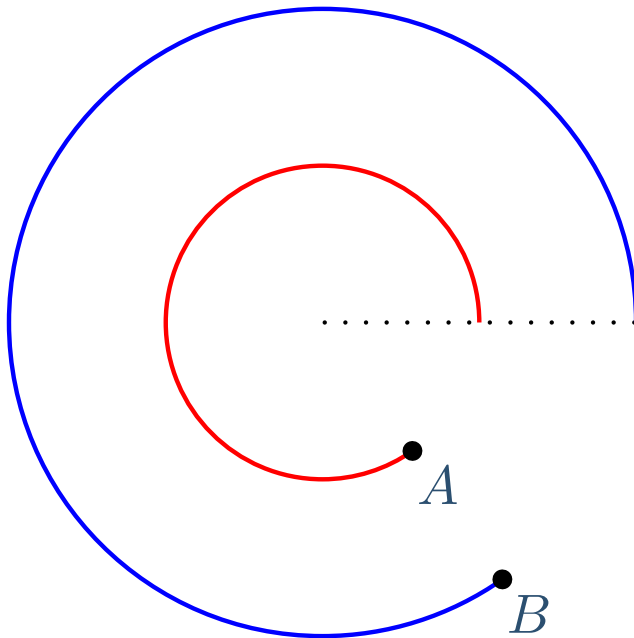


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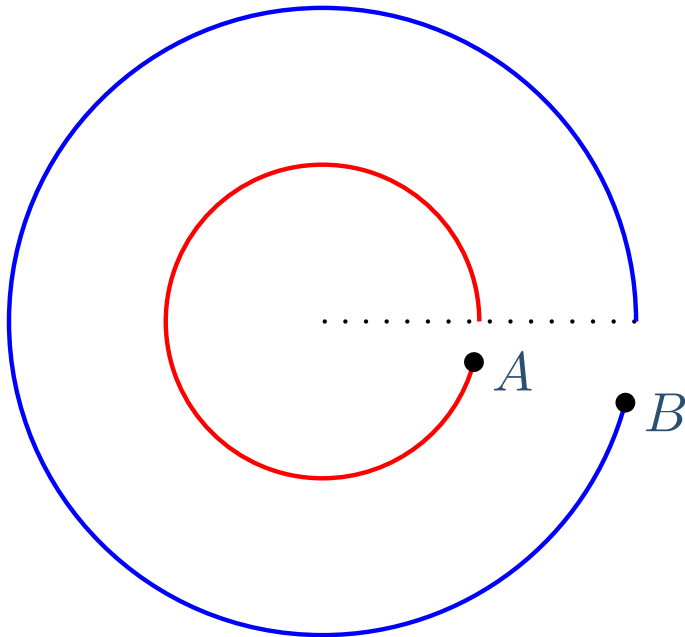


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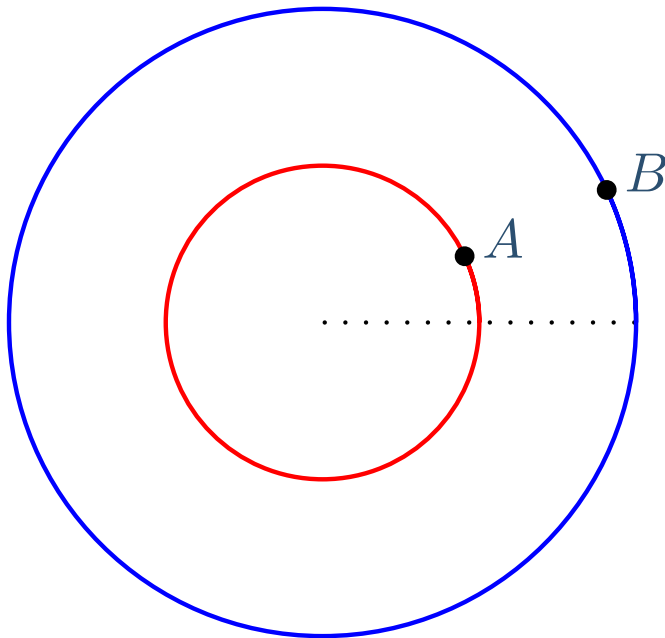


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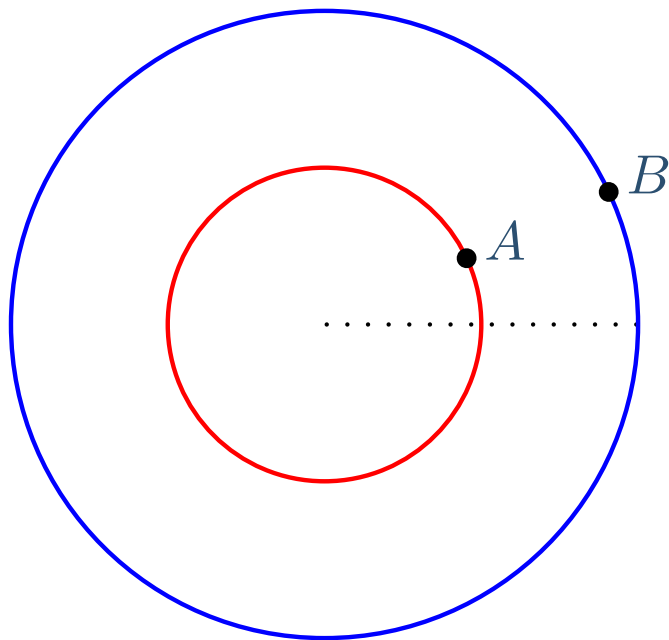
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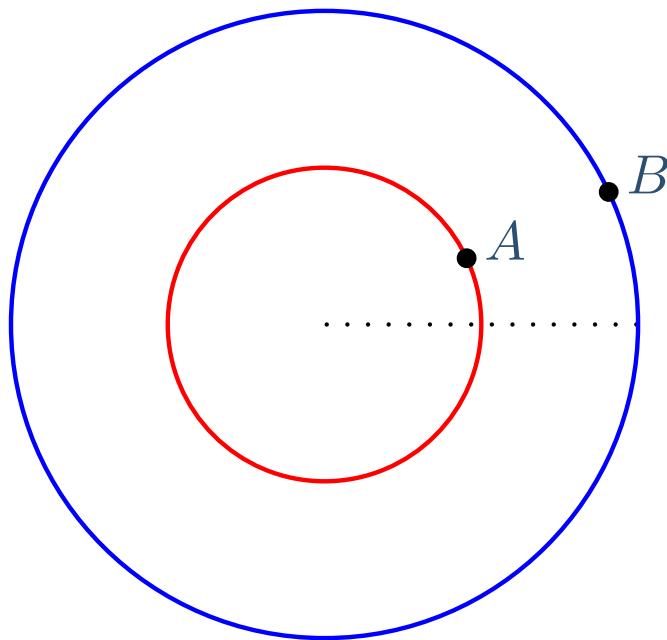
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Distance traveled during one revolution:

Rotation

Rotational Motion - Spinning or rolling of rigid bodies.

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Follow two points, A and B

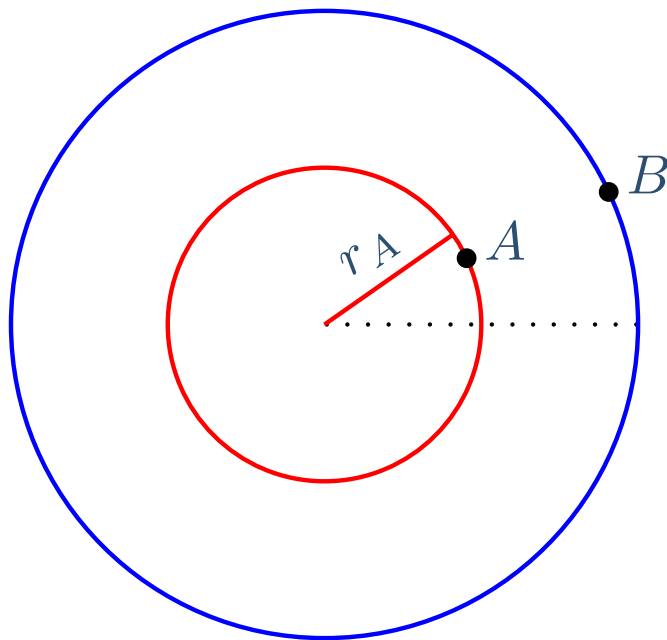
Distance traveled during one revolution:

$$A : 2\pi r_A$$

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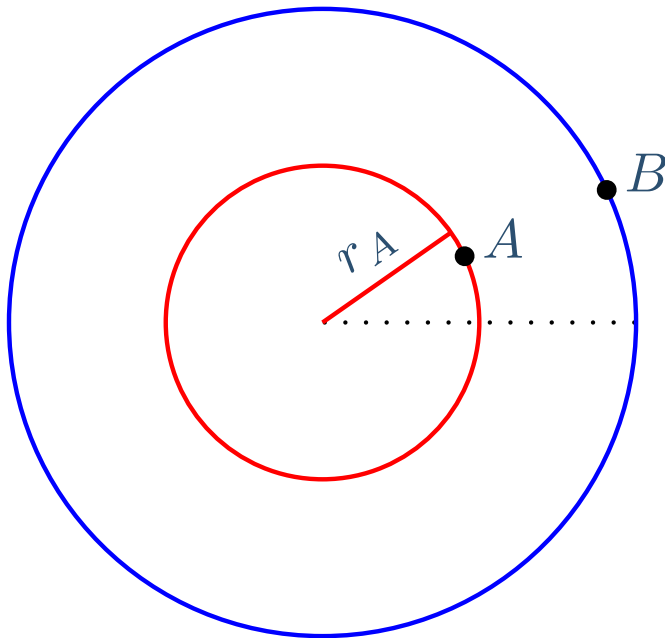
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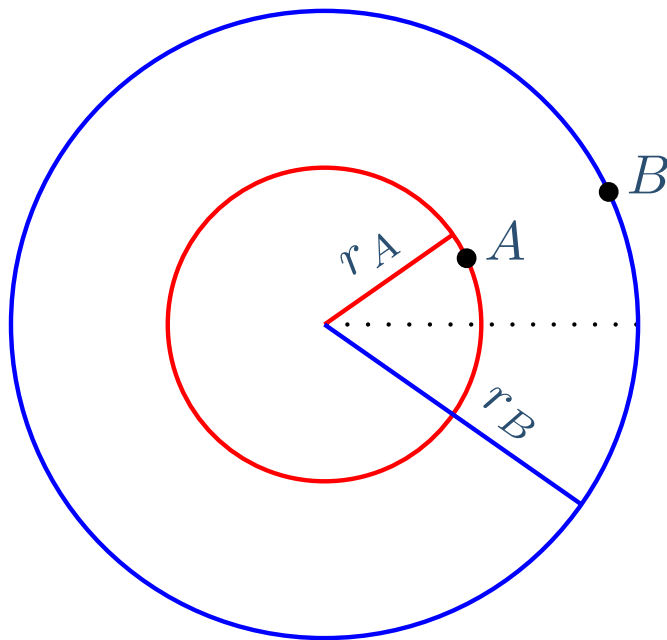
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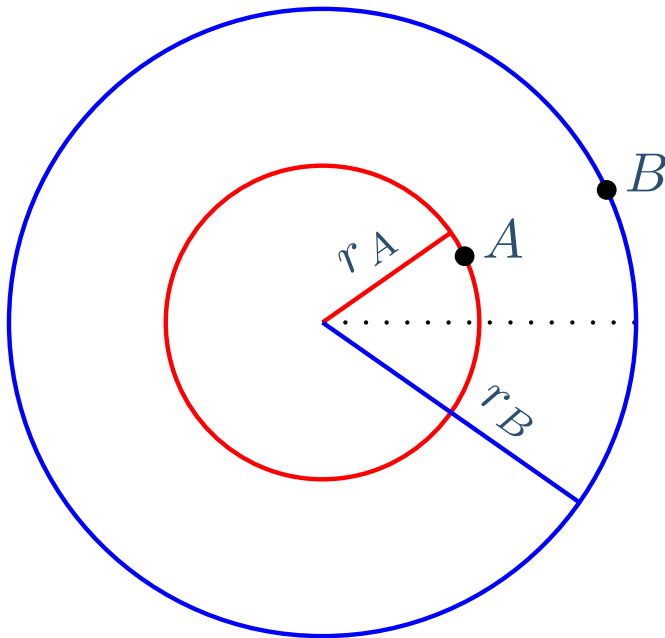
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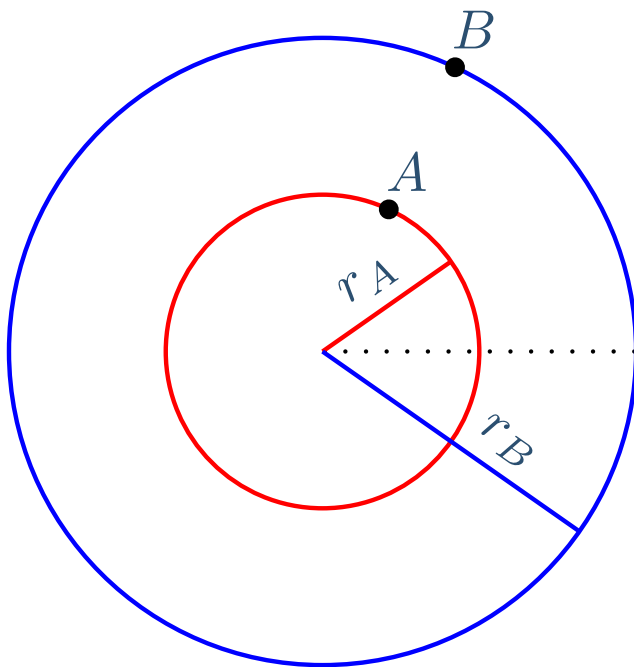
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B travels farther than A

Rotation

Rotational Motion - Spinning or rolling of rigid bodies.

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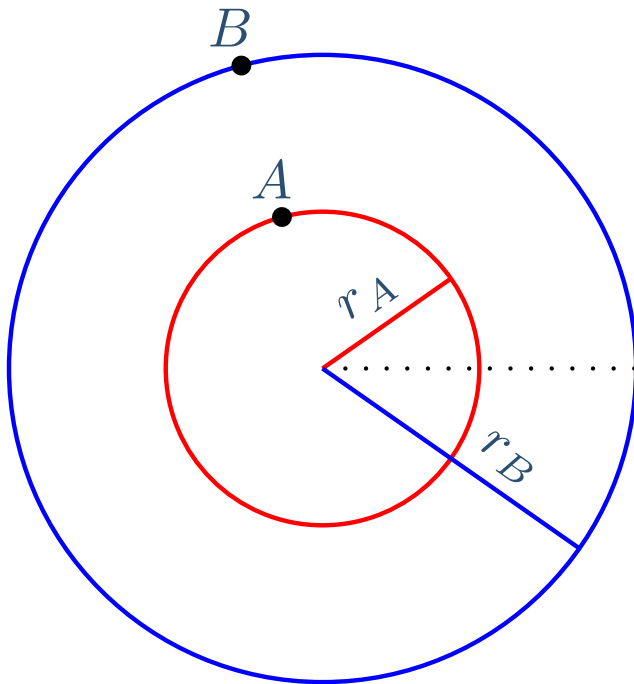
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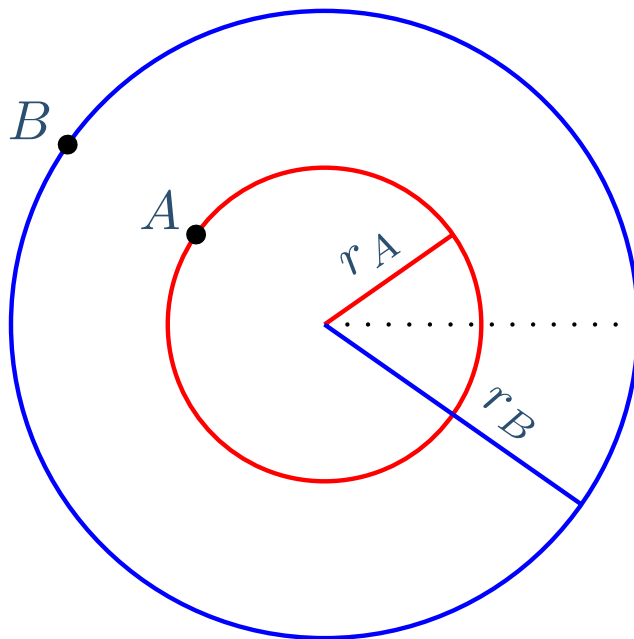
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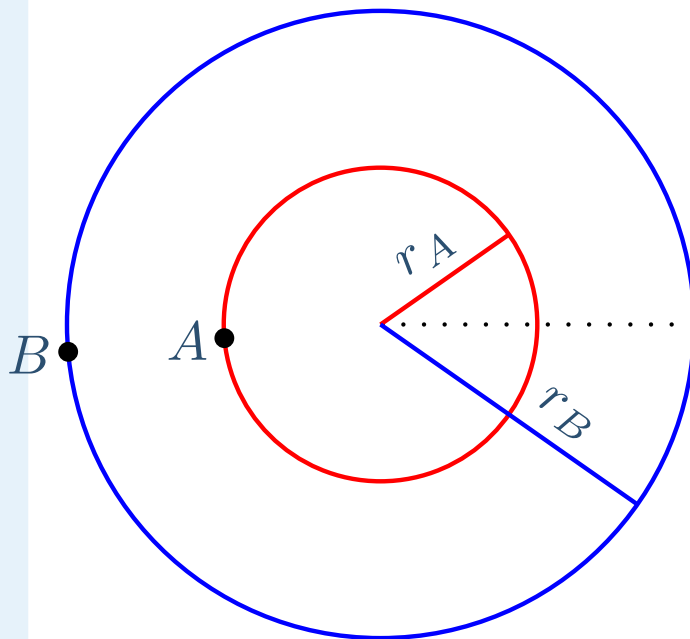
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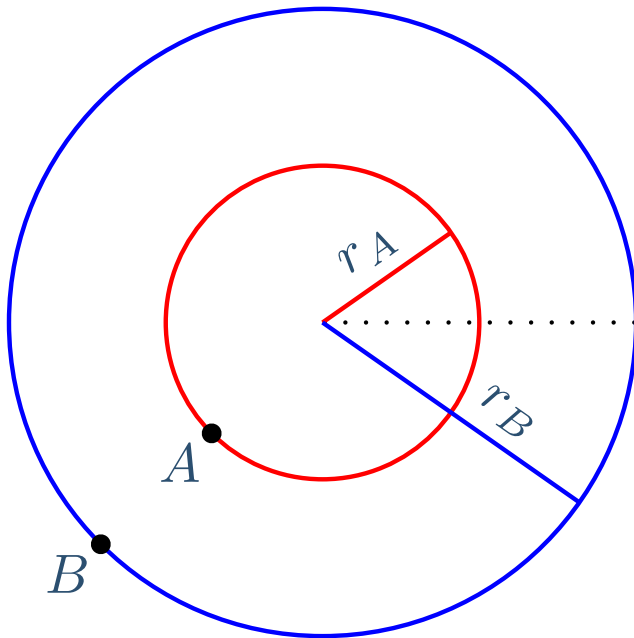
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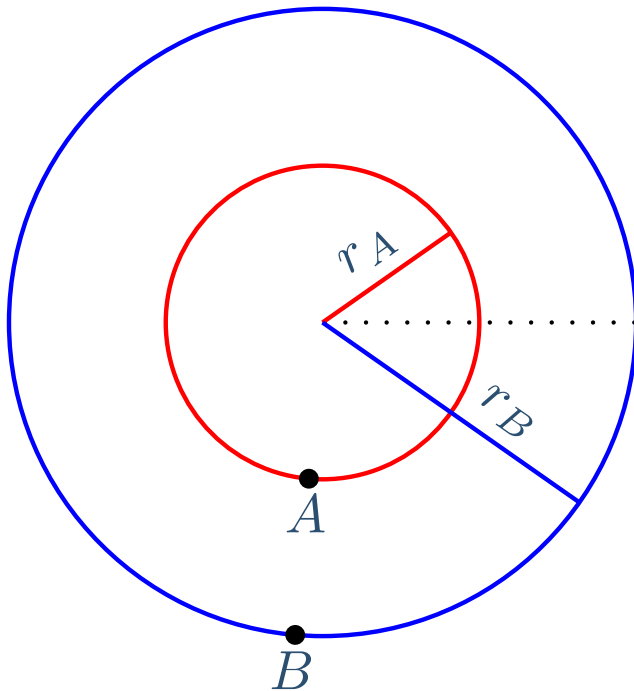
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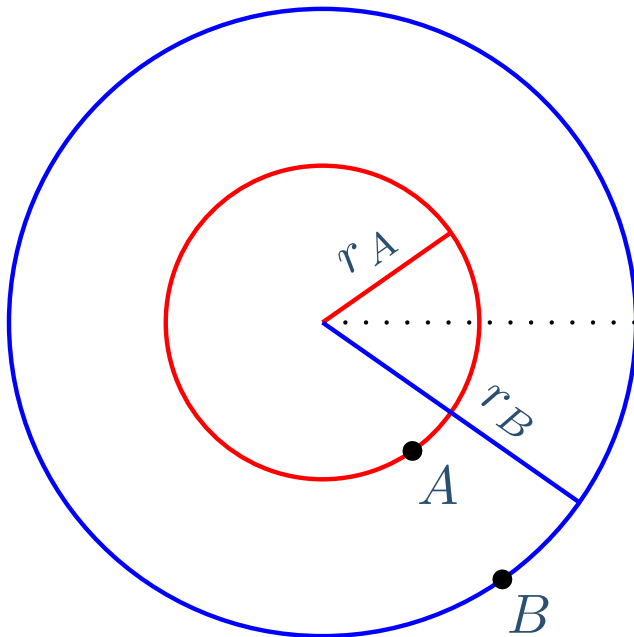
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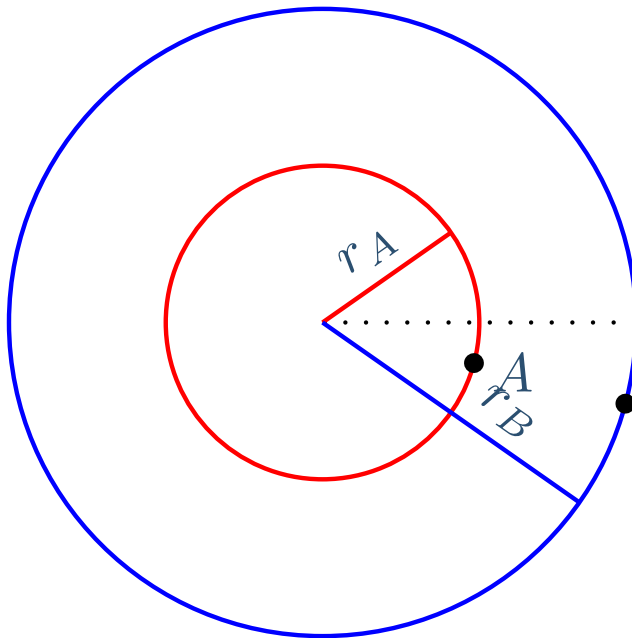
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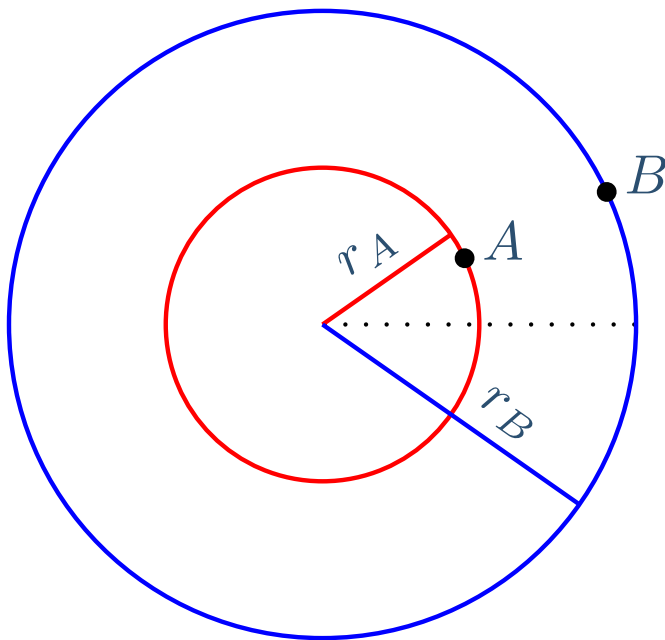
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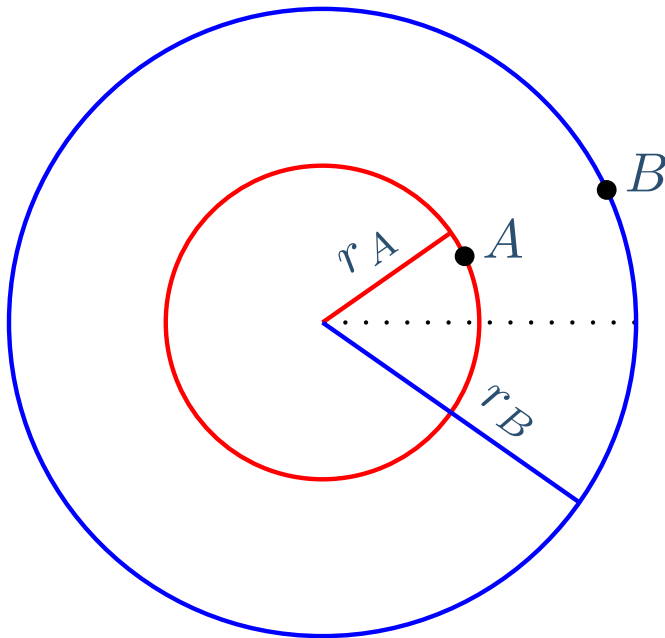
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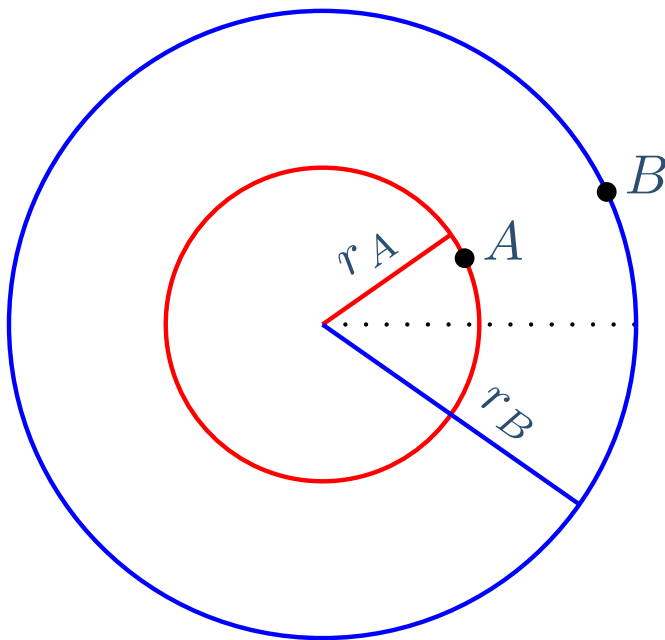
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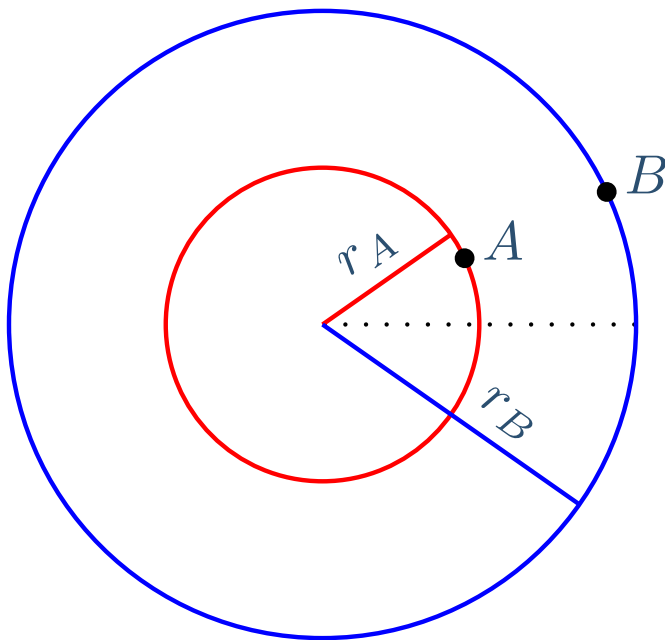
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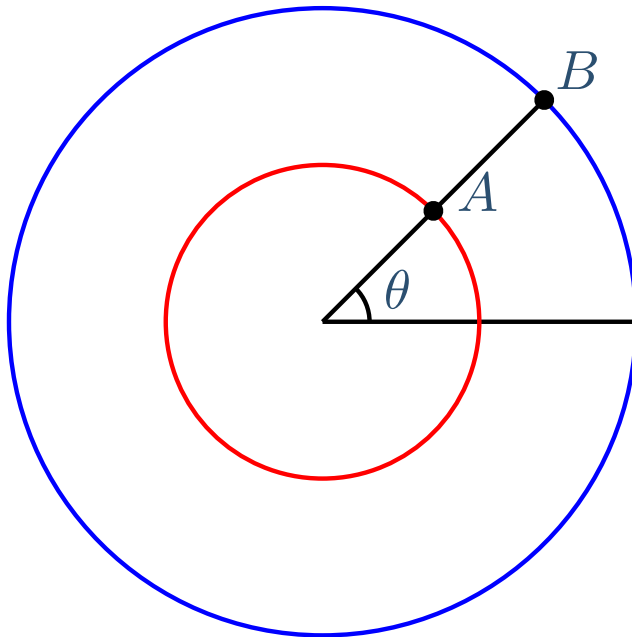
A spinning object has infinitely many speeds

Angular Motion

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

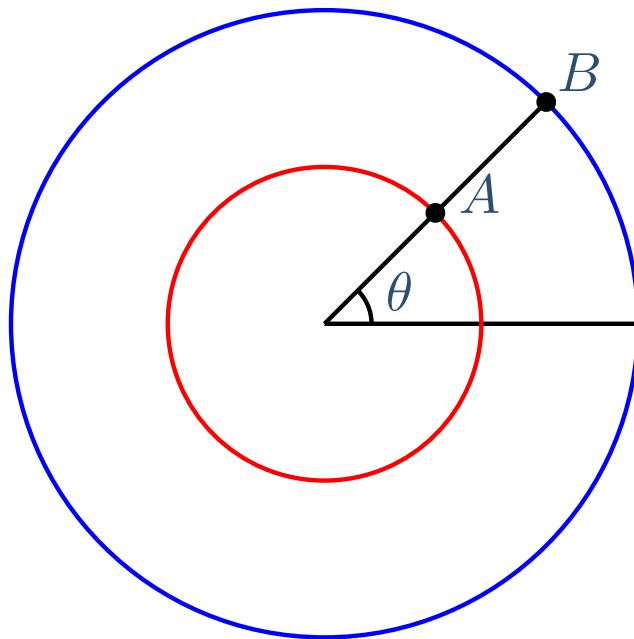
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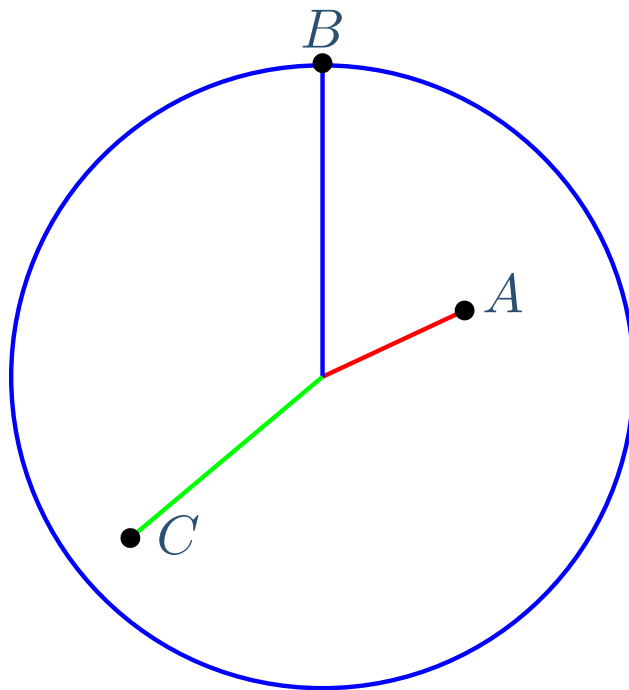
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All points rotate through the same angle

Angular Motion

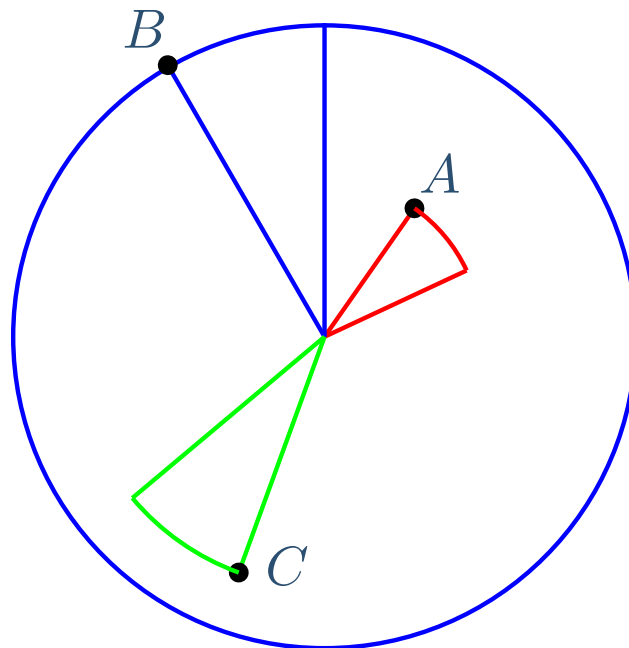
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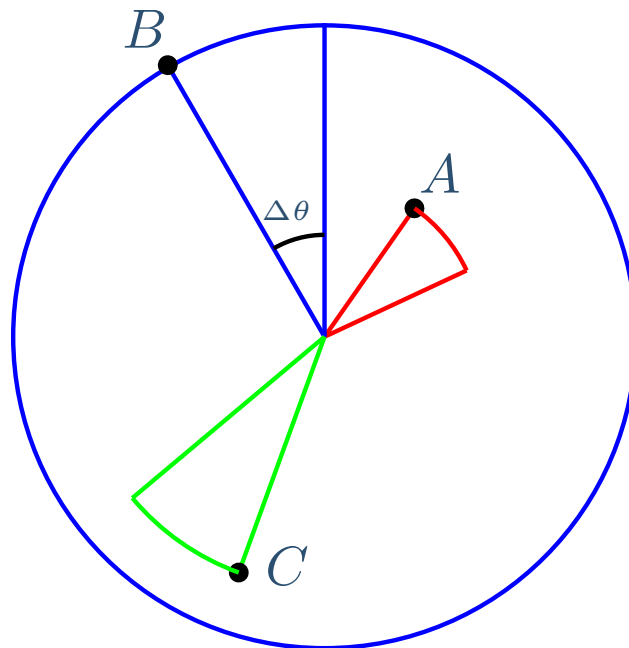
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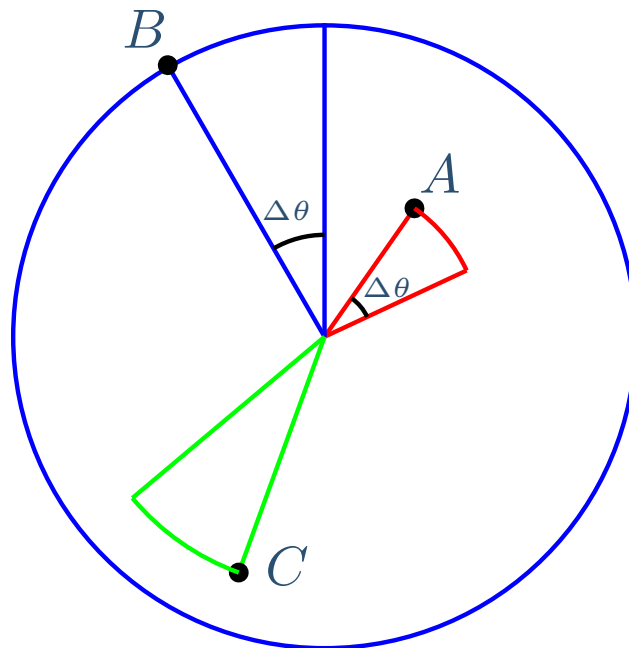
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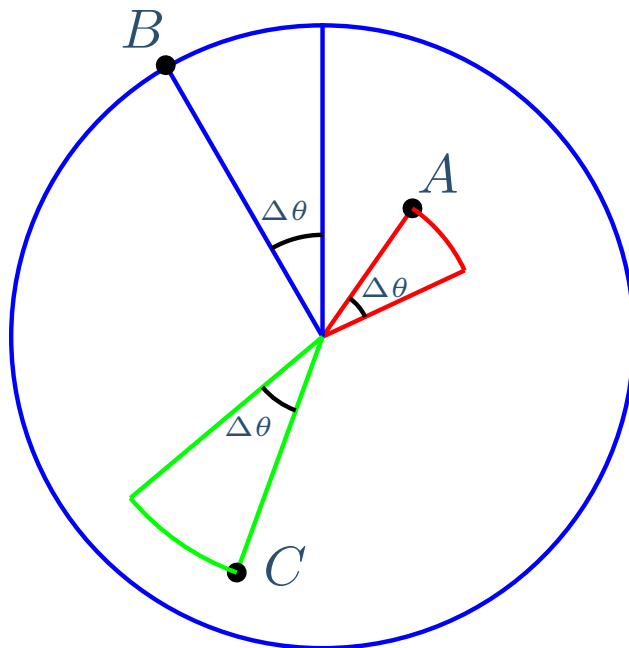
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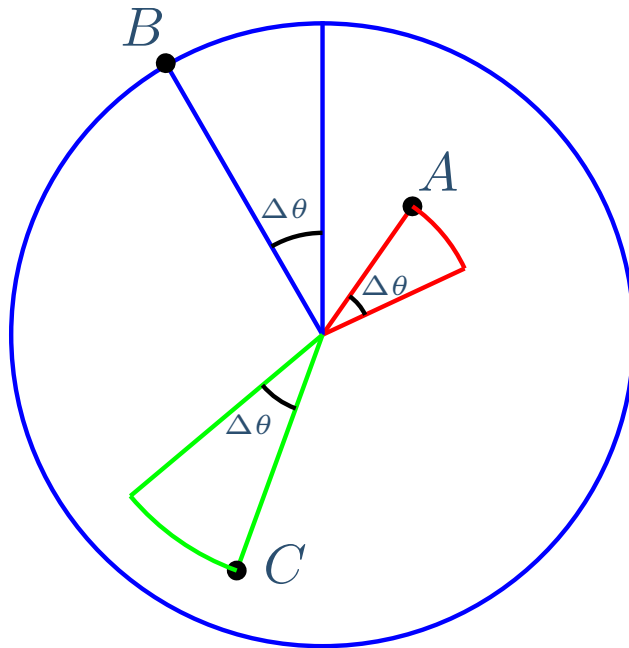
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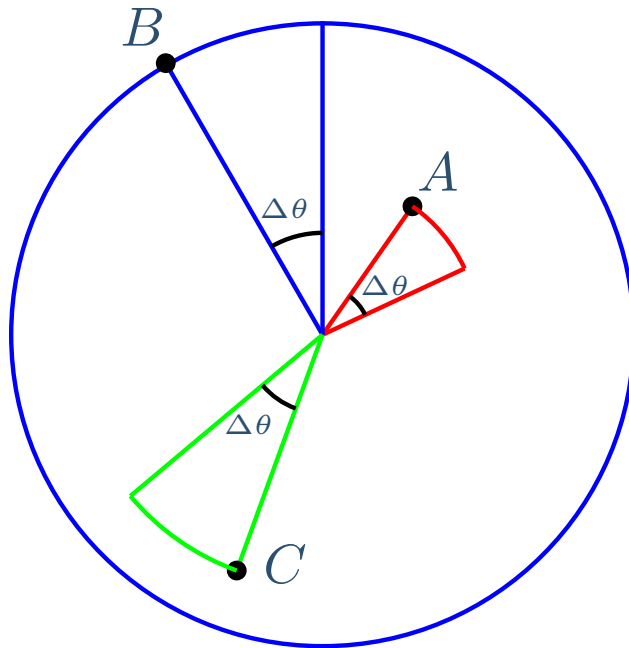


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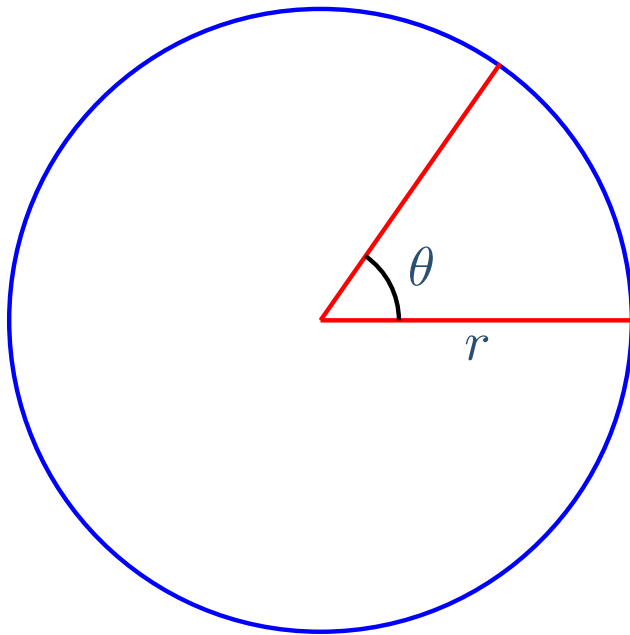
A rotating object has infinitely many linear speeds but only one angular speed

Angle

In this chapter, we'll find it necessary to use radians instead of degrees to measure angles.

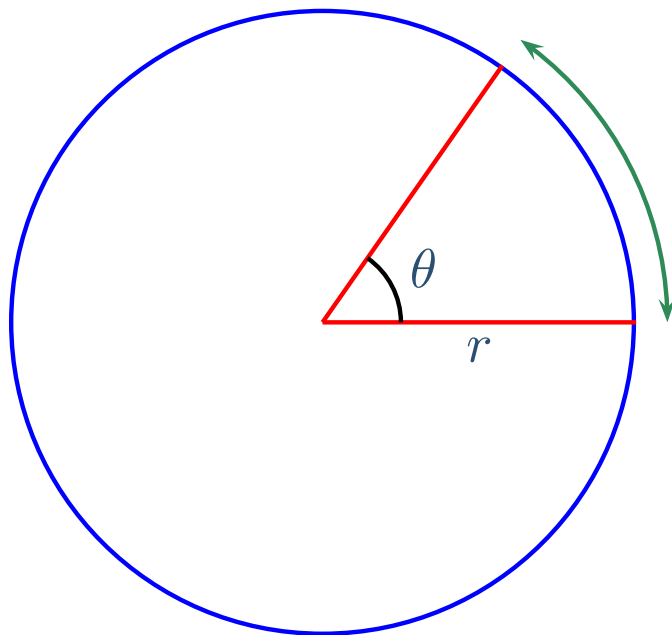
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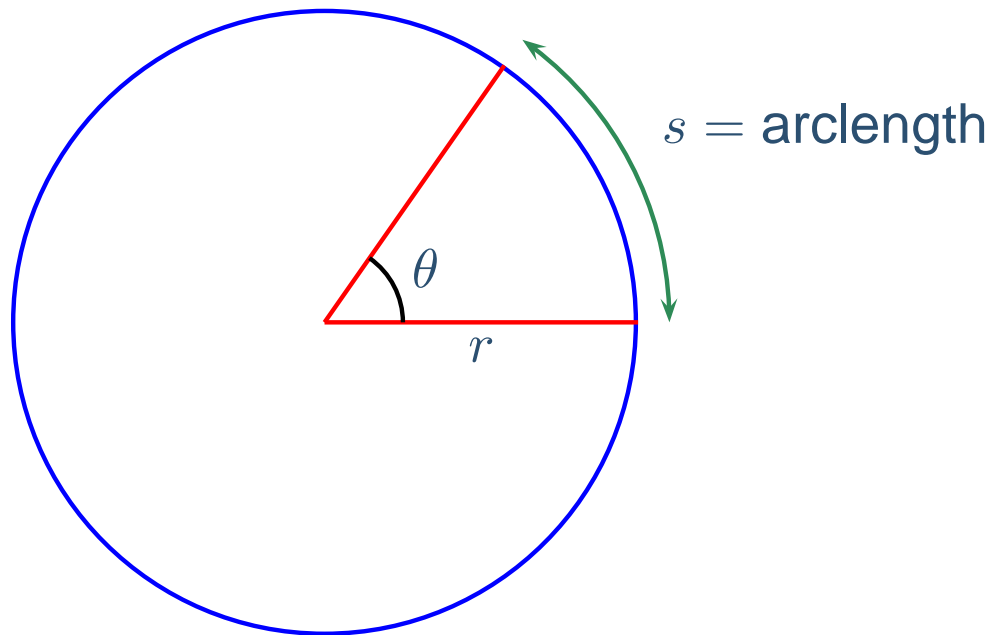
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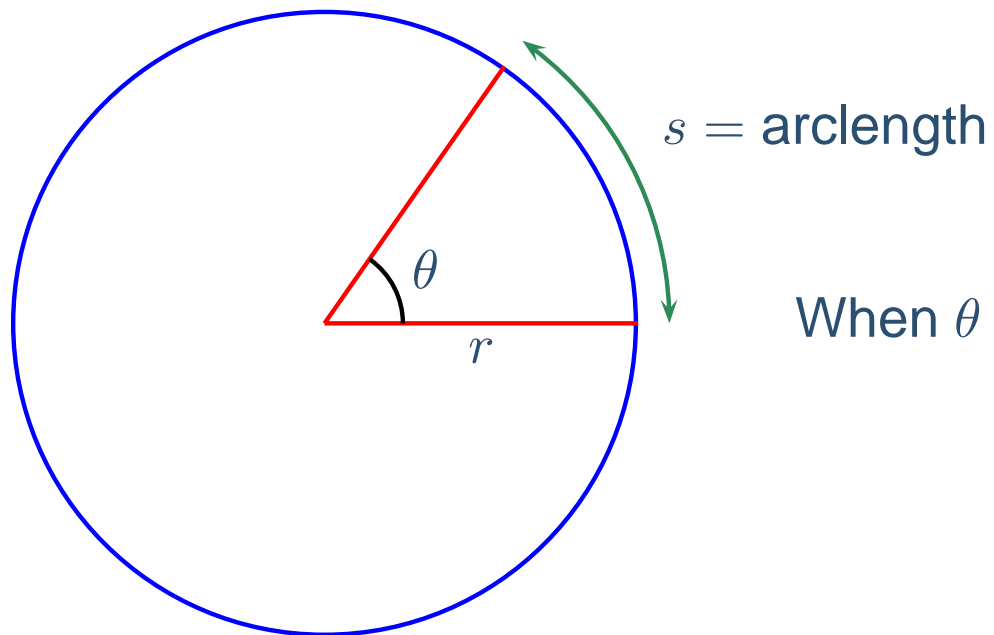
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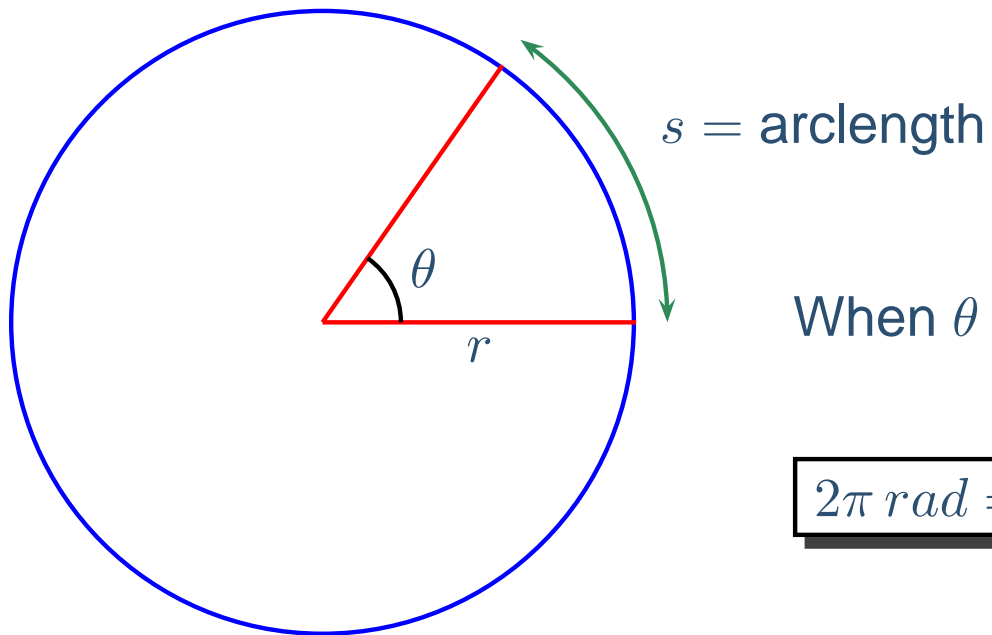
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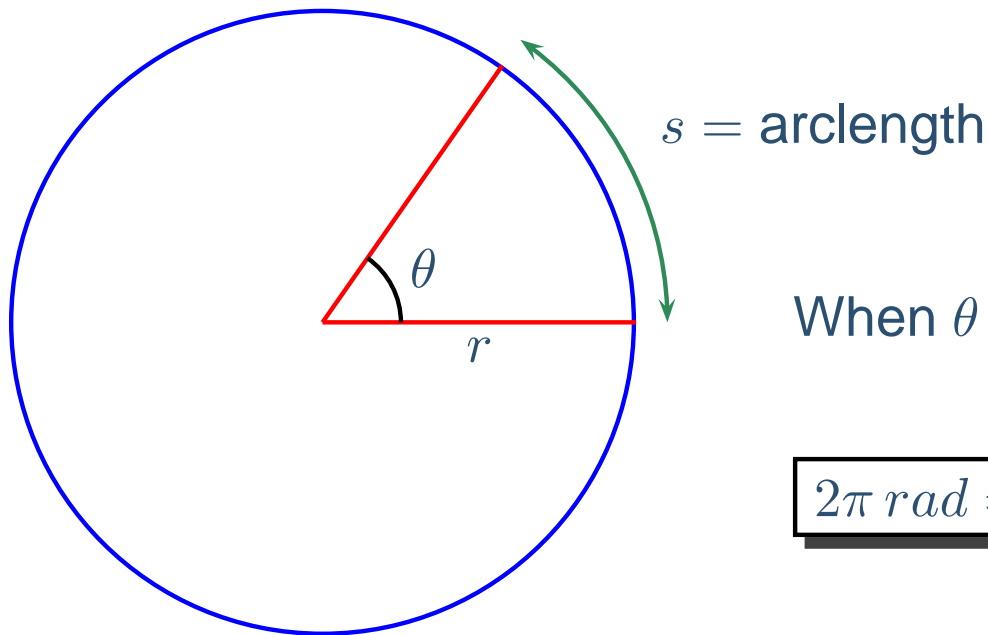


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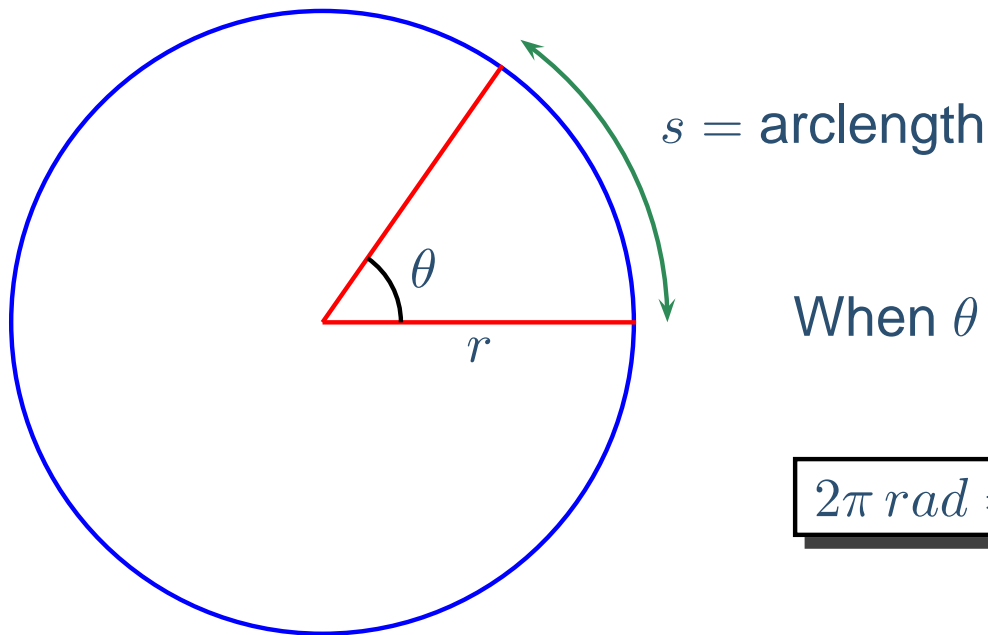
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“*rad*” is a way specify an angular quantity