March 26, Week 10

Today: Chapter 8, Momentum

Homework #8:
Mastering Physics: 8 problems from chapter 8
Written Question: 8.101
Due April 2 at 11:59pm

Exam #4, Friday, April 6.

Practice Problems for chapters 5, 6, and 7 available on Mastering Physics

Review

Momentum: $\boxed{\overrightarrow{\mathbf{p}} = M\overrightarrow{\mathbf{v}}}$ Unit: $kg \cdot m/s$

Momentum measures how “hard" it is to change the velocity of an object.

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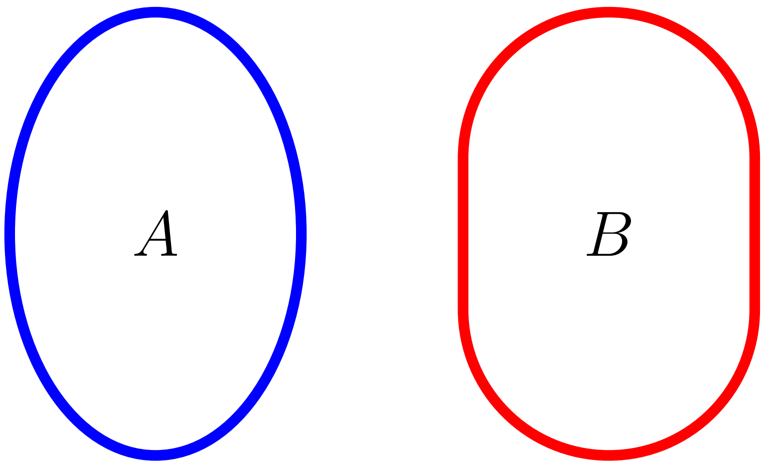
Impulse-Momentum: $\boxed{\overrightarrow{\mathbf{J}} = \overrightarrow{\mathbf{F}}_{av}\Delta t}$ $\boxed{\Sigma\overrightarrow{\mathbf{J}} = \Delta\overrightarrow{\mathbf{p}}}$

Conservation of Momentum

Conservation of Momentum



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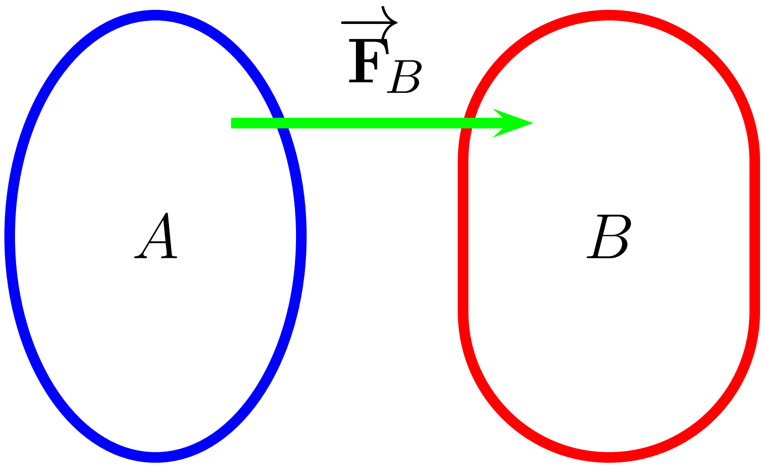
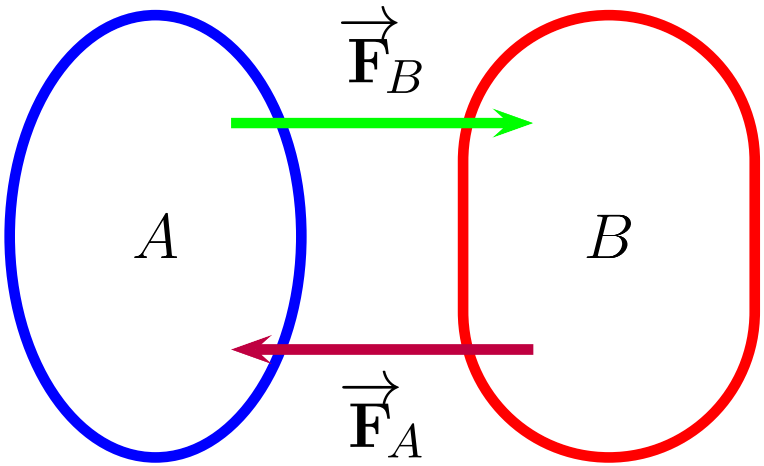


$\vec{\mathbf{F}}_B =$ Force on B due to A

Conservation of Momentum



$\overrightarrow{\mathbf{F}}_B =$ Force on B due to A

$\overrightarrow{\mathbf{F}}_A =$ Force on A due to B

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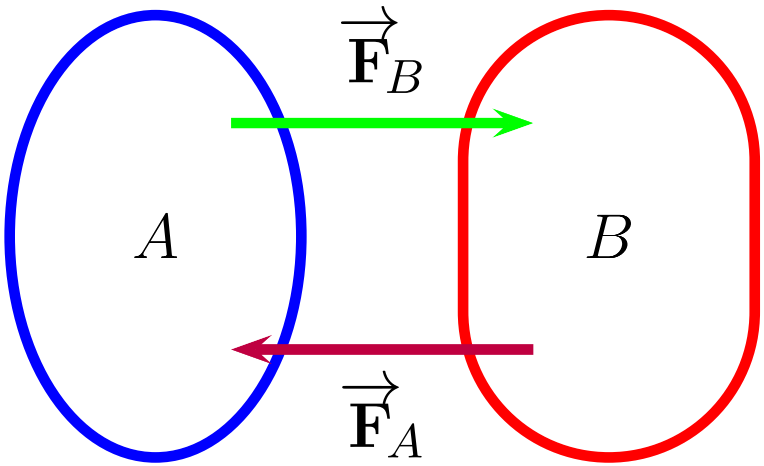

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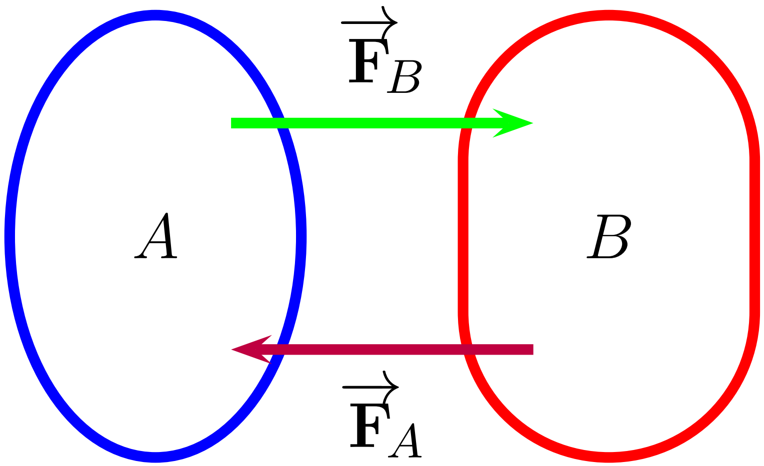

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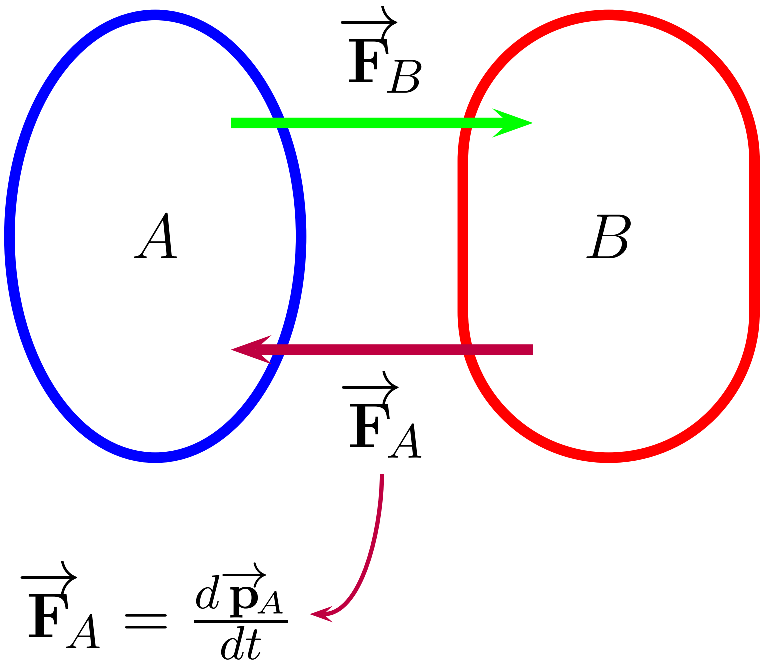

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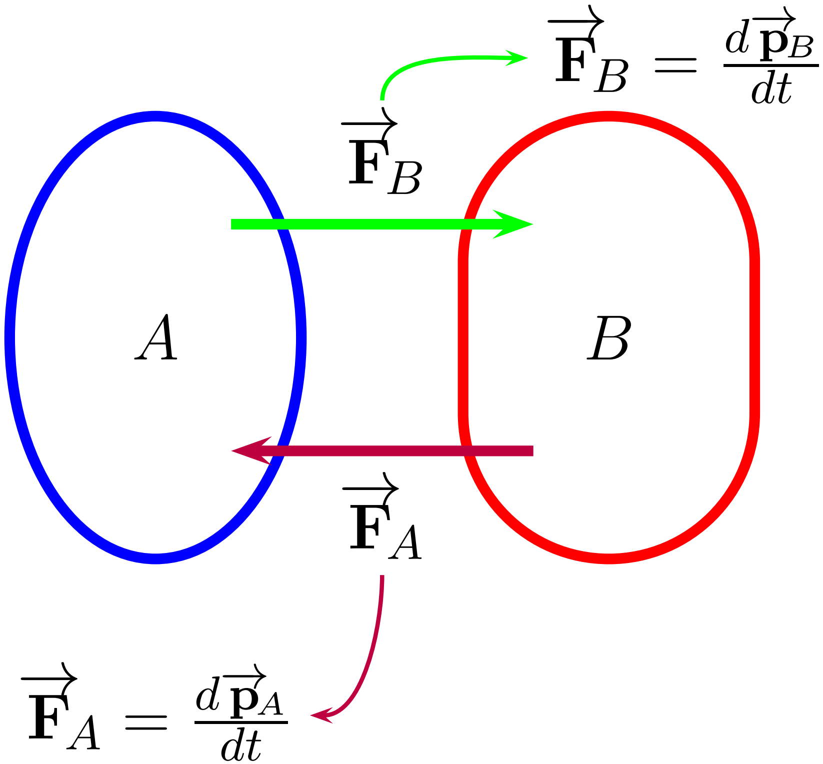

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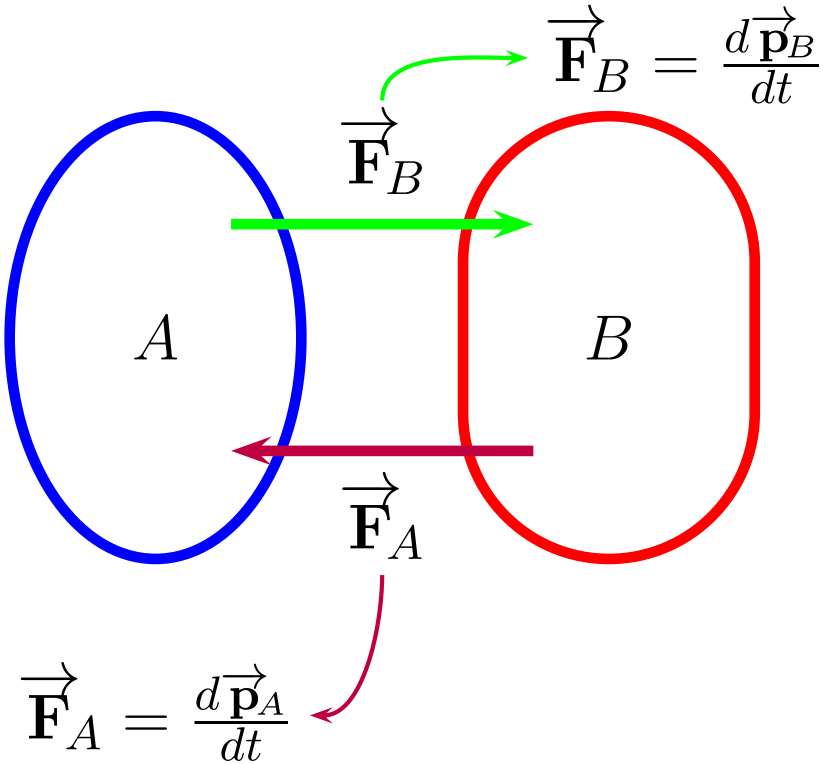

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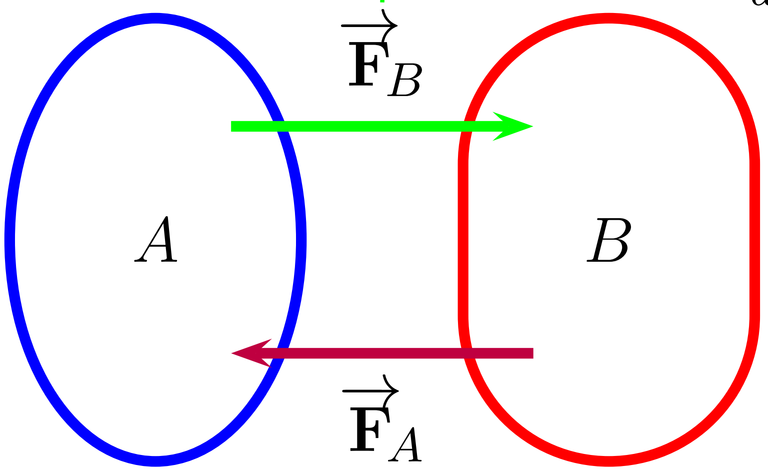
$$\overrightarrow{\mathbf{F}}_B = \frac{d\overrightarrow{\mathbf{p}}_B}{dt}$$



$$\overrightarrow{\mathbf{F}}_A = \frac{d\overrightarrow{\mathbf{p}}_A}{dt}$$

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Conservation of Momentum

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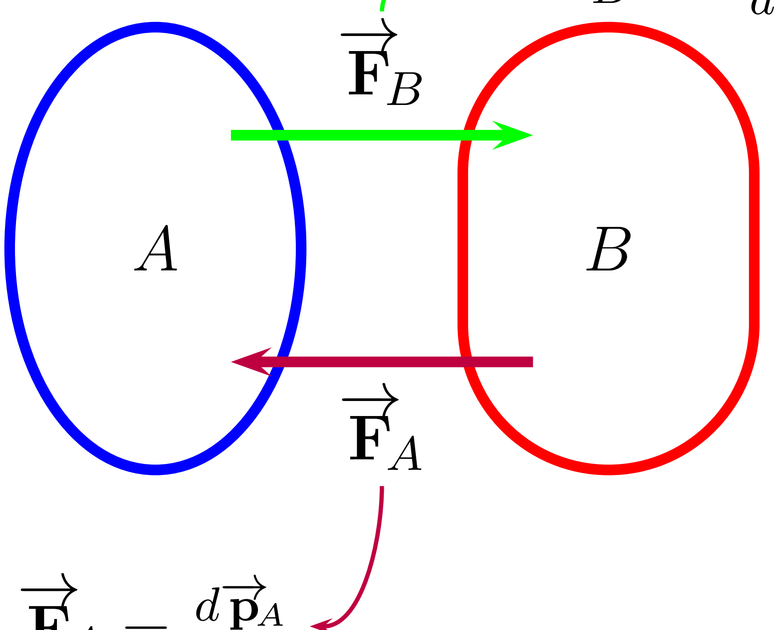

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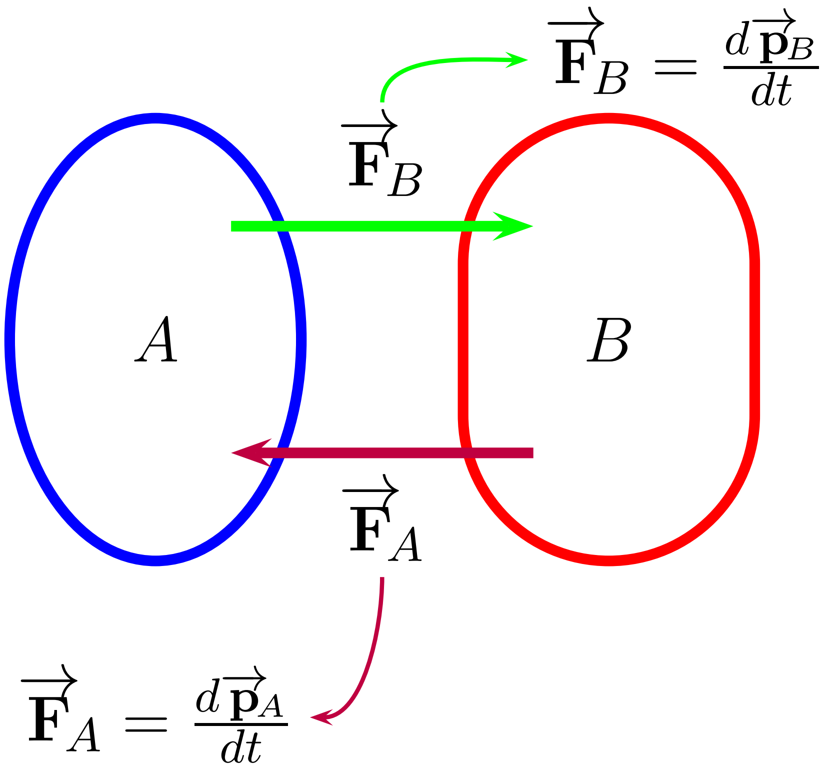
Conservation of Momentum



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$$\Rightarrow \boxed{\Delta\left(\overrightarrow{\mathbf{p}}_A + \overrightarrow{\mathbf{p}}_B\right) = 0}$$

Conservation of Momentum II

$\Delta\left(\vec{\mathbf{p}}_A + \vec{\mathbf{p}}_B\right) = 0 \Rightarrow$ the total momentum of the system can't change.

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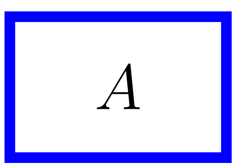

Before

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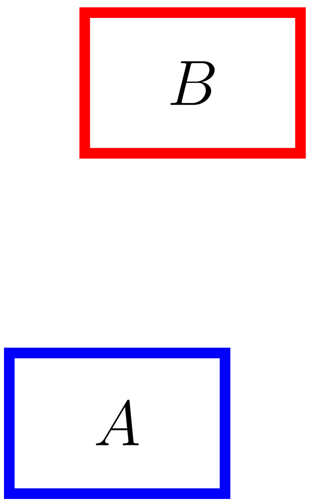

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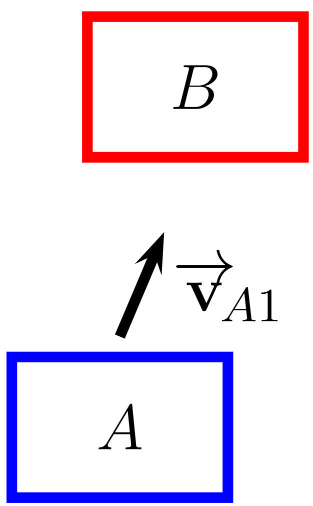

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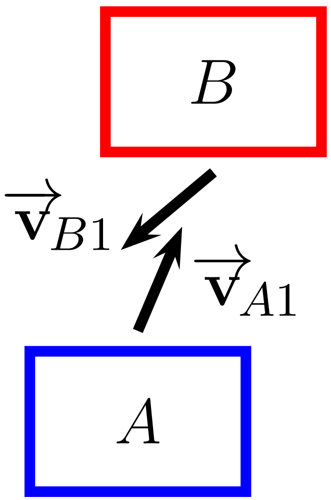

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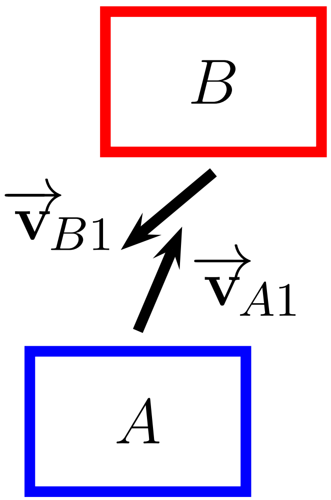

Before

$M_A \overrightarrow{\mathbf{v}}_{A1} + M_B \overrightarrow{\mathbf{v}}_{B1}$

Conservation of Momentum II

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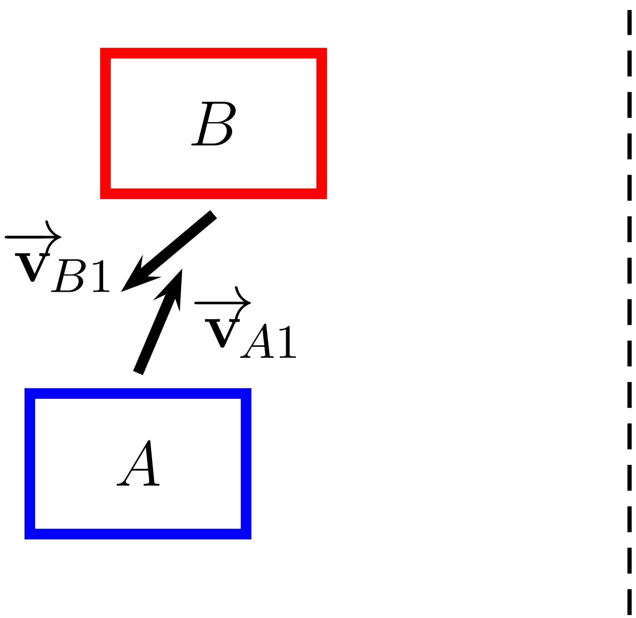

Before After

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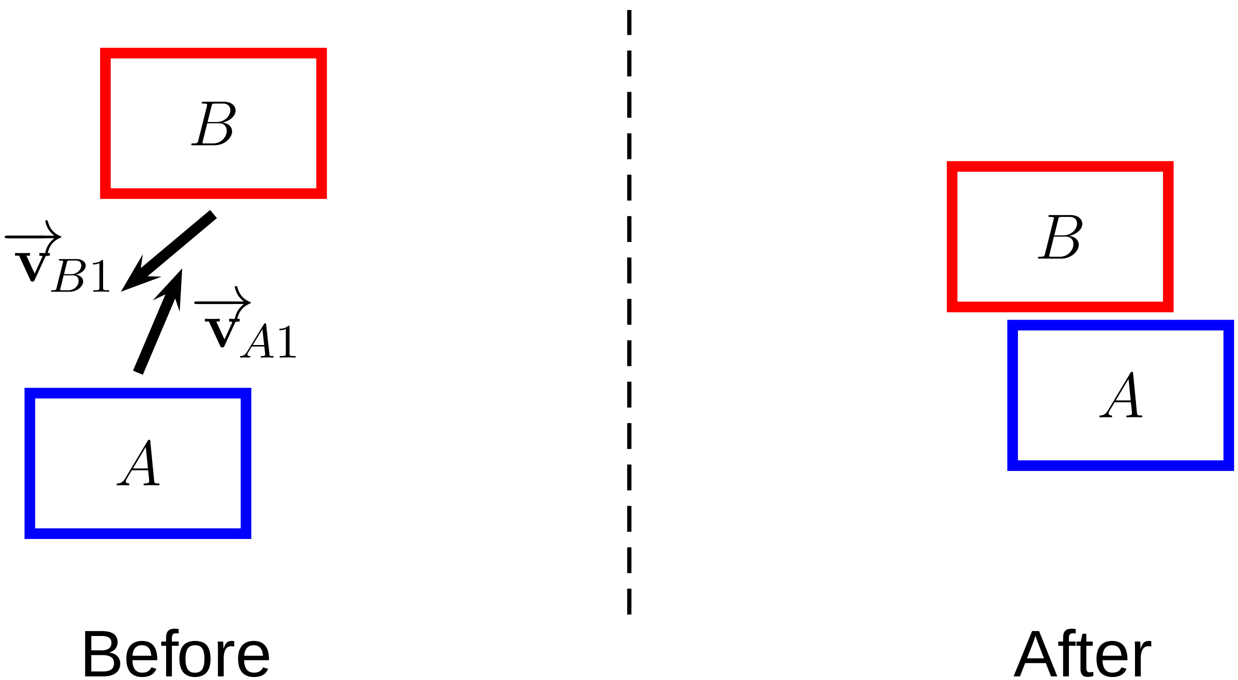

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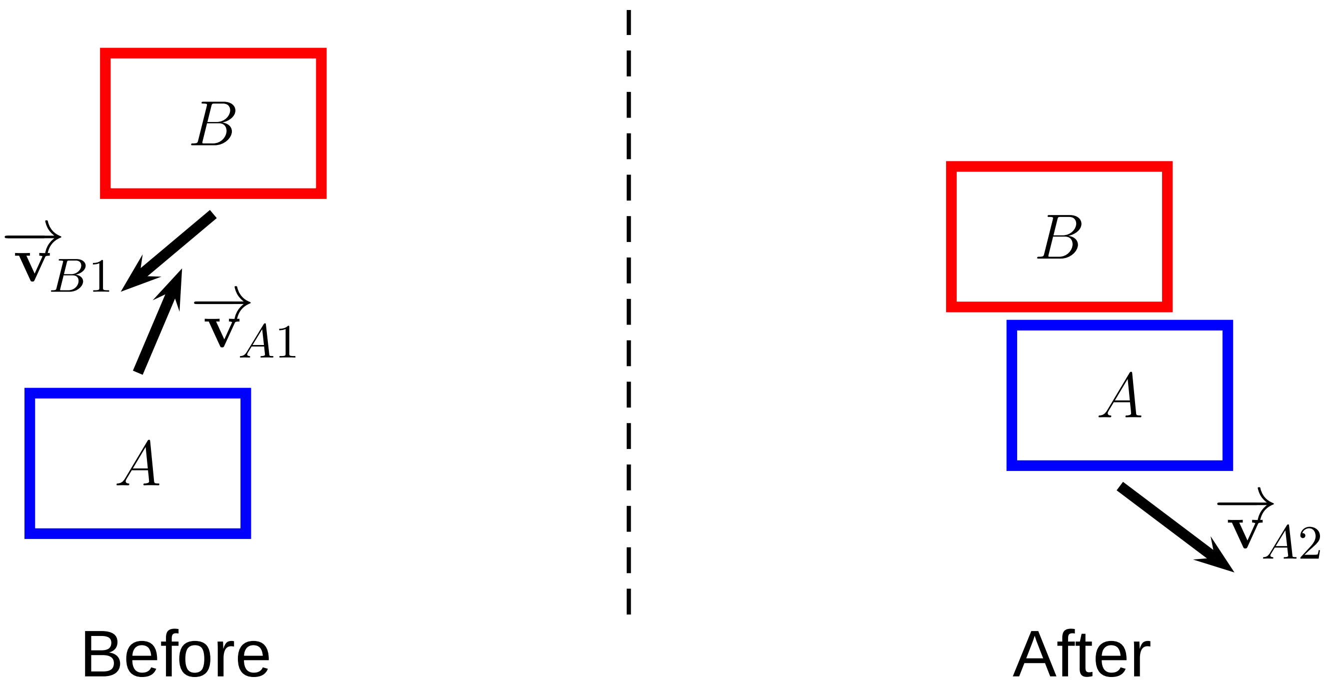

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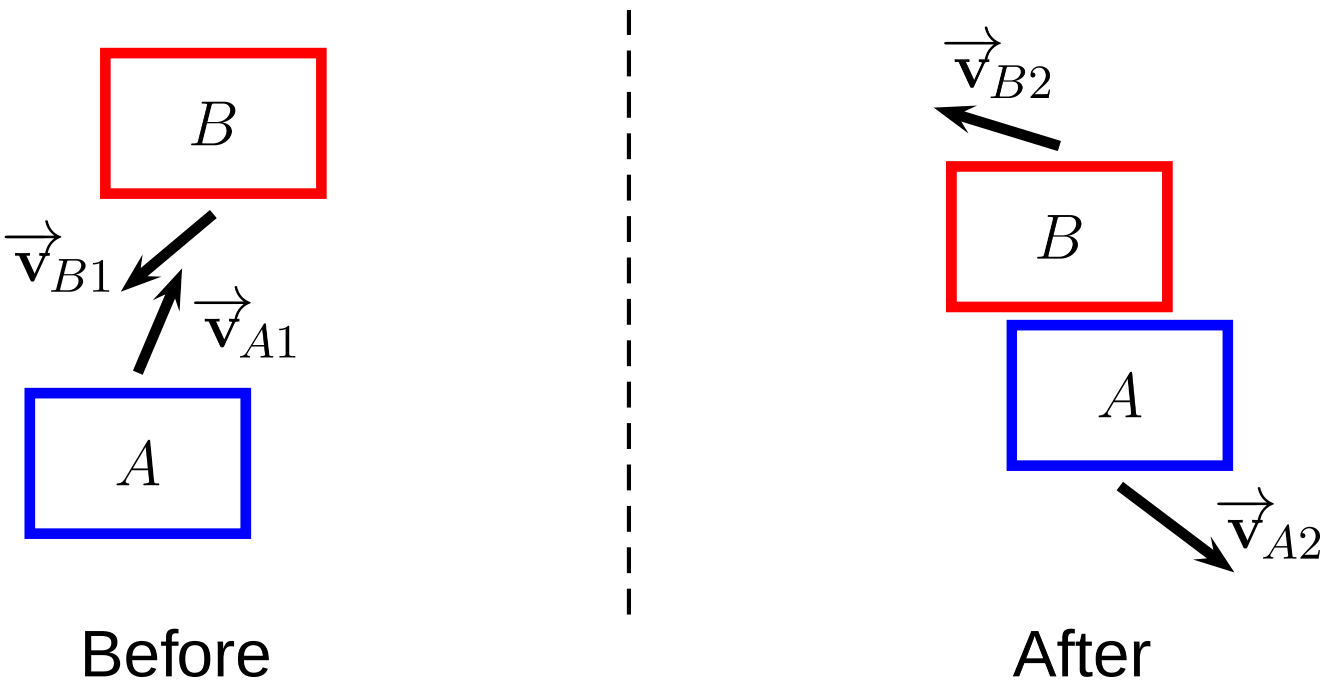

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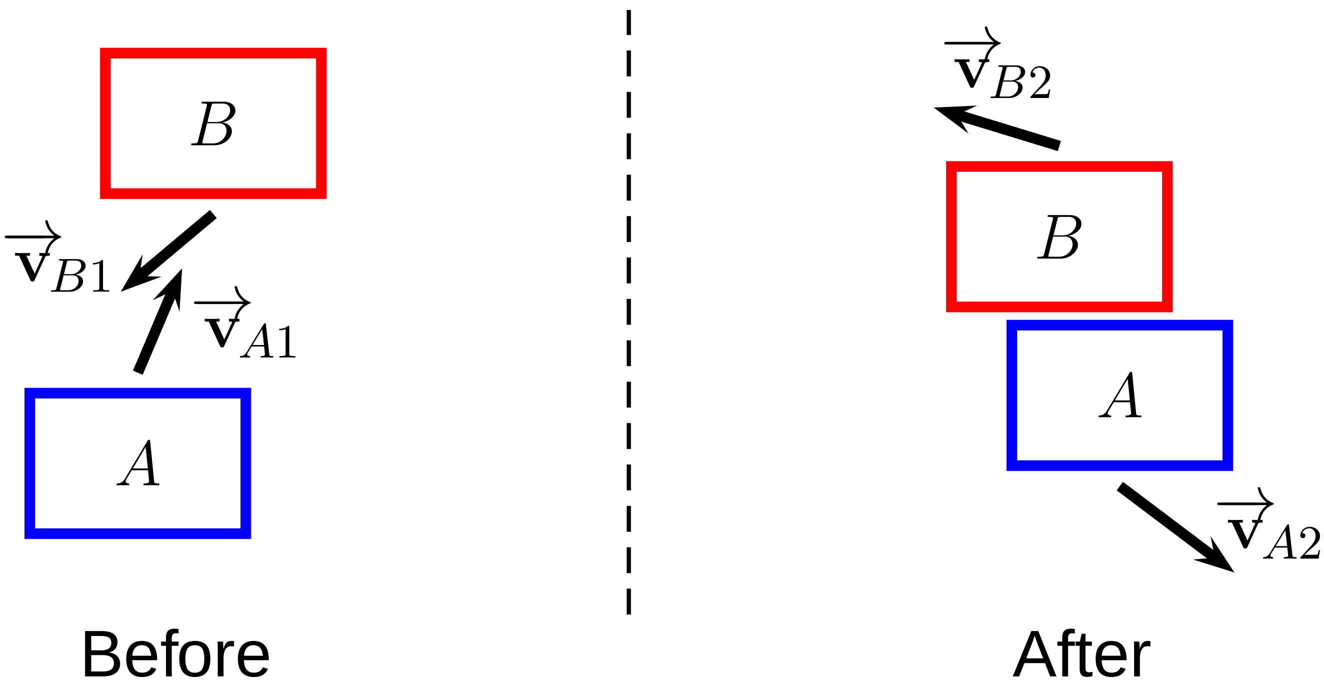

$$M_A \overrightarrow{\mathbf{v}}_{A1} + M_B \overrightarrow{\mathbf{v}}_{B1} \qquad M_A \overrightarrow{\mathbf{v}}_{A2} + M_B \overrightarrow{\mathbf{v}}_{B2}$$

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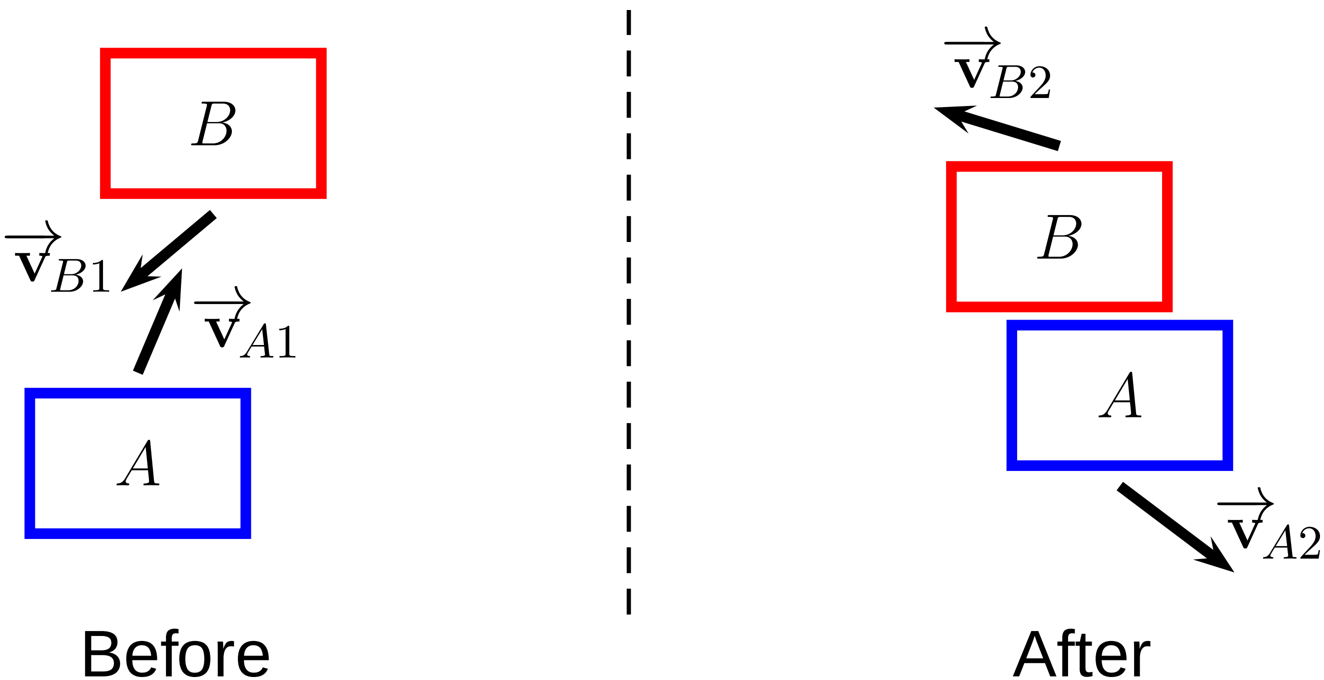

$$M_A \vec{\mathbf{v}}_{A1} + M_B \vec{\mathbf{v}}_{B1} = M_A \vec{\mathbf{v}}_{A2} + M_B \vec{\mathbf{v}}_{B2}$$

Clicker Quiz

A mass $M_A = m$ moving with velocity $3\overrightarrow{\mathbf{v}}$ to the right collides with an object $M_B = 2m$ that is at rest. If M_A bounces to the left with a speed v, how fast must M_B be going?

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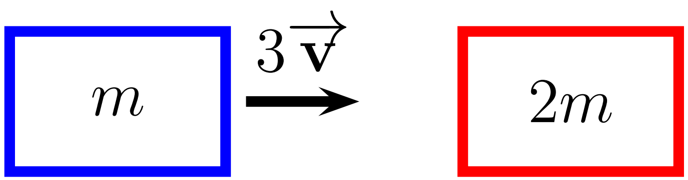

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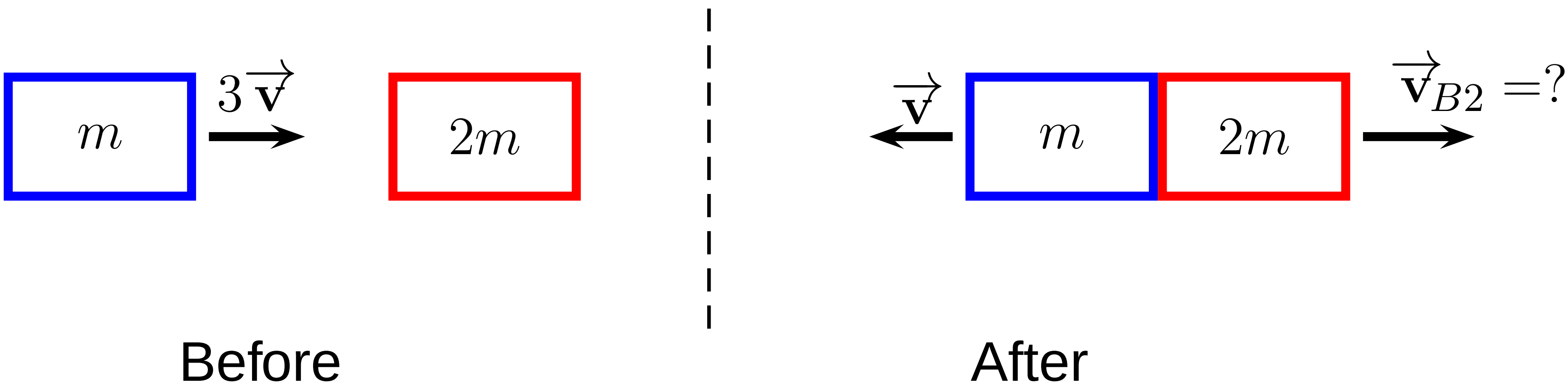

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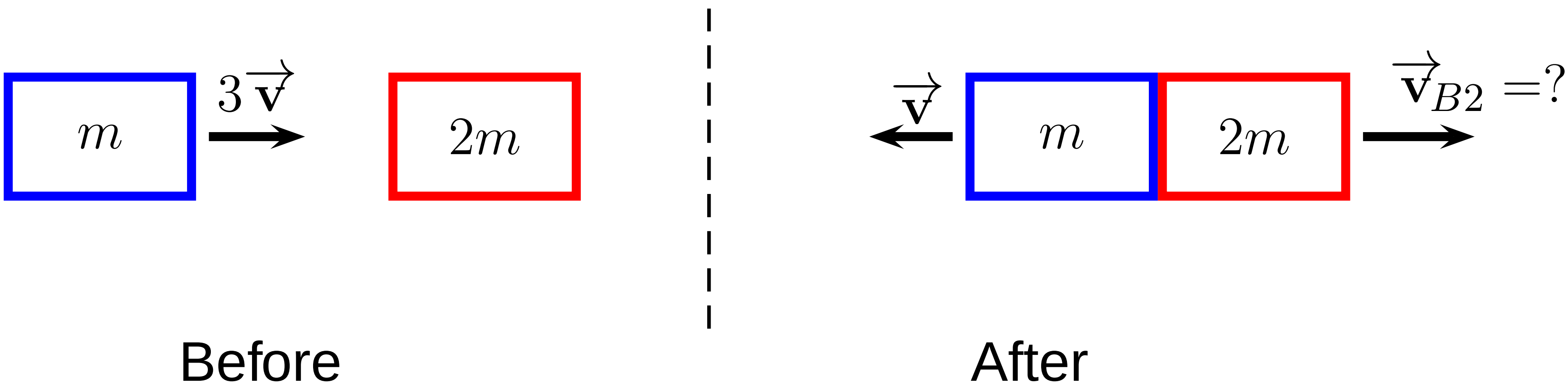

(a) $3v$

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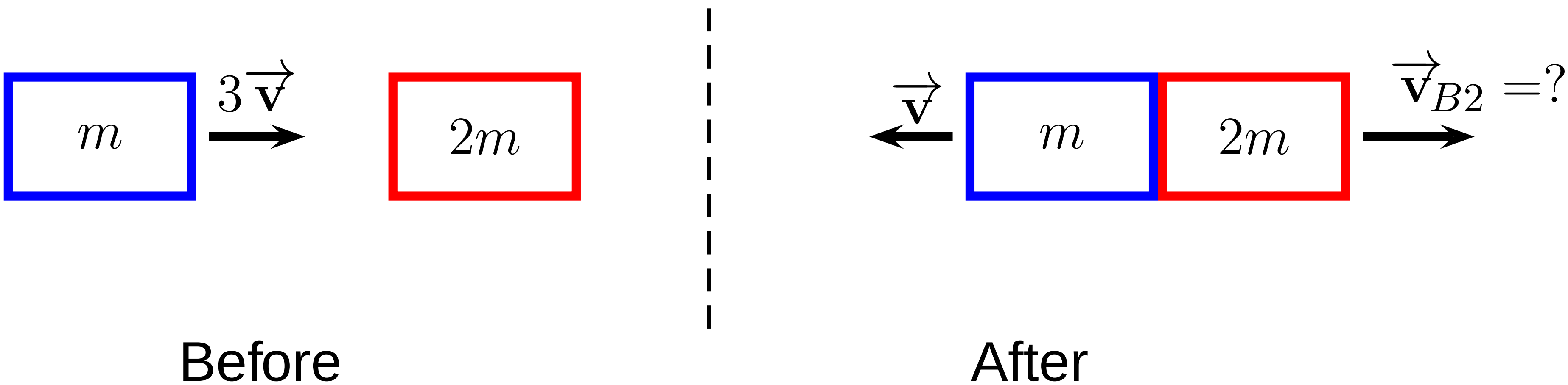

(a) $3v$ (b) $2v$

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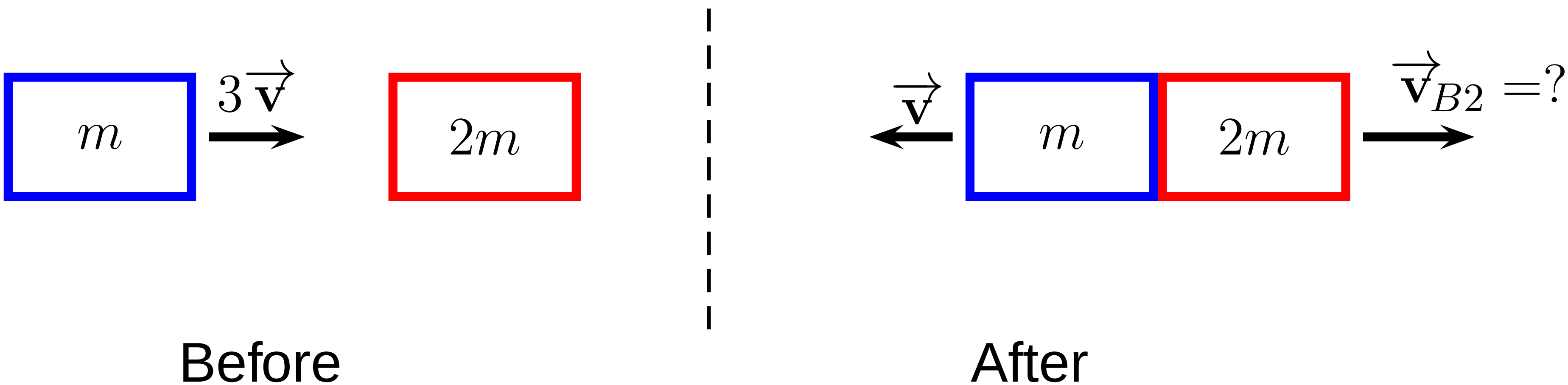

(a) $3v$ (b) $2v$ (c) v

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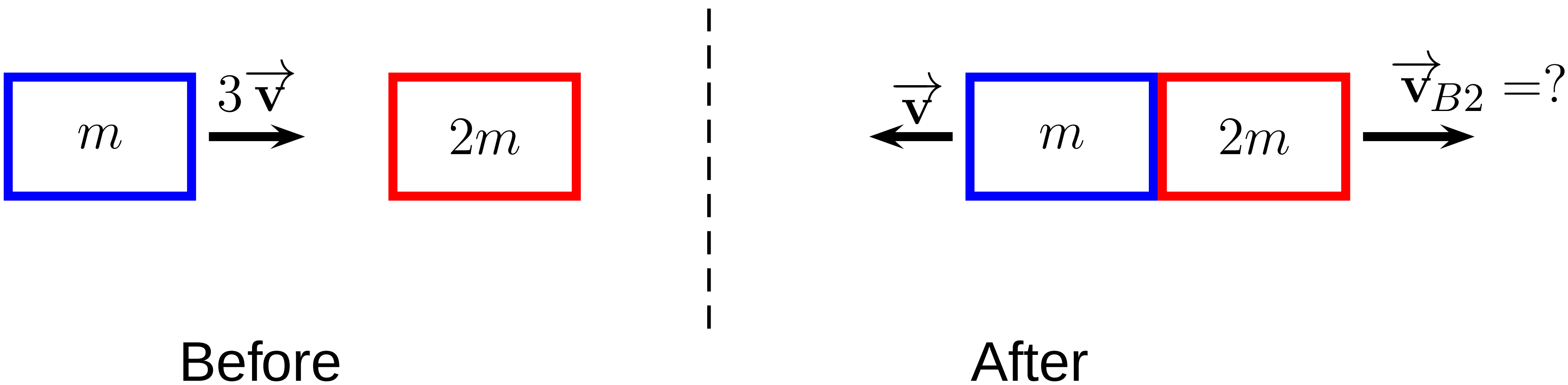

(a) $3v$ (b) $2v$ (c) v (d) 0

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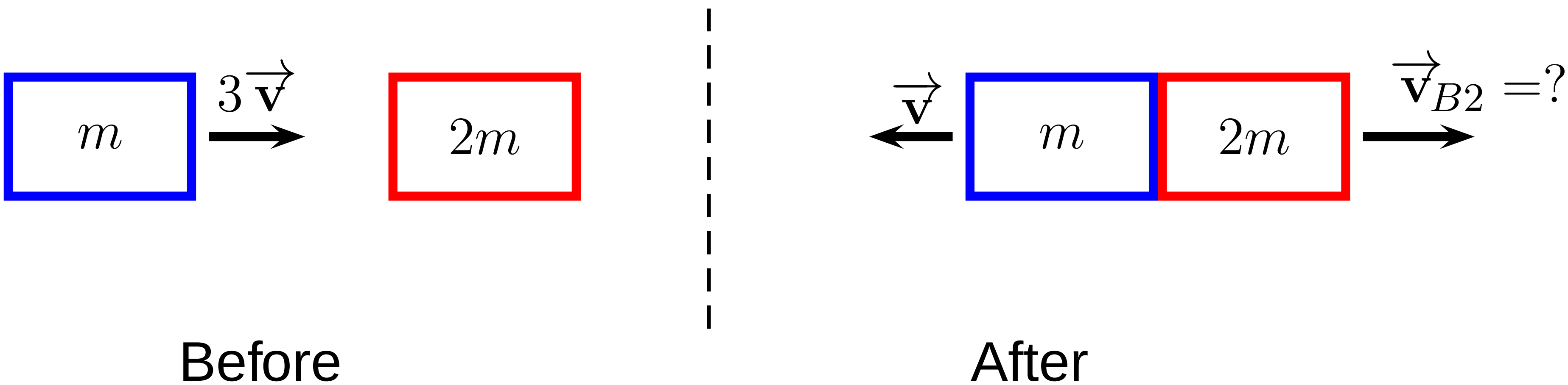

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Examples

$$\boxed{M_A \overrightarrow{\mathbf{v}}_{A1} + M_B \overrightarrow{\mathbf{v}}_{B1} = M_A \overrightarrow{\mathbf{v}}_{A2} + M_B \overrightarrow{\mathbf{v}}_{B2}}$$

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Example: A $M_A = 5$-kg block with $\overrightarrow{\mathbf{v}}_{A1} = 15\,m/s$ to the right hits a $M_B = 12.5$-kg block that has $\overrightarrow{\mathbf{v}}_{B1} = 6\,m/s$ to the left. If M_B bounces with a $\overrightarrow{\mathbf{v}}_{B2} = 3\,m/s$ to the right, what velocity *must* M_A have?

Examples

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

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Example: A $M_A = 5$-kg block with $\overrightarrow{\mathbf{v}}_{A1} = 15\,m/s$ at 45° hits a $M_B = 12.5$-kg block that has $\overrightarrow{\mathbf{v}}_{B1} = 6\,m/s$ to the left. If M_B bounces with a $\overrightarrow{\mathbf{v}}_{B2} = 3.49\,m/s$ to the right, what velocity *must* M_A have?