

Lesson 3: Properties of Vectors

Recall: Properties of Vector Addition

- a) Associative: $\mathbf{a} + (\mathbf{b} + \mathbf{c}) = (\mathbf{a} + \mathbf{b}) + \mathbf{c}$
- b) Commutative: $\mathbf{a} + \mathbf{b} = \mathbf{b} + \mathbf{a}$

Properties of Scalar Multiplication

- a) Associative: $k(m\mathbf{a}) = km(\mathbf{a})$
- b) Distributive: $k(\mathbf{a} + \mathbf{b}) = k\mathbf{a} + k\mathbf{b}$

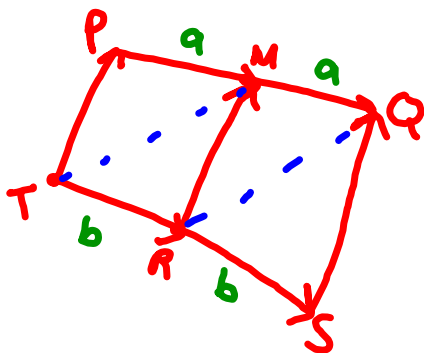
Example 1: Simplify, given $x = 2a - 3b$ and $y = a + 4b$

a) $3x - 5y$ b) $-2(x - y)$

$$\begin{aligned}
 &= 3(2\vec{a} - 3\vec{b}) - 5(\vec{a} + 4\vec{b}) \\
 &= 6\vec{a} - 9\vec{b} - 5\vec{a} - 20\vec{b} \\
 &= \vec{a} - 29\vec{b}
 \end{aligned}$$

$$\begin{aligned}
 &-2(x - y) \\
 &= -2((2\vec{a} - 3\vec{b}) - (\vec{a} + 4\vec{b})) \\
 &= -2(\vec{a} - 7\vec{b}) \\
 &= -2\vec{a} + 14\vec{b}
 \end{aligned}$$

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$$2\vec{RM} = \vec{TP} + \vec{SQ}$$

$$\vec{RM} + \vec{b} = \vec{TM}$$

$$\vec{TP} + \vec{a} = \vec{TM}$$

$$\vec{RM} + \vec{b} = \vec{TP} + \vec{a}$$

$$\vec{RM} + \vec{a} = \vec{RQ}$$

$$\vec{b} + \vec{SQ} = \vec{RQ}$$

$$\vec{RM} + \vec{a} = \vec{b} + \vec{SQ}$$

$$\vec{RM} + \cancel{\vec{b}} + \vec{RM} + \cancel{\vec{a}} = \vec{TP} + \cancel{\vec{a}} + \vec{b} + \vec{SQ}$$

$$2\vec{RM} = \vec{TP} + \vec{SQ}$$

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$$2\vec{x} + 3\vec{y} = \vec{a}$$

$$y = \frac{\vec{a}}{3} - \frac{2}{3}\vec{x}$$

$$\vec{y} = \frac{1}{13}\vec{a} + \frac{12}{13}\vec{b}$$

$$-\vec{x} + 5\vec{y} = 6\vec{b}$$

$$\vec{x} = 5\vec{y} - 6\vec{b}$$

$$\vec{x} = 5\left(\frac{\vec{a}}{3} - \frac{2}{3}\vec{x}\right) - 6\vec{b}$$

$$\vec{x} = \frac{5}{3}\vec{a} - \frac{10}{3}\vec{x} - 6\vec{b}$$

$$\frac{13}{3}\vec{x} = \frac{5}{3}\vec{a} - 6\vec{b}$$

$$\vec{x} = \frac{5}{13}\vec{a} - \frac{18}{13}\vec{b}$$