

# Questions: Vector addition and scalar multiplication

Renee Knapp, Kin Wang Pang

## Summary

A selection of questions for the study guide on vector addition and scalar multiplication.

*Before attempting these questions, it is highly recommended that you read [Guide: Vector addition and scalar multiplication](#).*

## Q1

Answer the following questions.

1.1. If  $\mathbf{a} = 4\mathbf{i} + 5\mathbf{j} + 7\mathbf{k}$  and  $\mathbf{b} = 8\mathbf{i} + 2\mathbf{j} + 4\mathbf{k}$ , find  $\mathbf{a} + \mathbf{b}$ .

1.2. If  $\mathbf{a} = 3\mathbf{j} + 4\mathbf{k}$  and  $\mathbf{b} = 2\mathbf{i} + 5\mathbf{k}$ , find  $\mathbf{a} + \mathbf{b}$ .

1.3. If  $\mathbf{a} = -2\mathbf{i} + 6\mathbf{k}$  and  $\mathbf{b} = -4\mathbf{i} + 11\mathbf{j} - 8\mathbf{k}$ , find  $\mathbf{a} - \mathbf{b}$ .

1.4. If  $\mathbf{a} = 4\mathbf{i} + 12\mathbf{j} - 7\mathbf{k}$ ,  $\mathbf{b} = 3\mathbf{i} - 3\mathbf{j} - 2\mathbf{k}$  and  $\mathbf{c} = 11\mathbf{i} - 4\mathbf{j} + 9\mathbf{k}$ , find  $\mathbf{a} - (\mathbf{b} + \mathbf{c})$ .

## Q2

Solve the following, expressing your answers in terms of the unknown scalars  $x, y, z$ .

2.1. If  $\mathbf{a} = \begin{bmatrix} x \\ 2y \\ 0 \end{bmatrix}$  and  $\mathbf{b} = \begin{bmatrix} 3x \\ 5y \\ 0 \end{bmatrix}$ , find  $\mathbf{a} + \mathbf{b}$ .

2.2. If  $\mathbf{a} = \begin{bmatrix} 5 \\ 3y \\ 5z \end{bmatrix}$  and  $\mathbf{b} = \begin{bmatrix} -2 \\ 2x \\ 6z \end{bmatrix}$ , find  $\mathbf{a} - \mathbf{b}$ .

2.3. If  $\mathbf{a} = \begin{bmatrix} 2x \\ 3y \\ 4z \end{bmatrix}$ ,  $\mathbf{b} = \begin{bmatrix} -2x \\ y \\ 0 \end{bmatrix}$  and  $\mathbf{c} = \begin{bmatrix} 0 \\ 4y \\ 4z \end{bmatrix}$ , find  $\mathbf{a} + \mathbf{b} - \mathbf{c}$ .

2.4. If  $\mathbf{a} = \begin{bmatrix} 2x \\ 3y \\ 5z \end{bmatrix}$ , what is  $\mathbf{a} + \mathbf{0}$ ?

### Q3

Answer the following questions.

3.1. If  $\mathbf{u} = 5\mathbf{j} + 6\mathbf{k}$ , find  $3\mathbf{u}$ .

3.2. If  $\mathbf{v} = \begin{bmatrix} 0 \\ -3 \\ 7 \end{bmatrix}$ , find  $-6\mathbf{v}$ .

3.3. If  $\mathbf{u} = \begin{bmatrix} 0 \\ 5 \\ 6 \end{bmatrix}$  and  $\mathbf{v} = \begin{bmatrix} 0 \\ -3 \\ 7 \end{bmatrix}$ , find  $4\mathbf{v} - 3\mathbf{u}$ .

3.4. If  $\mathbf{u} = \begin{bmatrix} 0 \\ 5 \\ 6 \end{bmatrix}$ ,  $\mathbf{v} = \begin{bmatrix} 0 \\ -3 \\ 7 \end{bmatrix}$  and  $\mathbf{w} = \begin{bmatrix} 2 \\ 3 \\ -4 \end{bmatrix}$ , find  $-2\mathbf{w} - (4\mathbf{u} - 2\mathbf{v})$ .

### Q4

Answer the following questions.

4.1. If  $A = (3, 4, 5)$ ,  $B = (-2, 5, 7)$ , find  $\overrightarrow{AB}$ .

4.2. If  $A = (2, 5, 7)$ ,  $B = (6, 11, 7)$  and  $C = (0, 1, 2)$ , find  $\overrightarrow{AB} - \overrightarrow{AC}$ .

4.3. If  $\overrightarrow{AB} = \begin{bmatrix} 6 \\ 7 \\ -2 \end{bmatrix}$  and  $B = (1, 5, 9)$ , find the coordinates of  $A$ .

4.4. If  $\mathbf{a} = 2\mathbf{i} + 3\mathbf{j}$  and  $\mathbf{b} = 3\mathbf{i} - 5\mathbf{j}$ , find  $13\mathbf{i} - 9\mathbf{j}$  in terms of  $\mathbf{a}$  and  $\mathbf{b}$ .

4.5. If  $\mathbf{a} = \begin{bmatrix} 3 \\ 5 \\ z \end{bmatrix}$ ,  $\mathbf{b} = \begin{bmatrix} -1 \\ -3 \\ 4 \end{bmatrix}$  and  $2\mathbf{a} + 3\mathbf{b} = \begin{bmatrix} x \\ y \\ 0 \end{bmatrix}$ , solve for the unknown scalars  $x, y, z$ .

4.6. Given that  $\mathbf{a}$  and  $\mathbf{b}$  are parallel, if  $\mathbf{a} = (x - 7)\mathbf{i} + (5x + 1)\mathbf{k}$  and  $\mathbf{b} = -2\mathbf{i} + 8\mathbf{k}$ , find  $x$ .

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After attempting the questions above, please click [this link](#) to find the answers.

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## **Version history and licensing**

v1.0: initial version created 08/23 by Renee Knapp, Kin Wang Pang as part of a University of St Andrews STEP project.

- v1.1: edited 05/24 by tdhc.

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