# Questions: Vector addition and scalar multiplication

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**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.