

FULL REVIEW

Full Review — Vector Addition and Subtraction — Calculus-Based

Review the essential ideas, relationships, and problem-solving tools for Vector Addition and Subtraction.

 TIME 45–60 minutes	 BEST FOR A complete topic review	 FINISH WITH A readiness check
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After this full review, you'll be able to...

recall the essential ideas, apply them to representative problems, and determine what to study next.

HOW TO USE THIS GUIDE

Work through the stages in order. Write directly in the spaces provided, check your work in the Solutions section, and finish by choosing the next resource that matches your confidence.

Choose how you want to review: work through this guide, follow the online review, or watch the video review.

[Start the Review Online →](#)

[Watch the Video Review →](#)

YOU WILL NEED

Pencil or pen • Calculator if needed • Approximately 45–60 minutes

FR-02 • COURSE ALIGNMENT

Course Alignment

This Physics Sensei Topic Review is an independent learning resource. Use it to reinforce key concepts, prepare for homework, or review before a quiz or exam.

Related Unit Review: If you need to review the complete unit material, review [Vectors and Components here →](#)

RESOURCE: Physics Sensei Topic Review TOPIC ID: MEC-U02-T02 TOPIC: Vector Addition and Subtraction PARENT UNIT: MEC-U02 — Vectors and Components COURSE LEVEL: Calculus-Based	BEST USED ✓ After learning the topic ✓ Before starting homework ✓ Before a quiz or exam
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FR-03 • YOUR REVIEW PLAN

Your Review Plan

Complete these six stages in order. Each stage builds on the previous one and prepares you for the final readiness check.

6 stages • Approximately 45–60 minutes

1 Warm-Up Check Activate prior knowledge.	2 Core Concepts Review the essential ideas.	3 Guided Practice Apply what you learned.
4 Confidence Check Confirm your understanding.	5 Summary Review the key ideas.	6 Next Step Continue your learning.

PRINTING TIP

For student copies, print double-sided and keep the Solutions section after the student activities so learners attempt each activity before checking their work.

FR-04 • STAGE 1 OF 6

Warm-Up Check

Before you begin, take a moment to see what you already remember. Do not worry about getting everything right. This is only a starting point.

ACTIVITY 1**Recall Activity 1**

Answer before revealing the response.

$\vec{A} = A_x \vec{e}_1 + A_y \vec{e}_2$ and $\vec{B} = B_x \vec{e}_1 + B_y \vec{e}_2$. Write $\vec{A} + \vec{B}$.

ACTIVITY 2**Recall Activity 2**

Answer before revealing the response.

$\vec{r}_1 = (2, -1)$, $\vec{r}_2 = (-1, 3)$. Find $\Delta \vec{r} = \vec{r}_2 - \vec{r}_1$.

FR-04 • WARM-UP CHECK CONTINUED

ACTIVITY 3

Recall Activity 3

Answer before revealing the response.

$\vec{A} = (1, 2)$, $\vec{B} = (-2, 1)$. Find $2\vec{A} - \vec{B}$.

Ready to strengthen your understanding?

You've refreshed what you already know. Next, reinforce the essential concepts that will help you solve problems with confidence.

Continue to Core Concepts →

FR-05 • STAGE 2 OF 6

Core Concepts

Let's rebuild the key ideas one step at a time. Focus on understanding the relationships before worrying about solving problems.

KEY CONCEPT 1

Vector Operations in a Fixed Basis

Choose a fixed basis and combine corresponding coefficients. The basis vectors themselves do not change during ordinary vector addition or subtraction, so the operation is linear and componentwise.

$$\vec{A} \pm \vec{B} = (A_x \pm B_x)\mathbf{e}_1 + (A_y \pm B_y)\mathbf{e}_2$$

EXAMPLE: $\vec{A} = (1, 2)$, $\vec{B} = (-2, 1)$: $\vec{A} + \vec{B} = (-1, 3)$.

SENSEI NOTE: Do not mix components from different basis directions.

KEY CONCEPT 2

Displacement as a Position-Vector Difference

The displacement from one point to another is obtained by subtracting the initial position vector from the final position vector. A translation of the coordinate origin adds the same constant vector to both positions and therefore cancels.

$$\Delta\vec{r} = \vec{r}_2 - \vec{r}_1$$

EXAMPLE: $\vec{r}_1 = (2, -1)$, $\vec{r}_2 = (-1, 3)$: $\Delta\vec{r} = (-3, 4)$, $|\Delta\vec{r}| = 5$.

SENSEI NOTE: Order matters: reversing the subtraction reverses the displacement direction.

FR-05 • CORE CONCEPTS CONTINUED

KEY CONCEPT 3

Linear Combinations Preserve Component Structure

Expressions such as $\alpha\vec{A} + \beta\vec{B}$ are evaluated by distributing the scalars and combining like basis components. This is the same algebra used later with vector-valued functions.

$$\alpha\vec{A} + \beta\vec{B} = (\alpha A_x + \beta B_x)\mathbf{e}_1 + (\alpha A_y + \beta B_y)\mathbf{e}_2$$

EXAMPLE: For $\vec{A} = (2, -1)$, $\vec{B} = (-3, 4)$, $3\vec{A} - 2\vec{B} = (12, -11)$.

SENSEI NOTE: Apply each scalar to every component of its vector before combining terms.

Ready to apply these ideas?

You've reinforced the essential concepts. Now put them into practice by working through guided examples and building your problem-solving confidence.

[Continue to Guided Practice →](#)

FR-06 • STAGE 3 OF 6

Guided Practice

Now it's time to apply what you've reviewed. Work through each activity in order. The examples become gradually more challenging, and each prepares you for the final readiness check.

PRACTICE 1**Worked Example**

Evaluate the complete linear combination.

$\vec{A} = (2, -1)$, $\vec{B} = (-3, 4)$. Find $3\vec{A} - 2\vec{B}$ and its magnitude.

FR-06 • GUIDED PRACTICE CONTINUED

PRACTICE 2

Guided Problem

Use final position minus initial position.

$\vec{r}_1 = 2\mathbf{e}_1 - \mathbf{e}_2$ and $\vec{r}_2 = -\mathbf{e}_1 + 3\mathbf{e}_2$. Find $\Delta\vec{r}$ and $|\Delta\vec{r}|$.

PRACTICE 3

Independent Problem

Subtract vector-valued functions before evaluating time.

$\vec{r}_1(t) = (t^2, 2t)$ and $\vec{r}_2(t) = (3t, t - 1)$. Find $\vec{r}_2(t) - \vec{r}_1(t)$, then evaluate at $t = 2$.

Ready to check your understanding?

You've practiced the essential skills with guidance. Now solve a few short problems on your own and confirm you're ready to move forward.

Continue to Confidence Check →

FR-07 • STAGE 4 OF 6

Confidence Check

You've rebuilt the key ideas and practiced them with guidance. Now try these short questions on your own to check your understanding before moving on.

QUICK CHECK 1**Sum and Difference**

Compute both vectors.

$\vec{A} = (1, -2)$, $\vec{B} = (4, 3)$. Find $\vec{A} + \vec{B}$ and $\vec{A} - \vec{B}$.

QUICK CHECK 2**Position Difference**

Find the displacement and magnitude.

$\vec{r}_1 = (1, 2)$, $\vec{r}_2 = (4, -2)$. Find $\vec{r}_2 - \vec{r}_1$.

FR-07 • CONFIDENCE CHECK CONTINUED

QUICK CHECK 3

Vector-Valued Function Sum

Evaluate at the stated time.

$\vec{A}(t) = (t, t^2)$, $\vec{B}(t) = (2t, -t)$. Find $\vec{A}(2) + \vec{B}(2)$.

HOW DID IT GO?

I answered ____ of 3 questions correctly.

Use the Solutions section to check your reasoning, then take one final look at the essential ideas.

You've checked your understanding.

Take one final look at the essential ideas before deciding what to do next.

Continue to Summary →

FR-08 • STAGE 5 OF 6

Summary

Before moving on, take one final look at the most important ideas from this review.

KEY TAKEAWAY 1

Use a Fixed Basis Consistently

Add and subtract corresponding coefficients while the basis directions remain fixed.

KEY TAKEAWAY 2

Displacement Is a Difference

$\Delta \vec{r} = \vec{r}_2 - \vec{r}_1$ is final minus initial and is unchanged by a common translation of the origin.

KEY TAKEAWAY 3

Linear Combinations Extend Naturally

Scalar multiples and vector-valued functions use the same componentwise addition and subtraction rules.

MY ONE-SENTENCE SUMMARY

In my own words, the most important idea is:

Ready for your next step?

You've reviewed the essential ideas one last time. Now choose the resource that best matches how confident you feel.

Continue to Next Step →

ANSWER KEY • CHECK AFTER ATTEMPTING

Solutions and Explanations

Use these solutions to check your reasoning—not only your final answer.

WARM-UP • ACTIVITY 1**Recall Activity 1**

$$(A_x + B_x)\mathbf{e}_1 + (A_y + B_y)\mathbf{e}_2.$$

WHY IT WORKS: With a fixed basis, vector addition becomes addition of scalar coefficients.

WARM-UP • ACTIVITY 2**Recall Activity 2**

$$(-3, 4).$$

WHY IT WORKS: Final minus initial gives the directed separation between the positions.

WARM-UP • ACTIVITY 3**Recall Activity 3**

$$(4, 3).$$

WHY IT WORKS: Scalar multiplication and vector addition/subtraction distribute over components.

SOLUTIONS • GUIDED PRACTICE

PRACTICE 1**Worked Example**

$$3\vec{A} - 2\vec{B} = (12, -11); \text{ magnitude} = \sqrt{265} \approx 16.3.$$

WHY IT WORKS: Scaling and subtraction are both componentwise; only after combining do you calculate the magnitude.

PRACTICE 2**Guided Problem**

$$\Delta\vec{r} = -3\mathbf{e}_1 + 4\mathbf{e}_2; |\Delta\vec{r}| = 5.$$

WHY IT WORKS: The basis coefficients subtract directly and the common coordinate origin cancels.

PRACTICE 3**Independent Problem**

$$\vec{r}_2 - \vec{r}_1 = (3t - t^2, -t - 1); \text{ at } t = 2, \text{ the separation vector is } (2, -3).$$

WHY IT WORKS: Vector-valued functions add and subtract componentwise at every value of t .

SOLUTIONS • CONFIDENCE CHECK

QUICK CHECK 1

Sum and Difference

(5, 1) and (-3, -5), respectively.

WHY IT WORKS: Corresponding components are combined independently.

QUICK CHECK 2

Position Difference

(3, -4), with magnitude 5.

WHY IT WORKS: Final minus initial gives the directed separation.

QUICK CHECK 3

Vector-Valued Function Sum

(6, 2).

WHY IT WORKS: At $t = 2$, $\vec{A} = (2, 4)$ and $\vec{B} = (4, -2)$; then add components.

READINESS GUIDE

3 correct: You're ready to continue. • 2 correct: Review the missed idea, then continue. • 0–1 correct: Revisit Core Concepts or choose more practice.

FR-09 • STAGE 6 OF 6

Next Step: Continue Learning

Great work! You've completed this review. Choose the next resource that best matches how confident you feel.

 I'm Still Unsure Review the key ideas and examples again. Review Again →	 I Need More Practice Continue with additional practice for this topic. Go to Practice →	 I'm Ready Continue to the next recommended resource. Continue →
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RECOMMENDED LINKS

[Review this topic again →](#)[Find additional practice →](#)[Choose another type of physics help →](#)

Continue reviewing with these companion resources.

[Start the Review Online →](#)[Watch the Video Review →](#)

PHYSICS HELP THAT MAKES SENSE

A Physics Sensei review never ends at the last question. It always guides you toward the next useful step.

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