

FOCUSED REVIEW

Focused Review — Vector Components and Unit Vectors — Calculus-Based

Review the most important ideas, reinforce the essential skills, and confirm you're ready to move on.

 TIME 15–20 minutes	 BEST FOR Focused review	 FINISH WITH Greater confidence
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After this focused review, you'll be able to...

recognize the key concepts, reinforce your problem-solving skills, and continue with greater confidence.

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 15–20 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-T01
TOPIC: Vector Components and Unit Vectors
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

FR-03 • YOUR REVIEW PLAN

Your Review Plan

Complete these six focused stages in order. Each stage reinforces your understanding and prepares you for a final confidence check.

6 stages • Approximately 15–20 minutes

1 Warm-Up Check Refresh key ideas.	2 Core Concepts Reinforce the essentials.	3 Guided Practice Strengthen key skills.
4 Confidence Check Confirm your understanding.	5 Summary Remember the essentials.	6 Next Step Choose your next step.

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 minute to reactivate what you already know. This quick warm-up will help you focus on the most important ideas before moving on.

WARM-UP 1**Key Ideas**

Identify coefficients in the Cartesian basis.

For $A = 3 \hat{i} - 4 \hat{j} + 12 \hat{k}$, list A_x , A_y , and A_z .

WARM-UP 2**Common Mistakes**

Connect components to differentiation.

If $\mathbf{r}(t) = x(t)\hat{i} + y(t)\hat{j}$, what are the components of $d\mathbf{r}/dt$ in a fixed Cartesian basis?

FR-04 • WARM-UP CHECK CONTINUED

WARM-UP 3

Quick Application

Check a unit vector.

Given $A=(3,4,0)$, write the unit vector $\hat{A}$ in the direction of A .

Ready to strengthen your understanding?

You've refreshed the most important ideas. Now reinforce the concepts you'll use most often.

Continue to Core Concepts →

FR-05 • STAGE 2 OF 6

Core Concepts

Let's reinforce the most important concepts you'll need to solve problems with confidence. Focus on the ideas that appear most often in homework, quizzes, and exams.

KEY CONCEPT 1

Cartesian Basis Representation

A Cartesian vector is a linear combination of orthonormal basis vectors. The coefficients are the vector components in that basis.

$$\mathbf{A} = A_x \hat{i} + A_y \hat{j} + A_z \hat{k}$$

EXAMPLE (2,-1,3) means $2\hat{i} - \hat{j} + 3\hat{k}$.

SENSEI NOTE Changing coordinates changes components, not the underlying geometric vector.

KEY CONCEPT 2

Unit Vector in an Arbitrary Direction

Normalize a nonzero vector to isolate direction. This is useful for forces, fields, and directional derivatives.

$$\hat{\mathbf{A}} = \mathbf{A}/|\mathbf{A}|$$

EXAMPLE For $\mathbf{A}=(3,4,0)$, $\hat{\mathbf{A}}=(3/5,4/5,0)$.

SENSEI NOTE Normalization is undefined for the zero vector.

Ready to apply these ideas?

You've reinforced the essential concepts. Now strengthen your problem-solving skills by working through a few guided examples.

[Continue to Guided Practice →](#)

FR-06 • STAGE 3 OF 6

Guided Practice

Now apply the key concepts you've just reviewed. Work through these focused practice activities to reinforce your problem-solving skills before the final confidence check.

PRACTICE 1

Guided Example

For $A=(2,-3,6)$, find $|A|$ and $\hat{A}$.

$$|A|=7; \hat{A}=(2/7)\hat{i}-(3/7)\hat{j}+(6/7)\hat{k}.$$

PRACTICE 2

Independent Check

Let $r(t)=t^2 \hat{i} + 3t \hat{j}$. Find $v(t)=dr/dt$ and $v(2)$.

$$v(t)=2t \hat{i}+3 \hat{j}; v(2)=4 \hat{i}+3 \hat{j}.$$

Ready for a confidence check?

You've reinforced the essential skills through focused practice. Now confirm your understanding with two short questions.

[Continue to Confidence Check →](#)

FR-07 • STAGE 4 OF 6

Confidence Check

You've reinforced the key concepts and practiced the essential skills. Now confirm you're ready to move forward by completing these short confidence checks.

CONFIDENCE CHECK 1

Normalization

Normalize the vector.

Find a unit vector parallel to $(0, -5, 12)$.

CONFIDENCE CHECK 2

Component Derivative

Differentiate componentwise.

If $A(t) = \sin t \hat{i} + t^2 \hat{j}$, find dA/dt .

HOW DID IT GO?

I answered ____ of 2 questions correctly.

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

You've confirmed your understanding.

Take one final look at the essential ideas before choosing your next step.

Continue to Summary →

FR-08 • STAGE 5 OF 6

Summary

Before moving on, take one final look at the essential ideas you'll want to remember.

KEY TAKEAWAY 1**Basis Expansion**

Components are scalar coefficients relative to a chosen basis.

KEY TAKEAWAY 2**Normalization**

Dividing a nonzero vector by its magnitude produces its direction unit vector.

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. Replace each placeholder with a concise answer and the essential explanation.

WARM-UP • ACTIVITY 1

Key Ideas

$$A_x=3, A_y=-4, A_z=12.$$

WHY IT WORKS The scalar coefficients of the basis vectors are the Cartesian components.

WARM-UP • ACTIVITY 2

Common Mistakes

$$dx/dt \text{ and } dy/dt.$$

WHY IT WORKS The Cartesian basis vectors are constant, so differentiation acts on the scalar component functions.

WARM-UP • ACTIVITY 3

Quick Application

$$\hat{A}=(3/5)\hat{i}+(4/5)\hat{j}.$$

WHY IT WORKS Dividing a vector by its magnitude produces a vector of magnitude 1.

SOLUTIONS • GUIDED PRACTICE

PRACTICE 1**Guided Example**

$$|A|=7; \hat{A}=(2/7)\hat{i}-(3/7)\hat{j}+(6/7)\hat{k}.$$

WHY IT WORKS The solution follows directly from the component equations and direction conventions reviewed above.

PRACTICE 2**Independent Check**

$$\mathbf{v}(t)=2t\hat{i}+3\hat{j}; \mathbf{v}(2)=4\hat{i}+3\hat{j}.$$

WHY IT WORKS The solution follows directly from the component equations and direction conventions reviewed above.

SOLUTIONS • CONFIDENCE CHECK

CONFIDENCE CHECK 1

Normalization

$(0, -5/13, 12/13)$.

WHY IT WORKS The component signs, magnitude relation, and basis notation determine the result.

CONFIDENCE CHECK 2

Component Derivative

$\cos t \hat{i} + 2t \hat{j}$.

WHY IT WORKS The component signs, magnitude relation, and basis notation determine the result.

READINESS GUIDE

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

FR-09 • STAGE 6 OF 6

Next Step: Continue Learning

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

? I'm Still Unsure Review the focused review again to strengthen the essential concepts. Review Again →	🎯 I Need More Practice Build confidence with additional practice problems. Go to Practice →	✓ I'm Ready Continue to the next topic or learning 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.

PhysicsSensei.com