

FOCUSED REVIEW

Focused Review — Two-Dimensional Kinematics with Components — 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 [Motion in Two Dimensions here →](#)

RESOURCE: Physics Sensei Topic Review
TOPIC ID: MEC-U04-T01
TOPIC: Two-Dimensional Kinematics with Components
PARENT UNIT: MEC-U04 — Motion in Two Dimensions
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**

Answer before revealing the response.

A 12 m/s velocity is directed 60° above $+x$. Which component uses cosine if the angle is measured from $+x$?

WARM-UP 2**Common Mistakes**

Answer before revealing the response.

Why can the vector equation $\mathbf{a} = d\mathbf{v}/dt$ be handled as separate x- and y-component equations for the same motion?

FR-04 • WARM-UP CHECK CONTINUED

WARM-UP 3

Quick Application

Answer before revealing the response.

A velocity has components 6 m/s and 8 m/s. What is its speed?

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

Resolving vectors into component functions

Choose axes and resolve magnitude-angle vectors into signed components before applying calculus. The same components can be written as $\mathbf{v}(t) = \langle v_x(t), v_y(t) \rangle$ or $\mathbf{r}(t) = \langle x(t), y(t) \rangle$. If θ is measured from $+x$, $v_x = v \cos \theta$ and $v_y = v \sin \theta$, with signs determined by the actual directions.

$$\mathbf{v} = \langle v_x, v_y \rangle = \langle v \cos \theta, v \sin \theta \rangle; \quad \mathbf{v}(t) = d\mathbf{r}/dt$$

EXAMPLE A 12 m/s vector at 60° has components (6.0, 10.4) m/s. Those are the velocity components used in the vector function $\mathbf{v}(t)$.

SENSEI NOTE Vector calculus begins after the components are defined. Sketch the vector and axes first so the signs and trigonometric factors are correct.

KEY CONCEPT 2

Component kinematics through derivatives and integrals

Velocity and acceleration remain componentwise: $v_x = dx/dt$, $v_y = dy/dt$, $a_x = dv_x/dt$, and $a_y = dv_y/dt$. Integrate each axis over the same elapsed time. For constant acceleration, these integrals produce the familiar one-dimensional kinematic equations separately in x and y .

$$\mathbf{v}_i(t) = \mathbf{v}_i(0) + \int_0^t \mathbf{a}_i(\tau) d\tau; \quad \text{if } \mathbf{a}_i \text{ is constant: } \Delta \mathbf{r}_i(t) = \mathbf{v}_i(0)t + \frac{1}{2}\mathbf{a}_i t^2$$

EXAMPLE If $v_x(0) = 4$ m/s and $a_x = 2$ m/s², then after 3 s the horizontal displacement is 21 m, exactly as in the constant-acceleration component equation.

SENSEI NOTE Use component values in component equations. The total speed is not a substitute for v_x or v_y .

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

Resolve the initial vector and write it as a velocity component pair.

An object starts with speed 10 m/s at 37° above $+x$. Use $\cos 37^\circ \approx 0.80$ and $\sin 37^\circ \approx 0.60$. Find $\mathbf{v}(0) = (v_x(0), v_y(0))$.

PRACTICE 2

Independent Check

Use component integration for one shared time interval.

Initial velocity is $\mathbf{v}(0) = (5, 2)$ m/s and constant acceleration is $\mathbf{a} = (1, -3)$ m/s². Find the displacement vector $\Delta \mathbf{r}$ after 2 s.

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

Resolve an angled velocity

Use the angle from $+x$.

A 15 m/s velocity is 53° above $+x$. Use $\cos 53^\circ \approx 0.60$ and $\sin 53^\circ \approx 0.80$. Find the velocity components.

CONFIDENCE CHECK 2

Recombine component velocity

Find the magnitude from the two components.

An instantaneous velocity is $v = \langle 9, 12 \rangle$ m/s. Find the speed.

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**Resolve the physical vector first**

Magnitude-angle information becomes signed component functions before derivatives or integrals are applied.

KEY TAKEAWAY 2**Evolve each component with one shared time**

Derivatives and integrals act componentwise; constant acceleration reduces to the familiar axis-by-axis kinematic equations.

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. Compare your approach with the concise reasoning below.

WARM-UP • ACTIVITY 1

Key Ideas

The horizontal component uses cosine: $v_x = 12 \cos 60^\circ = 6.0 \text{ m/s}$.

WHY IT WORKS The horizontal leg is adjacent to an angle measured from +x; the vertical component uses sine.

WARM-UP • ACTIVITY 2

Common Mistakes

Because $\mathbf{a} = d\mathbf{v}/dt$ means $a_x = dv_x/dt$ and $a_y = dv_y/dt$. Both equations use the same time variable for the same physical interval.

WHY IT WORKS Vector differentiation is componentwise, so the axes can be solved independently and then interpreted together.

WARM-UP • ACTIVITY 3

Quick Application

Speed = $\sqrt{6^2 + 8^2} = 10 \text{ m/s}$.

WHY IT WORKS Speed is the magnitude of the instantaneous velocity vector, found from perpendicular components.

SOLUTIONS • GUIDED PRACTICE

PRACTICE 1

Guided Example $v(0) = \{8.0, 6.0\} \text{ m/s.}$

WHY IT WORKS Resolve the 10 m/s vector with cosine and sine before using any component evolution equation.

PRACTICE 2

Independent Check $\Delta r = \{12, -2\} \text{ m.}$

WHY IT WORKS For constant acceleration, integrating twice gives $\Delta r = v(0)t + \frac{1}{2}at^2$ component by component over the same 2 s.

SOLUTIONS • CONFIDENCE CHECK

CONFIDENCE CHECK 1

Resolve an angled velocity $v = \langle 9, 12 \rangle$ m/s.WHY IT WORKS Use $v_x = v \cos\theta$ and $v_y = v \sin\theta$ with the angle measured from $+x$.

CONFIDENCE CHECK 2

Recombine component velocitySpeed = $\sqrt{9^2 + 12^2} = 15$ m/s.WHY IT WORKS The magnitude of $\mathbf{v} = d\mathbf{r}/dt$ is found from its perpendicular x - and y -components.

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.

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