FULL REVIEW

Full Review: Momentum and Collisions — Algebra-Based

60-minute algebra-based review of momentum and collisions, emphasizing algebraic momentum, impulse, and collision problem solving.

◷ TIME	◎ BEST FOR	✓ FINISH WITH
60 minutes	Full Review	Greater confidence

After this review, you'll be able to…

calculate momentum and impulse, solve one- and two-dimensional conservation problems, and distinguish elastic, inelastic, and perfectly inelastic collisions.

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 60 minutes

FR-02 • UNIT ALIGNMENT

Unit Alignment

This Physics Sensei Unit Review covers MEC-U07 — Momentum and Collisions using the Algebra-Based treatment. Use it to reinforce the unit, prepare for homework, or review before a quiz or exam.

UNIT ID: MEC-U07 **UNIT: Momentum and Collisions** **TREATMENT: Algebra-Based** **RESOURCE: Unit Review**	**BEST USED** ✓ After reading the chapter ✓ Before starting homework ✓ Before a quiz or exam

Explore Momentum and Collisions Online →

Physics Sensei Unit Reviews use independent organization, wording, examples, and explanations.

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 60 minutes

1 **Warm-Up Check — page 4** Activate prior knowledge.	2 **Core Concepts — page 6** Review the essential ideas.	3 **Guided Practice — page 8** Apply what you learned.
4 **Confidence Check — page 10** Confirm your understanding.	5 **Summary — page 12** Review the key ideas.	6 **Next Step — page 16** 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

Signed Momentum

Choose an axis and calculate a momentum component.

A 0.40 kg puck moves at 6.0 m/s west. If east is positive, what is its momentum?

ACTIVITY 2

Impulse Calculation

Use $J = F_{avg}\,\Delta t$.

A 150 N average force acts east for 0.080 s. What impulse is delivered?

FR-04 • WARM-UP CHECK CONTINUED

ACTIVITY 3

System Momentum

Add the momenta of all objects before the interaction.

A 2.0 kg cart at +3.0 m/s approaches a 1.0 kg cart at -2.0 m/s. What is the total initial momentum?

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 — page 6 →

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 Momentum and Conservation

For each object, $p = mv$. For an isolated system, $\Sigma p_i = \Sigma p_f$. In one dimension, use signed velocity components. In two dimensions, conserve x and y momentum separately.

$$p = mv;\ \Sigma p_i = \Sigma p_f$$

EXAMPLE If external impulse is negligible, the vector sum of momenta is unchanged even though individual object momenta can change.

SENSEI NOTE Write one conservation equation per independent spatial component.

KEY CONCEPT 2

Impulse-Momentum Theorem

Impulse is $J = \Delta p$. For a constant or average force, $J = F_{avg}\,\Delta t$. A force-time graph gives impulse from its signed area.

$$J = F_{avg}\,\Delta t = \Delta p$$

EXAMPLE If a 0.25 kg ball changes velocity from +8.0 to -4.0 m/s, Δp = -3.0 kg·m/s.

SENSEI NOTE Compute final minus initial momentum; the sign of impulse matters.

KEY CONCEPT 3

Collision Models and Energy

Momentum conservation applies to isolated collisions. In an elastic collision, kinetic energy is also conserved. In a perfectly inelastic collision, the objects share one final velocity. In other inelastic collisions, momentum is conserved but kinetic energy decreases.

$$m_1 v_{1i} + m_2 v_{2i} = m_1 v_{1f} + m_2 v_{2f}$$

EXAMPLE For sticking objects, $v_f = (m_1 v_{1i} + m_2 v_{2i})/(m_1 + m_2)$.

SENSEI NOTE Do not assume “bounce” means elastic; check the energy condition.

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 — page 8 →

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

Impulse and Final Velocity

Apply $J = m(v_f - v_i)$.

A 0.50 kg cart initially moves at +2.0 m/s. A +3.0 N force acts for 1.5 s. Find the final velocity.

FR-06 • GUIDED PRACTICE CONTINUED

PRACTICE 2

Perfectly Inelastic Collision

Conserve momentum and use the shared final velocity.

A 1.5 kg cart at +4.0 m/s sticks to a 0.50 kg cart at -2.0 m/s. Find their final velocity.

PRACTICE 3

Two-Dimensional Momentum

Conserve x and y components separately.

A 0.20 kg puck moving 5.0 m/s east strikes an identical puck at rest. Afterward the first puck moves 3.0 m/s at 30° north of east. Find the second puck velocity components.

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 — page 10 →

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

Impulse Sign

Answer without notes and justify the physical reasoning.

A 0.30 kg object changes velocity from +5.0 to -1.0 m/s. What is the impulse?

QUICK CHECK 2

Sticking Collision

Answer without notes and justify the physical reasoning.

Two equal masses move at +4.0 m/s and -2.0 m/s and stick. What is v_f?

FR-07 • CONFIDENCE CHECK CONTINUED

QUICK CHECK 3

Elastic Criterion

Answer without notes and justify the physical reasoning.

What two conservation equations can be used for a one-dimensional elastic collision?

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 — page 12 →

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 Signed Components

Momentum equations are vector equations; in 1D, signs carry the direction information.

KEY TAKEAWAY 2

Impulse Is Δp

Force and time determine the momentum change, not the final momentum by themselves.

KEY TAKEAWAY 3

Match the Collision Model

Use momentum for every isolated collision and add kinetic-energy conservation only for elastic collisions.

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 — page 16 →

ANSWER KEY • CHECK AFTER ATTEMPTING

Solutions and Explanations

Use these solutions to check your reasoning—not only your final answer. Use each answer and explanation to identify the step that supports the result.

WARM-UP • ACTIVITY 1

Signed Momentum

-2.4 kg·m/s.

WHY IT WORKS $p = mv = (0.40)(-6.0) = -2.4$ kg·m/s.

WARM-UP • ACTIVITY 2

Impulse Calculation

12 N·s east.

WHY IT WORKS $J = F_{avg}\,\Delta t = (150)(0.080) = 12$ N·s, positive for east.

WARM-UP • ACTIVITY 3

System Momentum

+4.0 kg·m/s.

WHY IT WORKS $P_i = (2.0)(3.0) + (1.0)(-2.0) = 4.0$ kg·m/s.

SOLUTIONS • GUIDED PRACTICE

PRACTICE 1

Impulse and Final Velocity

11.0 m/s.

WHY IT WORKS J = 4.5 N·s, so Δv = J/m = 9.0 m/s and v_f = 11.0 m/s.

PRACTICE 2

Perfectly Inelastic Collision

+2.50 m/s.

WHY IT WORKS P_i = 1.5(4.0) + 0.50(-2.0) = 5.0 kg·m/s. Divide by 2.0 kg.

PRACTICE 3

Two-Dimensional Momentum

v2x = 2.40 m/s, v2y = -1.50 m/s.

WHY IT WORKS Initial momentum is (1.00, 0) kg·m/s. Puck 1 has momentum (0.520, 0.300) kg·m/s; the remainder is (0.480, -0.300) kg·m/s. Divide by 0.20 kg.

SOLUTIONS • CONFIDENCE CHECK

QUICK CHECK 1

Impulse Sign

-1.8 N·s.

WHY IT WORKS $J = m(v_f - v_i) = 0.30(-1.0 - 5.0) = -1.8$ N·s.

QUICK CHECK 2

Sticking Collision

+1.0 m/s.

WHY IT WORKS For equal masses, v_f is the average of the signed initial velocities: (4.0 - 2.0)/2 = 1.0 m/s.

QUICK CHECK 3

Elastic Criterion

Conservation of momentum and conservation of kinetic energy.

WHY IT WORKS Elastic means the system keeps both total momentum and total kinetic energy.

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	**I Need More Practice**	**I'm Ready**
Review the key ideas and examples again.	Continue with additional practice for this topic.	Continue to the next recommended resource.
Review again: return to Warm-Up Check on page 4.	Go to Practice →	Continue →

RECOMMENDED LINKS

Review again: return to Warm-Up Check on page 4.

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