FULL REVIEW

Full Review: Momentum and Collisions — Foundational

60-minute foundational review of momentum and collisions, emphasizing physical meaning, system choice, vector direction, and conservation reasoning.

TIME	BEST FOR	FINISH WITH
60 minutes	Full Review	Greater confidence

After this review, you'll be able to…

explain momentum and impulse, choose a system, reason with momentum conservation, and distinguish elastic from 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 Foundational 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: Foundational** **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

Momentum Has Direction

Use mass, speed, and direction to reason about momentum.

A cart moves east. What two changes could increase the magnitude of its momentum?

ACTIVITY 2

Impulse Changes Momentum

Connect force and interaction time to a momentum change.

If the same average force acts for twice as long, how does the impulse change?

FR-04 • WARM-UP CHECK CONTINUED

ACTIVITY 3

Choose the System

Decide when total momentum can be treated as conserved.

Two carts collide on a nearly frictionless track. What external influence must be negligible during the collision for the two-cart momentum to be conserved?

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

Momentum and System Choice

Linear momentum is a vector: p = mv. Total system momentum is the vector sum of the momenta of all objects in the chosen system. Momentum conservation is a statement about a system, not about one object.

$$p = mv; \quad P = \Sigma p$$

EXAMPLE A heavier cart and a lighter cart can have the same momentum if the lighter cart moves faster.

SENSEI NOTE State the system before writing a conservation equation.

KEY CONCEPT 2

Impulse and Momentum Change

An impulse changes momentum. For a nearly constant net force, $J = F_{avg}\,\Delta t = \Delta p$. On a force-versus-time graph, the area under the curve is the impulse.

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

EXAMPLE A smaller force acting for a longer time can produce the same impulse as a larger force acting briefly.

SENSEI NOTE Impulse explains why increasing stopping time can reduce average force without changing the required momentum change.

KEY CONCEPT 3

Conservation and Collision Types

When external impulse is negligible, total momentum before an interaction equals total momentum after it. Momentum is conserved in elastic and inelastic collisions. Kinetic energy is also conserved only in an elastic collision; in a perfectly inelastic collision the objects stick together.

$$P_i = P_f; \text{ elastic: } K_i = K_f$$

EXAMPLE Two carts can lose kinetic energy in a collision while still conserving total momentum.

SENSEI NOTE Do not use kinetic-energy conservation unless the collision is stated or shown to be elastic.

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

Direction Check

Track signs and directions rather than treating momentum as a scalar.

A 0.50 kg cart moves east at 3.0 m/s and a 0.30 kg cart moves west at 2.0 m/s. Which direction is the total momentum?

FR-06 • GUIDED PRACTICE CONTINUED

PRACTICE 2

Sticking Collision

Use conservation of momentum for a perfectly inelastic collision.

A 1.0 kg cart moving right at 4.0 m/s sticks to a 3.0 kg cart initially at rest. What is their final speed and direction?

PRACTICE 3

Force-Time Reasoning

Read impulse from the area of a force-time graph.

A constant 10 N force acts to the right for 0.40 s on a cart. What momentum change does it produce?

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

Momentum Direction

Answer without notes and justify the physical reasoning.

Can an object have negative momentum? Explain.

QUICK CHECK 2

Collision Accounting

Answer without notes and justify the physical reasoning.

Is momentum conserved in a perfectly inelastic collision? Is kinetic energy?

FR-07 • CONFIDENCE CHECK CONTINUED

QUICK CHECK 3

Impulse Meaning

Answer without notes and justify the physical reasoning.

What does the area under a net force-versus-time graph represent?

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

Choose the System First

Momentum conservation depends on a clearly defined system and negligible external impulse.

KEY TAKEAWAY 2

Impulse Connects Force and Momentum

Interaction force and interaction time combine to determine the momentum change.

KEY TAKEAWAY 3

Momentum Survives Inelastic Collisions

Total momentum can be conserved even when kinetic energy is not.

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

Momentum Has Direction

Increase the cart mass or increase its speed; reversing direction changes the direction of momentum.

WHY IT WORKS Momentum is a vector with magnitude $p = mv$, so mass and speed set its magnitude while velocity sets its direction.

WARM-UP • ACTIVITY 2

Impulse Changes Momentum

The impulse doubles, so the momentum change doubles.

WHY IT WORKS Impulse equals average force times interaction time and also equals the change in momentum.

WARM-UP • ACTIVITY 3

Choose the System

The net external impulse on the two-cart system must be negligible.

WHY IT WORKS Internal collision forces occur in equal-and-opposite pairs and redistribute momentum inside the chosen system.

SOLUTIONS • GUIDED PRACTICE

PRACTICE 1

Direction Check

East. The eastward momentum is 1.5 kg·m/s and the westward momentum is 0.60 kg·m/s, leaving 0.90 kg·m/s east.

WHY IT WORKS Choose east as positive and add signed momenta.

PRACTICE 2

Sticking Collision

1.0 m/s to the right.

WHY IT WORKS Initial momentum is 4.0 kg·m/s right. The combined mass is 4.0 kg, so v_f = 1.0 m/s right.

PRACTICE 3

Force-Time Reasoning

4.0 N·s to the right.

WHY IT WORKS $J = F\,\Delta t = (10\text{ N})(0.40\text{ s}) = 4.0\text{ N·s} = 4.0\text{ kg·m/s}$.

SOLUTIONS • CONFIDENCE CHECK

QUICK CHECK 1

Momentum Direction

Yes. The sign represents direction relative to the chosen positive axis; momentum is a vector.

WHY IT WORKS A negative component is directional information, not “less momentum.”

QUICK CHECK 2

Collision Accounting

Momentum is conserved for an isolated system; kinetic energy is not.

WHY IT WORKS The objects can transform kinetic energy into thermal energy, sound, and deformation while total system momentum remains fixed.

QUICK CHECK 3

Impulse Meaning

Impulse, which equals the change in momentum.

WHY IT WORKS The time integral of net force is Δp; for a constant force this reduces to F_{avg} Δt.

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