

FOCUSED REVIEW

Focused Review — Newton's Laws of Motion — 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 Newton's Laws and Free-Body Diagrams here → <https://physicssensei.com/focused-unit-review-newtons-laws-and-free-body-diagrams-calculus-based/>

RESOURCE: Physics Sensei Topic Review
TOPIC ID: MEC-U05-T01
TOPIC: Newton's Laws of Motion
PARENT UNIT: MEC-U05 — Newton's Laws and Free-Body Diagrams
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.

State Newton's second law in momentum form.

WARM-UP 2

Common Mistakes

Answer before revealing the response.

If $\mathbf{v}(t)$ is constant, what are $\mathbf{a}$ and $\Sigma \mathbf{F}$ for constant mass?

FR-04 • WARM-UP CHECK CONTINUED

WARM-UP 3

Quick Application

Answer before revealing the response.

For an interaction A–B, write the vector relationship between the two third-law forces.

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

Net Force and Newton's First/Second Laws

The net external force equals the time derivative of momentum. For constant mass, this becomes $m \, d \, \mathbf{v}/dt$. The first law is the special case in which momentum is constant because the net force is zero.

$$\Sigma \mathbf{F} = 0 \rightarrow \mathbf{a} = 0$$

EXAMPLE Check the net force on one chosen object before deciding how its motion changes.

SENSEI NOTE Constant velocity means zero acceleration; it does not require the object to be at rest.

KEY CONCEPT 2

Newton's Third Law: Interaction Pairs

Third-law forces are simultaneous interaction forces on different bodies. The vector pair is equal and opposite even when the two bodies have very different accelerations.

$$\Sigma \mathbf{F} = d \, \mathbf{p}/dt; \text{ for constant mass, } \Sigma \mathbf{F} = m \, d \, \mathbf{v}/dt = m \, \mathbf{a}$$

EXAMPLE Use object labels on interaction forces so third-law partners stay on different free-body diagrams.

SENSEI NOTE Do not pair weight and normal force as a third-law pair; both can act on the same object.

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**

Work through the force inventory, net-force step, and motion conclusion.

A 2.0 kg particle has $\mathbf{v}(t) = (t^3 \hat{i} + 2t \hat{j})$ m/s. Find $\mathbf{F}(t)$ and evaluate it at $t = 2.0$ s.

PRACTICE 2**Independent Check**

Solve independently, showing the net-force reasoning.

Two skaters exert a third-law force pair of magnitude 120 N. If their masses are 60 kg and 40 kg, compare their acceleration magnitudes.

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

Newton's Laws Check 1

Solve and justify your conclusion.

If $\mathbf{p}(t) = (4t \hat{i} - t^2 \hat{j}) \text{ kg}\cdot\text{m/s}$, find $\mathbf{F}(t)$.

CONFIDENCE CHECK 2

Newton's Laws Check 2

Solve and justify your conclusion.

Can a third-law force pair produce different acceleration magnitudes? Explain mathematically.

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

Net force determines whether velocity changes.

Net force determines whether velocity changes.

KEY TAKEAWAY 2

Third-law forces act on different objects.

Third-law forces act on different objects.

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

$$\Sigma \mathbf{F} = d \mathbf{p} / dt.$$

WHY IT WORKS The result follows by isolating one object and applying the net-force rule or the correct interaction pair.

WARM-UP • ACTIVITY 2

Common Mistakes

$$\mathbf{a} = d \mathbf{v} / dt = 0 \text{ and therefore } \Sigma \mathbf{F} = 0.$$

WHY IT WORKS The result follows by isolating one object and applying the net-force rule or the correct interaction pair.

WARM-UP • ACTIVITY 3

Quick Application

$$\mathbf{F}_{A \rightarrow B} = -\mathbf{F}_{B \rightarrow A}.$$

WHY IT WORKS The result follows by isolating one object and applying the net-force rule or the correct interaction pair.

SOLUTIONS • GUIDED PRACTICE

PRACTICE 1

Guided Example

$\mathbf{a}(t) = (3t^2 \hat{i} + 2 \hat{j}) \text{ m/s}^2$, so $\mathbf{F}(t) = (6t^2 \hat{i} + 4 \hat{j}) \text{ N}$; at 2.0 s, $\mathbf{F} = (24 \hat{i} + 4 \hat{j}) \text{ N}$.

WHY IT WORKS The result follows by isolating one object and applying the net-force rule or the correct interaction pair.

PRACTICE 2

Independent Check

The forces have equal magnitude. $a = F/m$, so the 40 kg skater has 3.0 m/s^2 and the 60 kg skater has 2.0 m/s^2 .

WHY IT WORKS The result follows by isolating one object and applying the net-force rule or the correct interaction pair.

SOLUTIONS • CONFIDENCE CHECK

CONFIDENCE CHECK 1

Newton's Laws Check 1

$$\mathbf{F}(t) = d \mathbf{p}/dt = (4 \hat{i} - 2t \hat{j}) \text{ N}.$$

WHY IT WORKS The result follows by isolating one object and applying the net-force rule or the correct interaction pair.

CONFIDENCE CHECK 2

Newton's Laws Check 2

Yes. The force magnitudes are equal, but $a = F/m$; different masses give different acceleration magnitudes.

WHY IT WORKS The result follows by isolating one object and applying the net-force rule or the correct interaction pair.

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