FOCUSED REVIEW

Focused Review: Newton's Laws and Free-Body Diagrams

Use free-body diagrams, vector components, Newton's laws, friction, tension, and connected-system algebra to solve college-physics force problems.

◷ TIME	◎ BEST FOR	✓ FINISH WITH
15–20 minutes	Focused unit review	Greater confidence

After this focused review, you'll be able to…

construct complete free-body diagrams, resolve forces into components, and solve Newton's-law problems with friction, tension, and connected objects.

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 • UNIT ALIGNMENT

Unit Alignment

This bundle is aligned to the approved Physics Sensei unit specification below. Use it to recover the unit structure, reinforce key decisions, and confirm readiness for the next study task.

ARCHITECTURE: Physics Sensei Independent Mechanics UNIT: MEC-U05 — Newton's Laws and Free-Body Diagrams SCOPE: Unit Review PHYSICS LEVEL: Algebra-Based	BEST USED ✓ Before force-and-friction homework ✓ When component equations are the main challenge ✓ Before a quiz on Newton's laws and FBDs

Review Prerequisites →

Physics Sensei is an independent educational resource. This review is independently authored and organized under the approved Physics Sensei mechanics architecture.

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 — page 4** Refresh key ideas.	2 **Core Concepts — page 6** Reinforce the essentials.	3 **Guided Practice — page 7** Strengthen key skills.
4 **Confidence Check — page 8** Confirm your understanding.	5 **Summary — page 10** Remember the essentials.	6 **Next Step — page 14** 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

List only forces acting on the chosen object.

A crate is pulled across a rough horizontal floor by a rope angled upward. Which forces belong on the crate's free-body diagram?

WARM-UP 2

Common Mistakes

Translate the diagram into vector equations.

For a system accelerating horizontally with no vertical acceleration, what equations connect the force components to acceleration?

FR-04 • WARM-UP CHECK CONTINUED

WARM-UP 3

Quick Application

Do not pair forces that act on the same object.

A block rests on a table. Is the block's weight the Newton's-third-law partner of the table's normal force?

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 — page 6 →

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

Resolve forces before solving

After choosing axes, resolve angled forces into components and write one Newton-second-law equation per axis. Signs come from the chosen axes, not from memorized formulas.

$$\Sigma F_x = ma_x \quad \bullet \quad \Sigma F_y = ma_y$$

EXAMPLE For a pull T at angle θ above horizontal: $T_x = T\cos\theta$ and $T_y = T\sin\theta$. If vertical acceleration is zero, $N + T\sin\theta - mg = 0$.

SENSEI NOTE An angled pull changes the normal force, which can change friction. Solve the normal direction before substituting $f = \mu N$ when that model applies.

KEY CONCEPT 2

Use force models with their conditions

Weight is mg near Earth; an ideal rope transmits one tension; kinetic friction has magnitude $\mu_k N$ and opposes sliding; static friction adjusts up to $\mu_s N$.

$$f_k = \mu_k N \quad \bullet \quad f_s \leq \mu_s N$$

EXAMPLE Static friction is $f_s \leq \mu_s N$, not always $f_s = \mu_s N$. Equality applies only at impending slip.

SENSEI NOTE Write the inequality for static friction before assuming the limiting value.

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 — page 7 →

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

Worked Example

Resolve the angled pull and update the normal force first.

A 12 kg crate is pulled with 50 N at 30° above horizontal across a floor with $\mu_k = 0.20$. Find its acceleration. Use $g = 9.8\ m/s^2$.

PRACTICE 2

Guided Problem

Use the whole system for acceleration, then one block for tension.

Blocks of 4.0 kg and 6.0 kg are connected on a frictionless horizontal surface. A 30 N horizontal force pulls the 6.0 kg block. Find the acceleration and the tension.

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 — page 8 →

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

Net-force calculation

Apply ΣF = ma with signs.

An 8.0 kg box has 28 N right and 12 N left. What is its horizontal acceleration?

CONFIDENCE CHECK 2

Elevator normal force

Use acceleration sign consistently.

A 70 kg person accelerates upward at 1.2 m/s² in an elevator. What normal force does the floor exert? Use g = 9.8 m/s².

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 — page 10 →

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

Diagram first, components second

A disciplined FBD plus declared axes determines the signs and equations.

KEY TAKEAWAY 2

Use the correct force model

Normal force, friction, and tension depend on the interaction and constraints; they are not universal constants.

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 14 →

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

Weight, normal force, rope tension, and friction.

WHY IT WORKS All four are external interactions on the crate. The crate's velocity or acceleration is not itself a force.

WARM-UP • ACTIVITY 2

Common Mistakes

$\Sigma F_x = ma_x$ and $\Sigma F_y = 0$.

WHY IT WORKS Newton's second law is applied component by component. Zero vertical acceleration makes the vertical force sum zero even while horizontal acceleration is nonzero.

WARM-UP • ACTIVITY 3

Quick Application

No.

WHY IT WORKS Weight and normal both act on the block. Their third-law partners act on Earth and on the table, respectively.

SOLUTIONS • GUIDED PRACTICE

PRACTICE 1

Worked Example

2.06 m/s² horizontally in the pull direction.

WHY IT WORKS N = mg - 50 sin30° = 117.6 - 25 = 92.6 N. Then f_k = 0.20(92.6) = 18.52 N and T_x = 50 cos30° = 43.30 N. Thus F_net,x = 24.78 N and a = 24.78/12 = 2.065 m/s².

PRACTICE 2

Guided Problem

a = 3.0 m/s²; T = 12 N.

WHY IT WORKS For both blocks, a = 30/(4+6) = 3.0 m/s². For the 4.0 kg block alone, the only horizontal force is tension, so T = (4.0)(3.0) = 12 N.

SOLUTIONS • CONFIDENCE CHECK

CONFIDENCE CHECK 1

Net-force calculation

2.0 m/s² right.

WHY IT WORKS F_net = 28 - 12 = 16 N, so a = 16/8.0 = 2.0 m/s² right.

CONFIDENCE CHECK 2

Elevator normal force

770 N upward.

WHY IT WORKS With upward positive, N - mg = ma. Thus N = m(g+a) = 70(11.0) = 770 N.

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	**I Need More Practice**	**I'm Ready**
Review the focused review again to strengthen the essential concepts.	Build confidence with additional practice problems.	Continue to the next topic or learning 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