FULL REVIEW

Full Review — Drawing and Solving Free-Body Diagrams — Foundational

Review the essential ideas, relationships, and problem-solving tools for Drawing and Solving Free-Body Diagrams.

TIME	BEST FOR	FINISH WITH
45–60 minutes	A complete topic review	A readiness check

After this full review, you'll be able to…
recall the essential ideas, apply them to representative problems, and determine what to study next.

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 45–60 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 →

RESOURCE: Physics Sensei Topic Review TOPIC ID: MEC-U05-T02 TOPIC: Drawing and Solving Free-Body Diagrams PARENT UNIT: MEC-U05 — Newton's Laws and Free-Body Diagrams COURSE LEVEL: Foundational	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 stages in order. Each stage builds on the previous one and prepares you for the final readiness check.

6 stages • Approximately 45–60 minutes

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

Recall Activity 1

Answer before revealing the response.

A crate rests on a floor. List the forces acting on the crate.

ACTIVITY 2

Recall Activity 2

Answer before revealing the response.

A student draws weight, normal force, velocity, and acceleration arrows on an FBD. Which arrows do not belong?

FR-04 • WARM-UP CHECK CONTINUED

ACTIVITY 3

Recall Activity 3

Answer before revealing the response.

For a block on an incline, which axis choice usually makes the force equations simplest?

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 →

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

Free-Body Diagrams Isolate One Object

A free-body diagram (FBD) shows only the forces acting on the chosen object. Draw the object as a dot or simple box, then draw one arrow for each external force. Label each arrow by the interaction that causes it. Do not draw velocity or acceleration as forces.

$$\Sigma F = ma$$

EXAMPLE A book resting on a table has weight downward and a normal force upward.

SENSEI NOTE Ask: What is touching or pulling on the object?

KEY CONCEPT 2

Choose Axes and Resolve Forces

Choose x and y axes that make the force components simple. On a horizontal surface, x is usually horizontal and y vertical. On an incline, choosing x parallel to the slope and y perpendicular to it often reduces the algebra.

$$F_x = F \cos \theta; \; F_y = F \sin \theta$$

EXAMPLE A pull at angle θ has horizontal component F cos θ and vertical component F sin θ.

SENSEI NOTE Resolve a force only when it is not already along an axis.

FR-05 • CORE CONCEPTS CONTINUED

KEY CONCEPT 3

Apply Newton's Second Law by Direction

After the FBD is complete, write one force equation for each chosen direction. The signs come from your axes. If acceleration is zero in a direction, the net force in that direction is zero.

$$\Sigma F_x = ma_x; \Sigma F_y = ma_y$$

EXAMPLE For a box accelerating right on a level floor: Fpull – f = ma and N – mg = 0.

SENSEI NOTE Build the equations from the diagram; do not start with memorized formulas.

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 →

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

Worked Example

Draw the FBD, choose axes, and write the force equations.

A 10 kg crate is pulled right with 50 N on a level floor while kinetic friction is 20 N. Find the acceleration.

FR-06 • GUIDED PRACTICE CONTINUED

PRACTICE 2

Guided Problem

Build the FBD before solving.

A 6.0 kg box is pulled by a 30 N force at 25° above horizontal. Friction is 8.0 N. Find the horizontal acceleration; assume no vertical acceleration.

PRACTICE 3

Independent Problem

Resolve forces parallel and perpendicular to the incline.

A 4.0 kg block slides down a frictionless 30° incline. Find its acceleration along the slope and the normal force.

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 →

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

Force Inventory

Answer from your own FBD first.

Name the forces on a hanging mass attached to a vertical string.

QUICK CHECK 2

Component Equation

Answer from your own FBD first.

A force F acts at angle θ above +x. Write its x- and y-components.

FR-07 • CONFIDENCE CHECK CONTINUED

QUICK CHECK 3

Incline Equation

Answer from your own FBD first.

For a frictionless incline, write the equation along the slope if downhill is positive.

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 →

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

Isolate One Body

An FBD contains only external forces acting on the selected object.

KEY TAKEAWAY 2

Axes Control the Algebra

Choose axes first, then assign signs and resolve only the forces that need components.

KEY TAKEAWAY 3

Equations Come from the Diagram

Write $\Sigma F = ma$ by direction from the completed FBD; add constraints only when the physical situation requires them.

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

Recall Activity 1

Weight downward and normal force upward.

WHY IT WORKS Only forces acting on the crate belong on its FBD.

WARM-UP • ACTIVITY 2

Recall Activity 2

Velocity and acceleration arrows do not belong on an FBD.

WHY IT WORKS They describe motion, not interactions that exert force.

WARM-UP • ACTIVITY 3

Recall Activity 3

Choose one axis parallel to the incline and one perpendicular to it.

WHY IT WORKS This aligns the normal force with an axis and simplifies the weight components.

SOLUTIONS • GUIDED PRACTICE

PRACTICE 1

Worked Example

$\Sigma F_x = 50 - 20 = 30$ N; $a = 30/10 = 3.0$ m/s² to the right. Vertically, $N - mg = 0$.

WHY IT WORKS The FBD separates horizontal dynamics from vertical equilibrium.

PRACTICE 2

Guided Problem

$F_x = 30 \cos 25° = 27.2$ N. $\Sigma F_x = 27.2 - 8.0 = 19.2$ N, so $a_x = 19.2/6.0 = 3.20$ m/s².

WHY IT WORKS Resolve the angled pull before summing components.

PRACTICE 3

Independent Problem

Along slope: $ma = mg \sin 30°$, so $a = g \sin 30° = 4.9$ m/s² downhill. Perpendicular: $N = mg \cos 30° \approx 34$ N.

WHY IT WORKS Axes parallel/perpendicular to the incline make the two equations direct.

SOLUTIONS • CONFIDENCE CHECK

QUICK CHECK 1

Force Inventory

Tension upward and weight mg downward.

WHY IT WORKS Those are the external interactions acting on the hanging mass.

QUICK CHECK 2

Component Equation

$F_x = F \cos \theta$ and $F_y = F \sin \theta$.

WHY IT WORKS The components are projections of F onto the chosen axes.

QUICK CHECK 3

Incline Equation

$mg \sin \theta = ma$, so $a = g \sin \theta$.

WHY IT WORKS Only the component of weight parallel to the frictionless slope drives the along-slope acceleration.

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 →	**Go to Practice →**	**Continue →**

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 →

Online review page URL: https://physicssensei.com/full-topic-review-drawing-and-solving-free-body-diagrams-foundational/
Video review URL: PhysicsSensei.com
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Another type of physics help URL: PhysicsSensei.com

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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