FULL REVIEW

Full Review: Fluid Mechanics — Foundational

Review the essential ideas, relationships, and problem-solving tools for Fluid Mechanics.

◷	◎	✓
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 • TOPIC ALIGNMENT

Topic Alignment

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

TEXTBOOK: Independent Physics Sensei Unit Review **CHAPTER: Mechanics • MEC-U14** **TOPIC: Fluid Mechanics** **COURSE LEVEL: Foundational**	**BEST USED** ✓ After reading the chapter ✓ Before starting homework ✓ Before a quiz or exam

Review Prerequisites →

Physics Sensei is an independent educational resource designed to complement independently authored Physics Sensei materials. Physics Sensei content is independently authored and organized under the approved topic architecture.

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 — 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

Recall Activity 1

Predict before calculating.

A swimmer moves deeper in the same still water. Does the fluid pressure increase, decrease, or stay the same?

ACTIVITY 2

Recall Activity 2

Separate mass from volume.

Two blocks have equal mass, but one has twice the volume. Which has the smaller average density?

FR-04 • WARM-UP CHECK CONTINUED

ACTIVITY 3

Recall Activity 3

Track the flow.

Water flows steadily through a pipe that narrows. Does its speed increase, decrease, or stay the same?

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

Pressure, density, and hydrostatic equilibrium

Density describes how much mass occupies a volume. Pressure is normal force per area. In a fluid at rest, pressure increases with depth and acts in all directions at a point.

$\rho = m/V$; pressure increases with depth.

EXAMPLE A point 2 m below the surface has greater pressure than a point 1 m below the surface in the same liquid.

SENSEI NOTE Pressure is a scalar field. Do not draw a "pressure vector"; draw pressure forces normal to surfaces and use pressure differences to determine net force.

KEY CONCEPT 2

Buoyancy, floating, and apparent weight

A submerged object experiences larger pressure forces on its lower side than on its upper side. The resulting upward buoyant force equals the weight of displaced fluid. Floating occurs when the average forces balance.

F_B = weight of displaced fluid.

EXAMPLE A low-density block floats with only part of its volume submerged.

SENSEI NOTE Archimedes gives the buoyant force. It does not by itself say whether the object accelerates; compare all forces on the object.

FR-05 • CORE CONCEPTS CONTINUED

KEY CONCEPT 3

Flow rate, continuity, Bernoulli, and ideal-flow limits

Flow rate measures how much fluid passes per time. In steady incompressible flow, a narrower passage means faster flow. Bernoulli connects pressure, speed, and height when the ideal-flow assumptions are satisfied.

Q = volume/time; narrow section → larger speed.

EXAMPLE Water speeds up as it enters a narrower section of a steady pipe.

SENSEI NOTE Do not use “faster flow means lower pressure” as a universal slogan. First verify the two points are connected by a valid Bernoulli model and account for height, pumps, and losses.

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

Worked Example

Identify the pressure reference, choose gauge or absolute pressure, and solve with units.

A diver is 5.0 m below a lake surface. Is the pressure there greater than atmospheric pressure, and by what physical cause?

FR-06 • GUIDED PRACTICE CONTINUED

PRACTICE 2

Guided Problem

Draw the object free-body diagram and identify displaced fluid volume.

A block floats at rest with half its volume submerged in water. Compare its average density with water.

PRACTICE 3

Independent Problem

Apply continuity first, then decide whether Bernoulli is valid.

A steady stream enters a section with half the cross-sectional area. Predict the speed change.

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

Pressure model check

Answer and justify in one sentence.

Does pressure at a fixed depth depend on the shape of the container?

QUICK CHECK 2

Buoyancy check

Classify the statement.

"A floating object has no weight because buoyancy cancels it." Correct or incorrect?

FR-07 • CONFIDENCE CHECK CONTINUED

QUICK CHECK 3

Continuity and Bernoulli check

Choose the valid relationship.

In steady incompressible flow, what happens to speed when area decreases?

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

Pressure comes from force per area and hydrostatic balance

Use p, not a pressure vector. Distinguish gauge from absolute pressure, choose the correct depth/elevation reference, and use $p=p_0+\rho gh$ only when density is effectively constant.

KEY TAKEAWAY 2

Buoyancy is displaced-fluid weight

Find V_{disp} and ρ_{fluid}, then compare F_B with weight, tension, or support forces. Floating equilibrium is a force balance, not a disappearance of weight.

KEY TAKEAWAY 3

Continuity first; Bernoulli only under valid assumptions

Use mass conservation to connect area and speed. Then use Bernoulli only for the appropriate steady, incompressible, nonviscous model along a streamline unless additional energy/loss terms are included.

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 concise answer and explanation to check the essential reasoning.

WARM-UP • ACTIVITY 1

Recall Activity 1

It increases.

WHY IT WORKS Deeper points support a taller column of fluid above them.

WARM-UP • ACTIVITY 2

Recall Activity 2

The block with twice the volume; its density is half as large.

WHY IT WORKS Density is mass per volume, $\rho = m/V$.

WARM-UP • ACTIVITY 3

Recall Activity 3

Its speed increases.

WHY IT WORKS The same volume of incompressible fluid must pass each cross-section per unit time.

SOLUTIONS • GUIDED PRACTICE

PRACTICE 1

Worked Example

Yes. The water column above creates additional hydrostatic pressure.

WHY IT WORKS Pressure at the open surface is atmospheric; depth adds hydrostatic pressure.

PRACTICE 2

Guided Problem

Its average density is half the water density.

WHY IT WORKS For floating equilibrium, the displaced-fluid weight equals the object weight.

PRACTICE 3

Independent Problem

The speed doubles.

WHY IT WORKS Steady incompressible flow preserves volume flow rate.

SOLUTIONS • CONFIDENCE CHECK

QUICK CHECK 1

Pressure model check

No, for the same connected static fluid and surface pressure, it depends on depth, density, and g.

WHY IT WORKS Hydrostatic pressure is a field set by elevation and boundary pressure, not container shape.

QUICK CHECK 2

Buoyancy check

Incorrect. It has weight; the net force is zero because buoyancy balances it.

WHY IT WORKS Zero net force does not mean individual forces vanish.

QUICK CHECK 3

Continuity and Bernoulli check

Speed increases.

WHY IT WORKS The volume flow rate must remain consistent along the streamtube.

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