



INDEPENDENT MATHEMATICS, CHEMISTRY, AND PHYSICS LABORATORY

GRADUATE

A self-paced journey from mathematics, physics, and chemistry to principles of mechanical and aeronautical engineering.

Graduate

A self-paced journey from mathematics, physics, and chemistry to principles of mechanical and aeronautical engineering.

WHO THIS IS FOR

A high-school senior (or an ambitious junior) looking to enter a four-year mechanical or aeronautical engineering program.

WHAT THIS IS

Graduate is organized as eight Wings. Within each Wing is a series of knowledge Chambers — short topics with a worked example and numbered problems. The path runs from mathematics, physics, and chemistry to principles of mechanics and thermodynamics, and ends in a graduate qualifying paper. Tables, formulas, and a calculator sit on every desk.

WHAT THIS IS NOT

While the emphasis in these modules is building important skills, this is not a course for credit, nor is it affiliated with an accredited institution. Because the broad focus is directed toward mechanical engineering, other highly relevant knowledge areas, notably Information Technology, are not addressed here due to their sheer size and scope.

TO START

Some high-school algebra should be adequate to begin. It is expected that many sub-topics, especially in Math Foundations, will be a review for a science-oriented student.

THE EIGHT WINGS

I Math Foundation Studio · II Geometry Atrium · III Chemistry Bench · IV Applications Arena · V Physics Hall · VI Mechanics Bay · VII Thermodynamics Environment · VIII Graduate Vault. Two hundred and six chambers sit in those halls. The newest desks are Coordinate Geometry, Inverse Trigonometry, Residues & Contour Integrals, Z-Transforms, Columns & Buckling, and Bolted & Welded Joints.

WING

I · Math Foundation Studio	Number, algebra, and the first vector language
II · Geometry Atrium	Shape, measure, and angle
III · Chemistry Bench	Mole, reaction, and the first materials language
IV · Applications Arena	Change, space, and chance
V · Physics Hall	Motion, field, and the calculus of particles
VI · Mechanics Bay	Force, motion, and matter
VII · Thermodynamics Environment	Energy, flow, and heat
VIII · Graduate Vault	Continuum and qualification

How a day in the laboratory goes

01 Enter the laboratory.

The title page is a photograph of the hall. *Enter the laboratory* opens the eight wings and begins a chamber. Settings, Exam, Install, and Questions stay on that first page so you can reach them without walking the halls.

02 Open a wing, then a chamber.

Graduate is organized as eight Wings. Within each Wing is a series of knowledge Chambers. The map lists the chambers of the open wing; the other seven wings stay on the right so you can change halls without scrolling back to the top. A card that names a path assumes that earlier work has been mastered. You may still open any door.

03 Read the stem.

Every problem is a sentence or two, often with a figure. Numbers in the stem are the numbers you will use. Nothing is hidden in a sidebar.

04 Work the live bench.

Most problems open a manipulable figure under the stem — a titration curve, a pipe, a unit circle, a free-body. Drag the sliders. When a reading is ready, tap *Use* to drop it into the response. Help diagrams stay as still, stepped frames; the bench is the thing you turn.

05 Ask for a first move, then the next.

How to solve does not dump the method. It reveals one move at a time. Spotlight keeps the current line bright. All at once is there when you want the whole walk.

06 Search when you know the name, not the wing.

The box to the right of Settings takes a keyword. Chambers and problem types come back as a list. Pick one and the hall opens that desk.

07 Write a response, then Check.

Numeric answers take a tolerance. Expressions are compared on sample points, not as text. Multiple choice and multi-select sit on the same keypad. Check is the only judge.

08 Miss, then look.

A miss is not a lock. Hints, the formula desk, the tables, the periodic table, and the calculator stay in the chrome. The vault of flashcards is the same material in another cut.

09 Walk on, or sit a 16-item qualifying paper.

Solved problems mark the map. Exam sits the qualifying examination. Best scores stay on this computer.

A problem, from the stem to the check

THE STEM

The title of the problem is the family: a continuity question, a Mohr circle, a buffer. The stem is the whole of what you are asked. Context, when there is any, sits under it in a quieter voice.

THE LIVE BENCH

If the chamber has a figure you can turn, it appears under the stem as *Live bench* · *Titration* (or Pipe, or Mohr, or the name of the kit). The reading row under the sliders is the same numbers the method will use. *Use* copies a reading into the box so you are not transcribing by eye.

HOW TO SOLVE

Open it when the first line is not obvious. It is a walk, not an answer key. Key Thoughts are the few lines an instructor would underline on the board. Under that is a textbook walk of the open problem. Diagram steps in Help are still frames: Back and Next move the caption, they do not spin the bench.

THE RESPONSE

Type a number, an expression, or tap a choice. The keypad follows the wing: trig in Geometry, a few Greek letters in Physics, chemistry states on the Bench. Degrees and radians are a setting, not a per-problem switch.

CHECK

Check compares what you wrote with the key. A number is accepted inside a small tolerance. An expression is accepted if it matches on a handful of points. A correct check marks the problem on the map. A miss leaves the door open.

The calculator is the laboratory's own: 8×7 is 56, not a web widget. Formulas, flashcards, tables, and the periodic table open as desks, not pop-ups that hide the stem.

Desks you can open from any chamber

FORMULAS

Acronyms and formulas for this wing. Every line carries a When you use it note — the machine, the measurement, and the usual mix-up. Print the sheet if you want it on paper.

FLASHCARDS

Interactive flashcards for this wing. Flip, mark, sit a short drill. They do not replace the problems; they keep names in the hand.

SEARCH

To the right of Settings. Type a keyword — paris, quadratic formula, phugoid, mole. Jump to a chamber or to a problem type. Slash focuses the box.

TABLES

The data-table reference: logarithms, trigonometric values, physical constants, gases, strengths, densities, K_{sp} , beam deflections, pipe roughness, Fourier pairs, Fanno, steam, air, shocks, and the statistical books. Open a table from the list.

PERIODIC TABLE

Interactive periodic table — hover an element for isotopes and properties. Click a cell to pin the card.

CALCULATOR

The scientific calculator for this wing, with a tape. Degrees or radians follow Settings.

TOPICS

Tasks, figures, and worked examples for this wing — order of operations, a titration, a root locus — with sliders, so the picture moves before the problems do.

HOW TO SOLVE

The method for this family of story. First move, then the next. Key Thoughts, then the textbook walk of this problem. Spotlight or all at once.

HELP

A still diagram in stepped frames. Next diagram step and Previous diagram step do not collide with the chamber's Next.

PRINT

Print a problem set from one or more wings. For a desk without a screen.

Settings hold text size, theme, language, Fit to screen (on by default — the title photograph stays centered), and study preferences. Questions is how to open, install as an app, study, and sit a paper. Language changes the voice of the hall, not the mathematics. Problem stems stay in the language they were written.

The eight wings

Graduate is organized as eight Wings. Within each Wing is a series of knowledge Chambers. There are eight wings, two hundred chambers, and five thousand workable problems. A chamber is a short topic with a worked example and a run of numbered problems. Some chambers name earlier work; the map draws that as a path. A card that names a path assumes that earlier work has been mastered. You may ignore the path. Nothing is gated by a score.

MATH FOUNDATION STUDIO

Order of operations, fractions, and scale, then algebra through functions, then vectors and matrices — the arithmetic every later chamber assumes. Complex numbers live next door in Geometry Atrium, between trig identities and polar coordinates.

APPLICATIONS ARENA

Calculus, series, multivariable and linear algebra, then ODEs, numerical methods, probability, and the transforms used in engineering analysis.

CHEMISTRY BENCH

Matter and the atom, a bond, a mole, then gases, equilibrium, acids, kinetics, electrons, and the nucleus — the general chemistry of a first-year engineering course.

THERMODYNAMICS ENVIRONMENT

Thermodynamics, fluid mechanics, and heat transfer: the thermal-fluid core of engines, aircraft, and energy systems.

GEOMETRY ATRIUM

Euclidean construction, area, right-triangle trigonometry, the unit circle and identities, then polar coordinates and conics.

PHYSICS HALL

Algebra-trig university physics, then the calculus track: motion as derivatives, angular momentum, Gauss, Faraday, RLC as DEs, Maxwell and Poynting — Physics I/II as a chemistry, mechanical, or aeronautical program writes it.

MECHANICS BAY

Statics, strength, and materials first; then dynamics, vibration, and structural dynamics — the solid-mechanics spine of a mechanical or aeronautical degree. Paris law, ply failure, and journal bearings sit after fracture, laminates, and shafts.

GRADUATE VAULT

Continuum and elasticity first, then finite elements, analytical dynamics, compressible flow, method of characteristics, controls, flight modes, and a qualifying synthesis.

Progress is stored on this computer. Changing a browser, clearing the site, or moving to another machine starts a new map. The qualifying examination keeps a best score beside the attempt count.

What moves, and what stays still

LIVE BENCHES ON PROBLEMS

When a stem has a figure you can turn, it is a live bench: sliders, a reading, and *Use*. Acids open a titration with equivalence at 25 mL. Fluids open an open tank or a pipe, not a generic box. Circuits in RC mode keep τ in milliseconds when R is in $k\Omega$ and C in μF , so q/Q at $t = \tau$ is 0.632.

TOPICS

Each wing's Topics desk embeds the same kits — order of operations, a matrix, a titration, Snell, an oscillator, a pipe, Mohr, a root locus — so the picture is there before the first problem.

THE FLASK · WORKBENCHES

From the map, open the interactive workbenches. Twenty-five benches sit in a list:

Order of operations, fraction bars, powers of ten, 2×2 matrix, unit circle, right triangle, parallels, conic, parabola bench, free-body, beam V and M, Mohr circle, RC circuit, Snell, thin lens, charges, oscillator, waves, relativity, Otto cycle, ideal gas, pipe flow, titration, root locus, Nyquist.

They are the same kits as the live benches, without a stem. Use them to feel a curve before you sit the chamber, or after, when a number will not settle.

HELP DIAGRAMS

Help is still. Frames step with Previous diagram step and Next diagram step. They do not steal the chamber's Next. The bench is where you drag; Help is where you look.

The examination, and what ships

SIT THE QUALIFYING EXAMINATION

Exam on the title page sits a 16-item qualifying paper. Problems are drawn from the wings you have in front of you. Check as you go. A best score and an attempt count stay on this computer. It is a qualifying paper, not a credential.

SETTINGS

Text size, theme, language, and study preferences. These stay on this computer. Text size defaults two steps larger than a browser 16 px base. Language is the interface language. English is the default. Problem stems stay in the language they were written.

WHAT SHIPS

- Eight wings, one hundred ninety-four chambers, more than four thousand problems
- Live benches on problems, Topics, and the interactive workbenches
- Calculator, formulas, flashcards, tables, periodic table
- How-to walks, still Help diagrams, a print desk
- A 16-item qualifying paper
- This manual, and a filmed tour of the real laboratory
- Install on macOS or Windows — a self-installer, or the portable kit

A LAST LOOK AT THE PATH

Work Math Foundation Studio until the arithmetic is quiet. Geometry Atrium until a triangle does not need a sketch on scrap. Applications Arena until a derivative is a slope you can point at. Physics Hall and Chemistry Bench can run side by side. Mechanics Bay and Thermodynamics Environment ask for those four. The Graduate Vault is the last rooms — sit them when the earlier halls no longer feel like a foreign language.

The eight wings, as you will see them



I · MATH FOUNDATION STUDIO

Numbers, algebra, vectors and matrices. Order of operations, fractions, and scale, then algebra through functions, then vectors and matrices — the arithmetic every later chamber assumes.



II · GEOMETRY ATRIUM

Shape, measure, and angle. Euclidean construction, area, right-triangle trigonometry, the unit circle and identities, then complex numbers, polar coordinates and conics.



III · APPLICATIONS ARENA

Change, space, and chance. Calculus, series, multivariable and linear algebra, then ODEs, numerical methods, probability, and the transforms used in engineering analysis.



IV · PHYSICS HALL

Motion, field, and the calculus of particles. Algebra-trig university physics, then the calculus track: motion as derivatives, angular momentum, Gauss, Faraday, RLC as DEs, Maxwell and Poynting.



V · CHEMISTRY BENCH

Mole, reaction, and the first materials language. Matter and the atom, a bond, a mole, then gases, equilibrium, acids, kinetics, electrons, and the nucleus.



VI · MECHANICS BAY

Force, motion, and matter. Statics, strength, and materials first; then dynamics, vibration, and structural dynamics — the solid-mechanics spine of a mechanical or aeronautical degree.



VII · THERMODYNAMICS ENVIRONMENT

Energy, flow, and heat. Thermodynamics, fluid mechanics, and heat transfer: the thermal-fluid core of engines, aircraft, and energy systems.



VIII · GRADUATE VAULT

Continuum and qualification. Continuum and elasticity first, then finite elements, analytical dynamics, compressible flow, controls, and a qualifying synthesis.

Install on macOS or Windows — a self-installer, or the portable kit

THE PORTABLE KIT

Unzip the folder. Keep it together. Double-click **Open Graduate.html**. You should see the hall photograph and the buttons Enter the laboratory, Settings, Exam, Install, Questions, and About.

Do not open photographs inside the app/art folder — those are backgrounds, not the program. If the first screen is only a photograph, go back and open Open Graduate.html.

Windows: run **Launch Graduate.bat** and leave it open. If SmartScreen says it protected your PC: More info → Run anyway. macOS: run **Launch on Mac.command**. If macOS cannot verify the developer: right-click → Open → Open.

THE USER'S MANUAL AND THE TOUR

In the unzipped kit: **Graduate Users Manual.pdf** and **Graduate Tour.mp4**. Double-click either. They sit next to Open Graduate.html. The Windows installer and the Mac installer include the same two files. The tour is a film of the real laboratory being used — not a slideshow.

INSTALL AS AN APP

Use Install on the title page. Download the installer for your computer — **Graduate-Setup.exe** on Windows, **Graduate-Mac-Installer.zip** on a Mac.

Windows: double-click Graduate-Setup.exe. If Windows protects your PC: More info → Run anyway. Icons appear on the Desktop and in the Start menu.

macOS: open the zip, double-click Install Graduate. If macOS cannot verify the developer: right-click → Open → Open. Graduate is placed in Applications; drag it to the Dock.

Chrome or Edge is required for the frameless window. Do not use the browser's own Install / monitor icon. That icon points at a launcher page and shows “This site can't be reached” after you close it.

Names, a last word

WHAT TO CALL IT

The product is Graduate. Independent mathematics, chemistry, and physics laboratory. The house is Glenar Laboratory. The portable folder is Glenar-Laboratory. The Windows installer is Graduate-Setup.exe. The Mac installer is Graduate-Mac-Installer.zip.

WHAT THIS IS NOT

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A LAST WORD

Sit Math Foundation Studio until the arithmetic is quiet. Walk Geometry Atrium until a triangle is a figure you can turn. Then Physics Hall, Chemistry Bench, Mechanics Bay, Thermodynamics Environment, and the Graduate Vault, in that order or not — the map will wait. Check is the only judge. The benches will tell you the same number the page does, if you drag them until they do.

Graduate

Independent mathematics, chemistry, and physics laboratory

User's manual · eleven letter pages