Free Diagnostic Test

Calculus and Physics

Instructions

- **Do it cold:** no notes, no calculator unless required by your course.
- **Show work:** full reasoning for problem-solving questions.
- **Time:** 25-35 minutes per section (Calculus or Physics).
- **How to submit:** scan or take clear photos, combine into one PDF if possible, and upload at **stem1online.com/diagnostic**.
- **What happens next:** we will review your work and discuss a personalized plan during your free consult.

Choose what you need

You may complete either section (Calculus or Physics) or both. For Calculus, complete the Core section and the optional module that matches your course.

S.T.E.M. Online	Website: stem1online.com
Upload Portal	stem1online.com/diagnostic

Calculus Diagnostic

Complete the Core. Then complete **either** Calc I+ or Calc II/Series (whichever matches your current course).

Student Name: _____ Email: _____

Course: _____ School: _____

Date: _____ Exam Date (optional): _____

Core

Complete all core questions. Show work in the boxes.

1. Solve: 2^x = 8.

2. Simplify: (x^2 - 9)/(x - 3) for $x \neq 3$.

3. Find the domain of f(x) = ln(5 - 2x).

4. If f(x) = 3x - 7, find f^{-1}(x).

5. Compute: lim_{x→2} (x^2 - 4)/(x - 2).

6. Compute: lim_{x→0^+} ln(x).

7. Continuity: f(x)=x^2-1 for x≠1 and f(1)=k. Find k to make f continuous at x=1.

8. Differentiate: f(x) = x^3 sin(x).

9. Differentiate: f(x) = 1/sqrt(1 + x^2).

10. Implicit differentiation: x^2 + y^2 = 25. Find dy/dx.

11. Concept: If f'(x) < 0 on (a, b), what does that mean about f on (a, b)?

12. Find the tangent line to y = x^2 at x = 3.

13. Optimization: A rectangle has perimeter 20. What is the maximum possible area? (Show setup.)

14. Related rates: A circle's radius increases at 2 cm/s. How fast is area increasing when r = 5 cm?

15. Compute: ∫ (3x^2 - 4) dx.

16. Compute: ∫_{0}^{1} (2x + 1) dx.

Optional Module: Calc I+ (choose if this matches your course)

Complete this module only if it matches your course.

17. Substitution: ∫ 2x cos(x^2) dx.

18. Area between curves: y = x and y = x^2 on [0, 1].

19. Improper integral: ∫_{1}^{∞} 1/x^2 dx.

20. State the Mean Value Theorem and give one concrete consequence.

Optional Module: Calc II / Series / DE (choose if this matches your course)

Complete this module only if it matches your course.

21. Integration by parts: ∫ x e^x dx.

22. Partial fractions: ∫ 1/(x^2 - 1) dx.

23. Convergence: Compare Σ 1/n and Σ 1/n^2 (state which converges).

24. Taylor: Give the 2nd-order Taylor polynomial for e^x at x = 0.

25. Solve the differential equation y' = k y with y(0) = y0.

Extra Work / Notes (optional)

Physics Diagnostic

Complete the Mechanics Core. Then complete the optional E&M; module if it matches your course.

Student Name: _____ Email: _____

Course: _____ School: _____

Date: _____ Exam Date (optional): _____

Core

Complete all core questions. Show work in the boxes.

1. Convert 72 km/h to m/s.

2. Find the magnitude of the vector <3, 4>.

3. A 10 N force acts at 30° above the horizontal. Find Fx and Fy.

4. If x(t) = t^2 - 4t, find v(t) and a(t).

5. A ball is dropped from rest (ignore air resistance). Write y(t) and v(t) using g.

6. Concept: Explain the difference between average velocity and instantaneous velocity.

7. Draw a free-body diagram for a block on an incline with friction (label all forces).

8. A block slides down an incline (angle θ) with kinetic friction coefficient μk. Find the acceleration down the plane.

9. Atwood machine: two masses m1 and m2 connected by a light string over a frictionless pulley. Set up equations and solve for acceleration.

10. Work-energy: A block of mass m slides on a rough surface with coefficient μk. Starting speed v0. Find stopping distance.

11. Power: A motor does 1200 J of work in 3 s. Find the average power.

12. Momentum: Two objects stick together after collision (perfectly inelastic). Set up the momentum equation symbolically.

13. State the formula for centripetal acceleration and its direction.

14. Concept: Minimum speed at the top of a vertical circle (radius R) for an object to maintain contact (no slack).

15. Graph concept: What does the slope of an x-t graph represent? What does the area under a v-t graph represent?

16. Given a v(t) sketch (or data), how do you compute displacement on an interval? Explain.

Optional Module: Intro Electricity & Magnetism

Complete this module only if it matches your course.

17. State Coulomb's law and describe the direction of the force between two charges.

18. Define electric field E and relate it to force on a test charge.

19. Concept: Distinguish electric potential energy from electric potential (voltage).

20. Compute equivalent resistance for two resistors in series and in parallel (write formulas).

21. Ohm's law and power: Write V=IR and two equivalent power formulas.

22. Magnetic force: Write F = q (v cross B) and describe direction using right-hand rule.

23. Magnetic flux: define $\Phi = \int B \cdot dA$ (conceptually). What does it measure?

24. Induction: State Lenz's law (direction of induced current).

Extra Work / Notes (optional)