

BRIGHT SCHOLARS

AP+ EXAM PREP SERIES

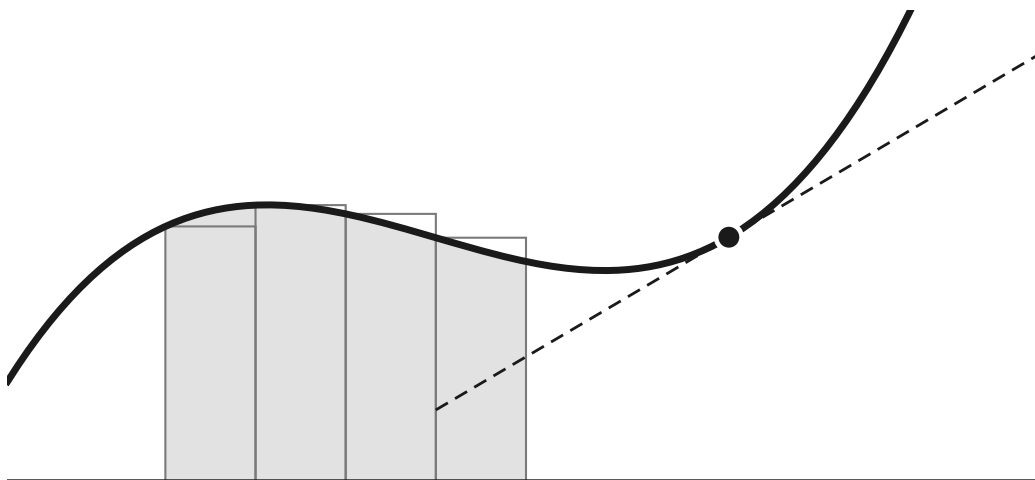
CALCULUS AB

REVIEW WORKBOOK

2027 EXAM

Limits • Derivatives • Integrals • FRQ Strategy

Understand change. Master functions. Solve with confidence.



Updated for the May 2027 hybrid digital exam • Diagnostic test • 8 units • Full-length practice exam

THIS BOOK BELONGS TO

Name _____

School / Teacher _____

AP exam date _____

Contents

GETTING STARTED

How to Use This Workbook	4
The 2027 AP Calculus AB Exam	5
8-Week Study Plan and Progress Tracker	6
Diagnostic Test	8
Algebra and Function Skills Check	15

UNITS

1 Limits and Continuity	17
2 Differentiation: Definition and Fundamental Properties	34
3 Differentiation: Composite, Implicit, and Inverse Functions	48
4 Contextual Applications of Differentiation	62
5 Analytical Applications of Differentiation	74
6 Integration and Accumulation of Change	88
7 Differential Equations	100
8 Applications of Integration	110

EXAM PREP

Graphing and Representation Lab	122
FRQ Builder: Six Cumulative Free-Response Questions	125
Calculator and Bluebook Desmos Skills Lab	138
Common Mistake Fixer	140
Condensed Final Mixed Review	142
Full-Length 2027 Practice Exam	152

ANSWERS

Answer Key and Worked FRQ Solutions	176
Final Tracker and Next Steps	184

i KNOW IT

Short concept notes in the margin, next to the problems that use them.

2 FRQ EDGE

Full free-response practice with a labeled work box for each part.

! FIX IT

The mistakes students make most often, named so you can catch them.

1

AP EXAM WEIGHT: 10-12% OF THE MULTIPLE-CHOICE SECTION

How can we describe what a function is doing near a point, even when the function is not defined at that point?

- ☐ Estimate a limit from a graph, a table, or an equation.
- ☐ Evaluate limits that give $\frac{0}{0}$ by factoring or rationalizing.
- ☐ Use the Squeeze Theorem when algebra fails.
- ☐ Apply the three-part continuity test and name each type of discontinuity.
- ☐ Find limits at infinity and horizontal asymptotes.
- ☐ Justify a conclusion with the Intermediate Value Theorem.

- 1.1** Estimating Limits from Graphs and Tables
- 1.2** Evaluating Limits Algebraically
- 1.3** The Squeeze Theorem
- 1.4** Continuity and Types of Discontinuity
- 1.5** Limits at Infinity
- 1.6** The IVT and Continuity on Intervals
- Unit Review: Mixed Practice, FRQ Edge, Fix It, Exit Ticket, READY+ Check

NO CALCULATOR

Without a calculator, try each one. If any takes more than a minute, review the Algebra and Function Skills Check.

a. Simplify $\frac{x^2 - 4}{x - 2}$

[illegible]

b. Evaluate $\sin(\pi/6)$

[illegible]

c. Evaluate $\ln(e^3)$

[illegible]

UNIT 1 | LESSON 1.1

Estimating Limits from Graphs and Tables

WHAT IS A LIMIT?

$\lim_{x \rightarrow a} f(x) = L$ means: as x gets close to a from either side, $f(x)$ gets close to L .

The limit describes the trend **near** a . It says nothing about $f(a)$, which might equal L , equal something else, or not exist.

NOTATION

$\lim_{x \rightarrow a^-} f(x)$: left-hand limit, from values less than a .

$\lim_{x \rightarrow a^+} f(x)$: right-hand limit, from values greater than a .

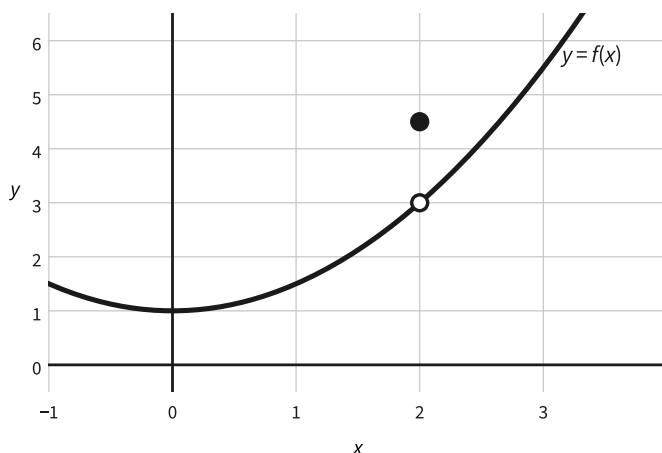
The two-sided limit exists only when both one-sided limits exist **and are equal**.

FIX IT

Confusing $f(a)$ with the limit. Always ask two separate questions: what does f equal at a , and what does f approach near a ?

GRAPH IT: ESTIMATING A LIMIT

The graph of f is shown. An open circle marks a value the graph approaches but does not reach; a filled circle marks the actual value of f .



1 Find $\lim_{x \rightarrow 2^-} f(x)$.

2 Find $\lim_{x \rightarrow 2^+} f(x)$.

3 Does $\lim_{x \rightarrow 2} f(x)$ exist? If so, what is it? Is it equal to $f(2)$?

TABLE CHECK: ESTIMATING LIMITS NUMERICALLY

When a graph is not available, evaluate the function at inputs closer and closer to a from both sides. If the outputs settle toward one number, that number is your estimate.

4 Complete the table for $f(x) = \frac{\sin x}{x}$ (radian mode), then estimate $\lim_{x \rightarrow 0} f(x)$.

x	-0.1	-0.01	-0.001	0.001	0.01	0.1
$f(x)$						

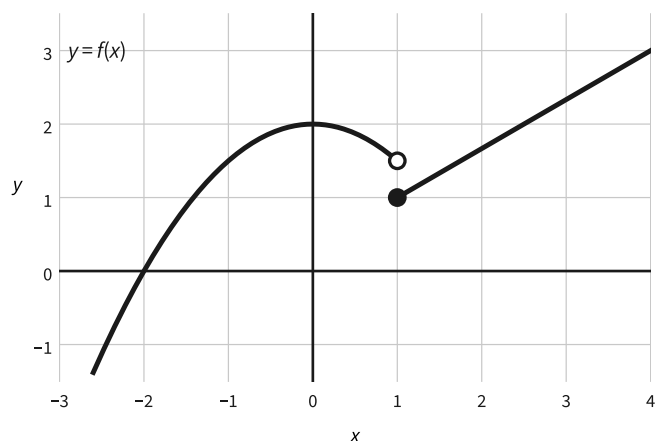
Estimate: $\lim_{x \rightarrow 0} \frac{\sin x}{x} \approx$ _____

- 5 Build your own table for $g(x) = \frac{x^2 - 1}{x - 1}$ with three values on each side of $x = 1$. Then estimate $\lim_{x \rightarrow 1} g(x)$.

x						
$g(x)$						

Estimate: $\lim_{x \rightarrow 1} g(x) \approx$ _____

📐 LIMIT CHECK: ONE-SIDED LIMITS



Use the graph of f to answer questions 6 to 9.

6 $\lim_{x \rightarrow 1^-} f(x) =$

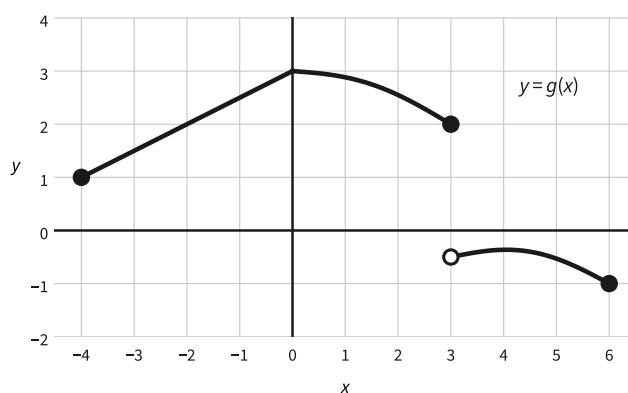
7 $\lim_{x \rightarrow 1^+} f(x) =$

- 8 Does $\lim_{x \rightarrow 1} f(x)$ exist? Justify your answer using the definition of a two-sided limit.

- 9 What is $f(1)$? How does it compare to the one-sided limits?

A Piecewise Graph

The function g is defined on $[-4, 6]$. Its graph is shown. The graph has a filled point at $(3, 2)$ and an open circle at $(3, -0.5)$, so $g(3) = 2$.



a Find $\lim_{x \rightarrow 3^-} g(x)$ and $\lim_{x \rightarrow 3^+} g(x)$.

b Does $\lim_{x \rightarrow 3} g(x)$ exist? Justify your answer.

FRQ EDGE • UNIT 1 • CONTINUED

c Is g continuous at $x = 3$? State which condition of continuity, if any, fails.

d Name the type of discontinuity at $x = 3$, if there is one, and explain how the graph shows it.

☒ **READY+ CHECK • SCORE YOURSELF**

CONFIDENCE ☐ 1 ☐ 2 ☐ 3 ☐ 4

☐ I stated both one-sided limits with correct notation.

☐ I compared the one-sided limits to decide whether the limit exists.

☐ I checked all three continuity conditions, not just one.

☐ I named the specific type of discontinuity.

Section I Answer Sheet

Fill in one bubble per question. You can also mark answers directly next to each question.

PART A • QUESTIONS 1 TO 29

⌚ 62 MINUTES

1 (A) (B) (C) (D)

2 (A) (B) (C) (D)

3 (A) (B) (C) (D)

4 (A) (B) (C) (D)

5 (A) (B) (C) (D)

6 (A) (B) (C) (D)

7 (A) (B) (C) (D)

8 (A) (B) (C) (D)

9 (A) (B) (C) (D)

10 (A) (B) (C) (D)

11 (A) (B) (C) (D)

12 (A) (B) (C) (D)

13 (A) (B) (C) (D)

14 (A) (B) (C) (D)

15 (A) (B) (C) (D)

16 (A) (B) (C) (D)

17 (A) (B) (C) (D)

18 (A) (B) (C) (D)

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23 (A) (B) (C) (D)

24 (A) (B) (C) (D)

25 (A) (B) (C) (D)

26 (A) (B) (C) (D)

27 (A) (B) (C) (D)

28 (A) (B) (C) (D)

29 (A) (B) (C) (D)

PART B • QUESTIONS 30 TO 42

⌚ 38 MINUTES

30 (A) (B) (C) (D)

31 (A) (B) (C) (D)

32 (A) (B) (C) (D)

33 (A) (B) (C) (D)

34 (A) (B) (C) (D)

35 (A) (B) (C) (D)

36 (A) (B) (C) (D)

37 (A) (B) (C) (D)

38 (A) (B) (C) (D)

39 (A) (B) (C) (D)

40 (A) (B) (C) (D)

41 (A) (B) (C) (D)

42 (A) (B) (C) (D)

Part A correct: _____ / 29

Part B correct: _____ / 13

Total: _____ / 42

Answer Key

Answers are grouped by section, with the page number of each set of problems. For free-response questions, the key shows the setup, the value, and how points are typically earned. Where more than one justification is reasonable, one strong version is shown. Check a whole section at a time, and redo anything you missed before reading the worked solution.

GETTING STARTED

Algebra and Function Skills Check

p. 16

- 1 $x + 2$
- 2 $\frac{1}{2}, \frac{1}{2}, 1$
- 3 $3; x = \frac{\ln 5}{2} \approx 0.805$
- 4 $\frac{1}{\sqrt{x+1}+1}$ for $x \neq 0$
- 5 $f: [-2, 2]; g: x > 1$

UNIT 1 • LIMITS AND CONTINUITY

Unit 1 Quick Start

p. 18

- a $x + 2$ for $x \neq 2$
- b $\frac{1}{2}$
- c 3

Lesson 1.1 • Graph It

p. 18

- 1 3
- 2 3
- 3 Yes, the limit is 3. But $f(2) = 4.5$, so the limit does not equal $f(2)$.

Lesson 1.1 • Table Check

p. 18

- 4 Values: 0.99833, 0.99998, 1.00000 (both sides, symmetric). The limit is 1.
- 5 Outputs equal $x + 1$ (for example 1.9, 1.99, 1.999 and 2.001, 2.01, 2.1), so the limit is 2.

Lesson 1.1 • One-Sided Limits

p. 19

- 6 1.5
- 7 1
- 8 No. The one-sided limits exist but are not equal ($1.5 \neq 1$).
- 9 $f(1) = 1$, which matches the right-hand limit only.

Lesson 1.2 • Limit Check

p. 20

- 1 8. Factor: $(x - 4)^{\frac{x+4}{x-4}} = x + 4$.
- 2 $\frac{1}{6}$. Factor $x - 9 = (\sqrt{x} - 3)(\sqrt{x} + 3)$, so the limit is $\frac{1}{3+3}$.
- 3 12. $(x - 2)^{\frac{x^2+2x+4}{x-2}} \rightarrow 4 + 4 + 4$.
- 4 $-\frac{1}{9}$. Combine: $\frac{x^2-3-(x+3)}{3x(x+3)} = -\frac{1}{3(x+3)}$.

Lesson 1.3 • Squeeze Theorem

p. 21

- 1 $-|x| \leq x \cos(1/x) \leq |x|$, and both bounds go to 0, so the limit is 0. Using $|x|$ keeps the bounds valid on both sides of 0.
- 2 0, since $-x^2 \leq x^2 \cos(1/x^2) \leq x^2$.
- 3 0, since $-1/x \leq (\sin x)/x \leq 1/x$ for $x > 0$, and both bounds go to 0.
- 4 0, since $-x^4 \leq x^4 \sin(1/x^3) \leq x^4$.
- 5 1, because $1 - x^2/2$ and 1 both approach 1.

Lesson 1.3 • Checkpoint

p. 22

- a 1. Both bounds approach 1, so the trapped expression does too.

- b The bounds must hold near 0 and approach the same finite value there.

Lesson 1.4 • Continuity Check

p. 23

- 1 Not continuous: condition 1 fails ($f(1)$ is undefined). The limit exists and equals 2.
- 2 Continuous: $g(0) = 0$ and both one-sided limits are 0.
- 3 Not continuous: conditions 1 and 2 fail ($h(2)$ is undefined and the limit is infinite).

Lesson 1.4 • Three Types

p. 23

- 4 A: removable; condition 3 fails ($\lim = 2$ but $f(1) = 4$). B: jump; condition 2 fails (left 2, right 3). C: infinite; conditions 1 and 2 fail.

Lesson 1.4 • Classify

p. 24

- 5 Jump. The left-hand limit is $1 = f(0)$ and the right-hand limit is 2, so condition 2 fails.
- 6 Removable. $\lim_{x \rightarrow 2} f(x) = 3$ but $f(2)$ is undefined, so condition 1 fails.
- 7 Yes. Define $f(2) = 3$.

Lesson 1.5 • Limits at Infinity

p. 25

- 1 $\frac{3}{5}$; asymptote $y = \frac{3}{5}$.
- 2 0; asymptote $y = 0$.
- 3 $-\infty$. The function decreases without bound, so there is no horizontal asymptote on this side.
- 4 $-\frac{7}{2}$; asymptote $y = -\frac{7}{2}$.

Lesson 1.6 • IVT

p. 26

- 1 $g(0) = 1$ and $g(\pi/2) = -\pi/2 \approx -1.57$. g is continuous, and 0 is between these values, so some c in $(0, \pi/2)$ has $\cos c = c$.
- 2 $f(0) = -1$ and $f(1) = 2$; f is continuous, so a root lies in $(0, 1)$.
- 3 0 is between $f(-2) = 6$ and $f(1) = -3$, and f is continuous, so the IVT applies.
- 4 $(1, 2)$, where w goes from -1 to 3, and $(3, 4)$, where w goes from 2 to -4 .
- 5 h is not continuous at $x = 0$, which is inside $[-1, 1]$.

Lesson 1.6 • IVT Checkpoint

p. 27

- 6 Yes, at least two: one in $(2, 4)$ where w goes from 5 to -1 , and one in $(6, 8)$ where w goes from -3 to 2. The data do not guarantee exactly two.

Lesson 1.6 • Continuity on Intervals

p. 27

- 7 Yes. At $x = 1$ both one-sided limits equal $2 = f(1)$. $\lim_{x \rightarrow -3^+} f(x) = -2 = f(-3)$ and $\lim_{x \rightarrow 5^-} f(x) = -2 = f(5)$.
- 8 No. $f(3)$ is undefined (and the limit is infinite).
- 9 Yes. g is continuous on $(2, 7]$ and $\lim_{x \rightarrow 2^+} g(x) = 0 = g(2)$.
- 10 No. The left-hand limit at 2 is 4 and the right-hand limit is 5, so the limit does not exist (jump).