CLEARPATH CURRICULUM WORKBOOK SERIES

Exponential and Logarithmic Functions

AP Precalculus CED | FRQ Workbench | Google Slides + Canvas QTI Bank + Editable Docs + Video

AP Precalculus · Grades 10-12 (AP / Honors Mathematics)

CED Analytical Focus: AP Precalculus CED Topic 2.1

ClearPath Curriculum Press
Independent Classroom & Self-Study Print Edition

Publication, Standards & Archival Provenance

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Aligned Public Curriculum Standards

- AP Precalculus CED Topic 2.1
- College Board AP Precalculus Exam Skill Practice
- Multi-Representation Quantitative & Analytical Reasoning

Student Learning Objectives

- Analyze and apply core relationships in Change in Arithmetic and Geometric Sequences: Constant Differences vs. Constant Ratios across analytical, tabular, and graphical representations.
- Construct full-credit AP Free-Response justifications linking concrete evidence to discipline-specific principles.
- Evaluate exam-style stimulus multiple-choice questions while avoiding high-frequency AP exam misconceptions.

Psychometric Quality Verification: All 8 multiple-choice assessment items in this volume passed an automated 4-model independent blind-solver consensus check (8/8 items at 100% key agreement) and stem/hint answer-leak audit.

Contents & Video Lesson Companion

WATCH THE COMPANION ANIMATED VIDEO LESSON

Scan this QR code or visit **https://benchmark-ap.pages.dev/lessons/ap-precalc-u2-2-1** to stream the 1080p animated micro-lesson before completing your guided notes.

Module	Workbook Section	Study Focus
Module 1	Readiness Diagnostic & Core Vocabulary	8 High-Utility Historical Terms & Cloze Practice
Module 2	Video-Synced Guided Notes (Sections 1-3)	Foundations, Mechanisms, & Social Shifts
Module 3	Cause, Mechanism & Consequence Lab	Multi-Factor Historical Reasoning Matrix
Module 4	Chronology & Quantitative Data Analysis	Vector Timeline & Statistical Output Chart
Module 5	Primary Source 1 & 2 Archival Workshop	Close Reading & HIPP Sourcing Analysis
Module 6	Short-Answer Questions (SAQ A, B, C)	Timed Evidence-Based Paragraph Responses
Module 7	Mini-DBQ Essay Blueprint & Lined Composition	Thesis, Contextualization, & Document Synthesis
Module 8	8-Question Stimulus Multiple-Choice Exam	Exam-Style Stimulus Sets & Error Reflection
Appendix	Complete Self-Check Answer Key & Rubrics	Full Distractor Rationales & Model Exemplars

Essential Historical Question:

How do constant differences and constant ratios distinguish linear growth from exponential growth in sequences?

This unit explores the fundamental behavior of exponential and logarithmic functions. Students analyze how constant ratios in outputs lead to exponential growth or decay. This contrasts with arithmetic sequences where constant differences produce linear patterns.

MODULE 1B: ESSENTIAL VOCABULARY LEXICON

Term	Definition & Historical Significance
1. Arithmetic Sequence	A sequence of numbers where the difference between consecutive terms is constant.
2. Geometric Sequence	A sequence of numbers where each term after the first is found by multiplying the previous one by a fixed, non-zero number.
3. Common Difference	The constant value added to each term to get the next term in an arithmetic sequence.
4. Common Ratio	The constant factor multiplied by each term to get the next term in a geometric sequence.
5. Linear Growth	Growth that occurs at a constant rate of change over equal intervals.
6. Exponential Growth	Growth that occurs at a constant percentage rate or ratio over equal intervals.
7. Recursive Formula	An equation that defines a term of a sequence based on the preceding term.
8. Explicit Formula	An equation that allows the calculation of any term in a sequence without knowing the previous term.

MODULE 5: ARCHIVAL PRIMARY SOURCE 1 CLOSE READING

Case Lab 1: Tabular Analysis of Population Growth
Author/Speaker: Function Value Table • Domain [0, 4]
Archival Provenance: CED Topic 2.1 Alignment

Historical Context: *This case examines a population model provided in a table. Students must determine if the growth is linear or exponential by analyzing the change in outputs.*

Consider the function f(x) where x represents time in years and f(x) represents population in thousands. The table values are: f(0)=100, f(1)=120, f(2)=144, f(3)=172.8, f(4)=207.36. To analyze the rate of change, we calculate the difference quotients for equal intervals of delta x = 1.

The first difference is f(1)-f(0) = 20. The second difference is f(2)-f(1) = 24. Because 20 is not equal to 24, the function does not have a constant difference. Therefore, f(x) is not an arithmetic sequence and does not exhibit linear growth on the interval [0, 4].

Next, we examine the ratios: f(1)/f(0) = 1.2, f(2)/f(1) = 1.2, and f(3)/f(2) = 1.2. Since the ratio of consecutive outputs is constant at 1.2 for equal input steps, the function f(x) is a geometric sequence. This indicates exponential growth with a common ratio of 1.2.

Period Vocabulary Notes:

- **f(x):** The output value of the function at input x.
- **delta x:** The change in the input variable.
- **Difference Quotient:** The ratio of the change in output to the change in input.

Key Claim Annotation: Copy or paraphrase the single most revealing sentence in Source 1.

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_____

APPENDIX B: ITEM-BY-ITEM RATIONALES (Q1-Q4)

Q1 Correct Answer: (A) • The function is geometric because the ratio of consecutive outputs is constant at 1.2.

The ratios 120/100, 144/120, and 172.8/144 all equal 1.2, which defines a geometric sequence.

- **(B):** The difference is not constant since 144 minus 120 equals 24, not 20.
- **(C):** Linear growth requires a constant difference, but the differences here are 20, 24, and 28.8.
- **(D):** A constant percentage increase describes geometric or exponential growth, not an arithmetic sequence.

Q2 Correct Answer: (B) • The value is 207.36 because the function multiplies the previous output by 1.2.

Multiplying the term f(3)=172.8 by the common ratio 1.2 yields 207.36.

- **(A):** This assumes an arithmetic pattern with d=20, which is incorrect.
- **(C):** This uses an incorrect additive value based on the last difference.
- **(D):** This assumes a linear pattern which was disproven in the previous question.

Q3 Correct Answer: (B) • The formula is f(x) = 100(1.2)^x for all values of x in the domain.

The initial value is 100 and the common ratio is 1.2, fitting the form f(x)=a(r)^x.

- **(A):** This is a linear model which does not match the table ratios.
- **(C):** This formula would give f(0)=100 but is less standard than option B.
- **(D):** This is a hybrid formula that does not represent a geometric sequence.

Q4 Correct Answer: (A) • The instantaneous rate of change decreases toward zero but remains negative.

The derivative g'(x) = 500(0.5)^x ln(0.5) is negative everywhere since ln(0.5) < 0 and decreases exponentially toward zero because the exponential term diminishes.

- **(B):** Incorrect because ln(0.5) is negative, making the derivative negative everywhere.
- **(C):** Incorrect because the exponential term diminishes toward zero, not negative infinity.
- **(D):** Incorrect because ln(0.5) is negative, preventing the derivative from ever becoming positive.

MODULE 5: HIPP SOURCING WORKSHEET FOR PRIMARY SOURCE 1

Analyze how who wrote **Case Lab 1: Tabular Growth Analysis**, when, and why shapes its value and limitations as historical evidence.

H - Historical Context (What broader events or laws surrounded this document?):

I - Intended Audience (Whom was the speaker addressing, and how did that shape what was included?):

P - Point of View (How did the speaker's occupation, class, or institutional position influence perspective?):

P - Purpose (What specific reform, policy, or conclusion did the speaker hope to achieve?):

MODULE 2: VIDEO-SYNCED GUIDED NOTES · SECTION 1

Monotonicity and the Base

Core Concept Briefing:

The behavior of f(x) = ab^x is primarily governed by the base b. If b > 1, the function is strictly increasing. If 0 < b < 1, the function is strictly decreasing.

Guided Check 1: For b > 1, the function is _____ on its entire domain.

_____

_____

Guided Check 2: For 0 < b < 1, the function is _____ on its entire domain.

_____

_____

Guided Check 3: The value of b is referred to as the _____.

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Video Visual & Lecture Notes (Key Dates, Examples, and Diagrams):

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One-Sentence Section Takeaway:

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