

Precalculus
Sequences and Exponential Models

10-topic bundle | 960 problems | Four activity formats

Included topics

The following pages list all 10 included resources in the suggested order, with a link to each product. Each resource retains its complete preview.

Suggested learning sequence

- 1. Sequences and model parameters
- 2. Growth, decay and reference points
- 3. Fit and compare regression models

In every topic

Answer Bank Challenge	24 tasks
Grid Rounds	24 tasks
Match & Move	24 cards
Error Analysis & Strategy	24 tasks
Quick Answer Key and Full Worked Solutions	included
Teacher / Parent Use Guide and Terms of Use	included

Product previews

The following preview pages show the cover, all four activity formats, and worked examples for each included resource, in the listed order.

80 PDFs and 10 READMEs; 722 buyer PDF pages across the 10 products.

Preview pages are not included in the buyer page count. Check the list against resources you already own.

Sets & Steps

Math Practice & Worked Solutions

Precalculus

Included topics

10-topic bundle | 960 problems | Four activity formats

01 Arithmetic vs Geometric Sequences

[View individual product and its full preview](#)

02 Sequences to Linear and Exponential Models

[View individual product and its full preview](#)

03 Exponential Parameters and Reference Points

[View individual product and its full preview](#)

04 Exponential Features and Concavity

[View individual product and its full preview](#)

05 Rewriting Exponential Expressions

[View individual product and its full preview](#)

06 Compound Growth and Decay Rates

[View individual product and its full preview](#)

07 Exponential Growth and Decay Applications

[View individual product and its full preview](#)

08 Exponential Functions from Two Points

[View individual product and its full preview](#)

09 Exponential Regression

[View individual product and its full preview](#)

10 Comparing Regression Models

[View individual product and its full preview](#)

10 included resources | Complete resource previews follow this guide.

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AP Precalculus
Arithmetic vs Geometric Sequences

Arithmetic vs Geometric Sequences | APPC-U02-P01

96 problems · Four activity formats

01	Answer Bank Challenge	24 tasks
02	Grid Rounds	24 tasks
03	Match & Move	24 cards
04	Error Analysis & Strategy	24 tasks
05	Quick Answer Key	96 answers
06	Full Worked Solutions	96 solutions
07	Teacher / Parent Use Guide	included
08	Terms of Use & License	included

Topic focus

Across 96 tasks this topic asks for terms, safe explicit form, and exponential limitation, explicit rule, signs, and real-domain limitation, all ratios and sequences, possible completions, two valid completions and conclusion and classification with failure evidence.

8 PDFs and a README; 51 buyer pages.

AP Precalculus

Arithmetic vs Geometric Sequences

Name: _____ Date: _____ Class: _____

Answer each question and record the matching bank letter. Give exact values. Give the whole requested response, including any reasoning the question asks for.

Classify the consecutive terms 1, 4, 9, 16 as arithmetic, geometric, or neither. For the answer bank, record the classification. Complete and justify all parts of the original task in your work. _____ Bank label: _____	Determine the sequence type for $-4, -9, -14, -19$ and state its step change. For the answer bank, record the common difference. Complete and justify all parts of the original task in your work. _____ Bank label: _____
Translate $a_0=12$ and $a_n=a_{n-1}-7$ into a direct rule for whole-number n. For the answer bank, record the expression for a_n. Complete and justify all parts of the original task in your work. _____ Bank label: _____	Convert $b_n=125(0.2^{n+1})$, $n = 0, 1, 2, \dots$, to a recurrence with the correct zeroth term. For the answer bank, record the zeroth term b_0. Complete and justify all parts of the original task in your work. _____ Bank label: _____
Classify 7, 14, 28, 56 and state the common change. For the answer bank, record the common ratio. Complete and justify all parts of the original task in your work. _____ Bank label: _____	Write an explicit formula for $b_1=100$ and $b_n=b_{n-1}-15$ for $n \geq 2$. For the answer bank, record the expression for b_n. Complete and justify all parts of the original task in your work. _____ Bank label: _____
For $a_n=\frac{7-2n}{5}$ at whole-number $n \geq 0$, find a_0 and an exact recurrence. For the answer bank, record the zeroth term a_0. Complete and justify all parts of the original task in your work. _____ Bank label: _____	An arithmetic sequence has $a_{10}=1$ and decreases by 2 each step. Write a_n from $n = 1$ onward and find a_1. For the answer bank, record the first term a_1. Complete and justify all parts of the original task in your work. _____ Bank label: _____

AP Precalculus

Arithmetic vs Geometric Sequences

Name: _____ Date: _____ Class: _____

Answer each question and show your reasoning in the workspace. Give exact values rather than decimals unless the question supplies a decimal. Give the whole requested response, including any reasoning the question asks for.

For indices 1 through 4, the terms are 11, 11, 11, 11. Classify every arithmetic or geometric description that applies and state its invariant. 	The terms at $n = 0, 1, 2, 3$ are all 0. If a geometric classification requires defined consecutive ratios, classify the sequence and explain the zero case.
For $a_n = 5 - 3(n - 1)$, $n = 1, 2, \dots$, give the necessary initial term and a recurrence. 	An account begins with \$120, and each completed deposit adds \$25. Let n count completed deposits. Write the balance sequence and list its first three graph points.
Complete the arithmetic sequence $a_1 = 4$, $a_2 = ?$, $a_3 = 16$, $a_4 = 22$, and justify the missing term. 	Convert $g_1 = 48$ and $g_n = \left(\frac{1}{2}\right)g_{n-1}$ for $n \geq 2$ into an explicit sequence rule.

AP Precalculus

Arithmetic vs Geometric Sequences

Name: _____ Date: _____ Class: _____

Begin at START. Answer the card, then find the matching final answer at the top of another card. Use the recording sheet for your reasoning. Visit each card once and continue to FINISH.

START Given $a_0=7$ and $a_n=a_{n-1}+4$ for $n \geq 1$, write a direct rule for whole-number n. Your response: _____	Incoming: $d = 5$ and $a_2=-1$. An arithmetic sequence has $a_3=14$ and $a_8=34$. Find its common difference and a_1. Context/domain: sequence <table border="1" data-bbox="824 611 1472 674"> <tbody> <tr> <td>3</td> <td>14</td> </tr> <tr> <td>8</td> <td>34</td> </tr> </tbody> </table> Your response: _____	3	14	8	34
3	14				
8	34				
Incoming: $r = 3$ and $a_1=-9$. A geometric sequence with positive ratio satisfies $a_2=12$ and $a_5=324$. Recover r and a_1. Your response: _____	Incoming: $d = -3$ and $a_1=31$. An arithmetic sequence satisfies $a_6=-5$ and $a_{10}=19$. Determine d and extrapolate backward to a_1. Your response: _____				
Incoming: $r = -3$, uniquely. For an arithmetic sequence indexed from 0, $a_2=5$ and $a_7=-10$. Find the common difference and a_0. Context/domain: sequence <table border="1" data-bbox="151 1472 797 1535"> <tbody> <tr> <td>2</td> <td>5</td> </tr> <tr> <td>7</td> <td>-10</td> </tr> </tbody> </table> Your response: _____	2	5	7	-10	Incoming: Geometric with ratio 0.8. A positive-ratio geometric sequence has $a_4=54$ and $a_7=2$. Recover the common ratio and a_1. Your response: _____
2	5				
7	-10				

AP Precalculus

**Arithmetic vs
Geometric Sequences**

Name: _____ Date: _____ Class: _____

Evaluate the supplied statement or method. Say whether it is correct, repair it if it is not, and verify the result exactly. Not every prompt contains an error.

The exact terms are 2, 10, 50, 245. A student calls them geometric with ratio 5. Evaluate the claim and state the fourth term that would make it true. Student work/claim: The first two ratios equal 5, so all four given terms form a geometric sequence. Identify the first invalid step or inference in the displayed work. Correct it and complete the original task.

A student labels 10, 7, 4, 1, -3 arithmetic with $d = -3$. Decide whether the complete exact list supports the claim and repair the last term if needed. Student work/claim: Every difference in the given list is -3 . Identify the first invalid step or inference in the displayed work. Correct it and complete the original task.

Can the blank in 4, ?, 14, 19, 25 be filled so the entire exact list is arithmetic? Explain which evidence is decisive. Student work/claim: Filling the blank with 9 makes the entire list arithmetic. Identify the first invalid step or inference in the displayed work. Correct it and complete the original task.

Arithmetic vs Geometric Sequences

Full Worked Solutions - excerpt

Worked example

Problem. Given $a_0 = 7$ and $a_n = a_{n-1} + 4$ for $n \geq 1$, write a direct rule for whole-number n .

Answer. $a_n = 7 + 4n$ for $n = 0, 1, 2, \dots$

Explanation and check.

From index 0 to index n there are n additions of 4, so the term is $7 + 4n$.

Worked example

Problem. Starting at $a_3 = 81$, each later term is one third of the previous term. Write the explicit rule for $n \geq 3$.

Answer. $a_n = 81\left(\frac{1}{3}\right)^{n-3}$.

Explanation and check.

The exponent is zero at the first allowed index and counts the subsequent divisions by 3.

AP Precalculus
Sequences to Linear and Exponential Models

Sequences to Linear and Exponential Models | APPC-U02-P02

96 problems · Four activity formats

01	Answer Bank Challenge	24 tasks
02	Grid Rounds	24 tasks
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07	Teacher / Parent Use Guide	included
08	Terms of Use & License	included

Topic focus
Across 96 tasks this topic asks for differences, ratios, interpretation, domain judgment, domain distinction, two compatible models, existence and reason and class and amount.
8 PDFs and a README; 62 buyer pages.

AP Precalculus

Sequences to Linear
and Exponential Models

Name: _____ Date: _____ Class: _____

Answer each question and record the matching bank letter. Give exact values. A value without its unit is not a complete answer.

Extend $a(n) = -4 + 1.5n$ from whole-number indices to all real x and evaluate $f(-2)$. For the answer bank, record the complete response required by the original task; use the given context to distinguish responses that share a numerical value. _____ Bank label: _____	An account begins with \$140 and receives exactly \$25 each week with no interest. Is the weekly pattern linear or exponential, and what is the balance after one week? For the answer bank, record the complete response required by the original task; use the given context to distinguish responses that share a numerical value. _____ Bank label: _____
A sequence starts at 18 and increases by 6 per index. If the constant rate is extended between indices, what is its value at index 2.5? For the answer bank, record the complete response required by the original task; use the given context to distinguish responses that share a numerical value. The starting value is the value at index 0. _____ Bank label: _____	A material starts at 250g and loses 12% of current mass per hour. Give its factor and model. For the answer bank, record the complete response required by the original task; use the given context to distinguish responses that share a numerical value. _____ Bank label: _____

AP Precalculus

Sequences to Linear
and Exponential Models

Name: _____ Date: _____ Class: _____

Answer each question and show your reasoning in the workspace. Give exact values rather than decimals unless the question supplies a decimal. A value without its unit is not a complete answer.

The sequence rule is $a(n) = 3 + 2n$ for whole-number n at least 0. Extend the same linear rule to real x at least 0, then find $f(2.5)$. 	Exact samples at $x = 0, 1, 2, 3$ are 5, 8, 11, 14. Which model class is consistent, and what does the finite table not prove? Context/domain: real-input data <table border="1"> <tbody> <tr><td>0</td><td>5</td></tr> <tr><td>1</td><td>8</td></tr> <tr><td>2</td><td>11</td></tr> <tr><td>3</td><td>14</td></tr> </tbody> </table> 	0	5	1	8	2	11	3	14
0	5								
1	8								
2	11								
3	14								
A balance starts at \$200 and rises each hour by 10% of the initial \$200, not its current value. Construct a real-time rule and classify it. 	For exact points (0, 1), (2, 7), and (5, 16), compare change per input unit rather than raw differences. Which class is supported? Context/domain: real-input data <table border="1"> <tbody> <tr><td>0</td><td>1</td></tr> <tr><td>2</td><td>7</td></tr> <tr><td>5</td><td>16</td></tr> </tbody> </table> 	0	1	2	7	5	16		
0	1								
2	7								
5	16								
$L(x) = 4 + 16x$ and $E(x) = 4(3^x)$ share (0, 4) and (2, 36). Compare their values at $x = 1$. Context/domain: matched models <table border="1"> <tbody> <tr><td>0</td><td>4</td></tr> <tr><td>2</td><td>36</td></tr> </tbody> </table> 	0	4	2	36	A linear table gives 10, 15, 20 and an exponential table gives 10, 15, 22.5 at $x = 0, 1, 2$. After the shared +5, what differs? 				
0	4								
2	36								

AP Precalculus

Sequences to Linear
and Exponential Models

Name: _____ Date: _____ Class: _____

Begin at START. Answer the card, then find the matching final answer at the top of another card. Use the recording sheet for your reasoning. Visit each card once and continue to FINISH.

START

Production starts at 12 units and adds 6 units per minute. Write the model. Use the complete final response to identify the next Match & Move card; show the reasoning required by the original task.

Your response: _____

Incoming: Both give factor 0.8: $\sqrt{0.64} = 0.8$ and cube root of $0.512 = 0.8$.

A sequence has value -2 at index 0 and adds 5 at each next whole-number index. Extend its constant-rate rule to real x and evaluate it at $x = -1.5$. Use the complete final response to identify the next Match & Move card; show the reasoning required by the original task.

Your response: _____

Incoming: L keeps $+5$ while ratios fall; E keeps ratio 2 while increments grow 5, 10, 20.

At consecutive inputs $-2, -1, 0, 1$, the exact outputs are $-7, -2, 3, 8$. Classify the data from their change pattern. Use the complete final response to identify the next Match & Move card; show the reasoning required by the original task.

Context/domain: integer samples

-2	-7
-1	-2
0	3
1	8

Your response: _____

Incoming: Linear: 105. Exponential: 15.

A population starts at 90 and grows 7% of current size per year. Write the model. Use the complete final response to identify the next Match & Move card; show the reasoning required by the original task.

Your response: _____

AP Precalculus

**Sequences to Linear
and Exponential Models**

Name: _____ Date: _____ Class: _____

Evaluate the supplied statement or method. Say whether it is correct, repair it if it is not, and verify the result exactly. Not every prompt contains an error.

A display begins with 46 items and staff add exactly 7 items each day. Classify the model and find the count after four days. Student work: exponential; 74 items. Identify the precise mathematical error or omitted condition, then complete the original task and verify the correction from the supplied givens.

Use $L(x) = 12 + 6x$ and $E(x) = 12(2^x)$ to refute “same starting value means same change.” Identify the precise error or unsupported step in the stated claim or method, then give the corrected conclusion and justify it from the supplied information.

Pallet count is $p(n) = 40 + 6n$ after n completed trucks. Does $p(2.5) = 55$ describe a sequence term in this context? Student work: No. The algebraic line gives 55, but 2.0 completed trucks is outside the stated event domain. Identify the precise mathematical error or omitted condition, then complete the original task and verify the correction from the supplied givens.

An amount starts at 400mg and loses 5% of its current amount each hour. Classify the change and find the amount after two hours. Student work: linear decay; 361mg. Identify the precise mathematical error or omitted condition, then complete the original task and verify the correction from the supplied givens.

Sequences to Linear and Exponential Models

Full Worked Solutions - excerpt

Worked example

Problem. A tank starts with $500L$ and drains at a fixed $30L$ per day. Write the model and name its change type.

Answer. $V(t) = 500 - 30t$, a linear decrease while $V(t) \geq 0$.

Explanation and check.

A fixed amount per time unit gives slope -30 rather than a percentage.

Worked example

Problem. An investment starts at \$ 600 and grows 5% of its current balance per year. State its factor and continuous-time rule.

Answer. The factor is 1.05 , so $B(t) = 600(1.05^t)$.

Explanation and check.

Current-value growth preserves a 1.05 multiplier while dollar increments change.

AP Precalculus
Exponential Parameters and Reference Points

Exponential Parameters and Reference Points | APPC-U02-P03

96 problems · Four activity formats

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Topic focus

Across 96 tasks this topic asks for adjusted ratios and limitation, adjusted sequences and conclusion, actual constant, base sign and consequence, degenerate class and failed condition and domain failures.

8 PDFs and a README; 57 buyer pages.

AP Precalculus

Exponential Parameters and Reference Points

Name: _____ Date: _____ Class: _____

Answer each question and record the matching bank letter. Give exact values. Give the whole requested response, including any reasoning the question asks for.

Classify $h(x) = 4(1^{x-7}) - 2$ and give its actual value for every x. For the answer bank, record the complete response required by the original task; use the given context to distinguish responses that share a numerical value. _____ Bank label: _____	Does $f(x) = (\frac{1}{2})(\frac{5}{4})^x$ define a real nonconstant exponential on all real inputs? Explain. For the answer bank, record the complete response required by the original task; use the given context to distinguish responses that share a numerical value. _____ Bank label: _____
Is $f(x) = -8(6^x)$ a real nonconstant exponential on all real x? Explain. For the answer bank, record the complete response required by the original task; use the given context to distinguish responses that share a numerical value. _____ Bank label: _____	For $N(t) = 40(0.9^{t-6}) + 12$, what happens at day 6, and what does 40 measure there? For the answer bank, record the complete response required by the original task; use the given context to distinguish responses that share a numerical value. _____ Bank label: _____
Translate the base 0.875 in $q(x) = 90(0.875^x)$ into a percent change per unit x. For the answer bank, record the complete response required by the original task; use the given context to distinguish responses that share a numerical value. _____ Bank label: _____	For which real p is $g(x) = 7(5 - 2p)^x$ a real nonconstant exponential on all real inputs? For the answer bank, record the complete response required by the original task; use the given context to distinguish responses that share a numerical value. _____ Bank label: _____

AP Precalculus

Exponential Parameters and Reference Points

Name: _____ Date: _____ Class: _____

Answer each question and show your reasoning in the workspace. Give exact values rather than decimals unless the question supplies a decimal. Give the whole requested response, including any reasoning the question asks for.

For which real m does $f(x) = 4(m + 2)^x$ define a real nonconstant exponential for every real x? _____ _____	For $f(x) = 7(2^x) + 5$, what ratio stays constant when x increases by 1? _____ _____
A student says $P(t) = 800(1.04^t)$ grows by 1.04% per year. Correct the statement. _____ _____	Does $g(x) = 2(-3)^x$ define a real exponential for every real x? Give a decisive input. _____ _____
For $f(x) = 6(2^{x-3})$, identify the input where the coefficient 6 appears as an output, then find $f(0)$. _____ _____	Interpret the base 0.73 in $A(t) = 320(0.73^t)$ as a percent change per unit time. _____ _____

AP Precalculus

Exponential Parameters and Reference Points

Name: _____ Date: _____ Class: _____

Begin at START. Answer the card, then find the matching final answer at the top of another card. Use the recording sheet for your reasoning. Visit each card once and continue to FINISH.

START For $f(x) = 9(2^x) + 4$, find $f(0)$ and interpret the coefficient 9 relative to the baseline. Use the complete final response to identify the next Match & Move card; show the reasoning required by the original task. Your response: _____	Incoming: $f(0) = 13$; the coefficient 9 is the displacement $13 - 4$ from baseline 4. For $g(x) = -11(3^x)$, find $g(0)$ and interpret the coefficient. Use the complete final response to identify the next Match & Move card; show the reasoning required by the original task. Your response: _____
Incoming: $g(0) = -11$; the coefficient is the zero-input output. Is $q(x) = 7((2 - \sqrt{3})^x)$ a valid real nonconstant exponential for all real x? Justify the base bounds. Use the complete final response to identify the next Match & Move card; show the reasoning required by the original task. Your response: _____	Incoming: Yes. Since $1 < \sqrt{3} < 2$, the base $2 - \sqrt{3}$ lies strictly between 0 and 1 and is not 1. For $f(x) = 4(3^x) - 10$, state the constant ratio involving displacement from the baseline. Use the complete final response to identify the next Match & Move card; show the reasoning required by the original task. Your response: _____
Incoming: $\frac{f(x+1)+10}{f(x)+10} = 3$. For $D(t) = 22(0.75^{t-3}) - 5$, find $D(3)$ and express $D(0)$. What does 22 represent? Use the complete final response to identify the next Match & Move card; show the reasoning required by the original task. Your response: _____	Incoming: $D(3) = 17$ and $D(0) = 22(\frac{4}{3})^3 - 5$; 22 is displacement above baseline -5 at day 3. Compare $f(x) = 12(0.6^x)$ and $g(x) = 6(0.6^x)$. How does the coefficient change affect every output? Use the complete final response to identify the next Match & Move card; show the reasoning required by the original task. Your response: _____

AP Precalculus

Exponential Parameters and Reference Points

Name: _____ Date: _____ Class: _____

Evaluate the supplied statement or method. Say whether it is correct, repair it if it is not, and verify the result exactly. Not every prompt contains an error.

Compare $f(x) = 8(1.2^{x-2}) + 5$ and $g(x) = 8(0.7^{x-2}) + 5$. Give their shared reference point and describe their directions to its right. Student work: Both pass through $(3, 13)$. To the right, f 's displacement grows while g 's displacement decays. Identify the precise mathematical error or omitted condition, then complete the original task and verify the correction from the supplied givens.

A table of integer inputs makes $u(x) = 5(-2)^x$ look defined. Why is it not a real exponential on all real inputs? Student work: Fractional inputs such as $x = \frac{1}{2}$ produce nonreal values, so integer evidence does satisfy the all-real domain requirement. Identify the precise mathematical error or omitted condition, then complete the original task and verify the correction from the supplied givens.

Interpret factors 1.12 and 0.12 as percent changes of a positive quantity. Distinguish percent of the prior value from percent increase or decrease. Student work: Factor 1.12 means 112% remains and a 12% increase. Factor 0.12 means 12% remains and an 87% decrease. Identify the precise mathematical error or omitted condition, then complete the original task and verify the correction from the supplied givens.

For $f(x) = 3(4^x) - 2$, compare raw output ratios and baseline-adjusted ratios at $x = 0, 1, 2$. Student work: Outputs 1, 10, 46 have raw ratios 10 and 4.6. Adding 2 gives displacements 3, 12, 47 with ratio 4. Identify the precise mathematical error or omitted condition, then complete the original task and verify the correction from the supplied givens.

Exponential Parameters and Reference Points

Full Worked Solutions - excerpt

Worked example

Problem. For $h(x) = 5(4^{x-1}) - 3$, compute $h(1)$ and $h(0)$. Which quantity is represented directly by the coefficient 5?

Answer. $h(1) = 2$ and $h(0) = -\frac{7}{4}$. The coefficient 5 is the displacement $h(1) - (-3)$, not either displayed output by itself.

Explanation and check.

At $x = 1$ the factor is 1, then the baseline -3 must still be added.

Worked example

Problem. For which real c is $h(x) = (c - 5)(2^x)$ a nonconstant exponential?

Answer. All real c except $c = 5$.

Explanation and check.

The base is already valid; only the coefficient must be nonzero.

AP Precalculus
Exponential Features and Concavity

Exponential Features and Concavity | APPC-U02-P04

96 problems · Four activity formats

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Topic focus

Across 96 tasks this topic asks for monotonicity and concavity, monotonicity, concavity, rate trend, monotonicity, concavity, slope trend, concavity and differences, differences and concavity and differences, direction, concavity.

8 PDFs and a README; 99 buyer pages.

AP Precalculus

Exponential Features and Concavity

Name: _____ Date: _____ Class: _____

Answer each question and record the matching bank letter. Give exact values. Give the whole requested response, including any reasoning the question asks for.

State the range and horizontal asymptote of $f(x) = -3(2^x)$. For the answer bank, record the complete response required by the original task; use the given context to distinguish responses that share a numerical value. _____ Bank label: _____	Find the absolute minimum and maximum of $f(x) = 4(\frac{1}{2})^x$ on $[1, 3]$. For the answer bank, record the complete response required by the original task; use the given context to distinguish responses that share a numerical value. _____ Bank label: _____
Is $f(x) = 6(1.2^x) + 3$ increasing or decreasing? Describe the exponential displacement from 3. For the answer bank, record the complete response required by the original task; use the given context to distinguish responses that share a numerical value. _____ Bank label: _____	State the range of $g(x) = 8(\frac{1}{3})^x$ and its limit as $x \rightarrow \infty$. For the answer bank, record the complete response required by the original task; use the given context to distinguish responses that share a numerical value. _____ Bank label: _____
Compare $f(x) = 3(1.4^x)$ and $g(x) = 12(1.4^x)$ for all real x. For the answer bank, record the complete response required by the original task; use the given context to distinguish responses that share a numerical value. _____ Bank label: _____	A nonconstant $f(x) = a(2^{cx}) + k$ stays below $y = k$ and decreases. What signs must a and c have? For the answer bank, record the complete response required by the original task; use the given context to distinguish responses that share a numerical value. _____ Bank label: _____

AP Precalculus

Exponential Features
and Concavity

Name: _____ Date: _____ Class: _____

Answer each question and show your reasoning in the workspace. Give exact values rather than decimals unless the question supplies a decimal. Give the whole requested response, including any reasoning the question asks for.

A known exponential has exact outputs 3, 6, 12, 24 at $x = 0, 1, 2, 3$. Use first differences to describe its concavity.

Precision: Given values are exact

x	f(x)
0	3
1	6
2	12
3	24

AP Precalculus

Exponential Features
and Concavity

Name: _____ Date: _____ Class: _____

Begin at START. Answer the card, then find the matching final answer at the top of another card. Use the recording sheet for your reasoning. Visit each card once and continue to FINISH.

START Is $h(x) = -10(0.8^x) - 2$ increasing or decreasing, and how does it approach its baseline? Use the complete final response to identify the next Match & Move card; show the reasoning required by the original task. Your response: _____	Incoming: It increases toward -2 from below. On $[2, \infty)$, determine the minimum and whether a maximum exists for $f(x) = 3(2^x) - 5$. Use the complete final response to identify the next Match & Move card; show the reasoning required by the original task. Your response: _____
Incoming: Minimum 7 at $x = 2$; no maximum. Find the range and both tail limits of $g(x) = 10 - 7(0.2^x)$. Use the complete final response to identify the next Match & Move card; show the reasoning required by the original task. Your response: _____	Incoming: Range $(-\infty, 10)$; $g(x) \rightarrow -\infty$ as $x \rightarrow -\infty$ and $g(x) \rightarrow 10$ from below as $x \rightarrow \infty$. Describe the monotonicity and concavity of $f(x) = 5(1.5^x) - 20$. Use the complete final response to identify the next Match & Move card; show the reasoning required by the original task. Your response: _____
Incoming: It is increasing and concave up. Find the effective one-unit factor and monotonicity of $f(x) = 10(2^{-3x}) + 1$. Use the complete final response to identify the next Match & Move card; show the reasoning required by the original task. Your response: _____	Incoming: The effective factor is $\frac{1}{8}$, so f decreases toward 1 from above. Find the absolute extrema of $f(x) = 5 - 2(\frac{1}{2})^x$ on $[-1, 2]$. Use the complete final response to identify the next Match & Move card; show the reasoning required by the original task. Your response: _____

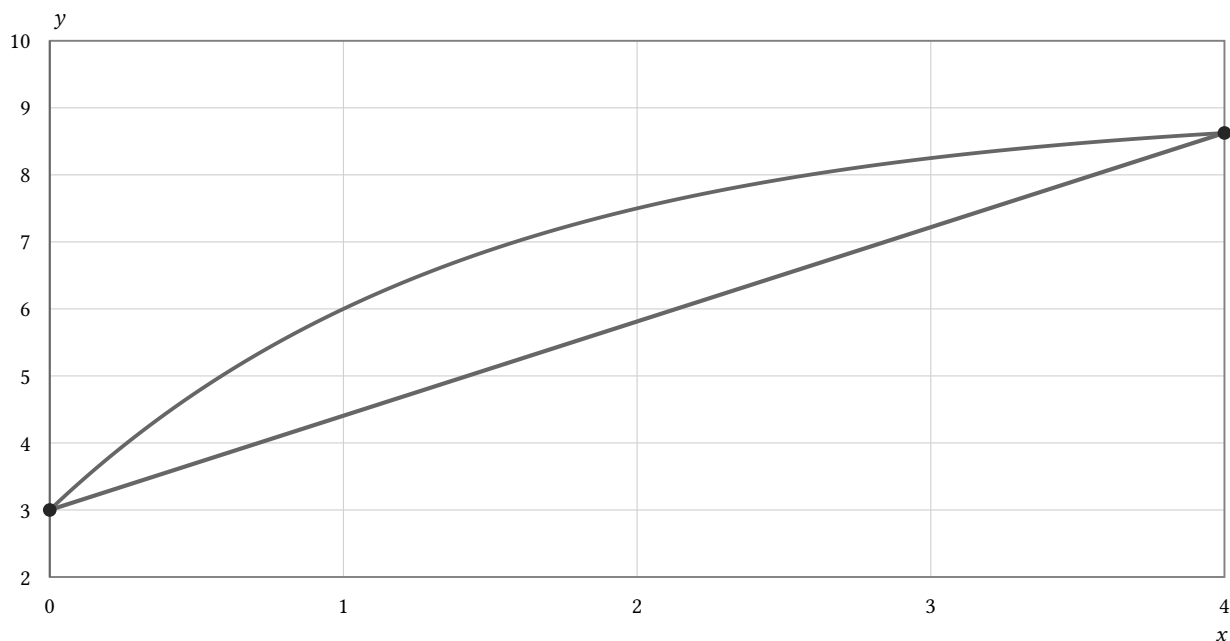
AP Precalculus

Exponential Features and Concavity

Name: _____ Date: _____ Class: _____

Evaluate the supplied statement or method. Say whether it is correct, repair it if it is not, and verify the result exactly. Not every prompt contains an error.

For $f(x) = 9 - 6(0.5^x)$, a chord joins $x = 0$ and $x = 4$. Does the chord overestimate or underestimate interior values? Explain. Student work: It underestimates them because f is concave up and lies above its chord in the interior. Identify the precise mathematical error or omitted condition, then complete the original task and verify the correction from the supplied givens.



Exponential Features and Concavity

Full Worked Solutions - excerpt

Worked example

Problem. A calculator rounds $f(12)$ to 0 for $f(x) = 0.1^x$. Explain why this does not mean the graph reaches its asymptote.

Answer. $f(12) = 10^{-12} > 0$. The value may round to 0, but no finite input makes a positive-base exponential equal 0.

Explanation and check.

Display precision is not exact attainment.

Worked example

Problem. Find where $f(x) = 2^x + 5$ and $g(x) = 3(2^x) - 1$ intersect, then state which is larger on each side.

Answer. Equality gives $2^x = 3$, so $x = \log \text{ base } 2 \text{ of } 3$. Before that $f > g$; after that $g > f$.

Explanation and check.

Different baselines and amplitudes create one order reversal.

AP Precalculus
Rewriting Exponential Expressions

Rewriting Exponential Expressions | APPC-U02-P05

96 problems · Four activity formats

01	Answer Bank Challenge	24 tasks
02	Grid Rounds	24 tasks
03	Match & Move	24 cards
04	Error Analysis & Strategy	24 tasks
05	Quick Answer Key	96 answers
06	Full Worked Solutions	96 solutions
07	Teacher / Parent Use Guide	included
08	Terms of Use & License	included

Topic focus

Across 96 tasks this topic asks for general proof and counterargument, normalized formulas and graph distinction, vertical multiplier and interpretation, exact multiplier, multiplier and interpretation and decision and normalized comparison.

8 PDFs and a README; 67 buyer pages.

AP Precalculus

Rewriting Exponential Expressions

Name: _____ Date: _____ Class: _____

Answer each question and record the matching bank letter. Give exact values. Give the whole requested response, including any reasoning the question asks for.

Rewrite $3(2^{x+2})$ in the form $A(B^x)$. For the answer bank, record the complete response required by the original task; use the given context to distinguish responses that share a numerical value. _____ Bank label: _____	Write 2^{-x} with x as a positive exponent. For the answer bank, record the complete response required by the original task; use the given context to distinguish responses that share a numerical value. _____ Bank label: _____
Put $2(5^{x-1})$ in the form $A(B^x)$. For the answer bank, record the complete response required by the original task; use the given context to distinguish responses that share a numerical value. _____ Bank label: _____	Write 10^{-x} using a positive exponent x and a base below 1. For the answer bank, record the complete response required by the original task; use the given context to distinguish responses that share a numerical value. _____ Bank label: _____
Rewrite $7(3^{x+1})$ as $A(B^x)$. For the answer bank, record the complete response required by the original task; use the given context to distinguish responses that share a numerical value. _____ Bank label: _____	Express $(\text{cube root of } 125)^x$ without a radical. For the answer bank, record the complete response required by the original task; use the given context to distinguish responses that share a numerical value. _____ Bank label: _____
For $f(x) = 3^x$, express $f(x+2)$ as a constant multiple of $f(x)$. For the answer bank, record the complete response required by the original task; use the given context to distinguish responses that share a numerical value. _____ Bank label: _____	Normalize $5(3^{2x-1})$ into $A(B^x)$, with an exact coefficient. For the answer bank, record the complete response required by the original task; use the given context to distinguish responses that share a numerical value. _____ Bank label: _____

AP Precalculus

Rewriting Exponential Expressions

Name: _____ Date: _____ Class: _____

Begin at START. Answer the card, then find the matching final answer at the top of another card. Use the recording sheet for your reasoning. Visit each card once and continue to FINISH.

START Normalize $\left(\frac{1}{7}\right)^{2-x}$ as $A(B^x)$ with $B > 1$. Use the complete final response to identify the next Match & Move card; show the reasoning required by the original task. Your response: _____	Incoming: $\left(\frac{1}{49}\right)(7^x)$ Convert $256^{3\frac{5}{8}}$ to a single exponential with an integer base. Use the complete final response to identify the next Match & Move card; show the reasoning required by the original task. Your response: _____
Incoming: 8^x Express $f\left(x + \frac{1}{3}\right)$ as a multiple of $f(x)$ when $f(x) = 8^x$. Use the complete final response to identify the next Match & Move card; show the reasoning required by the original task. Your response: _____	Incoming: $f\left(x + \frac{1}{3}\right) = 2f(x)$. Write $\left(\frac{1}{2}\right)(81^{\frac{5}{4} + \frac{1}{2}})$ as $A(B^x)$ with B an integer. Use the complete final response to identify the next Match & Move card; show the reasoning required by the original task. Your response: _____
Incoming: $\left(\frac{9}{2}\right)(3^x)$ Find a so that $a(2^{x+1}) = 14(2^x)$ for all real x . Use the complete final response to identify the next Match & Move card; show the reasoning required by the original task. Your response: _____	Incoming: $a = 7$ Express 3^{2-x} as $A(B^x)$ with $0 < B < 1$. Use the complete final response to identify the next Match & Move card; show the reasoning required by the original task. Your response: _____

AP Precalculus

Rewriting Exponential Expressions

Name: _____ Date: _____ Class: _____

Evaluate the supplied statement or method. Say whether it is correct, repair it if it is not, and verify the result exactly. Not every prompt contains an error.

Find h so that $2^{x+h} = 8(2^x)$ for every real x . Student work: $h = 4$ Identify the precise mathematical error or omitted condition, then complete the original task and verify the correction from the supplied givens.

The table shows $f(x) = 4^x + 2$ and $g(x) = 2^x + 2$ agree at $x = 0$. Are they identical? Use the normalized bases to explain. Student work: No. They share the translated anchor at $x = 0$, but bases 5 and 2 give different values for other inputs. Identify the precise mathematical error or omitted condition, then complete the original task and verify the correction from the supplied givens.

Precision: Given values are exact

x	$f(x)$	$g(x)$
-1	2.25	2.5
0	3	3
1	6	4

Rewriting Exponential Expressions

Full Worked Solutions - excerpt

Worked example

Problem. A student writes $3^{x+2} = 3^x + 9$. Identify the failed exponent law and give the correct rewrite.

Answer. Exponents add when same-base powers are multiplied, not added. The correct identity is $3^{x+2} = 9(3^x)$.

Explanation and check.

Use $3^{x+2} = 3^x \cdot 3^2$.

Worked example

Problem. Show that shifting $f(x) = 2^x$ right 3 units produces the same graph as a vertical scaling. State the scale factor.

Answer. $f(x - 3) = 2^{x-3} = (\frac{1}{8})2^x$, so the right shift equals multiplying outputs by $\frac{1}{8}$.

Explanation and check.

The constant exponent -3 factors out as 2^{-3} .

AP Precalculus
Compound Growth and Decay Rates

Compound Growth and Decay Rates | APPC-U02-P06

96 problems · Four activity formats

01	Answer Bank Challenge	24 tasks
02	Grid Rounds	24 tasks
03	Match & Move	24 cards
04	Error Analysis & Strategy	24 tasks
05	Quick Answer Key	96 answers
06	Full Worked Solutions	96 solutions
07	Teacher / Parent Use Guide	included
08	Terms of Use & License	included

Topic focus

Across 96 tasks this topic asks for three-year factors and ranking, one-year and five-year comparisons, model and exact factor, model and remaining factor, model and target factor and hourly and daily factors with percent interpretation.

8 PDFs and a README; 52 buyer pages.

AP Precalculus

Compound Growth and Decay Rates

Name: _____ Date: _____ Class: _____

Answer each question and record the matching bank letter. Give exact values. A value without its unit is not a complete answer.

An exponential process multiplies by 2.5 over six months. Determine its monthly factor and approximate monthly percent increase. For the answer bank, record the exact monthly factor. Complete and justify all parts of the original task in your work. _____ Bank label: _____	A quantity retains 96% every five days. Find its ten-day factor and cumulative percent decrease. For the answer bank, record the ten-day factor. Complete and justify all parts of the original task in your work. _____ Bank label: _____
An index grows by factor 1.03 each quarter. Find its 18-month factor and total percent increase. For the answer bank, record the exact 18-month factor. Complete and justify all parts of the original task in your work. _____ Bank label: _____	An exponential process has factor 9 over two days. Find the positive daily factor and daily percent increase. For the answer bank, record the positive daily factor. Complete and justify all parts of the original task in your work. _____ Bank label: _____
A quantity retains 80% each week. What factor and total percent decrease apply after two weeks? For the answer bank, record the two-week factor. Complete and justify all parts of the original task in your work. _____ Bank label: _____	A quantity has a 3-year half-life. Write its model and give the factor remaining after 6 years. For the answer bank, record the fraction remaining after 6 years. Complete and justify all parts of the original task in your work. _____ Bank label: _____
For $A(t) = A_0 e^{-0.05t}$, where t is in days, find the ten-day multiplier and percent decrease. For the answer bank, record the exact ten-day factor. Complete and justify all parts of the original task in your work. _____ Bank label: _____	A process multiplies by 1.12 every three days. Determine its nine-day factor and percent increase. For the answer bank, record the nine-day factor. Complete and justify all parts of the original task in your work. _____ Bank label: _____

AP Precalculus

Compound Growth and Decay Rates

Name: _____ Date: _____ Class: _____

Answer each question and show your reasoning in the workspace. Give exact values rather than decimals unless the question supplies a decimal. A value without its unit is not a complete answer.

A quantity is multiplied by 1.20 each year. What factor and percent change apply over two years? 	An exponential process has factor 4 over two hours. Find its positive hourly factor and hourly percent change.
The model $P(h) = 500(1.02^h)$ uses hours. Rewrite the same process using d days. 	A population doubles every 5 days. Write its factor model and state the factor after 10 days.
Process A grows by factor 1.20 every two years; process B grows by factor 1.09 each year. Which grows faster after normalizing to two years? 	For $Q(t) = Q_0 e^{0.04t}$, with t in years, find the five-year multiplier and percent increase.

AP Precalculus

Compound Growth and Decay Rates

Name: _____ Date: _____ Class: _____

Begin at START. Answer the card, then find the matching final answer at the top of another card. Use the recording sheet for your reasoning. Visit each card once and continue to FINISH.

START The model $T(s) = 18(0.97^{\frac{s}{15}})$ uses seconds and a 15-second factor. Rewrite it with m measured in minutes. For the matching card, record the expression for $T(m)$. Complete and justify all parts of the original task in your work. Your response: _____	Incoming: 1.2 Rewrite $C(d) = 60(1.5^d)$, with d in days, using h measured in hours. For the matching card, record the expression for $C(h)$. Complete and justify all parts of the original task in your work. Your response: _____
Incoming: $40(1.3)^{\frac{m}{60}}$ The model $F(m) = 200(1.03^m)$ uses months. Rewrite the same process with y in years. For the matching card, record the expression for $F(y)$. Complete and justify all parts of the original task in your work. Your response: _____	Incoming: $(\exp(-0.09), \exp(-0.36))$ A population has a monthly growth factor of 1.1. What is its growth factor over three months? For the matching card, record the three-month growth factor. Complete and justify all parts of the original task in your work. Your response: _____
Incoming: 27 A medication level is multiplied by 0.6561 every four hours. Find the equivalent hourly multiplier. For the matching card, record the hourly multiplier. Complete and justify all parts of the original task in your work. Your response: _____	Incoming: $0.4^{\frac{7}{2}}$ The model $Q(w) = 80(0.95^w)$ uses weeks. Rewrite it as a function of elapsed days d. For the matching card, record the expression for $Q(d)$. Complete and justify all parts of the original task in your work. Your response: _____

AP Precalculus

Compound Growth and Decay Rates

Name: _____ Date: _____ Class: _____

Evaluate the supplied statement or method. Say whether it is correct, repair it if it is not, and verify the result exactly. Not every prompt contains an error.

A student adds two 20% decreases and reports a 40% loss. Show the correct compounded result and explain the discrepancy. Student work/claim: Two losses of 20% sum to a 40% total loss. Identify the first invalid step or inference in the displayed work. Correct it and complete the original task.

A student divides a 30% two-interval increase by 2 and reports 15% per interval. Find the correct repeated factor and quantify what two 15% increases would produce. Student work/claim: A two-interval gain of 30% means 15% in each interval. Identify the first invalid step or inference in the displayed work. Correct it and complete the original task.

A report says that a 6% decrease every half-year means a 12% decrease in one year. Determine the actual annual percent decrease and explain the discrepancy. Student work/claim: Two half-year losses of 6% make an annual loss of 12%. Identify the first invalid step or inference in the displayed work. Correct it and complete the original task.

A two-year investment gain is 21%. A student divides by 2 and reports 10.5% per year. Find the constant annual percent rate that actually compounds to the observed gain, and verify it. Student work/claim: Divide the two-year gain 21% by two to obtain the annual compound rate. Identify the first invalid step or inference in the displayed work. Correct it and complete the original task.

Compound Growth and Decay Rates

Full Worked Solutions - excerpt

Worked example

Problem. A balance grows by factor 1.08 every two weeks. What factor and total percent increase apply over six weeks?

Answer. The six-week factor is $1.08^3 = 1.259712$, giving a 25.9712% increase.

Explanation and check.

Six weeks contains three of the stated two-week intervals.

Worked example

Problem. An exponential process has factor 4 over two hours. Find its positive hourly factor and hourly percent change.

Answer. The hourly factor is $\sqrt{4} = 2$, corresponding to a 100% hourly increase.

Explanation and check.

The positive unit factor must square to the stated two-hour multiplier.

AP Precalculus
Exponential Growth and Decay Applications

Exponential Growth and Decay Applications | APPC-U02-P07

96 problems · Four activity formats

01	Answer Bank Challenge	24 tasks
02	Grid Rounds	24 tasks
03	Match & Move	24 cards
04	Error Analysis & Strategy	24 tasks
05	Quick Answer Key	96 answers
06	Full Worked Solutions	96 solutions
07	Teacher / Parent Use Guide	included
08	Terms of Use & License	included

Topic focus

Across 96 tasks this topic asks for day-based formula, formula and day-fourteen value, formula and earlier value, formula and hour-four value, formula and modeled initial value and formula and prediction.

8 PDFs and a README; 54 buyer pages.

AP Precalculus

Exponential Growth and Decay Applications

Name: _____ Date: _____ Class: _____

Answer each question and record the matching bank letter. Give exact values. A value without its unit is not a complete answer.

An account starts with \$50 and increases by 12% of its current balance each year. Write its balance after t years. For the answer bank, record the complete response required by the original task; use the given context to distinguish responses that share a numerical value. _____ Bank label: _____	A subscriber count is 500 at week 6 and grows by factor 1.04 each week. Write a model $S(w)$ anchored at the known week. For the answer bank, record the complete response required by the original task; use the given context to distinguish responses that share a numerical value. _____ Bank label: _____
A count starts at 50 and doubles weekly through week 3. Thereafter it grows by factor 1.1 per week. Write a piecewise model with no jump. For the answer bank, record the complete response required by the original task; use the given context to distinguish responses that share a numerical value. _____ Bank label: _____	A fish population begins at 3500 and approaches a habitat capacity of 5000. Each year, 80% of the current difference from capacity remains. Write $P(t)$. For the answer bank, record the complete response required by the original task; use the given context to distinguish responses that share a numerical value. _____ Bank label: _____
Create a value table for $A(n) = 500(1.1)^n$ at $n = 0, 1, 2, 3$. For the answer bank, record the complete response required by the original task; use the given context to distinguish responses that share a numerical value. _____ Bank label: _____	At week 5 a quantity is 70, and afterward its weekly multiplier is 0.8. Write an anchor-form model using week w. For the answer bank, record the complete response required by the original task; use the given context to distinguish responses that share a numerical value. _____ Bank label: _____
A fund starts at 100, grows by factor 1.03 annually through year 5, and then retains factor 0.97 annually. Write a continuous piecewise model. For the answer bank, record the complete response required by the original task; use the given context to distinguish responses that share a numerical value. _____ Bank label: _____	A temperature starts at 90°F and approaches a 65°F environment. After each hour, 30% of its excess remains. Write $T(h)$. For the answer bank, record the complete response required by the original task; use the given context to distinguish responses that share a numerical value. _____ Bank label: _____

Name: _____ Date: _____ Class: _____

For $P(t) = 40(1.5)^t$, where t is a whole number of days from 0 through 4, construct a value table and state the initial value.

A room is 80°F when cooling begins toward a surrounding temperature of 20°F . Every ten minutes, half of the remaining temperature difference is retained. Build a model and find the temperature after thirty minutes.

A culture begins at 100, grows by factor 1.1 per day through day 3, and then decays by factor 0.8 per day. Construct a continuous-at-switch piecewise model through day 5 and evaluate day 5.

A quantity is 300 at $t = 4$ and grows by factor 1.25 every 2 time units. Audit the proposal $Q(t) = 300(1.25)^{\frac{t}{2}}$, repair it, and verify the anchor and one interval later.

A filter leaves 85% of the current impurity after each hour. If 200mg is present initially, write a model and state the percent removed per hour.

A process has value 250 at $t = 3$ and factor 1.2 per four time units. Construct its anchor form. The value is also reported as 300 at $t = 7$; determine whether that report is consistent and, if so, write the equivalent $t = 7$ anchor form.

AP Precalculus

Exponential Growth and Decay Applications

Name: _____ Date: _____ Class: _____

Begin at START. Answer the card, then find the matching final answer at the top of another card. Use the recording sheet for your reasoning. Visit each card once and continue to FINISH.

Incoming: $M(t) = 100 + 40(0.7)^t$. A measured level starts at 30 and approaches a floor of 12. Each week, 40% of its excess above 12 remains. Write a model $L(w)$. Use the complete final response to identify the next Match & Move card; show the reasoning required by the original task. Your response: _____	Incoming: $Q(t) = 250(1.008)^{\frac{t}{60}}$. A quantity equals 243 at $t = 5$ and triples every two time units. Find its value at $t = 1$. Use the complete final response to identify the next Match & Move card; show the reasoning required by the original task. Your response: _____
Incoming: $A(t) = 625(0.8)^{\frac{t-8}{4}}$. A machine worth \$1200 loses 7% of its current value each quarter. Write its value after q quarters. Use the complete final response to identify the next Match & Move card; show the reasoning required by the original task. Your response: _____	Incoming: $A(t) = 96\left(\frac{2}{3}\right)^{\frac{t-6}{4}}$, and $A(14) = 96\left(\frac{2}{3}\right)^2 = 42\frac{2}{3}$. At day 20 a quantity is 81 and is multiplied by $\frac{1}{3}$ every ten days. Write an anchored exponential formula. Use the complete final response to identify the next Match & Move card; show the reasoning required by the original task. Your response: _____
Incoming: $V(q) = 1200(0.93)^q$. An investment starts at 250, grows by factor 1.1 per quarter through quarter 4, and then by factor 1.03 per quarter. Write a continuous piecewise model. Use the complete final response to identify the next Match & Move card; show the reasoning required by the original task. Your response: _____	Incoming: 11 A measurement starts at 140 and approaches baseline 100. Each day, 70% of its excess above baseline remains. Write $M(t)$. Use the complete final response to identify the next Match & Move card; show the reasoning required by the original task. Your response: _____

AP Precalculus

Exponential Growth and Decay Applications

Name: _____ Date: _____ Class: _____

Evaluate the supplied statement or method. Say whether it is correct, repair it if it is not, and verify the result exactly. Not every prompt contains an error.

List the table values of $Q(n) = 30(2)^n$ for $n = 0, 1, 2, 3$. Student work: $(0, 30)$, $(1, 60)$, $(2, 120)$, and $(3, 239)$. Identify the precise mathematical error or omitted condition, then complete the original task and verify the correction from the supplied givens.

An asset starts at 400 and loses 12% of its current value each day. Audit the proposed model $V(t) = 400(0.12)^t$ and repair it. Identify the precise error or unsupported step in the stated claim or method, then give the corrected conclusion and justify it from the supplied information.

An account starts at 600 and gains 15% every three months. With t measured in months, audit $A(t) = 600(1.15)^{3t}$, repair it, and find the correct month-6 value. Identify the precise error or unsupported step in the stated claim or method, then give the corrected conclusion and justify it from the supplied information.

A score begins at 15 and approaches a ceiling of 75. Every two weeks, 60% of its remaining signed difference from the ceiling is retained. Build the model and evaluate week 6. Student work: $S(w) = 75 + 60(0.6)^{\frac{w}{2}}$, and $S(6) = 62.04$. Identify the precise mathematical error or omitted condition, then complete the original task and verify the correction from the supplied givens.

Exponential Growth and Decay Applications

Full Worked Solutions - excerpt

Worked example

Problem. A quantity is 96 at month 15 and has factor 1.2 every three months. Find its modeled value at month 6. Use the complete final response to identify the next Match & Move card; show the reasoning required by the original task.

Answer. The value is $\frac{96}{1.2^3} = 55\frac{5}{9} \approx 55.56$.

Explanation and check.

Month 6 is three three-month intervals earlier, so undo three factors of 1.2.

Worked example

Problem. A value begins at 260 and approaches baseline 200, retaining 90% of its excess each week. Write $V(w)$. Use the complete final response to identify the next Match & Move card; show the reasoning required by the original task.

Answer. $V(w) = 200 + 60(0.9)^w$.

Explanation and check.

The initial excess is 60; apply the weekly factor to that excess and add 200.

AP Precalculus
Exponential Functions from Two Points

Exponential Functions from Two Points | APPC-U02-P08

96 problems · Four activity formats

01	Answer Bank Challenge	24 tasks
02	Grid Rounds	24 tasks
03	Match & Move	24 cards
04	Error Analysis & Strategy	24 tasks
05	Quick Answer Key	96 answers
06	Full Worked Solutions	96 solutions
07	Teacher / Parent Use Guide	included
08	Terms of Use & License	included

Topic focus

Across 96 tasks this topic asks for parameters and model, sufficiency decision and parameters, uniqueness and parameters, a and model, base and model and consistency and information decision.

8 PDFs and a README; 92 buyer pages.

AP Precalculus

Exponential Functions from Two Points

Name: _____ Date: _____ Class: _____

Answer each question and record the matching bank letter. Give exact values. Give the whole requested response, including any reasoning the question asks for.

Can any exponential function fit exact rows (1, 4) and (1, 5)? For the answer bank, record the complete response required by the original task; use the given context to distinguish responses that share a numerical value.

Points:

x	f(x)
1	4
1	5

Bank label: _____

For $f(x) = 10 + a(0.5)^x$, is $f(2) = 15$ sufficient to determine the model? For the answer bank, record the complete response required by the original task; use the given context to distinguish responses that share a numerical value.

Bank label: _____

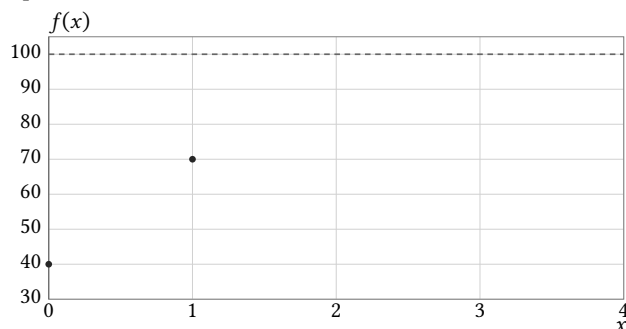
Relative to baseline 5, the exact outputs at $x = 0$ and $x = 1$ are 45 and 25. Determine the scale and positive base of their exponential displacement. For the answer bank, record the complete response required by the original task; use the given context to distinguish responses that share a numerical value.

Points:

x	f(x)
0	45
1	25

Bank label: _____

A graph on x : 0 to 4 by 1 and y : 30 to 105 by 10 has exact asymptote $y = 100$ and exact marks (0, 40) and (1, 70). Determine $f(x) = 100 + ab^x$. For the answer bank, record the complete response required by the original task; use the given context to distinguish responses that share a numerical value.



x	exact marked f(x)
0	40
1	70

Bank label: _____

AP Precalculus

Exponential Functions from Two Points

Name: _____ Date: _____ Class: _____

Answer each question and show your reasoning in the workspace. Give exact values rather than decimals unless the question supplies a decimal. Give the whole requested response, including any reasoning the question asks for.

Can one nonconstant real model $f(x) = ab^x$ with $b > 0$ pass through the exact points $(0, 5)$ and $(2, -20)$? Explain.

Points:

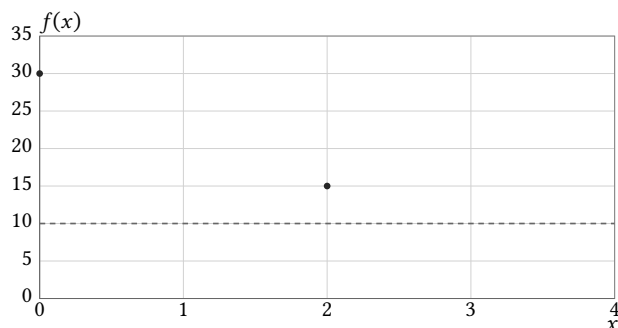
x	f(x)
0	5
2	-20

The exact equally spaced values are $f(0) = 20$, $f(1) = 35$, and $f(2) = 42.5$. Fit $f(x) = L + ab^x$ with $b > 0$ and $b \neq 1$.

Points:

x	f(x)
0	20
1	35
2	42.5

A graph on x : 0 to 4 by 1 and y : 0 to 35 by 5 has exact marked points $(0, 30)$ and $(2, 15)$ and horizontal asymptote $y = 10$. Estimate $f(x) = L + ab^x$ and state why these marks permit an exact result.



x	exact marked f(x)
0	30
2	15

Fit a pure exponential to exact points $(0, 50)$ and $(2, 72)$, then test the unused exact observation $(4, 103.68)$.

Unused Point: $(4, 103.68)$

x	f(x)
0	50
2	72

AP Precalculus

Exponential Functions from Two Points

Name: _____ Date: _____ Class: _____

Begin at START. Answer the card, then find the matching final answer at the top of another card. Use the recording sheet for your reasoning. Visit each card once and continue to FINISH.

START

Fit $f(x) = ab^x$ through exact points $(-2, 9)$ and $(0, 36)$. Use the complete final response to identify the next Match & Move card; show the reasoning required by the original task.

Points:

x	f(x)
-2	9
0	36

Your response: _____

Incoming: The two-unit ratio is 4, so $b = 2$. Since $f(0) = a$, $a = 36$; $f(x) = 36(2)^x$.

Fit a pure exponential to exact values 30, 45, and then check the unused value 67.5 at successive inputs 0, 1, 2. Use the complete final response to identify the next Match & Move card; show the reasoning required by the original task.

Unused Point: $(2, 67.5)$

x	f(x)
0	30
1	45

Your response: _____

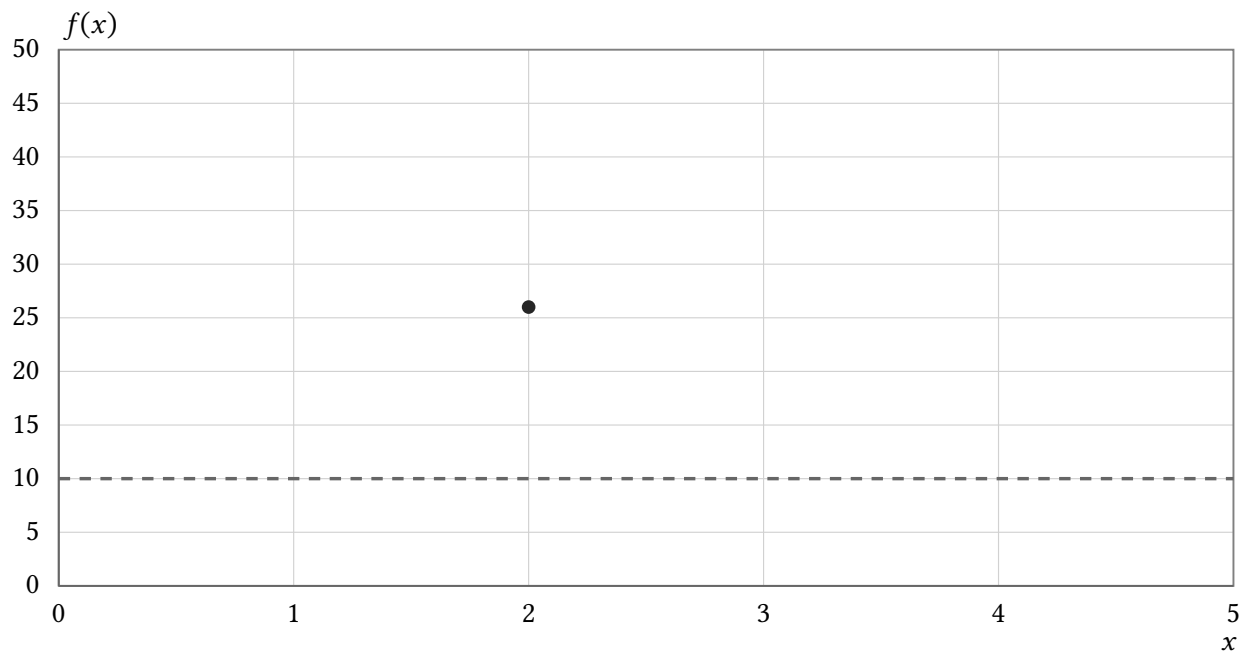
AP Precalculus

Exponential Functions from Two Points

Name: _____ Date: _____ Class: _____

Evaluate the supplied statement or method. Say whether it is correct, repair it if it is not, and verify the result exactly. Not every prompt contains an error.

A graph has exact baseline $y = 10$ and only exact point $(2, 26)$. Can $f(x) = 10 + ab^x$ be uniquely determined? Student work: No. The mark gives a $b^2 = 16$, leaving infinitely many negative bases and matching scales. A second point at a different input is needed. Identify the precise mathematical error or omitted condition, then complete the original task and verify the correction from the supplied givens.



x	exact marked f(x)
2	26

Exponential Functions from Two Points

Full Worked Solutions - excerpt

Worked example

Problem. Does exact value $f(3) = 25$ determine $f(x) = 20 + a(0.5)^x$? For the answer bank, record the complete response required by the original task; use the given context to distinguish responses that share a numerical value.

Answer. Yes. Since $20 + \frac{a}{8} = 25$, $a = 40$ and $f(x) = 20 + 40(0.5)^x$.

Explanation and check.

Only the scale is unknown once baseline and base are fixed.

Worked example

Problem. For $f(x) = a(3)^x$, does $f(2) = 45$ determine the model? For the answer bank, record the complete response required by the original task; use the given context to distinguish responses that share a numerical value.

Answer. Yes. Since $9a = 45$, $a = 5$ and $f(x) = 5(3)^x$.

Explanation and check.

The fixed base leaves one scale parameter, so one nonzero observation suffices.

AP Precalculus
Exponential Regression

Exponential Regression | APPC-U02-P09

96 problems · Four activity formats

01	Answer Bank Challenge	24 tasks
02	Grid Rounds	24 tasks
03	Match & Move	24 cards
04	Error Analysis & Strategy	24 tasks
05	Quick Answer Key	96 answers
06	Full Worked Solutions	96 solutions
07	Teacher / Parent Use Guide	included
08	Terms of Use & License	included

Topic focus
Across 96 tasks this topic asks for metrics and verdict, classification and verdict, metric and verdict, evidence statement, robustness conclusion and validity and weighting implication.
8 PDFs and a README; 88 buyer pages.

AP Precalculus

Exponential Regression

Name: _____ Date: _____ Class: _____

Answer each question and record the matching bank letter. Give exact values. A value without its unit is not a complete answer.

Format and interpret the regression using the reporting rule without rounding b before converting it to a percent.

Given: domain: months; payload: convention: raw-output least squares; report rule: coefficient a to nearest tenth and percent change to nearest tenth percent; technology result: a : 7.408; b : 0.9631

Bank label: _____

Write the original-scale model represented by the fitted excess.

Given: domain: hours; payload: baseline: 6; fitted excess: $e = 45(0.65)^t$; relation: $e = y - 6$

Bank label: _____

Interpret the base of this fitted colony model.

Given: domain: days; payload: convention: raw-output least squares; output unit: colonies; technology result: $N(t) = 18.4(1.065)^t$

Bank label: _____

The negative response is a displacement below zero, and technology fit its positive magnitude. Restore the signed model.

Given: domain: seconds; payload: baseline: 0; definition: $m = -y$; magnitude regression: $m(t) = 12.0(0.823)^t$; table: $(0, -12.0)$; $(2, -8.1)$; $(4, -5.5)$

Context/domain: seconds

0	-12.0
2	-8.1
4	-5.5

Bank label: _____

AP Precalculus

Exponential Regression

Name: _____ Date: _____ Class: _____

Answer each question and show your reasoning in the workspace. Give exact values rather than decimals unless the question supplies a decimal. A value without its unit is not a complete answer.

May all three rows be entered directly into a log-output exponential regression for $y = ab^x$? Explain before fitting.

Context/domain: minutes

0	8.2
2	4.1
4	0.0

AP Precalculus

Exponential Regression

Name: _____ Date: _____ Class: _____

Begin at START. Answer the card, then find the matching final answer at the top of another card. Use the recording sheet for your reasoning. Visit each card once and continue to FINISH.

START Convert the two-hour regression factor to an equivalent hourly percent increase. Given: domain: 2-hour blocks; payload: input definition: n counts two-hour blocks; technology result: $Q(n) = 9.3(1.44)^n$ Your response: _____	Incoming: The relative residual magnitudes are at most about 1.2%, but their signs alternate at consecutive days 0 through 7 before another positive residual at day 8. Percentage errors are small; the ordered oscillation is a pattern, so small magnitude alone does not establish an adequate pattern-free model. Compare the week-12 residuals after rounding only the amplitude. Given: domain: weeks; payload: observation: $x: 12; y: 27.4$; predictions: retained: 26.98; rounded: 27.05; residual definition: observed-predicted; retained model: $y = 51.86(0.947)^x$; rounded model: $y = 52(0.947)^x$ Your response: _____
Incoming: The student's 0.011 is a log-scale residual. The required original-scale residual is $39.0 - 38.12 = 0.88$. Find both residuals at the origin. Given: domain: months; payload: input: 0; observed: 20.6; retained model: $y = 20.54(0.92)^x$; rounded model: $y = 21(0.92)^x$ Your response: _____	Incoming: Dividing hours by 24 gives 0, 1, 3, 5 days, so the conversion is consistent. The fitted base is a factor per day, not per hour. A regression models the excess above a known level of 250. Restore the original response and state its long-run level. Given: domain: days; payload: baseline: 250; definition: $e = y - 250$; fitted excess: $e(t) = 84.5(0.91)^t$ Your response: _____

AP Precalculus

Exponential Regression

Name: _____ Date: _____ Class: _____

Evaluate the supplied statement or method. Say whether it is correct, repair it if it is not, and verify the result exactly. Not every prompt contains an error.

The numerical regression inputs are years since 2018, although the source table lists calendar years. Is the fit invalid, and how should it be interpreted? A student says recoding calendar years invalidates the fit and it predicts calendar year zero. Diagnose both claims.

The last measured value equals the known baseline. Diagnose the proposed baseline-corrected log regression and give two defensible next steps without silently altering the row. A student enters $\log(0)$ for the baseline-equal reading. Diagnose the operation and explain two defensible next steps.

Context/domain: hours

0	31
2	19
5	12

Exponential Regression

Full Worked Solutions - excerpt

Worked example

Problem. The residual magnitudes are modest, but every sign is positive. Interpret this evidence.

Answer. The model underpredicts every observation, showing a one-sided level bias rather than centered residuals. Its calibration should be reconsidered.

Explanation and check.

Observed-minus-predicted is positive whenever prediction is low.

Worked example

Problem. A chamber warms toward 72 degrees Fahrenheit from below. Regression was performed on the positive shortfall $d(t) = 72 - y(t)$, producing $d(t) = 18.6(0.81)^t$. Restore a model for y and describe its approach.

Answer. $y(t) = 72 - 18.6(0.81)^t$; it increases toward 72 from below.

Explanation and check.

The fitted magnitude is the amount below equilibrium, so subtract it from 72; the decaying shortfall makes y rise.

AP Precalculus
Comparing Regression Models

Comparing Regression Models | APPC-U02-P10

96 problems · Four activity formats

01	Answer Bank Challenge	24 tasks
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Topic focus
Across 96 tasks this topic asks for exponential base and predictions, maximum losses and model, why selection is premature, predictions and plausibility, qualified candidates and costs and feasibility.
8 PDFs and a README; 100 buyer pages.

AP Precalculus

Comparing Regression Models

Name: _____ Date: _____ Class: _____

Answer each question and record the matching bank letter. Give exact values. A value without its unit is not a complete answer.

Evaluate both candidate models at hour 3. For the answer bank, record the complete response required by the original task; use the given context to distinguish responses that share a numerical value. The exponential is $E(t) = 5(1.3)^t$. Evaluate at input 3. The quadratic is $Q(t) = 5 + t^2$.

Bank label: _____

Compute original-scale SSE for both candidates. For the answer bank, record the complete response required by the original task; use the given context to distinguish responses that share a numerical value. For the exponential model, the predicted outputs in input order are 9.5, 14.5, 19. Use the inputs 0, 2, 4, in that order. For the linear model, the predicted outputs in input order are 11, 14, 18. The observed outputs, in input order, are 10, 14, 19.

Bank label: _____

Select the simplest exact family and state its rate. For the answer bank, record the complete response required by the original task; use the given context to distinguish responses that share a numerical value.

Given domain/context: years

0	50
2	44
4	38
6	32

Bank label: _____

Select the most discriminating feasible observation. For the answer bank, record the complete response required by the original task; use the given context to distinguish responses that share a numerical value. The feasible months are 1, 3. The gaps are month10.1; month30.8; month52.4. The measurement resolution is 0.5.

Bank label: _____

AP Precalculus

Comparing Regression Models

Name: _____ Date: _____ Class: _____

Answer each question and show your reasoning in the workspace. Give exact values rather than decimals unless the question supplies a decimal. A value without its unit is not a complete answer.

Evaluate both fitted models at month 4. The exponential is $E(t) = 8.0(1.24)^t$. Use least squares on original output scale. The linear is $L(t) = 8.2 + 3.1t$. Evaluate at input 4. 	Choose the cheaper forecast under the stated asymmetric loss. The actual value is 100. Use this loss rule: underprediction costs \$5 per unit; overprediction costs \$1 per unit. The model predictions are exponential 106; linear 96.
Which feasible input is most useful for distinguishing the models? The feasible inputs are 0, 1, 5. Use measurement precision nearest unit. Use these candidate models: exponential $E(t) = 10(1.2)^t$; linear $L(t) = 10 + 2t$. 	The models are close during years 0 – 3. Compare their year-20 predictions and qualify the inference. The exponential is $E(t) = 50(1.08)^t$. Evaluate the future input 20. The linear is $L(t) = 50 + 5t$. The observations cover the input interval 0, 3.

AP Precalculus

Comparing Regression Models

Name: _____ Date: _____ Class: _____

Evaluate the supplied statement or method. Say whether it is correct, repair it if it is not, and verify the result exactly. Not every prompt contains an error.

Apply the production loss to choose a model. Student work: Quadratic underpredicts by 3 and costs 20; exponential overpredicts by 4 and costs 4. Choose quadratic because its unsigned error, 3, is smaller. Identify the precise mathematical error or omitted condition, then complete the original task and verify the correction from the supplied givens. The actual value is 60. The model predictions are exponential 64; quadratic 57. Use underprediction beyond 2 units costs 20; otherwise absolute error.

Choose a staffing model using the interval-specific loss. Student work: exponential costs $1 + 30 + 2 = 33$. Quadratic costs $2 + 1 + 1 = 4$, so choose quadratic; its avoidance of critical noon underprediction is decisive. Identify the precise mathematical error or omitted condition, then complete the original task and verify the correction from the supplied givens. The actual value is 20, 35, 28. The critical input interval is 11, 14. The hours are 8, 12, 16. For the linear model, the predicted outputs in input order are 19, 32, 30. For the quadratic model, the predicted outputs in input order are 22, 36, 27. Use inside critical interval, each understaffed unit costs 10; all other errors cost 1 per unit.

Which observation best tests the quadratic-turn claim? Student work: Day 10, because it lies after the proposed vertex and directly tests reversal; day 7 is before the turn where all three can still rise. Identify the precise mathematical error or omitted condition, then complete the original task and verify the correction from the supplied givens. Observations are available at inputs 7, 9. For the exponential model, the prediction is continues rising faster. For the linear model, the prediction is continues rising at day 9. For the quadratic model, the prediction is peaks at day 8 then falls. The measurement resolution is sufficient at both.

Compare both candidates by absolute and percent error at the row. Student work: Linear error is 4 units or 4%; linear error is 3 units or 3%. Exponential is closer by both measures at this observation. Identify the precise mathematical error or omitted condition, then complete the original task and verify the correction from the supplied givens. For the exponential model, the prediction is 103. Evaluate at input 8. For the linear model, the prediction is 96. The observed outputs, in input order, are 100.

Comparing Regression Models

Full Worked Solutions - excerpt

Worked example

Problem. Compare hour-3 outputs. Use the complete final response to identify the next Match & Move card; show the reasoning required by the original task. The exponential is $E = 12(1.3)^t$. Evaluate at input 3. The linear is $L = 12 + 5t$.

Answer. $L(3) = 27$ and $E(3) = 26.364$.

Explanation and check.

Substitute 3 into each candidate.

Worked example

Problem. Compare the day-6 fitted values. Use the complete final response to identify the next Match & Move card; show the reasoning required by the original task. The exponential is $E = 18(0.86)^t$. Evaluate at input 6. The linear is $L = 18 - 2t$.

Answer. $L(6) = 6$ and $E(6) \approx 7.28$.

Explanation and check.

Evaluate each rule at the same elapsed day.