

Precalculus
Exponential Growth & Decay Models | 3-Topic Precalculus
Bundle

3-topic bundle | 288 problems | Four activity formats

- 01

Compound Growth and Decay Rates
View individual product and its full preview
- 02

Exponential Growth and Decay Applications
View individual product and its full preview
- 03

Exponential Functions from Two Points
View individual product and its full preview

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.

24 PDFs and 3 READMEs; 198 buyer PDF pages across the 3 products.

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

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

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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: _____

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

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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: _____

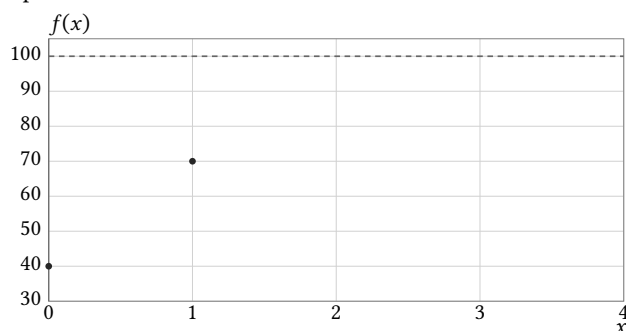
Relative to baseline 5, the exact outputs at $x = 0$ and $x = 1$ are 45 and 25. Determine the scale and positive base of their exponential displacement. For the answer bank, record the complete response required by the original task; use the given context to distinguish responses that share a numerical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

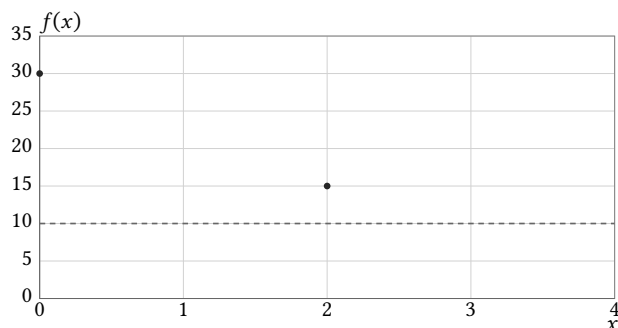
x	f(x)
0	5
2	-20

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: _____

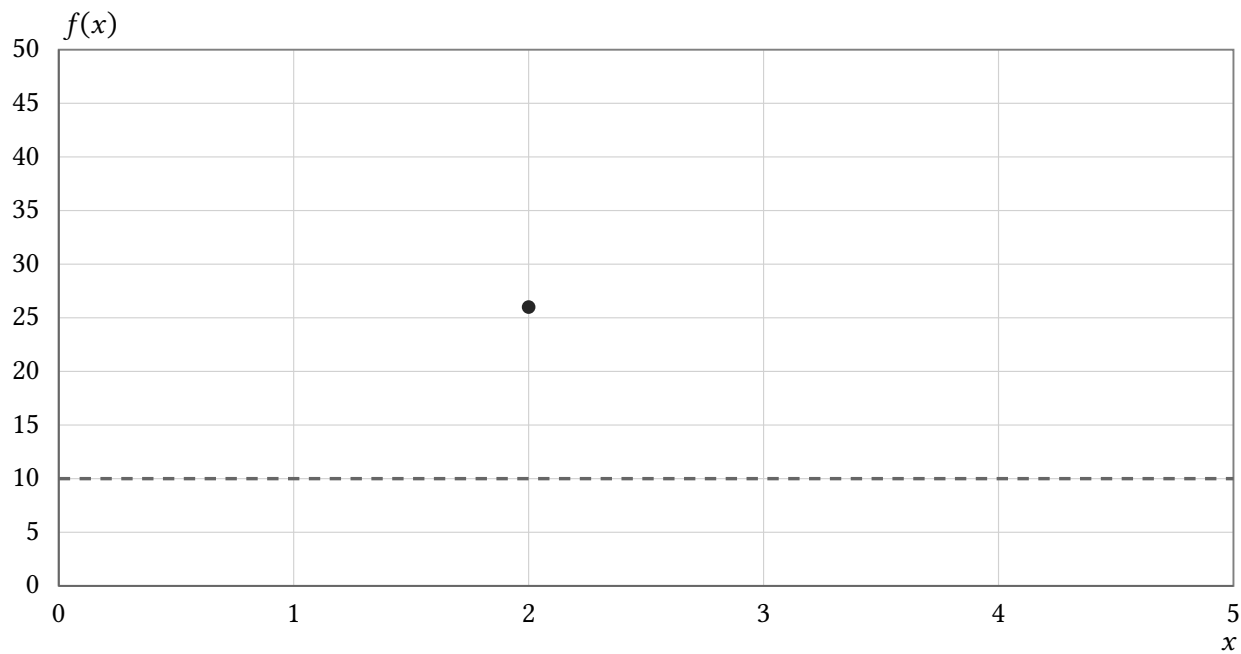
AP Precalculus

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.