Sets & Steps
Math Practice & Worked Solutions

Precalculus

Polynomial & Rational Function Collection | 20-Topic Precalculus Bundle

20-topic bundle | 1,920 problems | Four activity formats

Included topics

The following pages list all 20 included resources in the suggested order, with a link to each product. Each resource retains its complete 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.

160 PDFs and 20 READMEs; 1,551 buyer PDF pages across the 20 products.

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

This is a fixed collection of the listed products. Purchase includes the existing individual resource files. To open a product's online preview, follow its title link and select View Preview.

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Sets & Steps
Math Practice & Worked Solutions

Precalculus

Included topics

20-topic bundle | 1,920 problems | Four activity formats

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01 **Function Representations and Average Rates of Change**

View individual product and its full preview

02 **Comparing Average Rates of Change**

View individual product and its full preview

03 **Polynomial Degree, Zeros, and End Behavior**

View individual product and its full preview

04 **Function Symmetry, Finite Differences, and End Behavior**

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05 **Rational Function Domains and Sign Charts**

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06 **Vertical Asymptotes and One-Sided Behavior**

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07 **Holes in Rational Functions**

View individual product and its full preview

08 **Equivalent Polynomial Forms**

View individual product and its full preview

09 **Rational Expression Operations and Restrictions**

View individual product and its full preview

10 **Polynomial Division and Slant Asymptotes**

View individual product and its full preview

11 **Function Translations**

View individual product and its full preview

20 included resources | Complete resource previews follow this guide.

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Math Practice & Worked Solutions

Precalculus

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12 **Function Reflections, Stretches, and Compressions**

View individual product and its full preview

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View individual product and its full preview

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View individual product and its full preview

15 **Model Domains and Validity**

View individual product and its full preview

16 **Polynomial Modeling from Data**

View individual product and its full preview

17 **Rational Function Word Problems**

View individual product and its full preview

18 **Finding Parameters in Function Models**

View individual product and its full preview

19 **Interpreting and Comparing Function Models**

View individual product and its full preview

20 **Residuals and Model Validation**

View individual product and its full preview

20 included resources | Complete resource previews follow this guide.

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Sets & Steps
Math Practice & Worked Solutions

AP Precalculus

Function Representations and Average Rates of Change

Function Representations and Average Rates of Change | APPC-COMB-U01-P01-P02

96 problems · Four activity formats

Topic focus

Across 96 tasks this topic asks for exact average rate, degrees Celsius per day, kilopascals per hour, function decision with justification, value comparison and behavior statement and labeled qualitative graph.

8 PDFs and a README; 107 buyer pages.

The following pages use the same questions, given data, and notation as the final files. Question/card serial numbers and internal IDs are omitted in this preview only. Table values and matching responses are retained. Full answer keys are not included.

Published by Tusils LLC.

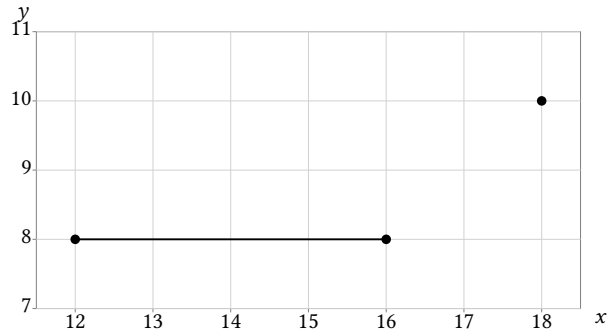
AP Precalculus

Function Representations and Average Rates of Change

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 exact graph consists of a line segment from $(12, 8)$ (solid) to $(16, 8)$ (solid); the isolated solid point $(18, 10)$. Find every input satisfying $y = 8$, respecting all endpoint markers.

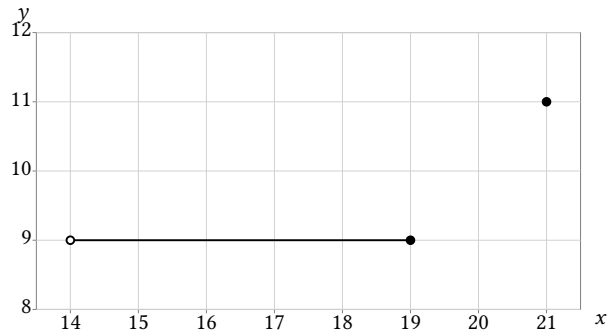


Bank label: _____

For a mixing tank, solution volume is $F(t) = 10 + 3t$ liters after t continuous minutes. Operation may last at most 8 minutes, but capacity is 22 liters. Give the feasible domain and output range.

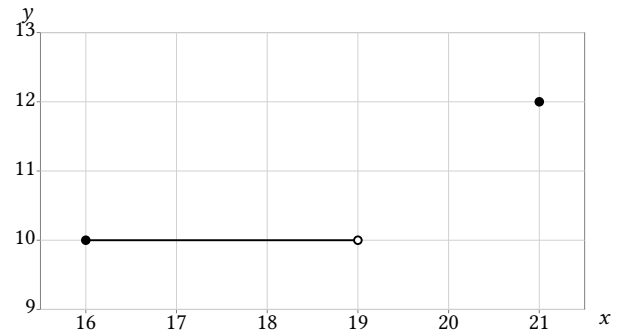
Bank label: _____

An exact graph consists of a line segment from $(14, 9)$ (open) to $(19, 9)$ (solid); the isolated solid point $(21, 11)$. Find every input satisfying $y = 9$, respecting all endpoint markers.



Bank label: _____

An exact graph consists of a line segment from $(16, 10)$ (solid) to $(19, 10)$ (open); the isolated solid point $(21, 12)$. Find every input satisfying $y = 10$, respecting all endpoint markers.



Bank label: _____

AP Precalculus

Function Representations and Average Rates of Change

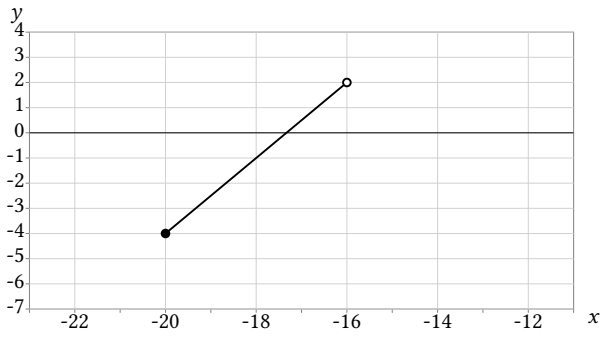
Name: _____ **Date:** _____ **Class:** _____

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 study controls number of concert tickets purchased and records total charge. The model is $f(x) = 4x + 2$, and $f(3) = 14$. Identify the input and output quantities with units, then interpret $f(3) = 14$.

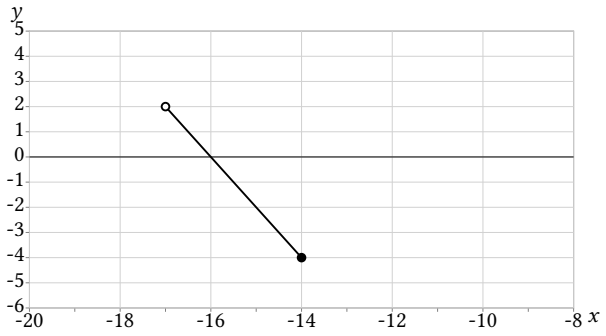
Measure the input in tickets and the total charge in dollars.

An exact graph uses one unit per tick and consists of a line segment from $(-20, -4)$ (solid) to $(-16, 2)$ (open). Determine the domain and range of the plotted relation; do not use the viewing-window edges.



For sealed sample tubes loaded into a rack, rack mass is $F(n) = 7 + 3n$. At most 4 items fit, and n must be a whole number. Give the feasible domain and range.

An exact graph uses one unit per tick and consists of a line segment from $(-17, 2)$ (open) to $(-14, -4)$ (solid). Determine the domain and range of the plotted relation; do not use the viewing-window edges.



AP Precalculus

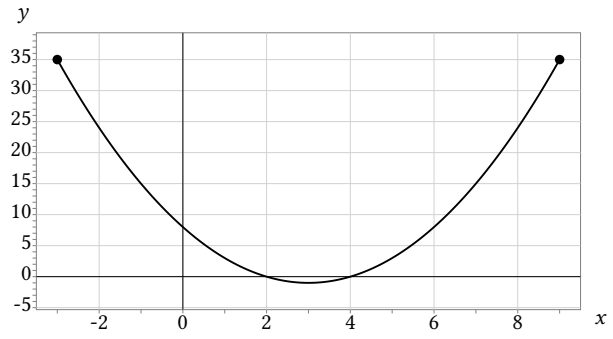
Function Representations and Average Rates of Change

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

An exact graph consists of the graph of $y = (x-3)^2 - 1$ for $-3 \le x \le 9$, with the left endpoint included and right endpoint included. Find every input satisfying $y = 15$, respecting all endpoint markers.



Your response: _____

Incoming: Rates are F: $0, T$: $5, G$: 0; ranking: $T > F = G$.

A relation is shown by isolated plotted points: $(29, 18), (30, 23), (32, 18), (34, 25)$. Is the relation a function of the first coordinate? Justify using the input-output condition.

Context/domain: precalculus

29	18
30	23
32	18
34	25

Your response: _____

Incoming: Rates are F: $-1, T$: $2, G$: 5; ranking: $G > T > F$.

A finite table gives $x = 3$, $f(x) = 14$; $x = 6$, $f(x) = 19$; $x = 9$, $f(x) = 17$. The function is continuous on the displayed interval, but no interpolation rule is specified. Evaluate the claim: 'The maximum output on $[3, 9]$ is 19.' State whether it is supported and identify exactly what the evidence does or does not determine.

Context/domain: precalculus

3	14
6	19
9	17

Your response: _____

Incoming: -2

Sketch one continuous qualitative graph of balloon altitude, measured in meters, versus elapsed time using breakpoints $[0, 4, 6, 9, 13]$. In order, the stages are: Stage A: increases while steepening; Stage B: remains constant; Stage C: decreases while flattening; Stage D: increases at a constant rate. Also satisfy this global constraint: the final level is above the initial level. Label both axes. Exact vertical values are not specified, so show only the required direction, pace, and sign information.

Your response: _____

AP Precalculus

Function Representations and Average Rates of Change

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 table gives $x=-5, f(x)=35$; $x=1, f(x)=?$; $x=5, f(x)=54$. The average rate of change from $x=-5$ to $x=1$ is 1. The table also claims an average rate of 3 from $x=1$ to $x=5$. After recovering the missing endpoint, decide whether all the information is consistent. Find the missing output and show the signed net-change equation. Student work/claim: The missing output is 41, so every supplied condition is satisfied. Identify the first invalid step or inference in the displayed work. Correct it and complete the original task.

Context/domain: precalculus

-5	35
1	_____
5	54

Diagnose the claim: 'A negative average rate means the function decreased throughout the interval.' Construct an exact one-unit-per-tick polyline counterexample on $[-3,4]$ with endpoints $(-3,13)$ and $(4,8)$, and verify both its average rate and contradictory interior behavior. Student work/claim: A negative average rate means the function decreased throughout the interval. Identify the first invalid step or inference in the displayed work. Correct it and complete the original task.

Context/domain: precalculus

-3	13
4	8

Function Representations and Average Rates of Change

Full Worked Solutions - excerpt

Worked example

Problem. Let $f(x) = kx^2 + 2x$ for real k. Its average rate on $[1, 4]$ is 12. Determine k.

Answer. 2

Explanation and check.

The average rate is $k(1 + 4) + 2 = 5k + 2$. Thus $5k + 2 = 12$ and $k = 2$.

Worked example

Problem. For $f(x) = x^3 - x$ and $a > 0$, simplify the average rate on $[-a, a]$. Explain which symmetry is used.

Answer. $a^2 - 1$

Explanation and check.

The odd function has $f(-a) = -f(a)$. The quotient is $2(a^3 - a\frac{)}{2a} = a^2 - 1$.

Sets & Steps
Math Practice & Worked Solutions

AP Precalculus

Comparing Average Rates of Change

Comparing Average Rates of Change | APPC-U01-P03

96 problems · Four activity formats

Topic focus

Across 96 tasks this topic asks for family with difference evidence, secant, interior comparison, curvature explanation, simplified rule in s, concavity and signed interval changes, secant rates, midpoint comparison, diagnosis and missing output or incompatibility proof.

8 PDFs and a README; 75 buyer pages.

The following pages use the same questions, given data, and notation as the final files. Question/card serial numbers and internal IDs are omitted in this preview only. Table values and matching responses are retained. Full answer keys are not included.

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AP Precalculus

Comparing Average Rates of Change

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.

For $f(x) = -x + 29$, derive the average rate of change on $[s, s+3]$ as a function of s. Then state what the rule shows about linear versus quadratic change.

Bank label: _____

For the unknown quadratic $f(x) = ax^2 + bx + c$, two width-2 secants begin at $x = -2$ and $x = 0$ and have rates 2 and -6, respectively. Also $f(-1) = 6$. Recover the coefficients supported by these constraints.

Bank label: _____

A function is declared linear on the equally spaced inputs in this exact table: $x = -2, y = -19$; $x = -1, y = -16$; $x = 0, y =$?; $x = 1, y = -10$; $x = 2, y = -5$. Find the missing output if the declaration is consistent; otherwise explain why no value can make all entries fit.

Required output: missing output or incompatibility proof

x	y
-2	-19
-1	-16
0	_____
1	-10
2	-5

Bank label: _____

For $f(x) = x^2 + 4x + 17$, derive the average rate of change on $[s, s+4]$ as a function of s. Then state what the rule shows about linear versus quadratic change.

Bank label: _____

AP Precalculus

Comparing Average Rates of Change

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 $f(x) = 3x^2 - 2x - 1$, derive the average rate of change on $[s, s+3]$ as a function of s. Then state what the rule shows about linear versus quadratic change.

For $f(x) = -2x^2 - 3x - 4$, derive the average rate of change on $[s, s+2]$ as a function of s. Then state what the rule shows about linear versus quadratic change.

For $f(x) = -2x^2 - 4x + 20$, derive the average rate of change on $[s, s+5]$ as a function of s. Then state what the rule shows about linear versus quadratic change.

A model is known to be linear, quadratic, or outside those two families. Its exact samples are $x = -2, y = 12$; $x = 1, y = 12$; $x = 4, y = 12$; $x = 7, y = 12$; $x = 10, y = 12$. Identify the consistent family and cite the decisive difference pattern.

Required output: family with difference evidence

x	y
−2	12
1	12
4	12
7	12
10	12

AP Precalculus

Comparing Average Rates of Change

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

On $[-2, 3]$, $L(x) = -x + 6$ and $Q(x) = L(x) - 2(x + 2)(x - 3)$. Verify that their endpoint secant rates agree, compare $L(0)$ and $Q(0)$, and use curvature to explain the interior difference.

Your response: _____

Incoming: Both endpoint rates are -1; $L(0) = 6$ and $Q(0) = 18$. Q is concave down.

The inputs are not equally spaced in the exact table $(-1, 17)$; $(1, 17)$; $(4, 47)$; $(5, 65)$. Normalize every output change by its actual width, attach each rate to the interval midpoint, and test the quadratic requirement that those midpoint-rate pairs lie on a line.

Required output: secant rates, midpoint comparison, diagnosis

x	y
-1	17
1	17
4	47
5	65

Your response: _____

Incoming: Rates: $0, 10, 18$; midpoints: $0, \frac{5}{2}, \frac{9}{2}$. The evidence is consistent with a quadratic.

For the unknown quadratic $f(x) = ax^2 + bx + c$, two width-1 secants begin at $x = -3$ and $x = -1$ and have rates -11 and -3, respectively. No output value is supplied. Recover the coefficients supported by these constraints.

Your response: _____

Incoming: a = 2 and $b = -1$, while c is undetermined without an output anchor.

The inputs are not equally spaced in the exact table $(2, -2)$; $(3, -15)$; $(6, -78)$; $(10, -218)$. Normalize every output change by its actual width, attach each rate to the interval midpoint, and test the quadratic requirement that those midpoint-rate pairs lie on a line.

Required output: secant rates, midpoint comparison, diagnosis

x	y
2	-2
3	-15
6	-78
10	-218

Your response: _____

AP Precalculus

Comparing Average Rates of Change

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.

Use the exact equally spaced table and the stated candidate families. A student reports slope 5 because successive outputs differ by 5. Identify the invalid inference and give the corrected conclusion supported by the exact data.

Required output: family with difference evidence

x	**y**
-4	0
-2	5
0	10
2	15
4	20

Use the exact equally spaced table and the stated candidate families. A student insists that a straight-line pattern is a nondegenerate quadratic because its second differences are constant. Identify the invalid inference and give the corrected conclusion supported by the exact data.

Required output: family with difference evidence

x	**y**
-3	-4
-2	-3
-1	-2
0	-1
1	0

Comparing Average Rates of Change

Full Worked Solutions - excerpt

Worked example

Problem. For $f(x) = x^2 + 4x + 17$, derive the average rate of change on $[s, s+4]$ as a function of s. Then state what the rule shows about linear versus quadratic change.

Answer. $R(s) = 2s + 8$; it increases with interval location.

Explanation and check.

The endpoint change factors as $4[2s + 8]$. Dividing by the nonzero width 4 gives $R(s) = 2s + 8$. Thus the secant rate increases with interval location.

Worked example

Problem. For $f(x) = 3x^2 + x + 35$, derive the average rate of change on $[s, s+5]$ as a function of s. Then state what the rule shows about linear versus quadratic change.

Answer. $R(s) = 6s + 16$; it increases with interval location.

Explanation and check.

The endpoint change factors as $5[6s + 16]$. Dividing by the nonzero width 5 gives $R(s) = 6s + 16$. Thus the secant rate increases with interval location.

Sets & Steps
Math Practice & Worked Solutions

AP Precalculus

Polynomial Degree, Zeros, and End Behavior

Polynomial Degree, Zeros, and End Behavior | APPC-COMB-U01-P04-P06

96 problems · Four activity formats

Topic focus

Across 96 tasks this topic asks for left/right signs and oriented behavior, dominant term and both tails by case, decision with structural reason, qualified local relative-size conclusion, justified eventual comparison and qualified zero-set and equality conclusion.

8 PDFs and a README; 88 buyer pages.

The following pages use the same questions, given data, and notation as the final files. Question/card serial numbers and internal IDs are omitted in this preview only. Table values and matching responses are retained. Full answer keys are not included.

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AP Precalculus

Polynomial Degree, Zeros, and End Behavior

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.

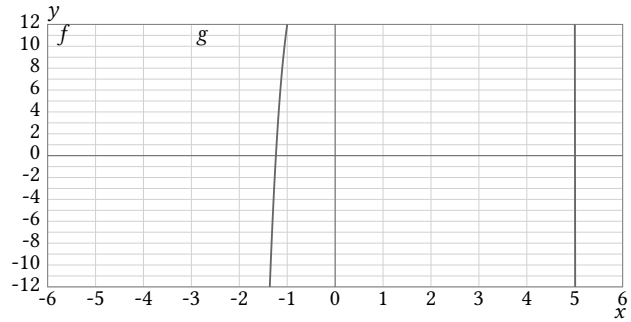
For $P(x) = 4x^3 - 4x^3 + 7 - 7$, determine the actual degree, leading term, and leading coefficient. Simplify only as much as needed and handle any constant or zero exception.

Bank label: _____

On the stated domain, the rule is $f(x) = x^4 + \frac{3}{x}$. Does it define a polynomial function? Simplify if useful and justify from coefficient, exponent, and domain structure.

Bank label: _____

For $f(x) = -x^6 + 5x^5 + 18$ and $g(x) = -x^6 - 17$, compare the requested difference after leading cancellation. Distinguish signed tail direction from eventual absolute magnitude and inspect cancellation when relevant.



Bank label: _____

For $P\_p(x) = (p - 1)x^4 - 2x^3 + 17$, describe both tails for $p > 1$, $p < 1$, and $p = 1$. Recompute degree at cancellation rather than assigning a zero leading coefficient.

Bank label: _____

AP Precalculus

Polynomial Degree, Zeros, and End Behavior

Name: _____ **Date:** _____ **Class:** _____

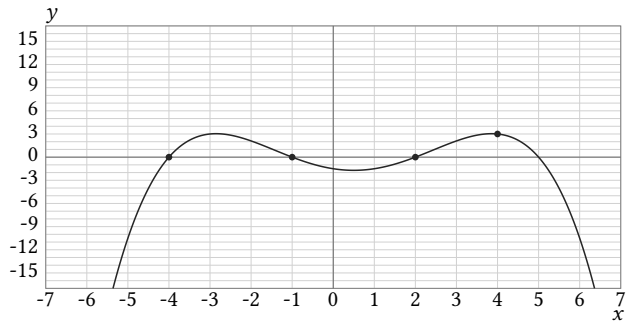
Answer each question and show your reasoning in the workspace. Give exact values rather than decimals unless the question supplies a decimal. Give the whole requested response, including any reasoning the question asks for.

For the polynomial $f(x) = x^6 + 2x^5 + 18$, describe both end behaviors. State the x-direction and output direction for each tail, and justify from the leading structure.

On the stated domain, the rule is $f(x) = \sqrt{2}x^1 - 2x + 11$. Does it define a polynomial function? Simplify if useful and justify from coefficient, exponent, and domain structure.

For $P(x) = (4x^3 + 1)(3x + 1)(-x + 1)$, determine the actual degree, leading term, and leading coefficient. Simplify only as much as needed and handle any constant or zero exception.

A continuous polynomial graph uses one unit per tick and includes exact visible points $(-4, 0), (-1, 0), (2, 0), (4, 3)$. Its certified arrows state $y \to -\infty$ as $x \to -\infty$ and $y \to -\infty$ as $x \to +\infty$. Infer the necessary degree parity and leading-coefficient sign. Does this identify a unique degree?



AP Precalculus

Polynomial Degree, Zeros, and End Behavior

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.

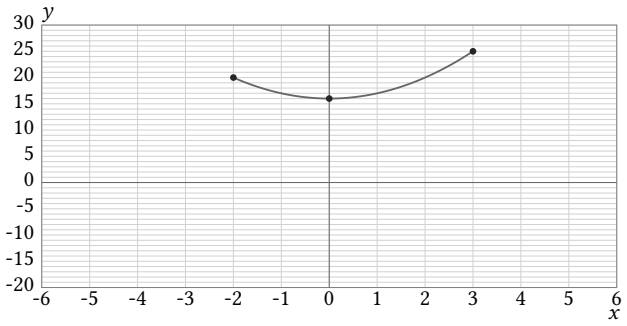
START

For $P(x) = 5x^5 - 5x^5 - 2x^3 + 11$, determine the actual degree, leading term, and leading coefficient. Simplify only as much as needed and handle any constant or zero exception.

Your response: _____

Incoming: Degree 3; leading term $-2x^3$; leading coefficient -2.

An exact polynomial graph uses rule $x^2 + 16$, one unit per tick, domain $[-2, 3]$, supplied feature points $(-2, 20), (0, 16), (3, 25)$, and certified behavior: no full-domain tails are asserted. Determine which absolute extrema are justified on the stated domain; distinguish local from global evidence.



Your response: _____

AP Precalculus

Polynomial Degree, Zeros, and End Behavior

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.

Construct one polynomial of minimum allowed degree at least 2, with even degree, positive leading coefficient, and constant term 1. Give a formula and verify both tails. A student writes only the final conclusion and omits the substitution, algebra, domain check, or justification required by the prompt. Diagnose the incomplete reasoning and supply the missing work.

Polynomial Degree, Zeros, and End Behavior

Full Worked Solutions - excerpt

Worked example

Problem. For $P(x) = 5x^5 - 5x^5 - 2x^3 + 11$, determine the actual degree, leading term, and leading coefficient. Simplify only as much as needed and handle any constant or zero exception.

Answer. Degree 3; leading term $-2x^3$; leading coefficient -2.

Explanation and check.

After the needed combining or leading-factor multiplication, the highest surviving power is 3 with coefficient -2.

Worked example

Problem. For $P(x) = 4x^3 - 4x^3 + 7 - 7$, determine the actual degree, leading term, and leading coefficient. Simplify only as much as needed and handle any constant or zero exception.

Answer. The result is the zero polynomial, whose ordinary degree and leading coefficient are undefined.

Explanation and check.

All terms cancel. The zero polynomial has no highest nonzero power, so it has no ordinary degree or leading coefficient.

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AP Precalculus

Function Symmetry, Finite Differences, and End Behavior

Function Symmetry, Finite Differences, and End Behavior | APPC-COMB-U01-P07-P09

96 problems · Four activity formats

Topic focus

Across 96 tasks this topic asks for classification with identity check, classification with mapped-point evidence, unit-bearing conditional model comparison, scaled difference and unchanged degree, two tail sides and crossing qualifier and forced values or exact conflict.

8 PDFs and a README; 94 buyer pages.

The following pages use the same questions, given data, and notation as the final files. Question/card serial numbers and internal IDs are omitted in this preview only. Table values and matching responses are retained. Full answer keys are not included.

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AP Precalculus

Function Symmetry, Finite Differences, and End Behavior

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.

Find all real k for which $f_k(x)=kx^3+17x$ is even. Collect like powers and set every coefficient of the incompatible parity to zero; report whether the result is unique, free, or inconsistent.

Bank label: _____

Classify $f(x)=-x^2+3$ as even, odd, both, or neither. Compute and simplify $f(-x)$; do not use the parity of the highest degree alone.

Bank label: _____

A polynomial is declared even. Its exact partial table gives $f(0)=6$. Recover every forced entry and diagnose any conflict, enforcing the paired-input law and the odd-function origin condition.

Complete response required: forced values or exact conflict.

x	f(x)
0	6

Bank label: _____

Construct an odd polynomial with $f(0)=1$. If impossible, prove the contradiction from the symmetry identity.

Bank label: _____

AP Precalculus

Function Symmetry, Finite Differences, and End Behavior

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.

Classify $f(x) = 0$ as even, odd, both, or neither. Compute and simplify $f(-x)$; do not use the parity of the highest degree alone.	Classify $f(x) = 3x^9 - 5x$ as even, odd, both, or neither. Compute and simplify $f(-x)$; do not use the parity of the highest degree alone.
A polynomial is declared odd and satisfies $f(1) = 5$. Infer both $f(-1)$ and $f(0)$, including the forced graph feature at the origin.	Construct an odd polynomial of degree at most 5 with $f(1) = 1$ and $f(2) = 8$. Give one formula and verify both values.
Find all real k for which $f_k(x)=kx^4 + 4x^2$ is even. Collect like powers and set every coefficient of the incompatible parity to zero; report whether the result is unique, free, or inconsistent.	Construct an even polynomial of degree at most 4 with $f(0) = 1$ and $f(1) = 3$. Give one formula and verify symmetry.

AP Precalculus

Function Symmetry, Finite Differences, and End Behavior

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: The data are inconsistent with a declared odd function: $f(-1)$ must equal -5, not 6.

Find all real k for which $f_k(x)=(k-5)x^3+6x^2$ is even. Collect like powers and set every coefficient of the incompatible parity to zero; report whether the result is unique, free, or inconsistent.

Your response: _____

Incoming: Yes. The inputs are equally spaced (the step need not be 1), so ordinary successive differences may be compared.

A polynomial is declared even. Its exact partial table gives $f(3)=10$, $f(-3)=11$, $f(0)=1$. Recover every forced entry and diagnose any conflict, enforcing the paired-input law and the odd-function origin condition.

Complete response required: forced values or exact conflict.

x	f(x)
3	10
-3	11
0	1

Your response: _____

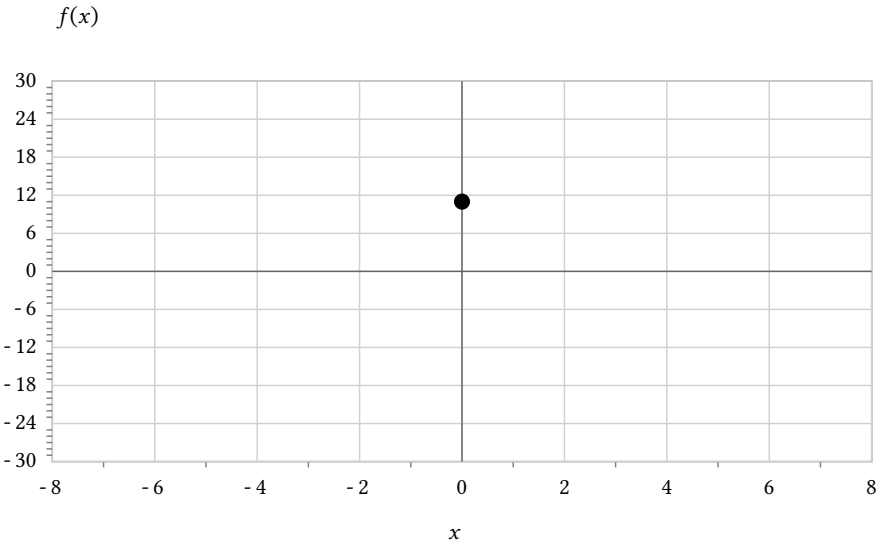
AP Precalculus

Function Symmetry, Finite Differences, and End Behavior

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 polynomial is declared odd. Its exact partial graph gives $f(0) = 11$. Recover every forced entry and diagnose any conflict, enforcing the paired-input law and the odd-function origin condition. A student reads only one visible feature of the graph and states the conclusion without checking scale, domain, endpoints, or marked exclusions. Diagnose the incomplete reasoning and give the corrected justification.



0	11

Viewing window	Minimum	Maximum
x	-8	8
y	-30	30

x	f(x)
0	11

Function Symmetry, Finite Differences, and End Behavior

Full Worked Solutions - excerpt

Worked example

Problem. Construct an even polynomial with $f(1) = 3$ and $f(-1) = 4$. If impossible, identify the exact paired-value conflict.

Answer. Impossible: even symmetry requires $f(-1) = f(1) = 3$, not 4.

Explanation and check.

Apply the symmetry identity directly to the prescribed values; the contradiction prevents any polynomial from satisfying all conditions.

Worked example

Problem. Construct an odd polynomial with $f(0) = 1$. If impossible, prove the contradiction from the symmetry identity.

Answer. Impossible: odd symmetry forces $f(0) = 0$, contradicting $f(0) = 1$.

Explanation and check.

Apply the symmetry identity directly to the prescribed values; the contradiction prevents any polynomial from satisfying all conditions.

Sets & Steps
Math Practice & Worked Solutions

AP Precalculus

Rational Function Domains and Sign Charts

Rational Function Domains and Sign Charts | APPC-U01-P10

96 problems · Four activity formats

Topic focus

Across 96 tasks this topic asks for compatible graph with decisive feature, verified formula or impossibility proof, exact real domain, repaired solution with domain/sign reason, qualified exact zero conclusion and complete real parameter set.

8 PDFs and a README; 59 buyer pages.

The following pages use the same questions, given data, and notation as the final files. Question/card serial numbers and internal IDs are omitted in this preview only. Table values and matching responses are retained. Full answer keys are not included.

Published by Tusils LLC.

AP Precalculus

Rational Function Domains and Sign Charts

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.

Determine the real domain of the original rule $f(x)=\frac{x+40}{(x-6)^2(x-10)(x^2+23)}$. Factor the denominator as needed and preserve exclusions even if a factor cancels.

Bank label: _____

Find all real zeros and x-intercepts of $f(x)=\frac{(x+3)(x+1)(x-2)}{(x+1)(x-5)(x^2+15)}$. List numerator roots first, then enforce the original denominator restrictions.

Bank label: _____

The table rows (x, reported $f(x)$) are $(-9, 0.03), (-8, 0.00), (-7, -0.02)$. Additional exact information: $f(-8)=\frac{1}{500}$ exactly. Decide what zero claim is warranted, using the stated precision and definition status.

Required output: qualified exact zero conclusion

x	**reported** $f(x)$
-9	0.03
-8	0.00
-7	-0.02

Bank label: _____

Find all real zeros and x-intercepts of $f(x)=\frac{(x+9)(x+7)(x+4)}{(x+7)(x+1)(x^2+9)}$. List numerator roots first, then enforce the original denominator restrictions.

Bank label: _____

AP Precalculus

Rational Function Domains and Sign Charts

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.

Determine the real domain of the original rule $f(x) = \frac{(x+2)x}{(x+2)(x-4)}$. Factor the denominator as needed and preserve exclusions even if a factor cancels.	Construct one real rational function with zeros $\{-6, -3\}$, exclusions $\{0, 2\}$, and common factor $(x - 2)$, or prove the conditions incompatible. No hole height is prescribed.
A student argues: "For $\frac{(x+3)x}{x} = 0$, cancel to $(x + 3) = 0$ and include both $x = -3$ and $x = 0$ as zeros." Diagnose the exact error and repair the solution while preserving original-domain and sign conditions.	Determine the real domain of the original rule $f(x) = \frac{(x-14)}{(x-11)(x^2+27)}$. Factor the denominator as needed and preserve exclusions even if a factor cancels.
Solve $f(x) = \frac{0}{(x-11)(x-13)} \leq 0$. Use the original factored rule to build a sign chart and state every endpoint membership explicitly.	Construct one real rational function with zero set containing 5 and excluded set also containing 5, or prove the conditions incompatible. No hole height is prescribed.

AP Precalculus

Rational Function Domains and Sign Charts

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

Solve $f(x) = \frac{(x+8)}{(x+6)} > 0$. Use the original factored rule to build a sign chart and state every endpoint membership explicitly.

Your response: _____

Incoming: Solution: $(-\infty, -8) \cup (-6, \infty)$.

Find all real zeros and x-intercepts of $f(x) = \frac{(x+13)(x+11)}{(x+13)(x+11)(x^2+5)}$. List numerator roots first, then enforce the original denominator restrictions.

Your response: _____

Incoming: Real zeros: none; there are no x-intercepts.

Solve $f(x) = \frac{0}{(x+9)(x+7)} \leq 0$. Use the original factored rule to build a sign chart and state every endpoint membership explicitly.

Your response: _____

Incoming: Solution: $(-\infty, -9) \cup (-9, -7) \cup (-7, \infty)$.

Determine all real k such that $x = -5$ is a real zero of $f_k(x) = \frac{x-k}{x}$. Enforce numerator zero and original denominator nonzero simultaneously.

Your response: _____

Incoming: k = −5.

Solve $f(x) = \frac{(x+6)(x+4)}{(x+4)(x+1)} < 0$. Use the original factored rule to build a sign chart and state every endpoint membership explicitly.

Your response: _____

Incoming: Solution: $(-6, -4) \cup (-4, -1)$.

Solve $f(x) = \frac{(x+10)(x+8)}{(x+8)(x+5)} < 0$. Use the original factored rule to build a sign chart and state every endpoint membership explicitly.

Your response: _____

AP Precalculus

Rational Function Domains and Sign Charts

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 argues: "For $\frac{x(x-3)}{x-3} = 0$, cancel to $x = 0$ and include both $x = 0$ and $x = 3$ as zeros." Diagnose the exact error and repair the solution while preserving original-domain and sign conditions. Identify the first invalid inference, give the corrected solution set, and justify it using the original equation.

A student argues: "For $\frac{(x-3)(x-6)}{x-6} = 0$, cancel to $(x - 3) = 0$ and include both $x = 3$ and $x = 6$ as zeros." Diagnose the exact error and repair the solution while preserving original-domain and sign conditions. Identify the first invalid inference, give the corrected solution set, and justify it using the original equation.

A student argues: "For $\frac{x-1}{x-4} = 1$, cross-multiply and include $x = 4$ because both sides become 0." Diagnose the exact error and repair the solution while preserving original-domain and sign conditions. Identify the first invalid inference, give the corrected solution set, and justify it using the original equation.

Rational Function Domains and Sign Charts

Full Worked Solutions - excerpt

Worked example

Problem. Construct one real rational function with zero set containing 5 and excluded set also containing 5, or prove the conditions incompatible. No hole height is prescribed.

Answer. No such rational function exists.

Explanation and check.

Impossible: a rational zero must be in the domain, while $x = 5$ is required to be outside the domain.

Worked example

Problem. Determine all real k such that $x = 2$ is a real zero of $f_k(x) = \frac{x-k}{x-k}$. Enforce numerator zero and original denominator nonzero simultaneously.

Answer. No real value of k works.

Explanation and check.

The numerator condition at $x = 2$ forces $k = 2$, but then the denominator is also zero at $x = 2$. The only candidate is forbidden.

Sets & Steps
Math Practice & Worked Solutions

AP Precalculus

Vertical Asymptotes and One-Sided Behavior

Vertical Asymptotes and One-Sided Behavior | APPC-U01-P11

96 problems · Four activity formats

Topic focus

Across 96 tasks this topic asks for two signed one-sided limits, complete generic and exceptional classification, verified formula or impossibility proof, evidence-based pole decision, qualified local limit conclusion and exact pole set with residual orders.

8 PDFs and a README; 120 buyer pages.

The following pages use the same questions, given data, and notation as the final files. Question/card serial numbers and internal IDs are omitted in this preview only. Table values and matching responses are retained. Full answer keys are not included.

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AP Precalculus

Vertical Asymptotes and One-Sided Behavior

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.

Determine every vertical asymptote of $f(x) = \frac{(x-2)^2(x-6)}{(x-2)^2(x-6)^2(x^2+19)}$. Collect common factors and compare multiplicities; do not call every original denominator zero a pole.

Bank label: _____

AP Precalculus

Vertical Asymptotes and One-Sided Behavior

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.

Determine every vertical asymptote of $f(x) = \frac{(x-11)^2(x-15)}{(x-11)^2(x-15)^2(x^2+28)}$. Collect common factors and compare multiplicities; do not call every original denominator zero a pole.

AP Precalculus

Vertical Asymptotes and One-Sided Behavior

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 $f(x) = \frac{3}{(x-1)(x^2+18)}$, analyze the two one-sided limits at $x = 1$. Use the residual denominator parity and the sign of the nonzero local cofactor.

Your response: _____

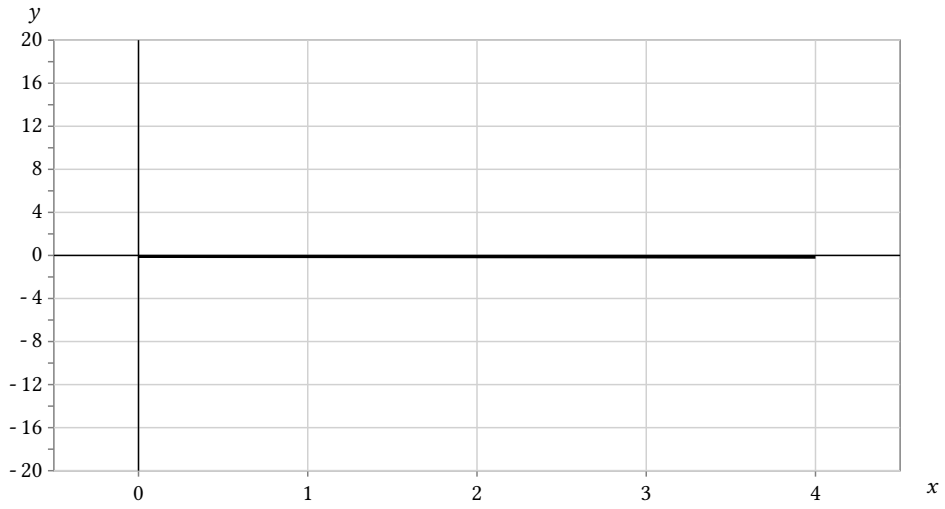
AP Precalculus

Vertical Asymptotes and One-Sided Behavior

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.

An exact display uses $f(x) = \frac{1}{x-10}$ on window $[0, 4]$. A student claims: "No spike appears in the window $[0, 4]$, so the function has no vertical asymptote." Diagnose the claim using residual denominator factors rather than visual height alone. Diagnose the no-spike claim by locating the actual pole relative to the displayed window.



Vertical Asymptotes and One-Sided Behavior

Full Worked Solutions - excerpt

Worked example

Problem. Construct a simple rational example satisfying one pole at $x = -6$ with left limit $+\infty$ and right limit $-\infty$, or prove it impossible. Verify pole order and every prescribed one-sided sign.

Answer. One example is $f(x) = -\frac{1}{x+6}$.

Explanation and check.

The denominator power 1 has the required parity and numerator sign -1; direct local sign analysis verifies both branches.

Worked example

Problem. Construct a simple rational example satisfying one pole at $x = 0$ with left limit $-\infty$ and right limit $+\infty$, or prove it impossible. Verify pole order and every prescribed one-sided sign.

Answer. One example is $f(x) = \frac{1}{x}$.

Explanation and check.

The denominator power 1 has the required parity and numerator sign 1; direct local sign analysis verifies both branches.

Sets & Steps
Math Practice & Worked Solutions

AP Precalculus

Holes in Rational Functions

Holes in Rational Functions | APPC-U01-P12

96 problems · Four activity formats

Topic focus

Across 96 tasks this topic asks for verified original ratio or impossibility proof, height membership conclusion with alternate-preimage check, corrected value-limit-hole statement, separate limit and point-value claims, exact removable point coordinates and required point value or impossibility.

8 PDFs and a README; 116 buyer pages.

The following pages use the same questions, given data, and notation as the final files. Question/card serial numbers and internal IDs are omitted in this preview only. Table values and matching responses are retained. Full answer keys are not included.

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AP Precalculus

Holes in Rational Functions

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.

Locate every removable hole of $f(x) = \frac{(x+6)(x+2)(-x-1)}{(x+6)(x+2)}$. The reduced rule is not the original value at an excluded input; report full coordinates and ignore any residual pole except to keep it distinct.

Bank label: _____

The exact approach table follows the continuation $g(x) = -x + 1$ near $x = -8$. The point definition says: $f(c)$ is undefined. State the two-sided limit when justified and state $f(-8)$ separately.

Given original rule: $f(x) = \frac{(x+8)(-x+1)}{(x+8)}, x \neq -8$

x	reported f(x)
-9	10
$-\frac{17}{2}$	$\frac{19}{2}$
$-\frac{81}{10}$	$\frac{91}{10}$
$-\frac{79}{10}$	$\frac{89}{10}$
$-\frac{15}{2}$	$\frac{17}{2}$
-7	8

Bank label: _____

AP Precalculus

Holes in Rational Functions

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.

Locate every removable hole of $f(x) = \frac{x(-x-2)}{x(x-5)}$. The reduced rule is not the original value at an excluded input; report full coordinates and ignore any residual pole except to keep it distinct.

The exact approach table follows the continuation $g(x) = 2x - 1$ near $x = 5$. The point definition says: $f(5) = 11$ is separately defined. State the two-sided limit when justified and state $f(5)$ separately.

Given original rule: $f(x) = \frac{(x-5)(2x-1)}{(x-5)}, x \neq 5$

x	reported f(x)
4	7
$\frac{9}{2}$	8
$\frac{49}{10}$	$\frac{44}{5}$
$\frac{51}{10}$	$\frac{46}{5}$
$\frac{11}{2}$	10
6	11

AP Precalculus

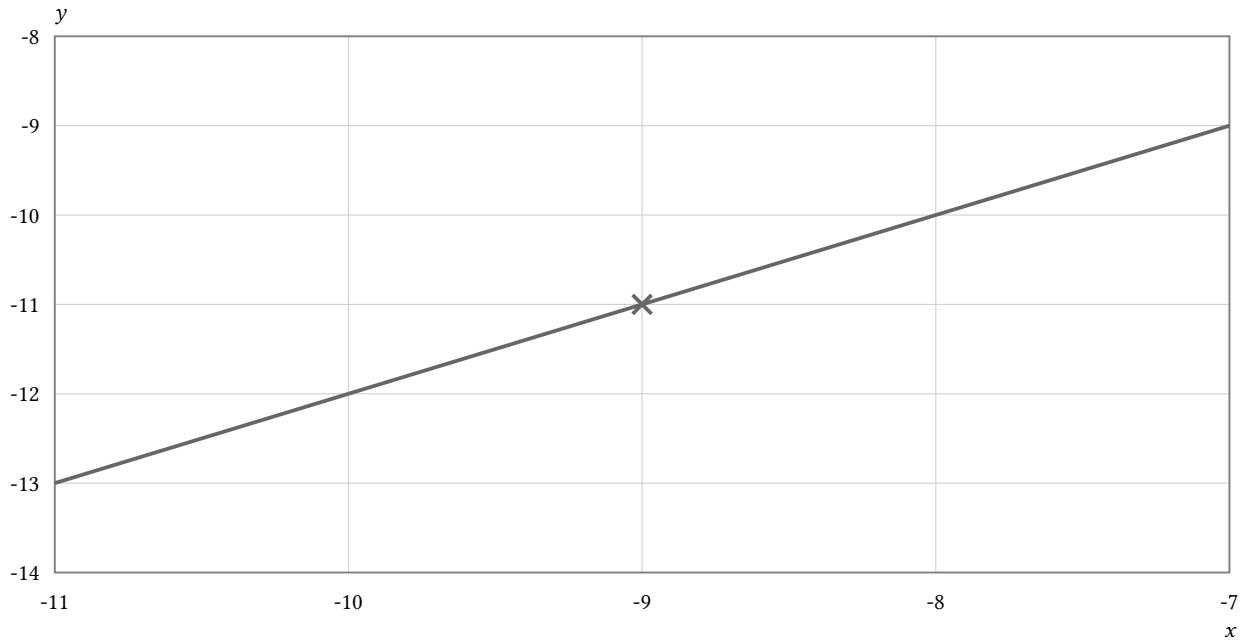
Holes in Rational Functions

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

Construct an original rational function satisfying reduced graph $y = x - 2$ with one hole at $(-9, -11)$, or prove it impossible. Verify every target height against the reduced graph.



Your response: _____

AP Precalculus

Holes in Rational Functions

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 claims: “For $f(x) = \frac{(x-2)(x-1)}{x-2}$, $\frac{0}{0}$ means $f(2) = 0$.” Diagnose the implication and distinguish nearby equality, the limit, and the original point value. Identify the invalid inference. Give the nearby simplified rule, the two-sided limit when justified, and the original point value separately.

A student claims: “For $f(x) = \frac{(x+1)(x-1)}{x+1}$, $\frac{0}{0}$ means $f(-1) = 0$.” Diagnose the implication and distinguish nearby equality, the limit, and the original point value. Identify the invalid inference. Give the nearby simplified rule, the two-sided limit when justified, and the original point value separately.

Holes in Rational Functions

Full Worked Solutions - excerpt

Worked example

Problem. Determine the point value, if any, that makes this function continuous at $x = 9$: $f(x) = \frac{1}{x-9}$ for $x \neq 9$, with a proposed finite $f(9)$. Verify a finite two-sided limit before assigning the point.

Answer. No finite point value can make the function continuous.

Explanation and check.

The one-sided outputs diverge with opposite signs at $x = 9$, so no finite two-sided limit exists to use as a fill value.

Worked example

Problem. Determine the point value, if any, that makes this function continuous at $x = 0$: $f(x) = \frac{1}{x}$ for $x \neq 0$, with a proposed finite $f(0)$. Verify a finite two-sided limit before assigning the point.

Answer. No finite point value can make the function continuous.

Explanation and check.

The one-sided outputs diverge with opposite signs at $x = 0$, so no finite two-sided limit exists to use as a fill value.

Sets & Steps
Math Practice & Worked Solutions

AP Precalculus

Equivalent Polynomial Forms

Equivalent Polynomial Forms | APPC-U01-P13

96 problems · Four activity formats

Topic focus

Across 96 tasks this topic asks for form choice and exact revealed feature, consistent candidate with decisive evidence, first error, corrected identity, and lost graph feature, complete exact polynomial and requested coefficient, factored form plus newly visible feature and feature meaning with units and domain check.

8 PDFs and a README; 78 buyer pages.

The following pages use the same questions, given data, and notation as the final files. Question/card serial numbers and internal IDs are omitted in this preview only. Table values and matching responses are retained. Full answer keys are not included.

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AP Precalculus

Equivalent Polynomial Forms

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 answer may be used more than once.

Factor $P(x) = 2x^2 - 16x + 32$ to reveal useful structure. Explain the feature made visible by the factorization rather than merely listing roots. Bank label: _____	Rewrite $f(x) = 2x^2 + 1$ in vertex form. On the stated domain $-2 \le x \le 3$, determine the minimum value and where it occurs; justify the bound using square nonnegativity and check whether the vertex is feasible. Bank label: _____
Factor $P(x) = 2x^2 + 18x$ to reveal useful structure. Explain the feature made visible by the factorization rather than merely listing roots. Bank label: _____	Rewrite $f(x) = x^2 + 8x + 13$ in vertex form. On the stated domain all real x, determine the minimum value and where it occurs; justify the bound using square nonnegativity and check whether the vertex is feasible. Bank label: _____
Factor $P(x) = 3x^2 - 42x + 147$ to reveal useful structure. Explain the feature made visible by the factorization rather than merely listing roots. Bank label: _____	Rewrite $f(x) = 3x^2 + 12x + 11$ in vertex form. On the stated domain $-1 \le x \le 2$, determine the minimum value and where it occurs; justify the bound using square nonnegativity and check whether the vertex is feasible. Bank label: _____
Factor $P(x) = 3x^2 - 18x$ to reveal useful structure. Explain the feature made visible by the factorization rather than merely listing roots. Bank label: _____	Two equivalent descriptions of the same polynomial are vertex: $(x + 1)^2 + 2$; standard: $x^2 + 2x + 3$. Which named form most directly answers the request for vertex? State the feature it reveals and explain why equivalence alone does not make both forms equally efficient. Bank label: _____

AP Precalculus

Equivalent Polynomial Forms

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.

Rewrite $f(x) = 2x^2 - 12x + 17$ in vertex form. On the stated domain $1 \le x \le 6$, determine the minimum value and where it occurs; justify the bound using square nonnegativity and check whether the vertex is feasible.

Factor $P(x) = 2x^2 + 32x + 128$ to reveal useful structure. Explain the feature made visible by the factorization rather than merely listing roots.

Use the supplied complete Pascal table to expand $(4x - 4)^5$ and explain how signs and nonunit factors enter each coefficient.

Context/domain: precalculus

j	C(n,j)	power of x	power of constant term	resulting coefficient
0	1	5	0	1024
1	5	4	1	−5120
2	10	3	2	10240
3	10	2	3	−10240
4	5	1	4	5120
5	1	0	5	−1024

Determine all real parameter values that make the two forms $a(x - 3)^2 + k$ and $x^2 - 6x + 8$ identical for every x. Match only decisive coefficients first, then verify every coefficient.

AP Precalculus

Equivalent Polynomial Forms

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

Two equivalent descriptions of the same polynomial are factored: $2(x-2)(x-5)$; standard: $2x^2-14x+20$. Which named form most directly answers the request for initial output $f(0)$? State the feature it reveals and explain why equivalence alone does not make both forms equally efficient.

Your response: _____

Incoming: The roots t = 0 and $t = 9$ mean the object is at height 0 feet at launch and landing; both are feasible endpoints.

Use the supplied complete Pascal table to expand $(x+1)^2$ and explain how signs and nonunit factors enter each coefficient.

Context/domain: precalculus

j	C(n,j)	power of x	power of constant term	resulting coefficient
0	1	2	0	1
1	2	1	1	2
2	1	0	2	1

Your response: _____

Incoming: Use the factored form; it directly reveals $x=-1$ and $x=2$.

Factor $P(x)=x^2$ to reveal useful structure. Explain the feature made visible by the factorization rather than merely listing roots.

Your response: _____

Incoming: $(x-1)^3=x^3-3x^2+3x-1$.

Two equivalent descriptions of the same polynomial are vertex: $3(x+2)^2-1$; standard: $3x^2+12x+11$. Which named form most directly answers the request for quadratic extremum and where it occurs? State the feature it reveals and explain why equivalence alone does not make both forms equally efficient.

Your response: _____

AP Precalculus

Equivalent Polynomial Forms

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 claims $3(x-2)^2-1$ is identically equal to x^2-4x+3. Locate the algebraic error, write the corrected identity, and name one graph feature or value changed by the false rewrite. Diagnose the missing factor of 3 in expansion; compare the values at $x=0$. Give the corrected identity and explain why the claimed expressions are not equivalent.

A student claims $3x^2+2$ is identically equal to x^2+2. Locate the algebraic error, write the corrected identity, and name one graph feature or value changed by the false rewrite. Diagnose the omitted coefficient 3; compare the values at $x=1$. Give the corrected identity and explain why the claimed expressions are not equivalent.

A student claims $(x+2)^2$ is identically equal to x^2+4. Locate the algebraic error, write the corrected identity, and name one graph feature or value changed by the false rewrite. Diagnose the omitted cross term; compare both vertices and the values at $x=1$. Give the corrected identity and explain why the claimed expressions are not equivalent.

A student claims $(x+5)^2$ is identically equal to x^2+25. Locate the algebraic error, write the corrected identity, and name one graph feature or value changed by the false rewrite. Diagnose the omitted cross term; compare the values at $x=1$. Give the corrected identity and explain why the claimed expressions are not equivalent.

Equivalent Polynomial Forms

Full Worked Solutions - excerpt

Worked example

Problem. Factor $P(x) = x^2$ to reveal useful structure. Explain the feature made visible by the factorization rather than merely listing roots.

Answer. $P(x) = xx = x^2$; the repeated factor shows a double zero at $x = 0$.

Explanation and check.

The factorization $xx = x^2$ is an identity. The repeated factor shows a double zero at $x = 0$.

Worked example

Problem. Determine all real parameter values that make the two forms $a(x + 3)^2 + k$ and $x^2 + 6x + 7$ identical for every x. Match only decisive coefficients first, then verify every coefficient.

Answer. a = $1, k = -2$.

Explanation and check.

Coefficient matching yields the unique pair $a = 1, k = -2$, and substitution reproduces $x^2 + 6x + 7$.

Sets & Steps
Math Practice & Worked Solutions

AP Precalculus

Rational Expression Operations and Restrictions

Rational Expression Operations and Restrictions | APPC-U01-P14

96 problems · Four activity formats

Topic focus

Across 96 tasks this topic asks for recommended representation with preserved domain, function equality and exact agreement domain, verified original ratio and exact exclusion set, correct rewrite, exclusion, and test-input evidence, simplified rule plus every original exclusion and single ratio, reduced rule, and sourced exclusions.

8 PDFs and a README; 55 buyer pages.

The following pages use the same questions, given data, and notation as the final files. Question/card serial numbers and internal IDs are omitted in this preview only. Table values and matching responses are retained. Full answer keys are not included.

Published by Tusils LLC.

AP Precalculus

Rational Expression Operations and Restrictions

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 $R(x)=\frac{(x+2)(x-6)(2x+3)}{(x+2)(x-6)(x-2)}$ in reduced form and state its original domain. Cancel only common nonzero factors; do not restore an input merely because it disappears from the denominator. Bank label: _____	Choose the more useful of the two supplied forms to determine the horizontal asymptote and the nonzero remainder in a quotient-remainder form. A (single ratio): $\frac{-3(x+2)+1}{x+2}$; B (supplied quotient-remainder): $-3+\frac{1}{x+2}$. State the feature, explain why that form exposes it, and retain every original excluded input. Bank label: _____
Rewrite $R(x)=6(x+1)\frac{x-5}{(x+1)(x-5)}$ in reduced form and state its original domain. Cancel only common nonzero factors; do not restore an input merely because it disappears from the denominator. Bank label: _____	Determine all real k for which $\frac{x+k}{x-7}$ and $\frac{x+2}{x-7}$ define identical functions. First compare the algebraic identity, then check zero denominators and whether the domains coincide. Bank label: _____
Rewrite $R(x)=5(x+7)\frac{x+1}{(x+7)(x+1)}$ in reduced form and state its original domain. Cancel only common nonzero factors; do not restore an input merely because it disappears from the denominator. Bank label: _____	Determine all real k for which $\frac{(x+2)(x+k)}{(x+2)(x-3)}$ and $\frac{x+k}{x-3}$ define identical functions. First compare the algebraic identity, then check zero denominators and whether the domains coincide. Bank label: _____
Rewrite $R(x)=4(x-2)\frac{x-8}{(x-2)(x-8)}$ in reduced form and state its original domain. Cancel only common nonzero factors; do not restore an input merely because it disappears from the denominator. Bank label: _____	Choose the more useful of the two supplied forms to determine the horizontal asymptote and the nonzero remainder in a quotient-remainder form. A (single ratio): $\frac{3(x+5)+3}{x+5}$; B (supplied quotient-remainder): $3+\frac{3}{x+5}$. State the feature, explain why that form exposes it, and retain every original excluded input. Bank label: _____

AP Precalculus

Rational Expression Operations and Restrictions

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.

Construct an original rational ratio that reduces to $x - 1$ but has requested original exclusions $\{x = -1\}$. The reduced rule already excludes none; do not add redundant common factors or unintended restrictions.	Rewrite $(\frac{x+7}{x+4}) \div (\frac{x-3}{x})$ as one rational expression and state the domain. Track every component denominator before simplifying; for division, also exclude inputs where the divisor equals zero.
Rewrite $R(x) = \frac{(x+8)x(2x-3)}{(x+8)x(x+2)}$ in reduced form and state its original domain. Cancel only common nonzero factors; do not restore an input merely because it disappears from the denominator.	Given $f(x) = \frac{(x+6)(2x-3)}{(x+6)(x+1)}$ with excluded inputs $-6, -1$, and $g(x) = \frac{2x-3}{x+1}$ with $x \neq -6, -1$ with excluded inputs $-6, -1$. Decide whether they are identical functions and state exactly where their values agree. A matching simplified formula is not sufficient without matching domains.
Construct an original rational ratio that reduces to $x - 2$ but has requested original exclusions $\{x = -7\}$. The reduced rule already excludes none; do not add redundant common factors or unintended restrictions.	Rewrite $(\frac{x+5}{x+2})(\frac{x+2}{x-2})$ as one rational expression and state the domain. Track every component denominator before simplifying; for division, also exclude inputs where the divisor equals zero.

AP Precalculus

Rational Expression Operations and Restrictions

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

Rewrite $(\frac{x-2}{x-5}) \div (\frac{x-12}{x-9})$ as one rational expression and state the domain. Track every component denominator before simplifying; for division, also exclude inputs where the divisor equals zero.

Your response: _____

Incoming: The single ratio is $\frac{(x-2)(x-9)}{(x-5)(x-12)}$, reducing to $\frac{(x-2)(x-9)}{(x-5)(x-12)}$, with all real x except $x = 5, x = 9, x = 12$.

Determine all real k for which $\frac{x+k}{x+2}$ and $\frac{x}{x+2}$ define identical functions. First compare the algebraic identity, then check zero denominators and whether the domains coincide.

Your response: _____

Incoming: k = 0.

Rewrite $(\frac{x+10}{x+7}) \div (\frac{x}{x+3})$ as one rational expression and state the domain. Track every component denominator before simplifying; for division, also exclude inputs where the divisor equals zero.

Your response: _____

Incoming: The single ratio is $\frac{(x+10)(x+3)}{(x+7)x}$, reducing to $\frac{(x+10)(x+3)}{(x+7)x}$, with all real x except $x = -7, x = -3, x = 0$.

Construct an original rational ratio that reduces to $\frac{3x-2}{x+6}$ but has requested original exclusions $\{x = -6, x = -2\}$. The reduced rule already excludes $\{x = -6\}$; do not add redundant common factors or unintended restrictions.

Your response: _____

Incoming: One valid predecessor is $\frac{(x+2)(3x-2)}{(x+2)(x+6)}$, with all real x except $x = -6, x = -2$.

Rewrite $(\frac{x+3}{x}) + (\frac{4}{x})$ as one rational expression and state the domain. Track every component denominator before simplifying; for division, also exclude inputs where the divisor equals zero.

Your response: _____

Incoming: The single ratio is $\frac{x+7}{x}$, reducing to $\frac{x+7}{x}$, with all real x except $x = 0$.

Choose the more useful of the two supplied forms to determine the horizontal asymptote and the nonzero remainder in a quotient-remainder form. A (single ratio): $\frac{-2(x-6)+4}{x-6}$; B (supplied quotient-remainder): $-2 + \frac{4}{x-6}$. State the feature, explain why that form exposes it, and retain every original excluded input.

Your response: _____

AP Precalculus

Rational Expression Operations and Restrictions

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 rewrites $(x-3)\,\frac{x+2}{x-3}$ as $x+2$ for every real x. Identify the first invalid inference. State the corrected rule and its original domain, then test the designated input when it is allowed.

Designated test input: $x=3$.

A student rewrites $\frac{x-1}{x-4}$ as $-\frac{1}{-4}$. Identify the first invalid inference. State the corrected rule and its original domain, then test the designated input when it is allowed.

Designated test input: $x=1$.

A student rewrites $(x+3)\,\frac{x+2}{x+3}$ as $x+2$ for every real x. Identify the first invalid inference. State the corrected rule and its original domain, then test the designated input when it is allowed.

Designated test input: $x=-3$.

A student rewrites $\frac{4-x}{x-4}$ as 1. Identify the first invalid inference. State the corrected rule and its original domain, then test the designated input when it is allowed.

Designated test input: $x=5$.

Rational Expression Operations and Restrictions

Full Worked Solutions - excerpt

Worked example

Problem. Rewrite $\left(\frac{x+3}{x}\right) + \left(\frac{4}{x}\right)$ as one rational expression and state the domain. Track every component denominator before simplifying; for division, also exclude inputs where the divisor equals zero.

Answer. The single ratio is $\frac{x+7}{x}$, reducing to $\frac{x+7}{x}$, with all real x except $x = 0$.

Explanation and check.

Combining the operation gives $\frac{x+7}{x}$. The common denominator supplies the sole restriction. Therefore the complete exclusion set is 0.

Worked example

Problem. Rewrite $\left(\frac{x-9}{x-12}\right) + \left(\frac{6}{x-12}\right)$ as one rational expression and state the domain. Track every component denominator before simplifying; for division, also exclude inputs where the divisor equals zero.

Answer. The single ratio is $\frac{x-3}{x-12}$, reducing to $\frac{x-3}{x-12}$, with all real x except $x = 12$.

Explanation and check.

Combining the operation gives $\frac{x-3}{x-12}$. The common denominator supplies the sole restriction. Therefore the complete exclusion set is 12.

Sets & Steps
Math Practice & Worked Solutions

AP Precalculus

Polynomial Division and Slant Asymptotes

Polynomial Division and Slant Asymptotes | APPC-U01-P15

96 problems · Four activity formats

Topic focus

Across 96 tasks this topic asks for quotient line, remainder correction, and exclusion, quotient, remainder, and reconstructed identity, quotient and degree-valid remainder, validity verdict with both requirements, first invalid step and corrected continuation and missing polynomial or inconsistency proof.

8 PDFs and a README; 66 buyer pages.

The following pages use the same questions, given data, and notation as the final files. Question/card serial numbers and internal IDs are omitted in this preview only. Table values and matching responses are retained. Full answer keys are not included.

Published by Tusils LLC.

AP Precalculus

Polynomial Division and Slant Asymptotes

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.

Divide $12x^4 + 48x^3 + 3x^2 + 9x - 14$ by $3x + 12$. Insert zero placeholders for any missing powers, report q and r, and verify $p = dq + r$.

Bank label: _____

Determine the parameter value(s) so division of $k + x^2 + x$ by $x + 8$ has required remainder 0. Use the supplied exact constraint table and verify $p = dq + r$.

Complete response required: complete parameters with verified remainder.

input	p_k(input)	required remainder
-8	$56 + k$	0

Bank label: _____

Divide $2x^3 - 4x^2 + 2$ by $2x - 2$. Insert zero placeholders for any missing powers, report q and r, and verify $p = dq + r$.

Bank label: _____

In the identity $p(x) = d(x)q(x) + r(x), d(x) = x^2 + 3x + 8, q(x) = x - 1, r(x) = 1 - x$ are given. Determine the dividend $p(x)$. Then verify the identity and the strict condition $\deg r < \deg d$.

Bank label: _____

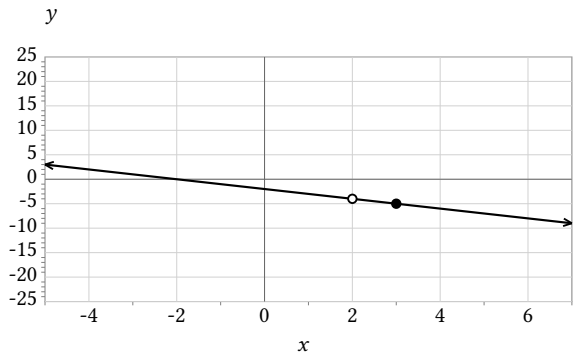
AP Precalculus

Polynomial Division and Slant Asymptotes

Name: _____ **Date:** _____ **Class:** _____

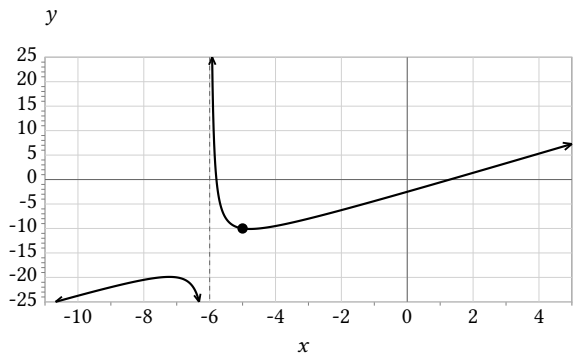
Answer each question and show your reasoning in the workspace. Give exact values rather than decimals unless the question supplies a decimal. Give the whole requested response, including any reasoning the question asks for.

Divide the numerator in $\frac{4-x^2}{x-2}$ by its denominator. Write the quotient-remainder form, derive the slant line, and explain why the correction tends to 0 while preserving $x = 2$ as excluded.



Divide $9x^4 + 9x^3 - 9x^2 - 3x + 7$ by $3x + 3$. Insert zero placeholders for any missing powers, report q and r, and verify $p = dq + r$.

Divide the numerator in $\frac{2x^2+9x-15}{x+6}$ by its denominator. Write the quotient-remainder form, derive the slant line, and explain why the correction tends to 0 while preserving $x = -6$ as excluded.



A student division of $3x^3 + 3x^2 + 6x$ by $3x$ first fails because the divisor leading coefficient was ignored when choosing the next quotient term. Explain the repair, finish the division, and verify the result.

AP Precalculus

Polynomial Division and Slant Asymptotes

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: $q(x) = 2x - 1, r(x) = -3$.

Divide $x^3 - x^2 + 16x - 32$ by $x^2 + x + 17$. Continue only while the current remainder degree is at least 2, then justify the stopping point.

Your response: _____

Incoming: $q(x) = x - 1, r(x) = x$.

In the identity $p(x) = d(x)q(x) + r(x)$, $p(x) = 2x^3 - 5x^2 + 7x - 3, q(x) = 2x - 1, r(x) = -x$ are given. Determine the divisor $d(x)$. Then verify the identity and the strict condition deg $r <$ deg d.

Your response: _____

Incoming: $3x - 2 + \frac{4}{x+5}$; slant asymptote $y = 3x - 2$.

Divide $x^3 - 3x^2 + 2x + 22$ by $x^2 - 5x + 11$. Continue only while the current remainder degree is at least 2, then justify the stopping point.

Your response: _____

Incoming: $q(x) = 2x + 1, r(x) = -3$.

Divide $4x^3 - 16x^2 - 8x + 12$ by $2x^2 - 10x + 6$. Continue only while the current remainder degree is at least 2, then justify the stopping point.

Your response: _____

AP Precalculus

Polynomial Division and Slant Asymptotes

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 is dividing $2x^3 - x^2 + 2x - 2$ by $2x - 1$. Diagnose this specific student statement: The quotient coefficient list $[1, 1]$ represents $x^2 + 1$. Correct the line or coefficient list, complete the division, and verify the quotient and remainder.

A student is dividing $x^3 - x - 1$ by $x - 1$. Diagnose this specific student statement: After subtracting x^3 - x^2 from $x^3 + 0x^2$ - $x - 1$, the remainder is - x^2 - $x - 1$. Correct the line or coefficient list, complete the division, and verify the quotient and remainder.

A student is dividing $x^3 - 3x^2 + 2x - 2$ by $x - 2$. Diagnose this specific student statement: Subtracting $x^3 - 2x^2$ from the dividend gives $-5x^2 + 2x - 2$. Correct the line or coefficient list, complete the division, and verify the quotient and remainder.

A student is dividing $2x^3 + 4$ by $2x + 2$. Diagnose this specific student statement: The descending coefficient list of $2x^3 + 4$ is $[2, 4]$. Correct the line or coefficient list, complete the division, and verify the quotient and remainder.

Polynomial Division and Slant Asymptotes

Full Worked Solutions - excerpt

Worked example

Problem. Divide $x^2 - 7x - 18$ by $x - 9$. Insert zero placeholders for any missing powers, report q and r, and verify $p = dq + r$.

Answer. $q(x) = x + 2, r(x) = 0$.

Explanation and check.

Successive leading-term cancellation gives $q = x + 2$ and $r = 0$. Re-expansion verifies $x^2 - 7x - 18 = (x - 9)(x + 2)$; the zero remainder makes the division exact.

Worked example

Problem. Divide $x^3 - x^2 + 16x - 32$ by $x^2 + x + 17$. Continue only while the current remainder degree is at least 2, then justify the stopping point.

Answer. $q(x) = x - 2, r(x) = x + 2$.

Explanation and check.

Multiplication gives $(x^2 + x + 17)(x - 2)$ and subtraction leaves $x + 2$. Its degree 1 is below 2, so the division is complete.

Sets & Steps
Math Practice & Worked Solutions

AP Precalculus

Function Translations

Function Translations | APPC-U01-P16

96 problems · Four activity formats

Topic focus

Across 96 tasks this topic asks for translation candidate and failure evidence, identify and correct mismatched row, corrected conclusions, translated rows plus rule, new formula and zero-time value and translated contextual model with units.

8 PDFs and a README; 79 buyer pages.

The following pages use the same questions, given data, and notation as the final files. Question/card serial numbers and internal IDs are omitted in this preview only. Table values and matching responses are retained. Full answer keys are not included.

Published by Tusils LLC.

AP Precalculus

Function Translations

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.

From the table, evaluate $g(-7)$ and $g(4)$ for $g(x) = f(x + 5) + 2$.

Complete response required: ordered pair of exact values.

u	$f(u)$
-8	-4
-2	6
3	0
9	11

Bank label: _____

If $g(x) = f(x - 2) - 4$, use the table to find $g(4)$.

Complete response required: exact value.

x	$f(x)$
-3	12
2	-5
7	1

Bank label: _____

Write g in terms of f when the graph of f is translated 4 units left and 2 units down. Explain the sign used inside f.

Bank label: _____

To determine $g(-3)$ for $g(x) = f(x + 8) - 2$, which source-table row is needed? If that row is $(5, 14)$, compute $g(-3)$.

Bank label: _____

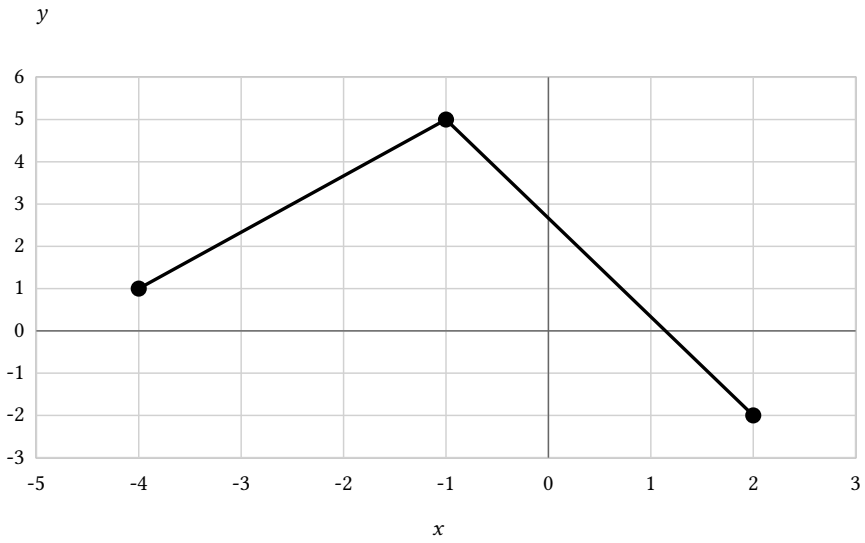
AP Precalculus

Function Translations

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 graph consists of closed line segments joining $(-4, 1)$ to $(-1, 5)$ to $(2, -2)$. Translate the graph 2 units left and 3 units up. Give the image of every listed vertex and retain the connections.



-4	1
-1	5
2	-2

AP Precalculus

Function Translations

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: Rows $(-13, 3)$, $(-7, -3)$, $(0, -11)$, and $(6, 2)$.

First set $p(x) = f(x) - 9$, then set $q(x) = p(x + 4)$. Collapse the two steps into one formula involving f and describe the two-coordinate displacement.

Your response: _____

Incoming: Rows $(-11, 2)$, $(-6, 8)$, $(2, -1)$; $g(x) = f(x + 7) + 2$.

Using only the displayed table for f, evaluate every determined value among $g(-4)$, $g(1)$, $g(5)$, and $g(0)$ when $g(x) = f(x + 1) - 3$. Identify any value that cannot be found.

Complete response required: determined values and unsupported query.

u	$f(u)$
-7	2
-3	9
2	-1
6	4

Your response: _____

Incoming: New y-intercept $(0, -4)$; old y-intercept maps to $(-7, 7)$.

The same translation, left 3 and up 4, is applied three times. Replace the repeated action by one vector and one rule g in terms of f.

Your response: _____

Incoming: h = 3, $k = -6$, so $g(x) = f(x - 3) - 6$.

Move the graph of f right 2 and up 10. Write g in terms of f and map the source point $(8, -3)$.

Your response: _____

AP Precalculus

Function Translations

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 table gives exact values of f. If $g(x) = f(x + 2) - 1$, use the displayed data to find $g(0)$. A student claims $g(0) = f(0) - 1 = -3$. Diagnose the horizontal-input error using the exact table, and give the complete corrected result.

Complete response required: exact value.

x	$f(x)$
-3	7
0	-2
2	5
5	1

Only the displayed values of f are known. For $g(x) = f(x - 3) - 1$, find every x supported by the table for which $g(x) = 5$. Do not assume f is one-to-one or extend the table. A student claims the supported answers are the source inputs -4 and 2 without any horizontal change. Diagnose the horizontal-input error using the exact table, and give the complete corrected result.

Complete response required: all displayed-data solutions.

u	$f(u)$
-4	6
-1	2
2	6
3	-3
7	2

Function Translations

Full Worked Solutions - excerpt

Worked example

Problem. Move the graph of f right 2 and up 10. Write g in terms of f and map the source point $(8,-3)$.

Answer. $g(x)=f(x-2)+10$; $(8,-3)$ maps to $(10,7)$.

Explanation and check.

A right shift uses $x-2$ inside, while an upward shift adds 10 outside. Adding $(2,10)$ to the point gives $(10,7)$.

Worked example

Problem. The complete solution of $f(u)>4$ is $(-7,-1)$ union $(3,8]$. If $g(x)=f(x+2)-9$, solve $g(x)>-5$.

Answer. $(-9,-3)$ union $(1,6]$.

Explanation and check.

The target inequality becomes $f(x+2)>4$. Thus $x+2$ must lie in the given source set; subtract 2 from every endpoint and preserve all inequality memberships.

Sets & Steps
Math Practice & Worked Solutions

AP Precalculus

Function Reflections, Stretches, and Compressions

Function Reflections, Stretches, and Compressions | APPC-U01-P17

96 problems · Four activity formats

Topic focus

Across 96 tasks this topic asks for supported conclusion and limitation, a and possible b, a and all b, forced and unidentifiable factors, description and a,b and explanation.

8 PDFs and a README; 71 buyer pages.

The following pages use the same questions, given data, and notation as the final files. Question/card serial numbers and internal IDs are omitted in this preview only. Table values and matching responses are retained. Full answer keys are not included.

Published by Tusils LLC.

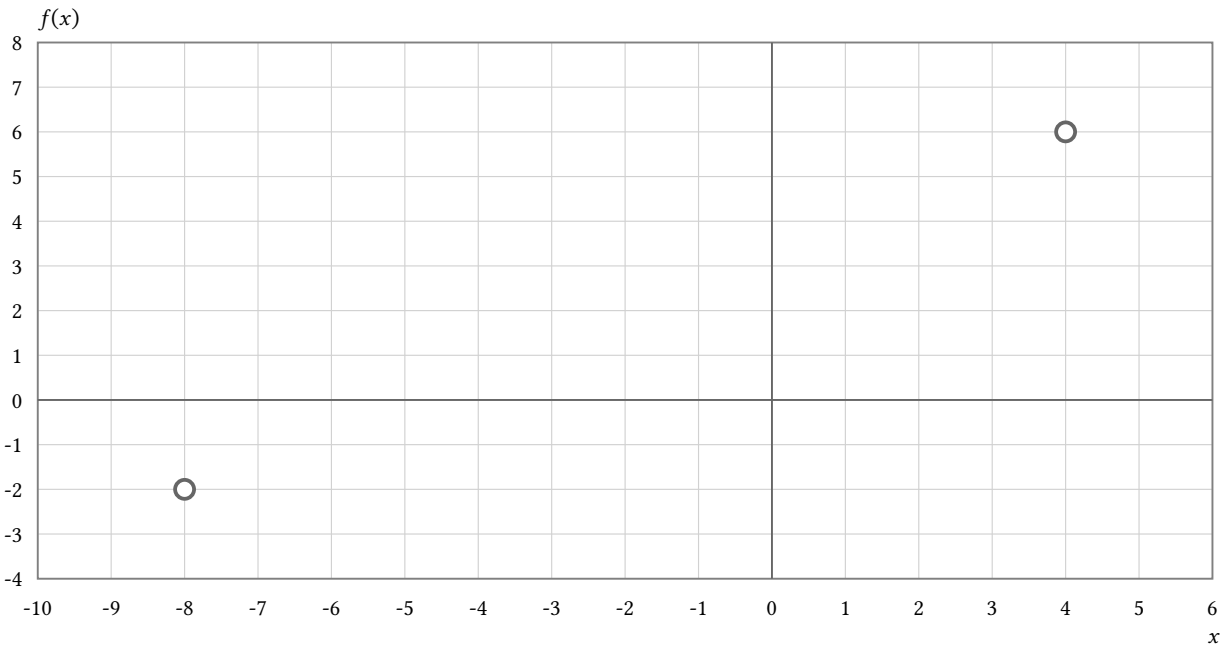
AP Precalculus

Function Reflections, Stretches, and Compressions

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.

A curve runs between open endpoints $(-8, -2)$ and $(4, 6)$. Where are its open endpoints under $g(x) = -f(\frac{x}{2})$?



Bank label: _____

AP Precalculus

Function Reflections, Stretches, and Compressions

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.

The table lists exact values of f. If $g(x) = 2f(-\frac{x}{2})$, find $g(6)$.

Required output: exact value

x	f(x)
-6	4
-3	-5
1	7
4	0

The domain of f is $[-6, 3)$ and its range is $(-2, 8]$. Determine the domain and range of $g(x) = -4f(-2x)$.

AP Precalculus

Function Reflections, Stretches, and Compressions

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

A table row for f is $(6, -4)$. Find its corresponding row for $g(x) = -5f(-2x)$.

Given f-table row

x	f(x)
6	-4

Your response: _____

Incoming: $[-3, 20]$

If f has domain $[2, 10]$ and range $[-4, 6]$, find the domain and range of $g(x) = 3f(2x)$.

Your response: _____

AP Precalculus

Function Reflections, Stretches, and Compressions

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 $g(x) = f(-3x)$, choose: horizontal stretch by 3, or horizontal compression by $\frac{1}{3}$ with y-axis reflection. Justify by point mapping. Diagnose this student claim: Multiplying the input by -3 stretches the graph horizontally by 3. Use the actual rule and supplied data to give the corrected conclusion and justify the input/output mapping.

Besides naming two axis reflections, what single rigid motion describes $g(x) = -f(-x)$? Diagnose this student claim: The two axis reflections cancel, leaving every point fixed. Use the actual rule and supplied data to give the corrected conclusion and justify the input/output mapping.

Can one fixed pair a, b map $(1, 2), (-2, 5), (4, -1)$ to $(3, 8), (-6, 15), (12, -4)$, respectively, under $g(x) = af(bx)$? Diagnose this student claim: The matching horizontal ratios alone establish one common pair a, b. Use the actual rule and supplied data to give the corrected conclusion and justify the input/output mapping.

Function Reflections, Stretches, and Compressions

Full Worked Solutions - excerpt

Worked example

Problem. Function f has domain $(-2, 6)$ and constant range $\{4\}$. Find both sets for $g(x) = -5f(2x)$.

Answer. Domain $(-1, 3)$; range $\{-20\}$.

Explanation and check.

Divide source inputs by 2 and multiply the sole output by -5.

Worked example

Problem. If f has domain $[2, 10]$ and range $[-4, 6]$, find the domain and range of $g(x) = 3f(2x)$.

Answer. Domain $[1, 5]$; range $[-12, 18]$.

Explanation and check.

Require $2x$ in $[2, 10]$, giving x in $[1, 5]$. Multiplying outputs by 3 gives $[-12, 18]$.

Sets & Steps
Math Practice & Worked Solutions

AP Precalculus

Combined Function Transformations

Combined Function Transformations | APPC-U01-P18

96 problems · Four activity formats

Topic focus

Across 96 tasks this topic asks for determinate or not, g from f, two maps, coordinate rules, equivalence and equivalence proof.

8 PDFs and a README; 70 buyer pages.

The following pages use the same questions, given data, and notation as the final files. Question/card serial numbers and internal IDs are omitted in this preview only. Table values and matching responses are retained. Full answer keys are not included.

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AP Precalculus

Combined Function Transformations

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.

Normalize $g(x) = 3f(6x + 15) - 2$ and state h. Bank label: _____	Normalize the inside of $g(x) = (\frac{3}{2})f(-0.4x - 2) + 1$ and state b, h. Bank label: _____
Double all x-coordinates of f, then shift the current graph left 3. Write $g(x)$. Bank label: _____	Function f has domain $[-3, 9)$ and range $(0, 8]$. Find both sets for $g(x) = (\frac{1}{2})f(\frac{x-7}{4}) - 3$. Bank label: _____

AP Precalculus

Combined Function Transformations

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.

Starting from f, shift the graph right 3 units and then double every x-coordinate. Write the final rule $g(x)$.	Function f has vertex (0,-2) and domain [-4,4]. Construct g(x)=a f(b(x-h))+k with a>0,b>0 so the vertex becomes (3,5) and domain becomes [1,5].
Let $f(u) = u + 1$ for $u < 0$ and $f(u) = u^2$ for $u \geq 0$. Write $g(x) = 2f(3(x - 4)) - 5$ as a piecewise function of x.	Normalize $g(x) = -4f(-2x - 6) + 1$ and give a, b, h, k and the coordinate map.

AP Precalculus

Combined Function Transformations

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: $(3, 0)$

Under (u, v) to $(h + \frac{u}{b}, k + av)$ with $a, b > 0$, source points $(0, 1), (4, 3)$ map to $(2, -1), (4, 5)$. Find a, b, h, k.

Complete response required: a, b, h, k.

2	-1	0	1
4	5	4	3

Your response: _____

Incoming: Domain $[-20, -8)$ union $\{-2\}$ union $(8, 16]$; range $[-8, 4]$ union (16,infinity).

The graph of f has vertical asymptote $x = -2$. Find the corresponding vertical asymptote of $g(x) = 3f(2(x - 5)) + 4$.

Your response: _____

Incoming: y = 3.

Under (u, v) to $(h + \frac{u}{b}, k + av)$ with $a, b > 0, (-3, 2), (5, 6)$ map to $(1, 7), (3, 15)$. Find a, b, h, k.

Complete response required: a, b, h, k.

1	7	-3	2
3	15	5	6

Your response: _____

Incoming: a = $2, b = -3, h = 5, k = -2$.

Under an affine graph map, $(0, 0)$ maps to $(-2, 5)$ and $(6, 4)$ maps to $(1, -3)$. Find a, b, h, k.

Complete response required: a, b, h, k.

-2	5	0	0
1	-3	6	4

Your response: _____

Incoming: a = $-2, b = 2, h = -2, k = 5$.

Rewrite $g(x) = 2f(3(x + 1)) + 5$ if $f(u) = 4$ for $u < 2$ and $f(u) = u - 1$ for $u \geq 2$.

Your response: _____

Incoming: $g(x) = 13$ for $x < -\frac{1}{3}$; $g(x) = 6x + 9$ for $x \geq -\frac{1}{3}$.

Under an affine graph map, $(0, 2), (10, -3)$ map to $(4, 1), (9, 11)$. Find a, b, h, k.

Complete response required: a, b, h, k.

4	1	0	2
9	11	10	-3

Your response: _____

AP Precalculus

Combined Function Transformations

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.

Shift f down 2, reflect the current graph across the x-axis, then triple outputs. Write $g(x)$. A student reports $g(x) = -3f(x) - 6$. Locate the sign or order-of-operations error, write the corrected intermediate calculation or coordinate map, and give the correct complete result.

Shift f left 2, triple current x-coordinates, reflect across the y-axis, then shift right 1. Write $g(x)$. A student reports $g(x) = f(\frac{-x-5}{3})$. Locate the sign or order-of-operations error, write the corrected intermediate calculation or coordinate map, and give the correct complete result.

Double outputs of f, reflect the current graph across the x-axis, then shift up 7. Write $g(x)$. A student reports $g(x) = -2f(x) - 7$. Locate the sign or order-of-operations error, write the corrected intermediate calculation or coordinate map, and give the correct complete result.

Halve x-coordinates of f, shift the current graph right 4, then reflect across the y-axis. Write $g(x)$. A student reports $g(x) = f(-2x + 8)$. Locate the sign or order-of-operations error, write the corrected intermediate calculation or coordinate map, and give the correct complete result.

Combined Function Transformations

Full Worked Solutions - excerpt

Worked example

Problem. For nonzero q, normalize g(x)=A f(qx-r)+K as A f(q(x-h))+K.

Answer. h=r/q, so g(x)=A f(q(x-r/q))+K.

Explanation and check.

Expand q(x-r/q)=qx-r.

Worked example

Problem. Function $f(d)$ gives euros d days after Jan 1. Define $g(w)$ for cents w weeks after Jan 8, using 110 cents per euro.

Answer. $g(w) = 110f(7 + 7w)$.

Explanation and check.

Jan 8 is day 7, and each new unit adds 7 days.

Sets & Steps
Math Practice & Worked Solutions

AP Precalculus

Building and Selecting Function Models

Building and Selecting Function Models | APPC-U01-P19

96 problems · Four activity formats

Topic focus

Across 96 tasks this topic asks for conclusion, claim, yes or no, decision, compatible model and model description.

8 PDFs and a README; 56 buyer pages.

The following pages use the same questions, given data, and notation as the final files. Question/card serial numbers and internal IDs are omitted in this preview only. Table values and matching responses are retained. Full answer keys are not included.

Published by Tusils LLC.

AP Precalculus

Building and Selecting Function 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.

A trapezoid has parallel bases x and $x + 4$ meters and height 6 meters. Select its area model. Bank label: _____	Which polynomial candidate has both tails falling? Bank label: _____
Admission costs \$12 plus \$4 for every hour, with no rate change. Does the fee require multiple operating branches? Bank label: _____	A square has side length s centimeters. Choose the candidate that models its area in square centimeters. Bank label: _____
Which formula has the two observed zeros? Candidate formulas: $(x + 2)(x - 5)$; $(x - 2)(x + 5)$; $x^2 + 10$. Observed: x-intercepts -2 and 5. Bank label: _____	A service charges \$15 once and \$9 for every month with no discounts. Is a piecewise model needed? Bank label: _____
A banner is x meters long and 7 meters wide. Which candidate represents area? Bank label: _____	Evaluate both models at the two requested inputs. Inputs: 1; 4. Models: $A(x) = 2x + 5$; $B(x) = x^2 + 1$. Bank label: _____

AP Precalculus

Building and Selecting Function 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.

For equally spaced inputs, the outputs are $11, 17, 23, 29$. Which supplied rule is supported, and what evidence is decisive? Candidate formulas: $3x + 11$; $x^2 + 11$; $\frac{11}{x+1}$.

Complete response required: model.

x	y
0	11
2	17
4	23
6	29

A parcel costs \$8 through $5kg$, then each kilogram beyond 5 adds \$3. Should the supplied model be one global line or a threshold piecewise rule?

The products xy are constant in the table. Select the supported candidate and state what the finite table does not prove. Candidate formulas: $\frac{24}{x}$; $24 - 3x$; $3x^2$.

Complete response required: model.

x	y
1	24
2	12
4	6
8	3

Inputs are not equally spaced. Which candidate exactly matches all four values, and why would raw first differences be misleading? Candidate formulas: $2 + 3x$; $2 + x^2$; $2 + x + x^2$.

Complete response required: model.

x	y
0	2
1	4
3	14
6	44

AP Precalculus

Building and Selecting Function 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.

Incoming: x = 2; $A(2) = 7$ and $B(2) = 12$.

A triangle has base $3xcm$ and perpendicular height $x + 2cm$. Select the area model.

Your response: _____

Incoming: Input B; its prediction gap 1.2 exceeds twice the 0.3 uncertainty.

A circular ring has inner radius r and outer radius $r + 2$. Select the area of material.

Your response: _____

Incoming: $\frac{x+2}{x+3}$.

Equal input steps give first differences $-5, -3, -1, 1$. Which supplied candidate is supported? Candidate formulas: $x^2 - 2x - 1$; $-x - 1$; $\frac{4}{x+3}$.

Complete response required: model.

x	y
−2	7
−1	2
0	−1
1	−2
2	−1

Your response: _____

Incoming: Piecewise rising segments separated by downward jumps at replacement times.

A1-by-1 square is removed from a rectangle measuring $x + 3$ by $x + 1$. Which expression models remaining area?

Your response: _____

AP Precalculus

Building and Selecting Function 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.

Given the explicit linear-family assumption, do the two distinct data points determine a unique candidate? Diagnose the student claim: Even within the stated linear family, the two distinct input-output points leave many different linear models. Use the exact supplied assumptions and data to provide a counterexample or decisive calculation and state the strongest justified conclusion.

Complete response required: model.

1	5
4	14

Exhibit two distinct polynomial models matching both data points. Diagnose the student claim: Only one polynomial can pass through these two data points. Use the exact supplied assumptions and data to provide a counterexample or decisive calculation and state the strongest justified conclusion.

Complete response required: two models.

0	2
1	5

Building and Selecting Function Models

Full Worked Solutions - excerpt

Worked example

Problem. A triangle has base $3xcm$ and perpendicular height $x + 2cm$. Select the area model.

Answer. $A(x) = 1.5x(x + 2)$.

Explanation and check.

Triangle area is one half the product of base and perpendicular height.

Worked example

Problem. A circular ring has inner radius r and outer radius $r + 2$. Select the area of material.

Answer. $\pi((r + 2)^2 - r^2)$.

Explanation and check.

Subtract the inner disk area from the outer disk area; both terms have square-length units.

Sets & Steps
Math Practice & Worked Solutions

AP Precalculus

Model Domains and Validity

Model Domains and Validity | APPC-U01-P20

96 problems · Four activity formats

Topic focus

Across 96 tasks this topic asks for assumption failure, boundary behavior, claim, status, feasibility and domains.

8 PDFs and a README; 47 buyer pages.

The following pages use the same questions, given data, and notation as the final files. Question/card serial numbers and internal IDs are omitted in this preview only. Table values and matching responses are retained. Full answer keys are not included.

Published by Tusils LLC.

AP Precalculus

Model Domains and Validity

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.

State the mathematical, observed, and contextual domains. The contextual range is $x \geq 0$. Use the model $\frac{1}{x+1}$. Observations cover $[0, 2]$. Bank label: _____	Where is the mass prediction physically feasible? The setting is mass. The physical constraint is $M \geq 0$. Use the model $M(t) = 36\text{-}t^2$. Assume $t \geq 0$. Bank label: _____
Name the three domains. The setting is seats. Allowed inputs are integers 0 through 40. The formula is defined for all real n. Observations cover $10, 20, 30$. Bank label: _____	State formula, observed, and shift domains. The setting is hours. The formula is defined for all real. Observations cover $[2, 7]$. The work shift spans $[0, 8]$. Bank label: _____
Separate formula, observation, and device-supported inputs. The setting is time. The device operates with $0 \leq t \leq 12$. The formula is defined for all real. Observations cover $2 \leq t \leq 8$. Bank label: _____	When does the hourly-rate assumption stop? The setting is parking. The cap is \$14/day. The rate is \$2/hour. Bank label: _____
List formula, observed, and trip domains. The setting is distance. The formula is defined for all real time. Observations cover 1 to 3 hours. The trip lasts 0 to 5 hours. Bank label: _____	For $t \geq 0$, when is volume feasible? The setting is storage. The physical constraint is $0 \leq V \leq 70$. Use the model $V(t) = 70 - 4t$. Bank label: _____

AP Precalculus

Model Domains and Validity

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.

State the mathematical, observed, and physically allowed input domains. The contextual range is time 0 through 10. Use the model $p(t) = t^2 + 1$. Observations cover $0 \le t \le 6$.	For $t \ge 0$, when does the model satisfy the population constraint? The setting is population. The physical constraint is $P \ge 0$. Use the model $P(t) = 80 - 5t$.
Classify a model prediction at input 4 relative to the data window. The observed inputs are $0, 2, 5, 8$. The requested input is 4.	Explain why the fixed-rate model should stop at 12 kg. The setting is agriculture. Use the model yield rises 4 units per kg. The trigger is soil nutrient exhausted after 12 kg.
Distinguish the formula domain from the observed and contextual count domains. The setting is inventory. The contextual range is 0 to 20 items. Observed n values are $1, 2, 3, 4$. Use the model $C(n) = 7n + 4$.	Can each policy use the rule at $x = 2.5$? The setting is tickets. Policy A requires real $0 \le x \le 8$. Policy B requires integer $0 \le x \le 8$. The requested input is 2.5. Use the rule $R(x) = 12x$.

AP Precalculus

Model Domains and Validity

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: Day 55 is extrapolation beyond the observed days 20 to 50; the observations alone do not establish that the model remains valid there. For which nonnegative x is the output a valid probability? The setting is probability. Use the model $p(x) = 0.2 + 0.1x$. Assume $x \geq 0$. Your response: _____	**Incoming:** $t > 3$. State the three domains. The contextual range is $[0, 8]$. Use the model $\frac{2}{x-5}$. Observations cover $[0, 3]$. Your response: _____
Incoming: Rent rises by exactly \$25 each month from an initial \$900. What must remain constant for this inverse relation? The setting is geometry. Use the model length=60/width. Your response: _____	**Incoming:** It is interpolation by location but unsupported by the pre-change protocol beyond dose 10. State the three input domains. The setting is time. The contextual range is $t \geq 0$. Use the model t^3-t. Observations cover $[1, 4]$. Your response: _____
Incoming: All reals except 6; $[0, 4]$; $[0, 6)$ union $(6, 12]$. Does the model ever violate nonnegativity for $t \geq 0$? The setting is inventory. Use the model $I(t) = \frac{30}{t+2}$. Assume $t \geq 0$. Your response: _____	**Incoming:** All real inputs; $\{2, 4, 6\}$; $\{0, 2, 4, 6, 8, 10\}$. Separate formula, observed, and device domains. The setting is devices. Allowed inputs are integers 0 to 6. The formula is defined for real x. Observations cover $1, 2, 4$. Your response: _____

AP Precalculus

Model Domains and Validity

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.

Replace the causal claim with one supported by the model fit. Diagnose this claim: A fitted line proves that study hours cause scores. Identify the unsupported inference or missing condition, give a defensible replacement, and state the evidence or model change needed. The setting is education. A student claims: study hours cause score because a line fits.

Give a defensible replacement and a useful test. Diagnose this claim: Four observed years prove that the trend continues forever. Identify the unsupported inference or missing condition, give a defensible replacement, and state the evidence or model change needed. The setting is climate. A student claims: trend continues forever. The supplied data are: four years.

Rewrite the conclusion and identify needed evidence. Diagnose this claim: Data from weeks 1 through 6 prove that week 20 will be exactly 74.3. Identify the unsupported inference or missing condition, give a defensible replacement, and state the evidence or model change needed. The setting is health. A student claims: week 20 will be exactly 74.3. Observations cover weeks 1 to 6.

Correct the reporting claim. Diagnose this claim: Measurements rounded to the nearest 10 units support the exact prediction 247.381. Identify the unsupported inference or missing condition, give a defensible replacement, and state the evidence or model change needed. The setting is production. A student claims: prediction exactly 247.381. Measurements are rounded to the nearest 10 units.

Model Domains and Validity

Full Worked Solutions - excerpt

Worked example

Problem. State the conserved quantity and a test of the model. The setting is chemistry. Use the model $c(V) = \frac{24}{V}$.

Answer. Solute amount stays 24 units; check whether measured products Vc remain near 24 as volume changes.

Explanation and check.

Dilution creates inverse concentration only when solute is neither added nor lost.

Worked example

Problem. State the model's change assumption. The setting is rent. Use the model $R(m) = 900 + 25m$.

Answer. Rent rises by exactly $\$\,25$ each month from an initial $\$\,900$.

Explanation and check.

The slope is presumed constant over modeled months.

Sets & Steps
Math Practice & Worked Solutions

AP Precalculus

Polynomial Modeling from Data

Polynomial Modeling from Data | APPC-U01-P21

96 problems · Four activity formats

Topic focus

Across 96 tasks this topic asks for regression model, uniqueness conclusion, family of models, attendance model, demand model and factored model.

8 PDFs and a README; 67 buyer pages.

The following pages use the same questions, given data, and notation as the final files. Question/card serial numbers and internal IDs are omitted in this preview only. Table values and matching responses are retained. Full answer keys are not included.

Published by Tusils LLC.

AP Precalculus

Polynomial Modeling from Data

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.

Record the calculator's quadratic model using approximate language. 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 setting is manufacturing. The supplied hypothetical fitted model is $q(x) = 1.05x^2 - 0.19x + 2.01$. The inputs have one unit spacing. The outputs are nearest tenth. Treat the supplied fitted expression as a hypothetical model to interpret; it is not specified as the unconstrained least-squares fit to every displayed row.

Given domain/context: manufacturing

inputs	outputs
0	2.0
1	2.9
2	6.2
3	10.8

Bank label: _____

Translate the arch prototype to the stated peak and give its operating domain. 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 setting is bridge arch. Work on the interval $0 \le t \le 8$. Use the prototype $-x^2$. The vertex is $(4, 10)$.

Bank label: _____

Write the area polynomial and its positive-side restriction. 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 setting is rectangular sign. The diagram dimensions are length $x + 3$ width $x - 1$. The length is $x + 3$. The width is $x - 1$.

Bank label: _____

Write a continuous two-stage charge 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. The setting is battery test. For the first stage, use charge remains 100 through hour 1. For the second stage, then loses $4(t - 1)^2$ through hour 5.

Bank label: _____

AP Precalculus

Polynomial Modeling from Data

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.

Build a height model using the turning point and measurement, and state its time domain. The setting is fountain. The maximum occurs at the point $(3, 20)$. The graph passes through $(1, 12)$. Restrict time to $0 \le t \le 6$.

Translate the labeled net into a polynomial volume model and its positive-length domain. The setting is packaging. Remove squares of side x at four corners. The diagram dimensions are base $20 - 2x$ by $14 - 2x$ height x. The base measures $20 - 2x$ by $14 - 2x$. The height is x. The sheet measures 20 by 14.

State the quadratic regression model and whether it passes through every measurement exactly. The setting is calibration. The supplied hypothetical fitted model is $y = 1.02x^2 + 0.01x + 0.04$. The inputs have one unit spacing. The outputs are nearest tenth. Treat the supplied fitted expression as a hypothetical model to interpret; it is not specified as the unconstrained least-squares fit to every displayed row.

Given domain/context: calibration

inputs	outputs
-2	4.1
-1	1.2
0	0.0
1	1.1
2	4.2

Write a two-stage model with an unambiguous rule at the transition. The setting is production. Restrict the input to $0 \le t \le 5$. For the first stage, use output grows as $4t$ before $t = 3$. For the second stage, after $t = 3$ add $(t - 3)^2$ to the accumulated 12.

AP Precalculus

Polynomial Modeling from Data

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: $S(x) = 2(\frac{x-1}{2})^3 - 2$, equivalently $\frac{(x-1)^3}{4} - 2$.

Use the single-turn trend to report an approximate polynomial model. Use the complete final response to identify the next Match & Move card; show the reasoning required by the original task. The setting is traffic noise. The inputs have one hour spacing. The outputs are nearest tenth. The supplied hypothetical fitted model is $n(t) = -1.03t^2 + 5.08t + 7.99$. Treat the supplied fitted expression as a hypothetical model to interpret; it is not specified as the unconstrained least-squares fit to every displayed row.

Given domain/context: traffic noise

inputs	outputs
0	8.0
1	12.1
2	14.2
3	13.9
4	11.8

Your response: _____

Incoming: $v(x)$ is approximately $0.98x^4 + 0.04x^2 + 1.06$ over the sampled inputs.

Use factored form to build the profit model. Use the complete final response to identify the next Match & Move card; show the reasoning required by the original task. The setting is profit. A measured point is $(1, 16)$. The zeros are -3 and 5.

Your response: _____

Incoming: $M(t) = 4t$ for $0 \le t < 3$, and $M(t) = 15 + 2(t-3)^2$ for $3 \le t \le 6$.

Construct the triangle area polynomial and impose positive dimensions. Use the complete final response to identify the next Match & Move card; show the reasoning required by the original task. The setting is triangular garden. The diagram dimensions are base x height $18 - 2x$. The base measures x. The height is $18 - 2x$.

Your response: _____

START

Apply the described translations to the cubic prototype. Use the complete final response to identify the next Match & Move card; show the reasoning required by the original task. The setting is response index. Use the operating domain $-4 \le x \le 2$. Use the prototype x^3. Translate the prototype 2 units left and 1 unit down.

Your response: _____

AP Precalculus

Polynomial Modeling from Data

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.

Construct an area polynomial from the dependent legs and restrict x physically. Student work: A(x)=(1/2)x(12-x), with 0<=x<12. Identify the precise mathematical error or omitted condition, then complete the original task and verify the correction from the supplied givens. The setting is triangular display. The diagram dimensions are horizontal leg x vertical leg 12-x. The horizontal leg has length x. The vertical leg has length 12-x. The two legs form a right angle.

Write a continuous fee model and assign $h = 2$ to the later rule. Student work: $C(h) = 5 + 3h$ for $0 \le h < 2$, and $C(h) = 11 + 2(h-2)^2$ for $2 \le h < 5$. Identify the precise mathematical error or omitted condition, then complete the original task and verify the correction from the supplied givens. The setting is parking fee. Restrict the input to $0 \le h \le 5$. For the first stage, use $5 + 3h$ through $h = 2$. For the second stage, begin at 11 and add $2(h-2)^2$.

Polynomial Modeling from Data

Full Worked Solutions - excerpt

Worked example

Problem. Use factored form to build the profit model. Use the complete final response to identify the next Match & Move card; show the reasoning required by the original task. The setting is profit. A measured point is $(1, 16)$. The zeros are -3 and 5.

Answer. $P(x) = -(x + 3)(x - 5)$.

Explanation and check.

At $x = 1$ the two factors multiply to negative sixteen, so a scale of negative one gives the measured profit.

Worked example

Problem. Find k and write the continuous piecewise model. The setting is signal. The first branch is $3t + 2$ for $t < 4$. The model must be continuous at $t = 4$. The second branch is $(t - 4)^2 + k$ for $t \geq 4$.

Answer. k = 14; use $3t + 2$ for $t < 4$ and $(t - 4)^2 + 14$ for $t \geq 4$.

Explanation and check.

Both pieces must have boundary value 14, which directly fixes the second piece's offset.

Sets & Steps
Math Practice & Worked Solutions

AP Precalculus

Rational Function Word Problems

Rational Function Word Problems | APPC-U01-P22

96 problems · Four activity formats

Topic focus

Across 96 tasks this topic asks for intensity model, model and invariant, model, concentrate fraction, concentration and domain and concentration model.

8 PDFs and a README; 54 buyer pages.

The following pages use the same questions, given data, and notation as the final files. Question/card serial numbers and internal IDs are omitted in this preview only. Table values and matching responses are retained. Full answer keys are not included.

Published by Tusils LLC.

AP Precalculus

Rational Function Word Problems

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.

Express width in terms of a nonnegative design input 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. Context: rectangle. Area: 99. Dimensions: Length: $x + 2$; Width: w. Bank label: _____	Model the juice fraction after adding only water. 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. Context: juice. Initial juice: 8. Initial volume: 20. Water added: x liters. Bank label: _____
Construct average printing cost per ticket. 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. Context: tickets. Per ticket: 2. Quantity: positive tickets n. Setup: 500. Bank label: _____	Model frequency from the fixed speed relation. 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. Context: waves. Relationship: fixed wave speed. Input: wavelength lambda>0. Speed: 340. Bank label: _____
Express height for a nonnegative parameter 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. Context: triangle. Area: 54. Dimensions: Base: $x + 3$; Height: h. Bank label: _____	Model concentration after adding pure water. 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. Context: cleaner. Initial solute: 15. Initial volume: 60. Water added: x. Bank label: _____
Express the second side as a function of positive 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. Context: rectangle. Area: 144. Dimensions: Other side: y; Side: x. Bank label: _____	Express height as a function of positive base. 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. Context: parallelogram. Area: 88. Dimensions: Base: b; Height: h. Bank label: _____

AP Precalculus

Rational Function Word Problems

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.

Track salt and total liquid separately to build the concentration. Context: saline. Added concentration: 0.2. Added volume: x liters. Initial salt: 6. Initial volume: 30.	Construct cost per poster and state the admissible inputs. Context: printing. Fixed cost: 240. Quantity: n positive posters. Variable cost: 3.
Model the completion time when both constant-rate pumps work together. Context: pumps. Relationship: parallel workers. Pump a time: 6. Pump b time: $b > 0$ hours.	Audit the proposed blue concentration using units and feasible range. Context: paint. Blue: 4. Proposed: $\frac{10}{4}$. Total: 10.
Construct average cost and identify which term prevents a finite horizontal baseline. Context: manufacturing. Quantity: $q > 0$. Total cost: $C(q) = 500 + 4q + 0.02q^2$.	Express height in terms of radius for the fixed-volume cylinder. Context: cylinder. Dimensions: Height: h; Radius: r. Volume: 200.

AP Precalculus

Rational Function Word Problems

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

Build the simplest zero-baseline saturating ratio. Use the complete final response to identify the next Match & Move card; show the reasoning required by the original task. Context: advertising. Half limit input: 5. Limit: 80.

Your response: _____

Incoming: $A(n) = \frac{2500}{n} + 30$ for integers $1 \le n \le 90$; the average remains above 30.

Model concentration after dilution. Use the complete final response to identify the next Match & Move card; show the reasoning required by the original task. Context: soap. Initial volume: 44. Soap: 11. Water: x liters.

Your response: _____

Incoming: $L(d) = \frac{288}{d^2}$ for $d > 0$.

Construct cost per badge. Use the complete final response to identify the next Match & Move card; show the reasoning required by the original task. Context: badges. Fixed: 360. Per badge: 1.5. Quantity: positive whole n.

Your response: _____

Incoming: $h(x) = \frac{180}{(x-3)(x+1)}$ for $x > 3$.

Express length for $x \ge 0$. Use the complete final response to identify the next Match & Move card; show the reasoning required by the original task. Context: rectangle. Area: 168. Width: $x + 4$.

Your response: _____

Incoming: $h(x) = \frac{84}{x-1}$ for $x > 1$.

Model the equal amount per participant. Use the complete final response to identify the next Match & Move card; show the reasoning required by the original task. Context: shared budget. Participants: positive whole n. Total: 750.

Your response: _____

Incoming: $I(d) = \frac{576}{d^2}$ for $3 \le d \le 18$.

Construct a zero-start learning model with the specified half-saturation input. Use the complete final response to identify the next Match & Move card; show the reasoning required by the original task. Context: learning. Half limit practice: 8. Limit: 100.

Your response: _____

AP Precalculus

Rational Function Word Problems

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.

Express length as a function of positive width. Student work: $L(w) = \frac{72}{w}$ for $w \geq 0$. Identify the precise mathematical error or omitted condition, then complete the original task and verify the correction from the supplied givens. Context: rectangle. Area: 72. Dimensions: Length: L; Width: w.

Model travel time from the fixed-distance invariant. Student work: $T(v) = \frac{180}{v}$ for $v \geq 0$. Identify the precise mathematical error or omitted condition, then complete the original task and verify the correction from the supplied givens. Context: travel. Distance: 180. Input: speed $v > 0$.

Identify the conservation mistake in the constant proposal. 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. Context: dye. Initial dye: 5. Initial volume: 25. Proposed: $\frac{5}{25}$. Water added: x.

Rational Function Word Problems

Full Worked Solutions - excerpt

Worked example

Problem. Track salt and total liquid separately to build the concentration. Context: saline. Added concentration: 0.2. Added volume: x liters. Initial salt: 6. Initial volume: 30.

Answer. $C(x) = \frac{6+0.2x}{30+x}$ for $x \geq 0$.

Explanation and check.

Added solution contributes both $0.2x$ salt and x total liters.

Worked example

Problem. Model concentration after dilution. Use the complete final response to identify the next Match & Move card; show the reasoning required by the original task. Context: soap. Initial volume: 44. Soap: 11. Water: x liters.

Answer. $C(x) = \frac{11}{44+x}$ for $x \geq 0$.

Explanation and check.

Water increases only the total volume.

Sets & Steps
Math Practice & Worked Solutions

AP Precalculus

Finding Parameters in Function Models

Finding Parameters in Function Models | APPC-U01-P23

96 problems · Four activity formats

Topic focus

Across 96 tasks this topic asks for existence, free family, freedom, parameter, parameters and check and parameters.

8 PDFs and a README; 59 buyer pages.

The following pages use the same questions, given data, and notation as the final files. Question/card serial numbers and internal IDs are omitted in this preview only. Table values and matching responses are retained. Full answer keys are not included.

Published by Tusils LLC.

AP Precalculus

Finding Parameters in Function 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.

Find k using the allowed input. 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. Use the function $f(x) = \frac{k}{x}$. The graph passes through $(4, 7)$.

Bank label: _____

Read the shifts and calibrate the scale. 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. Use the function $a(x - h)^2 + k$. The graph passes through $(0, 5)$. The vertex is $(-1, 2)$.

Bank label: _____

State the input-output feature encoded by 7 and 12. 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. Use the model $y = a(x - 7)^2 + 12$.

Bank label: _____

Use the two observations to recover the slope and intercept. 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: motion

0	4
3	19

Bank label: _____

AP Precalculus

Finding Parameters in Function 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.

Are a and b identifiable? Use the function $f(x) = ax + b$.

Complete response required: freedom.

1	4
1	4

Give units for a, b, and c. height is measured in meters. Use the model $h(t) = at^2 + bt + c$. time is measured in seconds.

Audit the fitted denominator. The calibration input is 2. A student claims $b = 2$. Use the function $\frac{a}{x-b}$.

Interpret $100, 500$, and a. Use the model $C(q) = a(q - 100)^2 + 500$.

Explain the effect of the small slope difference at $x = 100$. Both models have intercept 1. Evaluate at input 100. Their slopes are $(2.0, 2.03)$.

Find the first observation the claimed fit violates. A student claims $(2, 1)$. Use the function $ax + b$.

Given domain/context: linear fit

0	1
1	3
2	6

AP Precalculus

Finding Parameters in Function 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

Calibrate k at the allowed input. Use the complete final response to identify the next Match & Move card; show the reasoning required by the original task. Use the function $\frac{k}{x-1}$. The graph passes through $(4, 6)$.

Your response: _____

Incoming: a has liters per hour cubed, $t0$ has hours, and $R0$ has liters per hour.

Determine a and c. Use the complete final response to identify the next Match & Move card; show the reasoning required by the original task. Use the function $ax^2 + c$.

Given domain/context: quadratic

0	3
2	15

Your response: _____

Incoming: a = 2 and $b = 2$.

Decide uniqueness and recover k. Use the complete final response to identify the next Match & Move card; show the reasoning required by the original task. Use the function $10\frac{x}{x+k}$. The graph passes through $(2, 5)$.

Your response: _____

Incoming: a = 3 and $b = 1$; the third row is consistent but adds no freedom.

Recover the limiting level and inverse offset from the two features. Use the complete final response to identify the next Match & Move card; show the reasoning required by the original task. Use the function $a + \frac{b}{x+1}$. The horizontal limiting value is 4. The output at input zero is 10.

Your response: _____

Incoming: k is pressure-volume in kilopascal-liters.

Recover slope and baseline from the two measurements. Use the complete final response to identify the next Match & Move card; show the reasoning required by the original task.

Given domain/context: linear

0	−2
4	10

Your response: _____

Incoming: a = 3 and $b = -2$.

Decide whether k is identifiable and solve it. Use the complete final response to identify the next Match & Move card; show the reasoning required by the original task. Use the function $\frac{k}{x+2}$. The graph passes through $(1, 7)$.

Your response: _____

AP Precalculus

Finding Parameters in Function 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.

What do 6 and 18 represent? Student work: At reference time $t = 6$, the modeled temperature is 17. Identify the precise mathematical error or omitted condition, then complete the original task and verify the correction from the supplied givens. Use the model $T(t) = m(t - 6) + 18$.

Correct the claimed slope. 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 student claims $a = 2$. Use the function $ax + 2$. The graph passes through $(3, 11)$.

Finding Parameters in Function Models

Full Worked Solutions - excerpt

Worked example

Problem. Audit the fitted denominator. The calibration input is 2. A student claims $b = 2$. Use the function $\frac{a}{x-b}$.

Answer. The fit is invalid because x = 2 is undefined when $b = 2$.

Explanation and check.

A calibration equation cannot be cleared at a forbidden input.

Worked example

Problem. Interpret $100, 500$, and a. Use the model $C(q) = a(q - 100)^2 + 500$.

Answer. The reference quantity is 100, cost there is 500, and a controls curvature away from that quantity.

Explanation and check.

Shifted form attaches parameters to the vertex rather than input zero.

Sets & Steps
Math Practice & Worked Solutions

AP Precalculus

Interpreting and Comparing Function Models

Interpreting and Comparing Function Models | APPC-U01-P24

96 problems · Four activity formats

Topic focus

Across 96 tasks this topic asks for direction and changing-rate conclusion, growth conclusion, existence conclusion, rate and interpretation, rate and meaning and rate and sign meaning.

8 PDFs and a README; 85 buyer pages.

The following pages use the same questions, given data, and notation as the final files. Question/card serial numbers and internal IDs are omitted in this preview only. Table values and matching responses are retained. Full answer keys are not included.

Published by Tusils LLC.

AP Precalculus

Interpreting and Comparing Function 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.

Find the modeled tank volume after 4 hours and state its unit. 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.

Context: water storage.

Work on the domain $0 \le t \le 10$.

Evaluate at the input 4.

Measure the input in hours.

Use the model $V(t) = 480 + 35t - 2t^2$.

Measure the output in liters.

Bank label: _____

At what time does the graph predict exactly 20 customers in line? 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.

Context: queue length.

the horizontal axis measures minutes; the vertical axis measures customers.

The curve relation is below $y = 20$ for $t < 18$ and above $y = 20$ for $t > 18$.

Work on the domain $0 \le t \le 30$.

The intersection is $(18, 20)$.

The scale is 2 minutes horizontally and 5 customers vertically.

The target is 20 customers.

Bank label: _____

Where is the modeled arch height positive? 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.

Context: playground arch.

The constraint is $H(x) > 0$.

Work on the domain $0 \le x \le 12$.

Measure the input in feet.

Use the model $H(x) = -(x + 2)(x - 10)$.

Measure the output in feet.

Bank label: _____

Find the modeled factory output on day 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.

Context: factory output.

Evaluate at the input 3.

Measure the input in days.

Use the model $Q(d) = 90 + 24d - 3d^2$.

Measure the output in units.

Bank label: _____

AP Precalculus

Interpreting and Comparing Function 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.

At what feasible times does the model predict 22 degrees Celsius?

Context: greenhouse temperature.

Work on the domain $0 \le h \le 6$.

Measure the input in hours after sunrise.

Use the model $T(h) = 18 + 5h - h^2$.

Measure the output in degrees Celsius.

The target is 22.

Determine the mileage ranges on which each service is cheaper, including the break-even distance.

Context: delivery pricing.

Work on the domain $0 \le d \le 25$.

Measure the input in miles.

The model A is $A(d) = 18 + 1.6d$.

The model B is $B(d) = 30 + 0.8d$.

Measure the output in dollars.

The criterion is lower cost.

Find where along the span the clearance is at least 9 meters.

Context: arch clearance.

The constraint is $H(x) \ge 9$.

Work on the domain $0 \le x \le 8$.

Measure the input in meters from left support.

Use the model $H(x) = 12 - 0.75(x - 4)^2$.

Measure the output in meters.

The threshold is 9.

Compute the model's average rate of change from day 2 to day 6 and interpret its sign.

Context: reservoir depth.

Measure the input in days.

The interval is $(2, 6)$.

The model assumption is The listed values come from one continuous depth model.

Measure the output in centimeters.

Context/domain: reservoir depth

Input (days)	Output (centimeters)
2	74
6	58

AP Precalculus

Interpreting and Comparing Function 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

Find the average download rate over the indicated interval. Use the complete final response to identify the next Match & Move card; show the reasoning required by the original task.

Context: page downloads.

Measure the input in minutes.

The interval is $(2, 7)$.

Use the model $D(t) = 180 + 45t$.

Measure the output in downloads.

Your response: _____

Incoming: At t = 2 and $t = 6$ hours; the maximum is 48 milligrams per liter.

Use the supplied rounded model to predict temperature at 7 minutes. Use the complete final response to identify the next Match & Move card; show the reasoning required by the original task.

Context: coffee cooling.

The coefficient note is 0.18 is rounded to two decimal places.

Evaluate at the input 7.

Measure the input in minutes.

Use the model $T(t) = 21 + \frac{68}{1+0.18t}$.

Measure the output in degrees Celsius.

The report precision is nearest tenth.

Your response: _____

Incoming: 25.5 kilograms and 7 containers.

At what allowed price does the model predict 132 rentals? Use the complete final response to identify the next Match & Move card; show the reasoning required by the original task.

Context: rental demand.

Work on the domain $8 \le p \le 14$.

Measure the input in dollars.

Use the model $D(p) = 180 - 12(p - 8)^2$.

Measure the output in rentals.

The target is 132.

Your response: _____

Incoming: $-5 \le x < 3$ valve turns.

Find when the modeled noise level satisfies the 65-decibel limit. Use the complete final response to identify the next Match & Move card; show the reasoning required by the original task.

Context: warehouse noise.

The constraint is $N(t) \le 65$.

Work on the domain $0 \le t \le 10$.

Measure the input in hours.

Use the model $N(t) = 65 + (t - 2)(t - 5)(t - 8)$.

Measure the output in decibels.

Your response: _____

AP Precalculus

Interpreting and Comparing Function 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.

State when the modeled lake temperature is at least 18 degrees Celsius. Student work: $3 < m \leq 8$ months after January. Identify the precise mathematical error or omitted condition, then complete the original task and verify the correction from the supplied givens.

Context: lake temperature.

the horizontal axis measures months after January; the vertical axis measures degrees Celsius.

The crossings is $(3, 8)$.

The curve relation is below $y = 18$ before $m = 3$, on or above $y = 18$ from $m = 3$ through $m = 8$, below afterward.

Work on the domain $0 \leq m \leq 11$.

The endpoints is included.

The threshold is at least 18 degrees.

Interpreting and Comparing Function Models

Full Worked Solutions - excerpt

Worked example

Problem. Determine the feasible width that maximizes modeled area and give the maximum area.

Context: garden area.

Work on the domain $4 \le w \le 18$.

Measure the input in meters.

Use the model $A(w) = 48w - 2w^2$.

Measure the output in square meters.

Answer. w = 12 meters, with maximum area 288 square meters.

Explanation and check.

$A(w) = -2(w - 12)^2 + 288$, and the interior vertex lies in the allowed interval.

Worked example

Problem. Describe the long-run prediction of the model as impressions increase.

Context: advertising response.

Work on the domain $x \ge 0$.

Measure the input in thousands of impressions.

Use the model $R(x) = 72\frac{x}{x+18}$.

Measure the output in percent awareness.

Answer. Predicted awareness approaches 72 percent and does not exceed it under the model.

Explanation and check.

The numerator and denominator have the same degree, so the horizontal asymptote is $R = 72$ percent.

Sets & Steps
Math Practice & Worked Solutions

AP Precalculus

Residuals and Model Validation

Residuals and Model Validation | APPC-U01-P25

96 problems · Four activity formats

Topic focus

Across 96 tasks this topic asks for compliance and violations, acceptability, qualified adequacy, evidence claim, consistency judgment and correction and correction and meaning.

8 PDFs and a README; 105 buyer pages.

The following pages use the same questions, given data, and notation as the final files. Question/card serial numbers and internal IDs are omitted in this preview only. Table values and matching responses are retained. Full answer keys are not included.

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AP Precalculus

Residuals and Model Validation

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.

Find the residual and interpret it.

Given: domain: concert revenue; payload: observed: 18400; predicted: 19000; unit: dollars

Bank label: _____

Does the timing model meet the requirement?

Given: domain: package timing; payload: requirement: each error magnitude no greater than 2 minutes; residuals: $-1, 2, -3, 1$; unit: minutes

Bank label: _____

Find the observed tree mass.

Given: domain: tree mass; payload: definition: residual=observed-predicted; predicted: 48.2; residual: -1.6; unit: kilograms

Bank label: _____

State the four residual-plot coordinates.

Given: domain: room temperature; payload: input unit: hours; inputs: $0, 2, 5, 8$; residual unit: degrees Celsius; residuals: $-1, 0, 2, -2$

Construct the requested table/graph using the given axes, units and domain.

inputs	residuals
0	-1
2	0
5	2
8	-2

Bank label: _____

AP Precalculus

Residuals and Model Validation

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.

Compare the models and explain why signed totals are misleading.

Given: domain: daily sales; payload: criterion: sum of absolute residuals; model A residuals: $6, -6, 5, -5$; model B residuals: $2, 2, -2, -2$; unit: items

Give the points for the residual plot against week and specify the reference line.

Given: domain: plant height; payload: height unit: centimeters; input spacing: unequal; rows: (observed: 4; predicted: 5; week: 0); (observed: 11; predicted: 10; week: 2); (observed: 23; predicted: 21; week: 5); (observed: 36; predicted: 39; week: 9)

Construct the requested table/graph using the given axes, units and domain.

observed	predicted	week
4	5	0
11	10	2
23	21	5
36	39	9

Choose the more reasonable predictive model and address the perfect training fit.

Given: domain: traffic volume; payload: structures: model P: degree-7 polynomial; model Q: quadratic; training absolute errors: model P: $0, 0, 0, 0$; model Q: $3, 2, 2, 3$; unit: vehicles per minute; validation absolute errors: model P: $28, 35, 41$; model Q: $5, 6, 4$

Recover the prediction and explain the negative residual.

Given: domain: reservoir depth; payload: definition: residual=observed-predicted; observed: 42.3; residual: -1.8; unit: meters

AP Precalculus

Residuals and Model Validation

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: Case A has 5% error and case B has 0.25%; the same 0.2-meter residual is much more consequential at the smaller scale.

Use the model to produce the residual-plot points.

Given: domain: warehouse demand; payload: columns: day, observed orders; model: $P(t) = 50 + 8t$; rows: $(0, 51)$; $(2, 64)$; $(5, 93)$; $(9, 119)$

Construct the requested table/graph using the given axes, units and domain.

day	observed orders
0	51
2	64
5	93
9	119

Your response: _____

Incoming: Inputs $1 - 6$ form a positive-negative-positive curve, indicating model-shape mismatch; input 7 adds a12-kilowatt outlier beyond tolerance.

Calculate the residual-plot points.

Given: domain: sound level; payload: columns: distance meters, observed decibels; model: $P(x) = 80 - 3x$; rows: $(1, 76)$; $(3, 72)$; $(6, 64)$; $(10, 47)$

Construct the requested table/graph using the given axes, units and domain.

distance meters	observed decibels
1	76
3	72
6	64
10	47

Your response: _____

Incoming: No. The positive residual +6 is an underprediction exceeding the five-unit limit; -7, $+4$, and -3 satisfy their direction-specific limits.

Does the model satisfy the temperature requirement?

Given: domain: food temperature; payload: requirement: each magnitude at most 1 degree; residuals: $-1.2, 0.8, 1.5, -0.4$; unit: degrees Celsius

Your response: _____

Incoming: Model B is more reasonable there; its errors stay within 3 decibels, while A's spread expands to 15 despite its smaller training errors.

List the residual-plot points against day.

Construct the requested table/graph using the given axes, units and domain.

day	observed centimeters	predicted centimeters
0	12	11
3	19	21
8	27	24
14	31	35

Your response: _____

AP Precalculus

Residuals and Model Validation

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.

Identify the logical gap and replace the claim with a defensible conclusion. Diagnose the extension from three exact historical fits to thirty future years, including the changed migration mechanism.

Given: domain: population forecast; payload: claim: The model fits three observed years exactly, so it will predict the next 30 years exactly.; evidence: future domain: 3 through 30; mechanism change: a migration policy begins in year 3; residuals: $0, 0, 0$; sample years: $0, 1, 2$

Residuals and Model Validation

Full Worked Solutions - excerpt

Worked example

Problem. Judge the model for each intended use.

Given: domain: map distance; payload: residual: 0.12; unit: kilometer; uses: hiking map limit: 0.25; survey limit: 0.02

Answer. The 0.12-kilometer error is acceptable for the hiking map but not the survey, whose tolerance is only 0.02 kilometer.

Explanation and check.

The same error is compared with different decision thresholds.

Worked example

Problem. Recover the prediction and explain the negative residual.

Given: domain: reservoir depth; payload: definition: residual=observed-predicted; observed: 42.3; residual: -1.8; unit: meters

Answer. 44.1 meters; the prediction is 1.8 meters above the observation.

Explanation and check.

predicted=observed-residual= $42.3 - (-1.8) = 44.1$, consistent with overprediction.