Sets & Steps
Math Practice & Worked Solutions

Precalculus

Polar, Parametric & Conic Representations | 15-Topic Precalculus Bundle

15-topic bundle | 1,440 problems | Four activity formats

Included topics

The following pages list all 15 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.

120 PDFs and 15 READMEs; 1,769 buyer PDF pages across the 15 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

15-topic bundle | 1,440 problems | Four activity formats

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15 included resources | Complete resource previews follow this guide.

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Sets & Steps
Math Practice & Worked Solutions

Precalculus

Included topics

15-topic bundle | 1,440 problems | Four activity formats

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12 **Parametric Circles**

View individual product and its full preview

13 **Implicit Relations and Curves**

View individual product and its full preview

14 **Conic Sections from Equations and Data**

View individual product and its full preview

15 **Parametric Conic Sections**

View individual product and its full preview

15 included resources | Complete resource previews follow this guide.

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Sets & Steps
Math Practice & Worked Solutions

AP Precalculus

Equivalent Polar Coordinates

Equivalent Polar Coordinates | APPC-U03-P23

96 problems · Four activity formats

Topic focus

Across 96 tasks this topic asks for diagnosis and corrected pair, same or different, distance and location, one pair, one polar pair and equivalence group.

8 PDFs and a README; 157 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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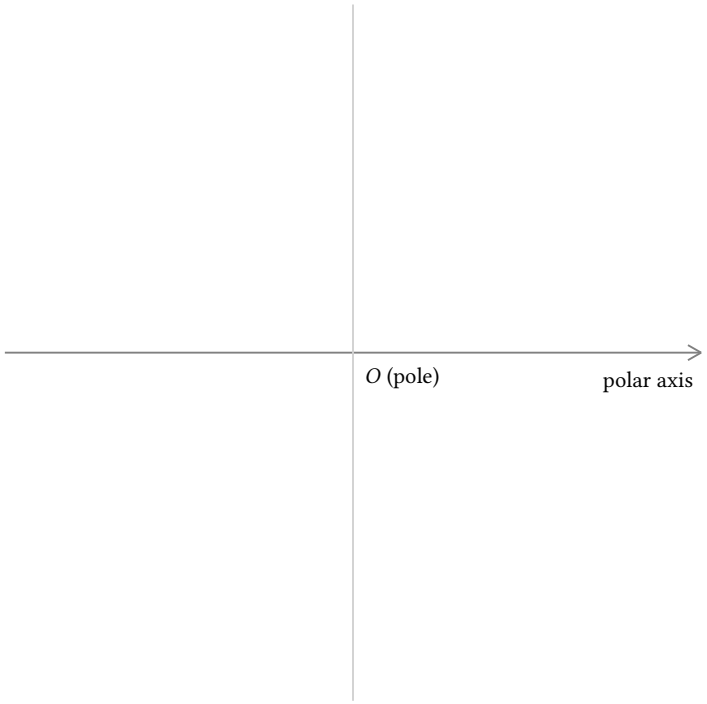
AP Precalculus

Equivalent Polar Coordinates

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 signed radius r that makes $(r, 5\frac{\pi}{6})$ equivalent to $(5, 11\frac{\pi}{6})$.



Condition or evidence	Supplied value
Incomplete polar record	$(r, 5\frac{\pi}{6})$
Known polar record	$(5, 11\frac{\pi}{6})$

Bank label: _____

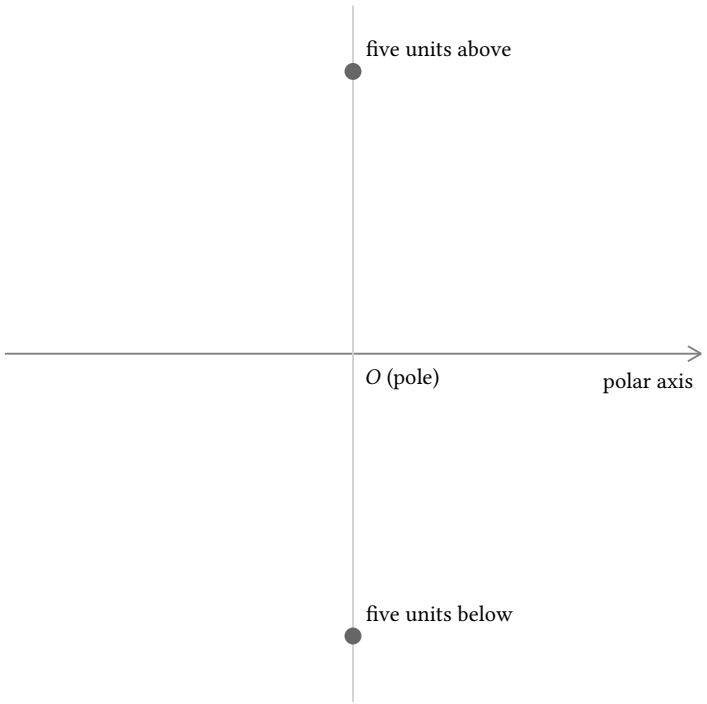
AP Precalculus

Equivalent Polar Coordinates

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 plot offers points five units above and five units below the pole. Which one represents $(-5, \frac{\pi}{2})$?



Condition or evidence	Supplied value
Candidate points	five units above five units below
Given polar record	$(-5, \frac{\pi}{2})$

AP Precalculus

Equivalent Polar Coordinates

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: $\theta = -3\frac{\pi}{10}$

An equivalent pair for $(7, 4\frac{\pi}{3})$ is required to have $\theta = \frac{\pi}{3} + 2k\pi$. What must r be for every integer k?

Solve the card and move only to the card whose incoming header matches the entire requested response.

Condition or evidence	Supplied value
Given angle form	$\theta = \frac{\pi}{3} + 2k\pi$
Incomplete polar record	(r, θ)
Known polar record	$(7, 4\frac{\pi}{3})$

Your response: _____

AP Precalculus

Equivalent Polar Coordinates

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 $(-a, \frac{\pi}{6})$ with $a = -5$, evaluate the radius before interpreting the point. Correct the claim that the visible minus sign automatically reverses the ray. Justify the comparison by distinguishing signed radius, ordinary distance and actual location.

Compare the stated cases, methods, or representations and justify the conclusion using the supplied conditions.

Condition or evidence	Supplied value
Assumption	$a = -5$
Given polar record	$(-a, \frac{\pi}{6})$
Student claim to examine	The written minus sign always means a negative radius.

Equivalent Polar Coordinates

Full Worked Solutions - excerpt

Worked example

Problem. Fill in r so the table entry $(r, 13\frac{\pi}{6})$ names the same point as $(3, \frac{\pi}{6})$.

Solve the problem, then match the entire requested response to one unused entry in the Answer Bank.

Candidate	Reference
$(r, 13\frac{\pi}{6})$	$(3, \frac{\pi}{6})$

Answer. r = 3

Explanation and check.

The angles differ by 2π, so the radius retains both its magnitude and sign.

Worked example

Problem. Complete the row $(r, 0)$ so it is equivalent to $(-8, \pi)$.

Solve the card and move only to the card whose incoming header matches the entire requested response.

Condition or evidence	Supplied value
Incomplete record	$(r, 0)$
Known record	$(-8, \pi)$

Answer. r = 8

Explanation and check.

The negative radius reverses the π ray to the 0 ray at distance 8, so the second pair uses $r = 8$.

Sets & Steps
Math Practice & Worked Solutions

AP Precalculus

Polar and Rectangular Coordinate Conversion

Polar and Rectangular Coordinate Conversion | APPC-U03-P24

96 problems · Four activity formats

Topic focus

Across 96 tasks this topic asks for polar pair plus check, polar coordinates, polar pair with quadrant check, rounded polar coordinates, rounded coordinates and positive-radius polar pair.

8 PDFs and a README; 154 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

Polar and Rectangular Coordinate Conversion

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 point has rectangular form $(3, y)$, polar radius 5, and lies above the x-axis. Complete the missing coordinate.

Solve the problem, then match the entire requested response to one unused entry in the Answer Bank.

Condition or evidence	Supplied value
Condition	$y > 0$
Given polar radius	5
Incomplete rectangular record	$(3, y)$

Bank label: _____

Convert the measured point $(0.4, -6)$ to positive-radius polar form using the stated rounding. Preserve the quadrant near the negative y-axis.

Solve the problem, then match the entire requested response to one unused entry in the Answer Bank.

x	y
0.4	-6

Condition or evidence	Supplied value
Required angle interval	$0^\circ \le \theta < 360^\circ$
Angle precision	nearest tenth
Radius precision	nearest hundredth

Bank label: _____

For $(-5, 2)$, find positive-radius polar coordinates to the nearest tenth of a degree. Explain the quadrant correction and check the signs of the two projections.

Solve the problem, then match the entire requested response to one unused entry in the Answer Bank.

x	y
-5	2

Condition or evidence	Supplied value
Required angle interval	$0^\circ \le \theta < 360^\circ$
Precision	nearest tenth of a degree

Bank label: _____

A calculator returns a reference angle near 20.6° for $(-8, -3)$. Produce the correct polar angle, radius, and a sign check by reprojection.

Solve the problem, then match the entire requested response to one unused entry in the Answer Bank.

Condition or evidence	Supplied value
Required angle interval	$0^\circ \le \theta < 360^\circ$
Given rectangular point	-8 -3
Precision	**Given angle θ** nearest tenth degree **Radius** nearest hundredth
Given calculator ratio angle	about 20.6°

Bank label: _____

AP Precalculus

Polar and Rectangular Coordinate Conversion

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

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

A positive-radius point has $\theta = 3\frac{\pi}{2}$ and $y = -4$. Determine r and the missing x-coordinate.

Show a complete response in the numbered workspace, preserving requested exactness, units, interval endpoints, and justification.

Condition or evidence	Supplied value
Given angle θ	$3\frac{\pi}{2}$
Radius convention	positive
Given x-coordinate	missing
Given y-coordinate	-4

AP Precalculus

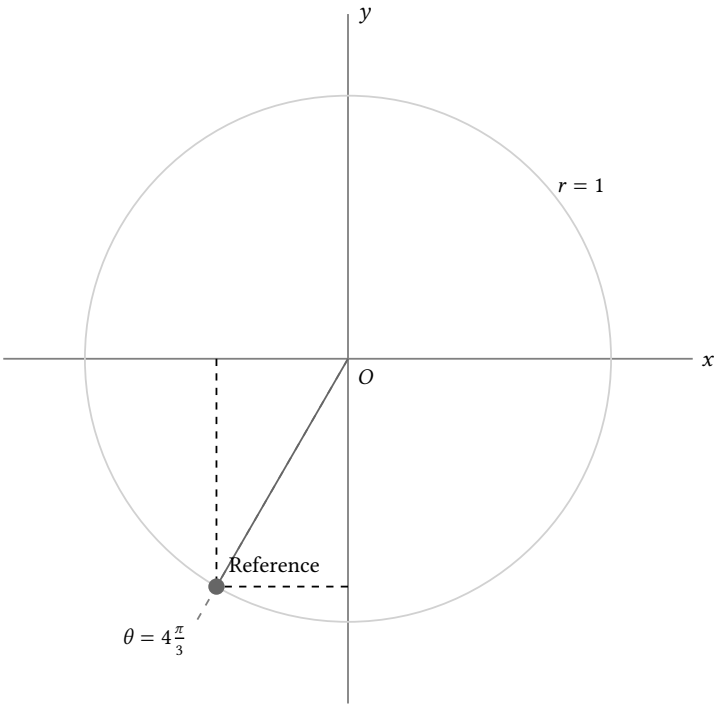
Polar and Rectangular Coordinate Conversion

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: $(11, 3\frac{\pi}{2})$

Convert $(-9, 4\frac{\pi}{3})$ and explain why both coordinates become positive.



cos θ	sin θ
$-\frac{1}{2}$	$-\frac{\sqrt{3}}{2}$

Condition or evidence	Supplied value
Given quadrant to verify	I
Given polar record	$(-9, 4\frac{\pi}{3})$

Your response: _____

AP Precalculus

Polar and Rectangular Coordinate Conversion

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 converts $(4, \frac{\pi}{6})$ to $(2, 2\sqrt{3})$. Identify the swapped roles and repair the ordered pair.

Identify the error or first invalid step, give the corrected result, and state a brief mathematical reason.

Condition or evidence	Supplied value
Given polar record	$(4, \frac{\pi}{6})$
Student rectangular result to examine	$(2, 2\sqrt{3})$

Polar and Rectangular Coordinate Conversion

Full Worked Solutions - excerpt

Worked example

Problem. A point has rectangular form $(3, y)$, polar radius 5, and lies above the x-axis. Complete the missing coordinate.

Solve the problem, then match the entire requested response to one unused entry in the Answer Bank.

Condition or evidence	Supplied value
Condition	$y > 0$
Given polar radius	5
Incomplete rectangular record	$(3, y)$

Answer. y = 4

Explanation and check.

From $3^2 + y^2 = 5^2$, $y^2 = 16$. The upper-half-plane condition selects $y = 4$ rather than -4.

Worked example

Problem. A point has radius 10, $y = -6$, and lies left of the y-axis. Reconstruct x.

Solve the problem, then match the entire requested response to one unused entry in the Answer Bank.

Condition or evidence	Supplied value
Condition	$x < 0$
Given polar radius	10
Incomplete rectangular record	$(x, -6)$

Answer. x = −8

Explanation and check.

The norm equation gives $x^2 + 36 = 100$, so $x = \pm 8$. The left-half-plane condition selects $x = -8$.

Sets & Steps
Math Practice & Worked Solutions

AP Precalculus

Polar Graphs from Tables

Polar Graphs from Tables | APPC-U03-P25

96 problems · Four activity formats

Topic focus

Across 96 tasks this topic asks for two new rows and adequacy explanation, two radius values, ordered rows, directed partial trace, polar graph and directed trace.

8 PDFs and a README; 93 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

Polar Graphs from Tables

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.

Complete the radius column for $r = 2$ at $\theta = 0$, $\frac{\pi}{2}$, and π, preserving the given angle order. Bank label: _____	For $r = 1 + \sin\theta$, evaluate the outputs at 0, $\frac{\pi}{2}$, and π and place them in the same order. Bank label: _____

AP Precalculus

Polar Graphs from Tables

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.

Plot the ordered table for $r = 1$ and add an arrow showing the direction as θ increases from 0 to 2π.

Required response

0	1
$\frac{\pi}{2}$	1
π	1
$3\frac{\pi}{2}$	1
2π	1

Sketch only the portion traced by $r = 2$ for $0 \le \theta \le \frac{\pi}{2}$, marking both endpoint statuses.

The $\theta - r$ graph is the horizontal line $r = 3$ for one full turn. Which plane trace matches, and why is the line $y = 3$ not the same graph?

The listed samples for $r = \sin(2\theta)$ are all zero. Explain why they do not show the trace, then evaluate the proposed extra input $\frac{\pi}{4}$.

Required response

0	0
$\frac{\pi}{2}$	0
π	0

Use the ordered rows for $r = \theta$ to construct the trace on $[0, \frac{\pi}{2}]$ and describe its direction.

Required response

0	0
$\frac{\pi}{4}$	$\frac{\pi}{4}$
$\frac{\pi}{2}$	$\frac{\pi}{2}$

Evaluate $r = 2\cos\theta - 1$ at the four listed angles. Keep zero and negative outputs unchanged for later plotting. The supplied angles, in order, are $\theta = 0, \frac{\pi}{3}, \pi, 3\frac{\pi}{2}$.

AP Precalculus

Polar Graphs from Tables

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: $(0, 1), (\frac{\pi}{4}, 0), (\frac{\pi}{2}, -1), (\pi, -1)$

Determine the plane arc traced by $r = -1$ for $0 \le \theta \le \frac{\pi}{2}$.

Required response

0	-1
$\frac{\pi}{2}$	-1

Your response: _____

Incoming: The upper arc from filled $(2, 0)$ through $(1, 1)$, approaching but not including the pole.

Complete the table for $r = 3\cos\theta$ at $\frac{\pi}{6}$, $\frac{\pi}{2}$, and $5\frac{\pi}{6}$.

Your response: _____

Incoming: An outward quadrant-III curve from $(-1, 0)$ to $(0, -\frac{3}{2})$, with both endpoints filled.

Determine the portion traced by $r = -1$ for $-\pi \le \theta \le \frac{\pi}{2}$, including its direction.

Required response

$-\pi$	-1
$-\frac{\pi}{2}$	-1
0	-1
$\frac{\pi}{2}$	-1

Your response: _____

Incoming: A three-quarter unit-circle arc from $(1, 0)$ through $(0, 1), (-1, 0)$, to $(0, -1)$.

Sketch the windowed trace of $r = \theta + \pi$ from $\theta = -\pi$ to $\theta = -\frac{\pi}{2}$.

Required response

$-\pi$	0
$-3\frac{\pi}{4}$	$\frac{\pi}{4}$
$-\frac{\pi}{2}$	$\frac{\pi}{2}$

Your response: _____

AP Precalculus

Polar Graphs from Tables

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 replaces the negative output of $r = \cos\theta$ by its magnitude. Repair the $\theta = \pi$ row and state where that signed-radius point plots.

Required response

0	1
$\frac{\pi}{2}$	0
π	1

A student submits the horizontal $\theta - r$ graph as the plane trace of $r = 2$. Explain the coordinate-system confusion and replace it with the correct polar graph.

Polar Graphs from Tables

Full Worked Solutions - excerpt

Worked example

Problem. Evaluate $r = 2 + \sin\theta - \cos\theta$ at the four quadrantal angles.

Answer. $(0, 1), (\frac{\pi}{2}, 3), (\pi, 3), (3\frac{\pi}{2}, 1)$

Explanation and check.

Insert the four sine-cosine pairs $(0, 1), (1, 0), (0, -1)$, and $(-1, 0)$ into the rule.

Worked example

Problem. Compute $r = 2\sin\theta + \cos(2\theta)$ at the four quadrantal angles.

Answer. $(0, 1), (\frac{\pi}{2}, 1), (\pi, 1), (3\frac{\pi}{2}, -3)$

Explanation and check.

Substitution gives $0 + 1, 2 - 1, 0 + 1$, and $-2 - 1$, respectively.

Sets & Steps
Math Practice & Worked Solutions

AP Precalculus

Polar Symmetry and Curve Tracing

Polar Symmetry and Curve Tracing | APPC-U03-P26

96 problems · Four activity formats

Topic focus

Across 96 tasks this topic asks for sufficient interval and retrace explanation, symmetry conclusion, once-through subinterval and retrace explanation, pole and nonpole multiplicities, pole multiplicity and nonpole verdict and partial/full/retraced judgment.

8 PDFs and a README; 156 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

Polar Symmetry and Curve Tracing

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.

On $r = 2\sin(3\theta)$, show that $\theta = \frac{\pi}{6}$ and $\theta = 7\frac{\pi}{6}$ represent the same petal tip and give its Cartesian coordinates.

Solve the problem, then match the entire requested response to one unused entry in the Answer Bank.

Given θ	Given r
$\frac{\pi}{6}$	2
$7\frac{\pi}{6}$	-2

Condition or evidence	Supplied value
Original polar rule	$r = 2\sin(3\theta)$
Given target point	distance 2 on ray $\frac{\pi}{6}$

Bank label: _____

How many times does $r = 2 + 2\cos\theta$ visit the pole on $0 \le \theta < 2\pi$? Distinguish that count from the closed-curve endpoint convention.

Solve the problem, then match the entire requested response to one unused entry in the Answer Bank.

Condition or evidence	Supplied value
Original polar rule	$r = 2 + 2\cos\theta$
Given equation for zero radius	$\cos\theta = -1$

Bank label: _____

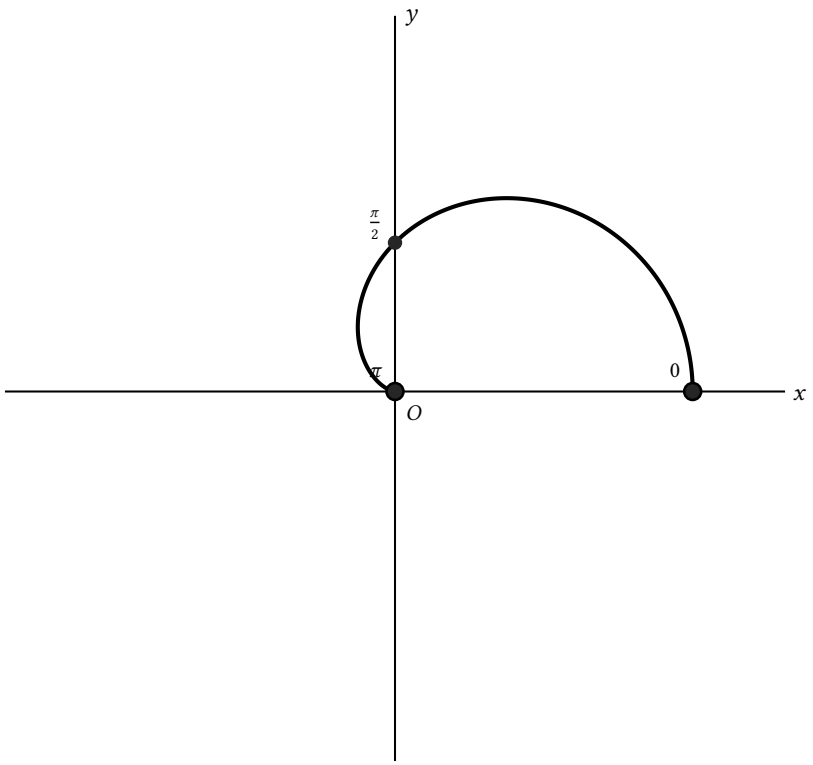
AP Precalculus

Polar Symmetry and Curve Tracing

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 $r = 1 + \cos\theta$ on $0 \le \theta \le \pi$, describe the direction of travel through the three labeled anchors as θ increases.



Given parameter	Given point or location
0	$(2, 0)$
$\frac{\pi}{2}$	$(0, 1)$
π	pole

Condition or evidence	Supplied value
Original polar rule	$r = 1 + \cos\theta$

AP Precalculus

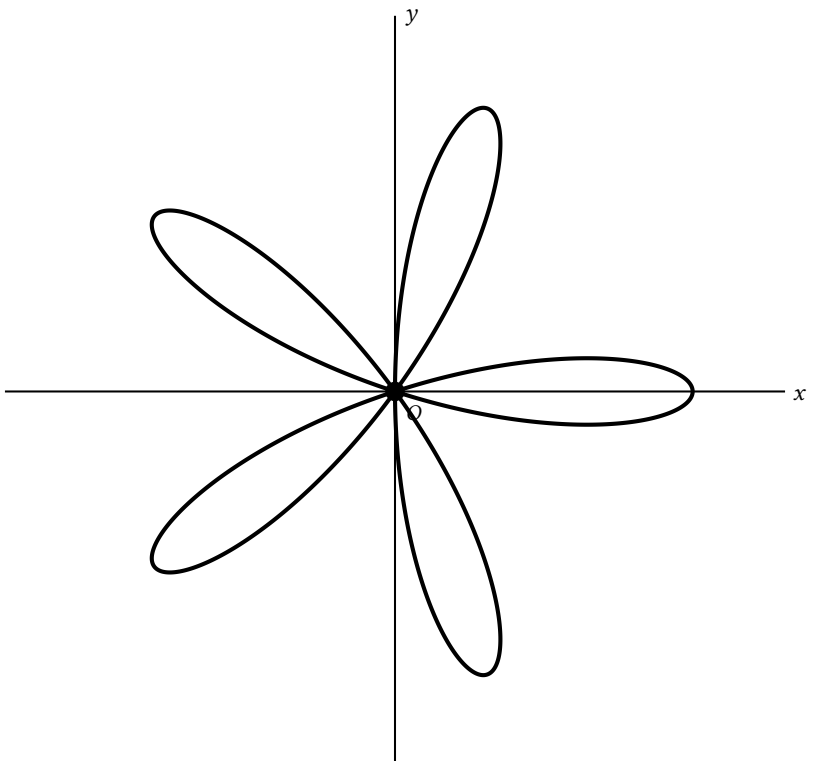
Polar Symmetry and Curve Tracing

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

Determine whether $-\frac{\pi}{2} \le \theta \le \frac{\pi}{2}$ is sufficient to trace every petal of $r = \cos(5\theta)$ once. Justify with a half-turn correspondence rather than a memorized rule.



Condition or evidence	Supplied value
Half turn relation	$r(\theta + \pi) = -r(\theta)$
Interval length	π
Original polar rule	$r = \cos(5\theta)$

Your response: _____

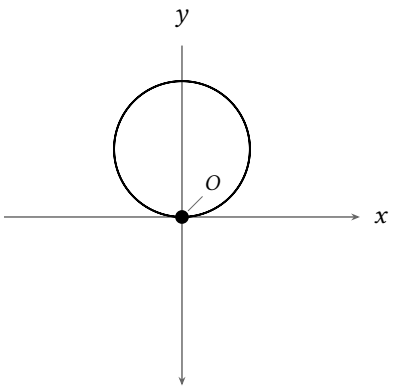
AP Precalculus

Polar Symmetry and Curve Tracing

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 says $r = \sin\theta$ needs all of $[0, 2\pi]$ for one trace because $\sin\theta$ has period 2π. Repair the claim using signed-radius equivalence.



Condition or evidence	Supplied value
Half turn relation	$r(\theta + \pi) = -r(\theta)$
Original polar rule	$r = \sin\theta$
Student claim to examine	A full 2π parameter interval is required because the radius has period 2π.

Polar Symmetry and Curve Tracing

Full Worked Solutions - excerpt

Worked example

Problem. Which parameters repeat the closing point of $r = 4$ on the closed interval $0 \le \theta \le 2\pi$?

Solve the problem, then match the entire requested response to one unused entry in the Answer Bank.

Condition or evidence	Supplied value
Given common-point reference	$(4, 0)$
Original polar rule	$r = 4$

Answer. $\theta = 0$ and $\theta = 2\pi$ both give $(4, 0)$.

Explanation and check.

The radius is 4 at both coterminal endpoint angles, so the two polar pairs locate the same point.

Worked example

Problem. A polar table contains $(\theta, r) = (\frac{\pi}{3}, 2)$ and $(4\frac{\pi}{3}, -2)$. Do the rows locate the same point? Give the coordinate.

Solve the card and move only to the card whose incoming header matches the entire requested response.

θ	Given r
$\frac{\pi}{3}$	2
$4\frac{\pi}{3}$	-2

Answer. Yes; both locate $(1, \sqrt{3})$.

Explanation and check.

The angles differ by π and the radii are opposites, so the polar pairs are equivalent. Converting the first gives $(2\cos(\frac{\pi}{3}), 2\sin(\frac{\pi}{3})) = (1, \sqrt{3})$.

Sets & Steps
Math Practice & Worked Solutions

AP Precalculus

Features of Polar Equations

Features of Polar Equations | APPC-U03-P27

96 problems · Four activity formats

Topic focus

Across 96 tasks this topic asks for minimum distance and locations, distance and parameter, ordered exact parameter list, closest point and distance, distance and location and distinct coordinate set.

8 PDFs and a README; 83 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

Features of Polar Equations

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.

In the family $r = a + \cos\theta$, choose a so that the curve reaches the pole at $\theta = \pi$. Bank label: _____	For $r = a + 2\sin\theta$ with $a \geq 2$, determine a if the greatest distance from the pole is 5. Bank label: _____
Determine a in $r = a + \sin\theta$ if every radius is negative and the closest distance to the pole is 2. Bank label: _____	At what parameter does $r = 5\theta$ reach the pole on $-1 \leq \theta \leq 1$? Bank label: _____

AP Precalculus

Features of Polar Equations

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.

Find every θ in $0 \le \theta \le \pi$ for which $r = 2\sin\theta$ is zero, and name the plane point reached.

AP Precalculus

Features of Polar Equations

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 $0 \le \varphi < 2\pi$, the curve $r = 3 + 3\cos(\theta - \varphi)$ has its cusp at the pole when $\theta = 5\frac{\pi}{6}$. Find φ. Your response: _____	**Incoming:** $\varphi = 11\frac{\pi}{6}$. Choose a in $r = 2 + a\cos\theta$ so that $\theta = 0$ is a pole parameter. Verify the resulting zero. Your response: _____
Incoming: -2 Find a if $r = a + 4\cos\theta$ must pass through the pole at $\theta = 2\frac{\pi}{3}$. Your response: _____	**Incoming:** a = 2. For k>0, the curve r=k(1-cos θ) has farthest distance 10. Determine k. Your response: _____

AP Precalculus

Features of Polar Equations

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 row gives $(\theta, r) = (\frac{\pi}{4}, -7)$, and a student reports a distance of -7. Correct both the distance and the plotted direction.

A student finds seven zero parameters for $r = \sin(3\theta)$ on $0 \le \theta \le 2\pi$ and reports seven different poles. Correct the feature count.

Features of Polar Equations

Full Worked Solutions - excerpt

Worked example

Problem. Choose a in $r = 2 + a\cos\theta$ so that $\theta = 0$ is a pole parameter. Verify the resulting zero.

Answer. -2

Explanation and check.

At $\theta = 0$ the radius is $2 + a$. Setting it to zero gives $a = -2$, and substitution yields $r(0) = 2 - 2 = 0$.

Worked example

Problem. For k>0, the curve r=k(1-cos θ) has farthest distance 10. Determine k.

Answer. k = 5.

Explanation and check.

The factor $1 - \cos\theta$ is largest at $\theta = \pi$, where it equals 2. Thus the farthest distance is $2k$, and $2k = 10$ gives $k = 5$.

Sets & Steps
Math Practice & Worked Solutions

AP Precalculus

Polar Rates of Change and Radial Motion

Polar Rates of Change and Radial Motion | APPC-U03-P28

96 problems · Four activity formats

Topic focus

Across 96 tasks this topic asks for supported or undetermined with alternative, estimated radius, exact signed rate and interpretation, local closest or farthest, local feature and inward and outward intervals.

8 PDFs and a README; 108 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

Polar Rates of Change and Radial Motion

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.

The average signed-radius rate from $\theta = 0$ to $\theta = 2$ is 3 units per radian, and $r(0) = -1$. Recover $r(2)$. Bank label: _____	The average radial rate over $2 \le \theta \le 4$ is -3, and $r(4) = 1$. Use the secant model to estimate $r(3)$. Bank label: _____
The average radial rate from $\theta = \frac{1}{2}$ to $\theta = \theta_2$ is -4. If $r(\frac{1}{2}) = 6$ and $r(\theta_2) = 2$, find θ_2. Bank label: _____	The average signed-radius rate from 30° to 90° is 2 units per radian, and $r(30^\circ) = 1$. Find $r(90^\circ)$. Bank label: _____

AP Precalculus

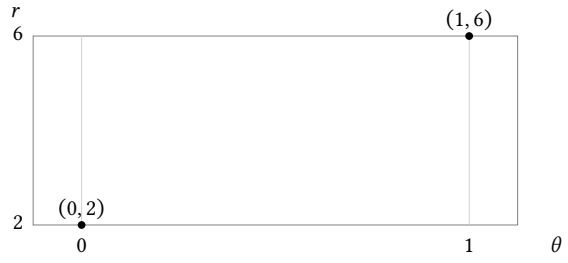
Polar Rates of Change and Radial Motion

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.

Throughout an angle interval, r is negative and increases from -7 toward -2. Is the point moving inward or outward relative to the pole?

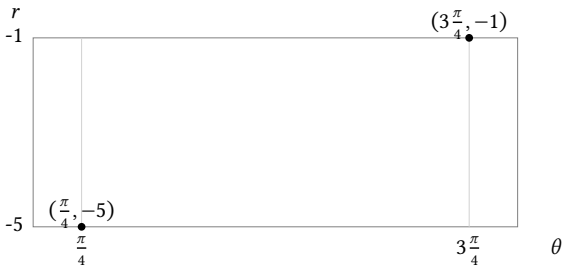
Using the average rate between the two table rows, estimate r at $\theta = \frac{1}{2}$. Is the result necessarily exact?



0	2
1	6

Near $\theta = a$, a radius graph stays positive and has a local minimum $r = 2$. What distance feature does the polar point have at a?

Compute the average signed-radius rate from $\theta = \frac{\pi}{4}$, where $r = -5$, to $\theta = 3\frac{\pi}{4}$, where $r = -1$.



$\frac{\pi}{4}$	-5
$3\frac{\pi}{4}$	-1

AP Precalculus

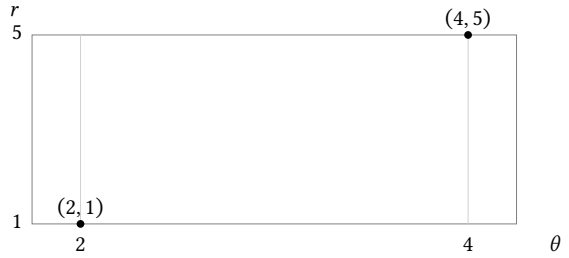
Polar Rates of Change and Radial Motion

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: $r(90^\circ) \approx 4$.

A table gives $r(2) = 1$ and $r(4) = 5$. Use the average rate to estimate $r(3)$, and say whether the estimate must be exact.



2	1
4	5

Your response: _____

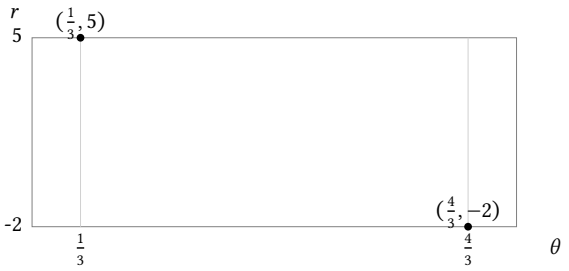
Incoming: Signed-radius rate 2; distance rate $\frac{4}{3}$ radial units per radian.

For $r = 2^\theta$, find the average radial rate from $\theta = 0$ to $\theta = 1$.

Your response: _____

Incoming: Both rates are -3 radial units per radian.

Find the average radial rate from $r(\frac{1}{3}) = 5$ to $r(\frac{4}{3}) = -2$.

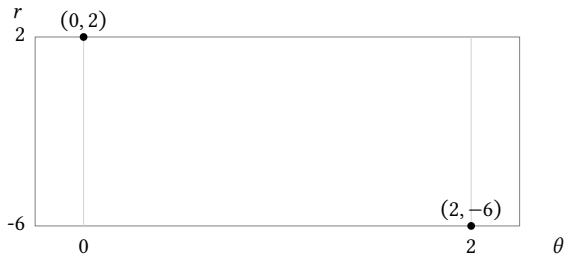


$\frac{1}{3}$	5
$\frac{4}{3}$	-2

Your response: _____

Incoming: The estimate is 10 and the actual radius lies in $[9.5, 10.5]$.

A diagram labels $r = 2$ at $\theta = 0$ and $r = -6$ at $\theta = 2$. Find the average radial and distance rates.



0	2
2	-6

Your response: _____

AP Precalculus

Polar Rates of Change and Radial Motion

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 computes $\frac{5-2}{90-30} = \frac{1}{20}$ and labels it radial units per radian. Repair the interpretation.

Required response

30°	2
90°	5

Polar Rates of Change and Radial Motion

Full Worked Solutions - excerpt

Worked example

Problem. A signed radius rises from 2 to 12 at average rate 5. What is the angular interval width?

Answer. $\theta_2 - \theta_1 = 2$ radians.

Explanation and check.

The radius change is 10. Dividing change by rate gives a width of 2 radians.

Worked example

Problem. For $r = 2^{\theta}$, find the average radial rate from $\theta = 0$ to $\theta = 1$.

Answer. 1 radial unit per radian.

Explanation and check.

The radius changes from 1 to 2 over one radian, so the secant quotient is 1.

Sets & Steps
Math Practice & Worked Solutions

AP Precalculus

Radius Graphs vs Polar Traces

Radius Graphs vs Polar Traces | APPC-U03-P29

96 problems · Four activity formats

Topic focus

Across 96 tasks this topic asks for graph sets, qualification and least point repeat, change descriptions, opposite trends, qualification about least period and two graph descriptions.

8 PDFs and a README; 167 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

Radius Graphs vs Polar Traces

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.

For $r = \sin(3\theta)$, determine the scalar period and the least positive shift that repeats the same parameterized polar point for every generic θ. Explain why they differ.

Solve the problem, then match the entire requested response to one unused entry in the Answer Bank.

Condition or evidence	Supplied value
Given parameter range or context	all real θ
Given half-turn relation	$r(\theta + \pi) = -r(\theta)$
Original rule	$r = \sin(3\theta)$

Bank label: _____

A table gives $r = 1, 2, 1$ at $\theta = 0, \frac{\pi}{2}, \pi$. State the plotted samples in the scalar and polar views.

Solve the problem, then match the entire requested response to one unused entry in the Answer Bank.

θ	Given r
0	1
$\frac{\pi}{2}$	2
π	1

Condition or evidence	Supplied value
Given parameter range or context	three sampled angles

Bank label: _____

AP Precalculus

Radius Graphs vs Polar Traces

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 complete scalar radius graph has highest value 5 and lowest value −7. Repair the claim that its top point must correspond to the farthest polar point.

Show a complete response in the numbered workspace, preserving requested exactness, units, interval endpoints, and justification.

Condition or evidence	Supplied value
Given parameter range or context	complete scalar graph
Claim to examine	The top of the scalar graph is always the farthest polar point.
Marked values	−7 5

AP Precalculus

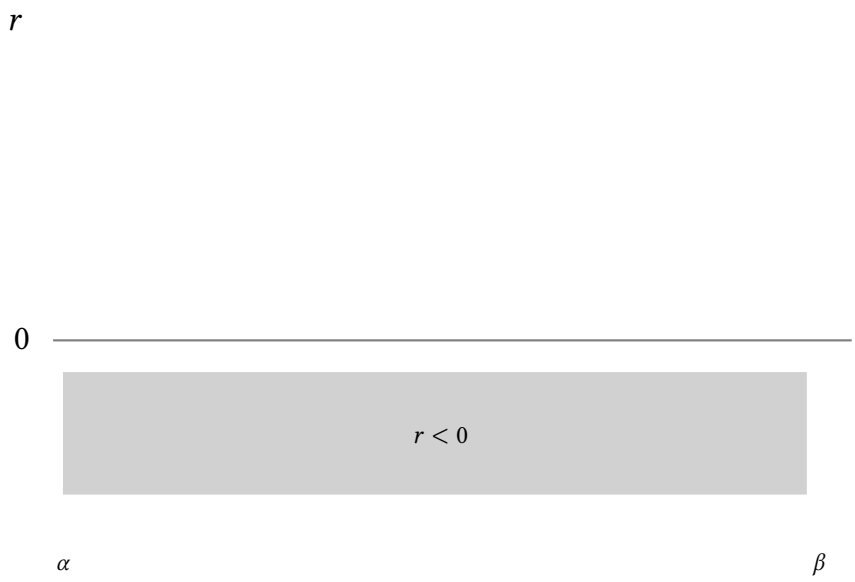
Radius Graphs vs Polar Traces

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 scalar value decreases, but the distance increases from 1 to 3.

A scalar $\theta - r$ graph is negative only on $\alpha < \theta < \beta$ and is zero at both endpoints. Translate this entire feature into a statement about the polar trace.



Condition or evidence	Supplied value
Boundary values	$r(\alpha) = r(\beta) = 0$
Condition	$r(\theta) < 0$ for $\alpha < \theta < \beta$
Given parameter range or context	interval (α, β)

Your response: _____

AP Precalculus

Radius Graphs vs Polar Traces

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 says every negative value on $a\theta - r$ graph becomes a polar point below the x-axis. Use $r = -2$ at $\theta = 3\frac{\pi}{2}$ to repair the claim.

Identify the error or first invalid step, give the corrected result, and state a brief mathematical reason.

Condition or evidence	Supplied value
Given parameter range or context	$\theta = 3\frac{\pi}{2}$
Polar pair	-2 $3\frac{\pi}{2}$
Student claim to examine	negative r means the plotted point has $y < 0$

A student claims: “Because the scalar radius repeats after π, the same polar point also repeats after π.” Diagnose the first invalid step or assumption, give the corrected conclusion, and justify the correction. Then complete the stated task: The scalar rule $\cos(2\theta)$ has period π. Does shifting θ by π repeat the same polar point?

Identify the error or first invalid step, give the corrected result, and state a brief mathematical reason.

Condition or evidence	Supplied value
Given parameter range or context	all real θ
Original rule	$r = \cos(2\theta)$
Given scalar period	π
Student claim to examine	Because the scalar radius repeats after π, the same polar point also repeats after π.

Radius Graphs vs Polar Traces

Full Worked Solutions - excerpt

Worked example

Problem. On an interval, r rises from -6 to -1. Compare the scalar graph's change with the polar point's distance change.

Solve the problem, then match the entire requested response to one unused entry in the Answer Bank.

Condition or evidence	Supplied value
Given parameter range or context	an interval with $r < 0$
Scalar behavior	r increases from -6 to -1

Answer. The scalar graph increases, while the polar point moves inward because its distance decreases from 6 to 1.

Explanation and check.

Scalar order uses signed outputs; polar distance uses absolute radius. Those measures move in opposite directions in this negative regime.

Worked example

Problem. For constant radius $r = -4$ while θ varies, compare scalar output change, polar distance change, and polar position change.

Solve the problem, then match the entire requested response to one unused entry in the Answer Bank.

Condition or evidence	Supplied value
Given parameter range or context	θ varies over an interval
Radius	constant -4

Answer. Scalar output and distance are both constant, but the polar position changes around the circle on opposite rays.

Explanation and check.

Neither r nor $|r|$ changes. The angle still changes the direction, so the point is not stationary in the plane.

Sets & Steps
Math Practice & Worked Solutions

AP Precalculus

Polar Models in Context

Polar Models in Context | APPC-U03-P30

96 problems · Four activity formats

Topic focus

Across 96 tasks this topic asks for feasibility decision, two model choices and noninterchangeability, supported model, admissibility decision, feasibility and repair and decision.

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.

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AP Precalculus

Polar Models in Context

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 rotating sensor obeys $r = 2 + \cos\theta$ and $\theta = \pi t$, with t in seconds. Write its radius as a function of time.

Bank label: _____

Held-out radii are 4.1 and 2.2 at $\theta = \frac{\pi}{3}$ and $2\frac{\pi}{3}$. Model A predicts 4.0 and 2.0; Model B predicts 3.6 and 2.7. With tolerance 0.25 at each angle, which model is supported?

Required response

$\frac{\pi}{3}$	4.1
$2\frac{\pi}{3}$	2.2

Bank label: _____

Engineers measure the maximum audible distance from a siren separately for each compass bearing. Choose a model that directly supports drawing the warning boundary.

Bank label: _____

A radius graph has maximum 9 at $\theta = \pi$ and minimum 3 at $\theta = 0$. Select the compatible model from $r = 6 - 3\cos\theta$, $r = 6 + 3\cos\theta$, and $r = 3 + 6\sin\theta$.

Bank label: _____

AP Precalculus

Polar Models in Context

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 boundary circle centered at $(3, 0)$ with radius 3 satisfies $r^2 = 6r\cos\theta$. Find its nonzero radial model and the angles where it gives a forward boundary point.	An accepted model $r = 5 - \sin\theta$ is explicitly valid only for $0 \le \theta \le \pi$. A report requests the modeled location at $\theta = 7\frac{\pi}{6}$. What should be reported?
Models A and B have equal held-out RMSE 0.18. In two safety-critical directions A's residuals are 0.08 and 0.11, while B's are 0.32 and 0.29; tolerance there is 0.15. Which model is validated for the safety use?	A signed radial signal is $r = 5\cos\theta$, and $\theta = \pi\frac{t-2}{4}$ so that the polar axis is reached at $t = 2s$. Express r as a function of t.
A radius graph has maxima at 0 and π and minima at $\frac{\pi}{2}$ and $3\frac{\pi}{2}$. Which candidate fits: $r = 5 + 2\cos\theta, r = 5 + 2\cos(2\theta)$, or $r = 5 + 2\sin(2\theta)$?	Radar gives the storm edge's distance from a station for every bearing at one instant. Choose a representation for drawing the current edge, then decide whether the same data can predict when the edge reaches a town.

AP Precalculus

Polar Models in Context

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 matching model is $r = 4 - 2\sin\theta$.

A scanner starts at angle $\frac{\pi}{6}$ and turns counterclockwise at 3 revolutions per minute. For $r = 4 + \cos\theta$ and t in minutes, write $\theta(t)$ and $r(t)$.

Your response: _____

Incoming: $\theta(t) = \frac{\pi}{6} + 6\pi t$ and $r(t) = 4 + \cos(\frac{\pi}{6} + 6\pi t)$.

A scanner follows $r = 3 + 2\sin\theta$ and turns according to $\theta = \pi\frac{t}{6}$. Write $r(t)$ and find the radius at $t = 3$ seconds.

Your response: _____

Incoming: $r(\theta) = \min(\frac{4}{|\cos\theta|}, \frac{3}{|\sin\theta|})$, with the usual convention that division by zero is ignored. A corner is hit when $\frac{4}{|\cos\theta|} = \frac{3}{|\sin\theta|}$, or $|\tan\theta| = \frac{3}{4}$.

Radii at $0, \frac{\pi}{2}, \pi, 3\frac{\pi}{2}$ are $3, 5, 7, 5$. Which candidate fits: $r = 5 - 2\cos\theta, r = 5 + 2\cos\theta$, or $r = 5 - 2\sin\theta$?

Required response

0	3
$\frac{\pi}{2}$	5
π	7
$3\frac{\pi}{2}$	5

Your response: _____

Incoming: $r(t) = 7 + \sin(\pi\frac{t-1}{4})$, and the scan covers $0 \le \theta \le \pi$.

For the signed rule $r = 1 + 3\cos\theta$, evaluate at $\theta = 4\frac{\pi}{3}$ and report the signed radius, distance from the origin, and Cartesian point.

Your response: _____

AP Precalculus

Polar Models in Context

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 device claims that $d(\theta) = 2\cos\theta$ is its nonnegative distance to an obstacle for every $0 \le \theta \le 2\pi$. Is the model physically admissible as stated?

An unlabeled polar loop is used to claim that a vehicle moved more slowly where the curve bends sharply. Diagnose the claim.

A student claims: “Model B has the smaller mean absolute error because it exactly matches the last observation more closely.” Diagnose the first invalid step or assumption, give the corrected conclusion, and justify the correction. Then complete or verify the underlying task: Held-out radii are $5.0, 4.2, 3.1, 4.1$. Models A and B predict $(4.9, 4.0, 3.2, 4.3)$ and $(5.4, 4.1, 2.7, 4.0)$. Which has the smaller mean absolute radial error?

A scanner can measure at most 10 m, but a proposed all-bearing model is $r = 7 + 4\cos\theta$. Is the model within the hardware range?

Polar Models in Context

Full Worked Solutions - excerpt

Worked example

Problem. A rotating sensor obeys $r = 2 + \cos\theta$ and $\theta = \pi t$, with t in seconds. Write its radius as a function of time.

Answer. $r(t) = 2 + \cos(\pi t)$

Explanation and check.

Substitute the supplied angle law $\theta = \pi t$ into the radial rule.

Worked example

Problem. A circular safety boundary has model $r = 6$. What boundary point corresponds to $\theta = \pi$?

Answer. $(-6, 0)$

Explanation and check.

At angle π, cosine is -1 and sine is 0, so $(r\cos\theta, r\sin\theta) = (-6, 0)$.

Sets & Steps
Math Practice & Worked Solutions

AP Precalculus

Parametric Tables and Curve Tracing

Parametric Tables and Curve Tracing | APPC-U04-P01

96 problems · Four activity formats

Topic focus

Across 96 tasks this topic asks for equal x and equal y input pairs, filled table, repeated point, equal-y pair, (t,x,y) table, ordered triples, anchor order and repeated-point times and vertex order and closure.

8 PDFs and a README; 157 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

Parametric Tables and Curve Tracing

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 $x = t + 3$ and $y = t^2 - 1$, complete the (t, x, y) rows for $t = -1, 0, 2$.

Bank label: _____

Find the common parameter domain of $x = \sqrt{t + 2}$ and $y = \frac{1}{t-1}$.

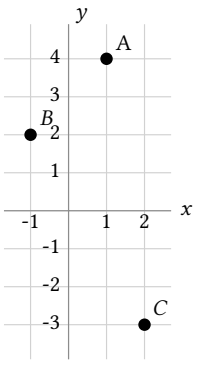
Bank label: _____

For $x = \cos t, y = \cos(2t)$ on $0 \le t \le 2\pi$, find every visit to $(0, -1)$.

Bank label: _____

A unit-scale plane trace labels $t = -2$ at $(1, 4)$, $t = 0$ at $(-1, 2)$, and $t = 3$ at $(2, -3)$. Write the corresponding component table.

Supplied labeled points



Given points only; connections between labels are unspecified here.
A: $t = -2(1, 4)$
B: $t = 0(-1, 2)$
C: $t = 3(2, -3)$

Bank label: _____

AP Precalculus

Parametric Tables and Curve Tracing

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.

Connect consecutive table points by straight segments for increasing t. List the vertex order and decide whether the path closes.

Required response

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

For $x = t^2 - 1, y = t^2$ on $-2 \le t \le 2$, find every t that visits $(0, 1)$. What causes the repeat?

AP Precalculus

Parametric Tables and Curve Tracing

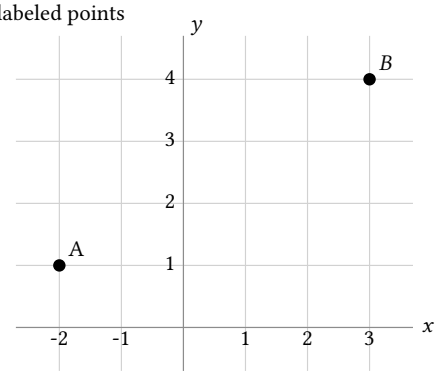
Name: _____ **Date:** _____ **Class:** _____

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 trace labels $t = 0$ at $(-2, 1)$, $t = 2$ at $(3, 4)$, and $t = 5$ again at $(-2, 1)$. Write the component rows and identify the repeated visit.

Supplied labeled points



Given points only; connections between labels are unspecified here.
A: $t = 0 (-2, 1)$
B: $t = 2 (3, 4)$
A: $t = 5 (-2, 1)$

Your response: _____

Incoming: Rows are $(0, -2, 1), (2, 3, 4), (5, -2, 1)$. The point $(-2, 1)$ is visited at both $t = 0$ and $t = 5$.

Connect consecutive samples in increasing t. Give the point sequence and identify any repeated location.

Required response

t	x	y
0	0	0
1	2	1
2	0	0
3	−1	2

Your response: _____

Incoming: The sequence is $(0, 0) \to (2, 1) \to (0, 0) \to (-1, 2)$. The origin is visited at $t = 0$ and $t = 2$.

Build the paired table for $x = t + 1$ and $y = 2t$ at $t = -2, 0, 3$.

Your response: _____

Incoming: [[−2, −1, −4], [0, 1, 0], [3, 4, 6]]

Determine the joint domain, identify the two denominator holes, and evaluate each attained outer boundary point. Work with -5≤t≤5. Restrict the parameter to [-5,5]. Use x=√((t+1)(t-4))/(t-5). Use y=ln(6-t)/(t+3).

Your response: _____

AP Precalculus

Parametric Tables and Curve Tracing

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 $x = t^2$ and $y = 2t - 1$, a student writes rows $(0, 0, 1), (1, 1, 3), (2, 4, -1)$. Identify the pairing error and give the correct table.

Identify the error or first invalid step, give the corrected result, and state a brief mathematical reason.

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

A student claims: "At $t = 0$ record $y = 0$, so all four requested rows are valid." Diagnose the first invalid step or assumption, give the corrected conclusion, and justify the correction. Then complete or verify the underlying task: Build the paired table for $x = t^2 - 3t, y = \frac{4}{t}$ at $t = -2, 0, 2, 4$, marking invalid inputs.

Parametric Tables and Curve Tracing

Full Worked Solutions - excerpt

Worked example

Problem. Build the (t, x, y) table for $x = |t| - 1, y = t^2 - 4$ at $t = -2, -1, 1, 3$. Identify any repeated plane point.

Answer. Rows are $(-2, 1, 0), (-1, 0, -3), (1, 0, -3), (3, 2, 5)$. The point $(0, -3)$ repeats at $t = -1$ and $t = 1$.

Explanation and check.

Both components are even in t on the paired ± 1 inputs, so those two rows have the same x and y outputs.

Worked example

Problem. For $x = (t - 1)(t + 1), y = (t - 2)(t + 1)$, find all visits to $(0, 0)$ on $-2 \le t \le 3$.

Answer. Only t = -1 visits $(0, 0)$.

Explanation and check.

$x = 0$ at $t = -1$ or 1, while $y = 0$ at $t = -1$ or 2. The only common root is -1.

Sets & Steps
Math Practice & Worked Solutions

AP Precalculus

Eliminating Parameters and Reparameterizing Curves

Eliminating Parameters and Reparameterizing Curves | APPC-U04-P02

96 problems · Four activity formats

Topic focus

Across 96 tasks this topic asks for covered old t-values and missing branch, parametric pair and parameter domain, pair and mixed t-domain, pair and parameter domain, relation and exact missing point and two exact set differences.

8 PDFs and a README; 63 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

Eliminating Parameters and Reparameterizing Curves

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.

Both pairs eliminate to the same familiar relation. Are their actual images equal?

Work on the domain $t \in \mathbb{R}$; $s \in \mathbb{R} \setminus \{0\}$.

The first parametrization is $x = t$; $y = t^2$.

The second parametrization is $x = \frac{1}{s}$; $y = \frac{1}{s^2}$.

Bank label: _____

Eliminate t from the two affine component rules.

Work on the domain all real t.

The x-coordinate satisfies $x = t - 4$.

The y-coordinate satisfies $y = 2t + 3$.

Bank label: _____

Eliminate t and keep the branch restriction.

Work on the domain $t \geq 0$.

The x-coordinate satisfies $x = t^2$.

The y-coordinate satisfies $y = t - 3$.

Bank label: _____

Eliminate t and describe the traced half of the locus with a Cartesian inequality.

Work on the domain $\frac{\pi}{3} \leq t \leq 4\frac{\pi}{3}$.

The endpoints is $((1, \frac{\sqrt{3}}{2}), (-1, -\frac{\sqrt{3}}{2}))$.

The x-coordinate satisfies $x = 2\cos t$.

The y-coordinate satisfies $y = \sin t$.

Required response

1	$\frac{\sqrt{3}}{2}$
-1	$-\frac{\sqrt{3}}{2}$

Bank label: _____

AP Precalculus

Eliminating Parameters and Reparameterizing Curves

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.

Use $t = -s$ to reparameterize the curve without changing its point set. Give the required s-domain and compare direction.

Work on the domain $-2 \le t \le 1$.

Use the parameter substitution $t = -s$.

The original parametrization is $x = t$; $y = t^2$.

Compare the point set, orientation, and number of visits for the two descriptions.

Work on the domain $0 \le t \le 2\pi$ and $0 \le s \le 2\pi$.

The first parametrization is $x = \cos t$; $y = \sin t$.

The second parametrization is $x = \cos(2s)$; $y = \sin(2s)$.

Use $t = y$, not $t = x$, to parametrize the restricted graph. Derive $x(t)$ and verify the supplied y-range.

Work on the domain $-1 \le x \le 3$.

The observed y range is $[-2, \frac{2}{5}]$.

The relation is $y = \frac{x-1}{x+2}$.

Eliminate t and identify the algebraic-locus point that is excluded by the strict bound.

Work on the domain $0 < t \le 3$.

The x-coordinate satisfies $x = t^2$.

The y-coordinate satisfies $y = t + 1$.

Eliminate t and state how much of the locus is covered.

Work on the domain $0 \le t \le 2\pi$.

The x-coordinate satisfies $x = 4 \sin t$.

The y-coordinate satisfies $y = 4 \cos t$.

Eliminate t and distinguish the two horizontal-axis endpoint statuses.

Work on the domain $\pi < t \le 2\pi$.

The x-coordinate satisfies $x = 2 \cos t$.

The y-coordinate satisfies $y = 2 \sin t$.

AP Precalculus

Eliminating Parameters and Reparameterizing Curves

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: They have the same image $y = x^2$ for $-1 \le x \le 1$. The first crosses it once from left to right; the second goes left-to-right and then right-to-left.

Eliminate t from the affine pair and state the x-domain.

Work on the domain all real t.

The x-coordinate satisfies $x = 2t - 1$.

The y-coordinate satisfies $y = t + 4$.

Your response: _____

Incoming: $x^2 + y^2 = 1$ with $x + y > 0$.

Eliminate t and retain the coordinate interval created by the asymmetric parameter bounds.

Work on the domain $-2 \le t \le 4$.

The x-coordinate satisfies $x = |t - 1|$.

The y-coordinate satisfies $y = t + 2$.

Your response: _____

Incoming: $x^2 + y^2 = 1$ with $x \ge 0$ and $y \ge 0$, including $(0, 1)$ and $(1, 0)$.

Do the two descriptions have the same image, and do they trace it in the same way?

Work on the domain $-1 \le t \le 1$ and $-\frac{\pi}{2} \le s \le 3\frac{\pi}{2}$.

The first parametrization is $x = t$; $y = t^2$.

The second parametrization is $x = \sin s$; $y = \sin^2 s$.

Your response: _____

Incoming: $x = -2$ with $-1 < y \le 8$.

Repair the student's $\pm$ choice and test the supplied extra point against the original rules.

Work on the domain $t \ge 0$.

Evaluate this student result: $y = \pm\sqrt{x} - 1$.

Check the point $(4, -3)$.

The x-coordinate satisfies $x = t^2$.

The y-coordinate satisfies $y = t - 1$.

Your response: _____

Incoming: $x = t + 2, y = \frac{1}{t}$ on $1 \le t \le 4$.

Eliminate t and identify the branch restriction inherited from $t \le 1$.

Work on the domain $t \le 1$.

The x-coordinate satisfies $x = (t - 1)^2$.

The y-coordinate satisfies $y = t + 2$.

Your response: _____

Incoming: The new pair is $x = s^3 - s, y = s^3 - s + 1$ and has the same point set. Its t-image is $[-\frac{2}{3\sqrt{3}}, \frac{2}{3\sqrt{3}}]$; $t = 0$ occurs at $s = -1, 0, 1$, and each nonzero interior t-value is attained twice within the interval.

Eliminate t without dropping either sign of the original parameter.

Work on the domain $-2 \le t \le 2$.

The x-coordinate satisfies $x = t^2$.

The y-coordinate satisfies $y = 2t + 1$.

Your response: _____

AP Precalculus

Eliminating Parameters and Reparameterizing Curves

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.

Repair the student's elimination and use the supplied point to expose the extra branch.

Work on the domain $t < 0$.

The original parametrization is $x = t^2$; $y = t$.

Evaluate this student result: $x = y^2$ with both signs of y.

Check the point $(1, 1)$.

Repair the canceled expression result and use the supplied point to show why the domain matters.

Work on the domain $t \in \mathbb{R}, t \neq 1$.

Evaluate this student result: $y = x + 1$ for every real x.

Check the point $(1, 2)$.

The x-coordinate satisfies $x = t$.

The y-coordinate satisfies $y = \frac{t^2-1}{t-1}$.

Eliminating Parameters and Reparameterizing Curves

Full Worked Solutions - excerpt

Worked example

Problem. Eliminate t from $x = t + 2, y = 3t - 1$ and state the x-domain.

Answer. y = $3x - 7$ for all real x.

Explanation and check.

From $x = t + 2, t = x - 2$. Substitution into y gives $3(x - 2) - 1 = 3x - 7$.

Worked example

Problem. Introduce a parameter for $y = x^2 - 3$ restricted to $-2 \le x \le 1$, and verify coverage.

Answer. x = $t, y = t^2 - 3$ with $-2 \le t \le 1$.

Explanation and check.

Choosing the free x-coordinate as t transfers the x restriction directly to t and reaches each permitted x once.

Sets & Steps
Math Practice & Worked Solutions

AP Precalculus

Parametric Equations of Lines

Parametric Equations of Lines | APPC-U04-P05

96 problems · Four activity formats

Topic focus

Across 96 tasks this topic asks for domain, interval notation, closed interval, interval, inequality and sufficiency statement and family.

8 PDFs and a README; 125 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

Parametric Equations of Lines

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.

Use a normal direction of the reference line to parametrize the perpendicular line through the point. point: $[3, -2]$; reference line: $x - 2y = 7$; required relation: perpendicular.

Bank label: _____

AP Precalculus

Parametric Equations of Lines

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.

Write parametric equations for the line through the point with the given direction. direction: $[3, 4]$; point: $[2, -1]$.	State the parameter interval that produces the full supporting line.
Determine whether changing both the anchor and direction scale changed the geometric line. domains: t and s real; first: $(x, y) = (-2 + t, 4 + 3t)$; second: $(x, y) = (1 + 2s, 13 + 6s)$.	Use the given direction angle and scale to parametrize the full line from the marked point. coordinate speed: 2; direction angle degrees: 150; point: $[1, 1]$.

AP Precalculus

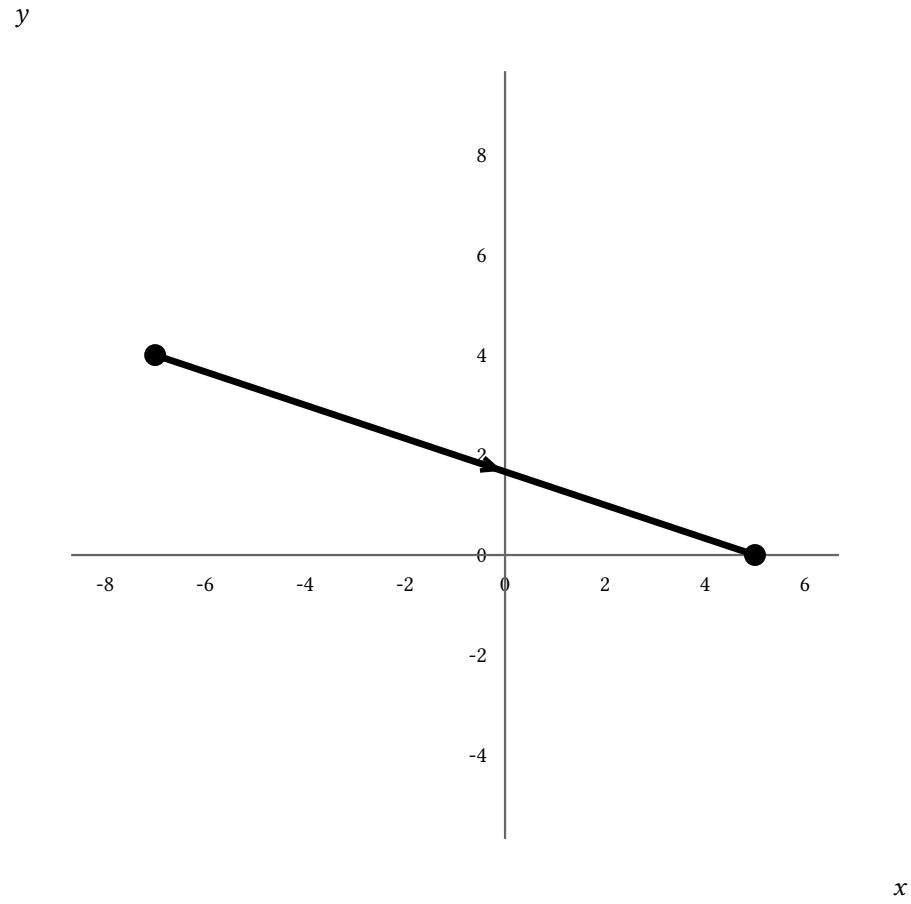
Parametric Equations of Lines

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: a = 2 and $b = 4$

Choose the t-values that trace exactly the highlighted closed segment. endpoint membership: both included; endpoint parameters: $[-2, 2]$; map: $x = 3t - 1, y = 2\text{-}t$; domain: to be selected.



Your response: _____

AP Precalculus

Parametric Equations of Lines

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 student interchanged point coordinates and direction components. Repair the parametrization. required direction: $[3, 1]$; required point: $[4, -2]$; student map: $x = 3 + 4t, y = 1 - 2t$.

The rates are right but the clock origin is not. Repair the student's timed segment. required: $(1, 4)$ at $t = 2$ and $(7, 1)$ at $t = 5$; student map: $x = 1 + 2t, y = 4 - t, 0 \le t \le 3$.

Parametric Equations of Lines

Full Worked Solutions - excerpt

Worked example

Problem. Find a parameter-free equation for the line image. map: $x = -3 + 2t, y = 5 + 5t$; domain: t real.

Answer. $5x - 2y = -25$

Explanation and check.

The combination $5(-3 + 2t) - 2(5 + 5t)$ is constantly -25.

Worked example

Problem. Give an affine parametrization of this horizontal line. equation: $y = -7$; domain: full line.

Answer. x = $t, y = -7$, with t real.

Explanation and check.

Let x vary freely while y remains equal to -7.

Sets & Steps
Math Practice & Worked Solutions

AP Precalculus

Parametric Circles

Parametric Circles | APPC-U04-P06

96 problems · Four activity formats

Topic focus

Across 96 tasks this topic asks for center, radius, start, orientation, exact set-builder list, interval, motion comparison and times, set, direction, parameter-rate comparison and locus, start, period, orientation.

8 PDFs and a README; 139 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

Parametric Circles

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

Solve the problem, then match the entire requested response to one unused entry in the Answer Bank.

Read the geometric and traversal features from the paired rule.

Solve the problem, then match the entire requested response to one unused entry in the Answer Bank.

Condition or evidence	Supplied value
Original parameter range or clock definition	t real
Given $x(t)$	$3 + 4\cos(t)$
Given $y(t)$	$-2 + 4\sin(t)$

Bank label: _____

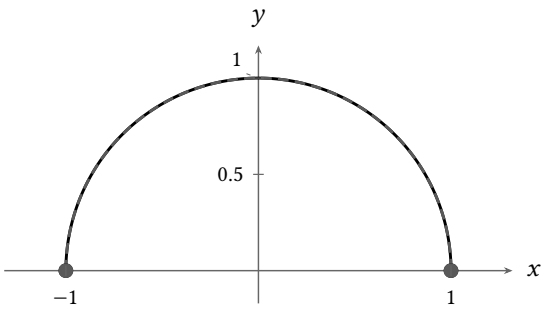
Model the ninety-second clockwise revolution from the delayed leftmost start.

Solve the problem, then match the entire requested response to one unused entry in the Answer Bank.

Condition or evidence	Supplied value
Given center	1 2
Original parameter range or clock definition	time t in seconds
Given direction	clockwise
Period seconds	90
Given radius	3
Start point	−2 2
Start time	30

Bank label: _____

Compare the two restricted maps as arc sets and as directed traversals.



Condition or evidence	Supplied value
Original parameter range or clock definition	$0 \le t \le \pi$ and $-\pi \le s \le 0$
First motion rule	$(\cos t, \sin t)$
Second motion rule	$(\cos(-s), \sin(-s))$

Bank label: _____

Account for the doubled angle when choosing the lower half-circle parameter window.

Solve the problem, then match the entire requested response to one unused entry in the Answer Bank.

Condition or evidence	Supplied value
Given arc	lower semicircle
Original parameter range or clock definition	to be selected
Given ending position	1 0
Given endpoint membership	both included
Given direction	counterclockwise
Given coordinate rule	$x = \cos(2t), y = \sin(2t)$
Given starting position	−1 0

Bank label: _____

AP Precalculus

Parametric Circles

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

Show a complete response in the numbered workspace, preserving requested exactness, units, interval endpoints, and justification.

Read the circle geometry and zero-time position from the rule.

Show a complete response in the numbered workspace, preserving requested exactness, units, interval endpoints, and justification.

Condition or evidence	Supplied value
Original parameter range or clock definition	t real
Given $x(t)$	$2 + 3\cos(t)$
Given $y(t)$	$4 + 3\sin(t)$

Construct the clockwise motion from the $3 - 4 - 5$ radius position without using a decimal phase.

Show a complete response in the numbered workspace, preserving requested exactness, units, interval endpoints, and justification.

Condition or evidence	Supplied value
Given center	2 -3
Original parameter range or clock definition	t real
Given direction	clockwise
Given radius	5
Given starting position	5 1

AP Precalculus

Parametric Circles

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

Begin at START. Solve the card, use the complete requested response as the outgoing match, and move to the unique card whose incoming header matches it; continue until FINISH.

Incoming: x = 3 sin(t), $y = 2 - 3\cos(t)$.

Construct a rule that begins at the top and initially moves right.

Solve the card, use the complete requested response as the outgoing match, and move to the unique card whose incoming header matches it; continue until FINISH.

Condition or evidence	Supplied value
Given center	−3 2
Original parameter range or clock definition	t real
Given direction	clockwise
Given radius	4
Given starting position	−3 6

Your response: _____

Incoming: x = −4-cos(t), $y = \sin(t)$.

Can any increasing parameter interval satisfy the endpoint and sweep requirements simultaneously?

Solve the card, use the complete requested response as the outgoing match, and move to the unique card whose incoming header matches it; continue until FINISH.

Condition or evidence	Supplied value
Original parameter range or clock definition	to be selected
Given ending position	1 0
Required sweep	exactly one-half revolution
Given coordinate rule	$x = \cos(t), y = \sin(t)$
Given starting position	1 0

Your response: _____

AP Precalculus

Parametric Circles

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 radius, phase, and orientation are correct, but one center coordinate is not. Repair it.

Identify the error or first invalid step, give the corrected result, and state a brief mathematical reason.

Condition or evidence	Supplied value
Original parameter range or clock definition	t real
Student rule to examine	$x = 1 + 3\cos(t), y = 2 + 3\sin(t)$
Given target requirements	**Given center** $1, -2$ **Given direction** counterclockwise **Given radius** 3 **Given starting position** $4, -2$

Parametric Circles

Full Worked Solutions - excerpt

Worked example

Problem. Read the basic circle geometry from the constants and amplitudes.

Solve the problem, then match the entire requested response to one unused entry in the Answer Bank.

Condition or evidence	Supplied value
Original parameter range or clock definition	t real
Given $x(t)$	$-2 + 6\cos(t)$
Given $y(t)$	$4 + 6\sin(t)$

Answer. Center $(-2, 4)$, radius 6.

Explanation and check.

The coordinate midlines are -2 and 4, and both components have amplitude 6.

Worked example

Problem. Identify the circle's center and radius from the paired rule.

Solve the problem, then match the entire requested response to one unused entry in the Answer Bank.

Condition or evidence	Supplied value
Original parameter range or clock definition	t real
Given $x(t)$	$5 + 2\cos(t)$
Given $y(t)$	$1 + 2\sin(t)$

Answer. Center $(5, 1)$ and radius 2.

Explanation and check.

The additive constants locate the center, and the equal sinusoidal amplitudes give the radius.

Sets & Steps
Math Practice & Worked Solutions

AP Precalculus

Implicit Relations and Curves

Implicit Relations and Curves | APPC-U04-P07

96 problems · Four activity formats

Topic focus

Across 96 tasks this topic asks for consistency judgment, possible entries, member set, invalid row, inequality and rule and restriction, rule, y-domain.

8 PDFs and a README; 104 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

Implicit Relations and Curves

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.

Exactly one row misses the relation. Which one?

Given: domain: x, y real; relation: $(x-2)(y+1)=6$; rows: $(5,1)$; $(-1,-3)$; $(4,2)$; $(3,4)$

Required response

x	y
5	1
-1	-3
4	2
3	4

Bank label: _____

Identify every coordinate pair that satisfies the scaled relation.

Given: domain: x, y real; relation: $\frac{x^2}{4}+\frac{y^2}{9}=1$; rows: $(0,3)$; $(2,0)$; $(1,2)$; $(\sqrt{2}, 3\frac{\sqrt{2}}{2})$

Required response

x	y
0	3
2	0
1	2
$\sqrt{2}$	$3\frac{\sqrt{2}}{2}$

Bank label: _____

How many rows lie on the relation, and which are they?

Given: domain: x, y real; relation: $2x-y=5$; rows: $(3,1)$; $(\frac{7}{2}, 2)$; $(\frac{1}{2}, -4)$; $(-1,-7)$

Required response

x	y
3	1
$\frac{7}{2}$	2
$\frac{1}{2}$	-4
-1	-7

Bank label: _____

Mark the valid rows, then explain what they show about y-values at $x=10$.

Given: domain: x, y real; relation: $y^2=x-1$; rows: (x: 10; y: 3); (x: 10; y: -3); (x: 10; y: 0)

Required response

x	y
10	3
10	-3
10	0

Bank label: _____

AP Precalculus

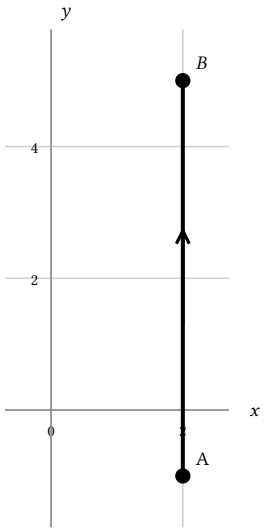
Implicit Relations and Curves

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.

Describe both coordinate changes along the arrow.

Given graph



A: $(2, -1)$

B: $(2, 5)$

AP Precalculus

Implicit Relations and Curves

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

Write every real y-branch and state the x-values for which it exists.

Given: domain: x, y real; isolated variable: y; relation: $y^2 = 4\text{-}x$

Your response: _____

Incoming: $y = \sqrt{4 - x}$ or $y = -\sqrt{4 - x}$, with $x \leq 4$.

Express the relation as a rule with x as input.

Given: domain: x, y real; isolated variable: y; relation: $2x + 3y = 12$

Your response: _____

Incoming: $y = 4 - (\frac{2}{3})x$ for every real x.

List every relation point with the prescribed first coordinate.

Given: domain: x, y real; input x: 3; relation: $y^2 = 12\text{-}x$

Your response: _____

Incoming: $(3, 3)$ and $(3, -3)$.

Determine whether the relation has any real point above this x-value.

Given: domain: x, y real; input x: 3; relation: $(y - 1)^2 = x - 4$

Your response: _____

Incoming: It has none.

Solve for x, keeping every real branch and the output-variable domain.

Given: domain: x, y real; isolated variable: x; relation: $(x - 2)^2 = y + 1$

Your response: _____

Incoming: $x = 2+\sqrt{y + 1}$ or $x = 2-\sqrt{y + 1}$, for $y \geq -1$.

Make y explicit and state the excluded vertical line.

Given: domain: x, y real; isolated variable: y; relation: $(x + 3)(y - 2) = 4$

Your response: _____

AP Precalculus

Implicit Relations and Curves

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.

Which proposed points belong to the relation?

Given: candidates: $(5, 3)$; $(5, -3)$; $(5, 1)$; domain: x, y real; relation: $y^2 = x + 4$

Identify the error or first invalid step, give the corrected result, and state a brief mathematical reason.

x	y
5	3
5	−3
5	1

A student claims: "All four listed rows satisfy $x^2 - y = 3$." Diagnose the first invalid step or assumption, give the corrected conclusion, and justify the correction. Then complete the stated task: Three rows satisfy the relation. Identify the one that does not.

Identify the error or first invalid step, give the corrected result, and state a brief mathematical reason.

x	y
−1	−2
0	−3
2	1
3	5

Implicit Relations and Curves

Full Worked Solutions - excerpt

Worked example

Problem. Determine whether the relation has any real point above this x-value.

Given: domain: x, y real; input $x: \ 3$; relation: $(y-1)^2 = x - 4$

Answer. It has none.

Explanation and check.

Substitution would make the square $(y-1)^2$ equal -1, impossible over the reals.

Worked example

Problem. Give a complete explicit description of the relation.

Given: domain: x, y real; relation: $y^2 = (x-1)^2$

Answer. y = $x - 1$ or $y = 1 - x$, for every real x.

Explanation and check.

Equality of the squares means $y = \pm(x-1)$; the two lines meet at $(1, 0)$.

Sets & Steps
Math Practice & Worked Solutions

AP Precalculus

Conic Sections from Equations and Data

Conic Sections from Equations and Data | APPC-U04-P08

96 problems · Four activity formats

Topic focus

Across 96 tasks this topic asks for axis, direction, x-intercepts, vertex, axis, direction, sample point, exact points, normalized form, equation or contradiction and equation or impossibility.

8 PDFs and a README; 158 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

Conic Sections from Equations and Data

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.

Use the two labeled rows to determine the vertex-form coefficient.

Required response

role	x	y
vertex	1	−2
curve point	3	6

Bank label: _____

Normalize the equation and determine whether any real point remains. domain: x, y real; equation: $x^2 + y^2 - 4x + 2y + 9 = 0$.

Bank label: _____

AP Precalculus

Conic Sections from Equations and 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. A value without its unit is not a complete answer.

List the graph-defining features of the hyperbola. domain: x, y real; equation: $\frac{x^2}{9} - \frac{y^2}{16} = 1$.

AP Precalculus

Conic Sections from Equations and 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.

START

Complete both squares and normalize the constant to 1. domain: x, y real; equation: $4x^2 + 9y^2 - 16x + 18y - 11 = 0$.

Your response: _____

Incoming: $\frac{(x-2)^2}{9} + \frac{(y+1)^2}{4} = 1$.

Use the labeled extreme-point table to construct the ellipse.

Required response

label	x	y
right	6	0
left	-6	0
top	0	2
bottom	0	-2

Your response: _____

AP Precalculus

Conic Sections from Equations and 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.

Find the constant error in the work and repair the conic description. domain: x, y real; equation: $4x^2 - 16x + y^2 + 6y - 11 = 0$; student work: $4(x-2)^2 + (y+3)^2 = 20$. Identify the error or first invalid step, give the corrected result, and state a brief mathematical reason.

A student claims: “The focus $(0, 2)$ gives $p = 1$, so the equation is $x^2 = 4y$ and $(4, 2)$ is not on the parabola.” Diagnose the first invalid step or assumption, give the corrected conclusion, and justify the correction. Then complete or verify the underlying task: Build the focal equation and test the proposed point. candidate point: $4, 2$; domain: vertical parabola; focus: $0, 2$; rule: $x^2 = 4py$; student claim: The focus $(0, 2)$ gives $p = 1$, so the equation is $x^2 = 4y$ and $(4, 2)$ is not on the parabola.; vertex: $0, 0$. Identify the stated incorrect claim or first invalid step, give the corrected result, and state a brief mathematical reason.

Conic Sections from Equations and Data

Full Worked Solutions - excerpt

Worked example

Problem. State the two defining geometric features. domain: x, y real; equation: $x^2 + y^2 = 81$.

Answer. Center $(0, 0)$, radius 9.

Explanation and check.

The equation is a sum of squared displacements equal to 9^2.

Worked example

Problem. Write the exact equation without converting the radius to a decimal. center: $-3, 1$; domain: circle; radius: $\sqrt{11}$.

Answer. $(x + 3)^2 + (y - 1)^2 = 11$.

Explanation and check.

Coordinate differences measure displacement from $(-3, 1)$, and the equation uses radius squared.

Sets & Steps
Math Practice & Worked Solutions

AP Precalculus
Parametric Conic Sections

Parametric Conic Sections | APPC-U04-P09

96 problems · Four activity formats

Topic focus

Across 96 tasks this topic asks for coverage and orientation, image, number of traversals, start visits, coverage, start, direction, branches and parameter pieces, parametric pair and parametric pair and domain.

8 PDFs and a README; 49 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

Parametric Conic Sections

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.

Parametrize one counterclockwise traversal from the stated start. direction: counterclockwise; domain: $0 \le t \le 2\pi$; equation: $\frac{(x-2)^2}{25} + \frac{(y+1)^2}{9} = 1$; start: rightmost point. Bank label: _____	Parametrize only the component above the center. desired: upper branch only; domain: $-\frac{\pi}{2} < t < \frac{\pi}{2}$; equation: $\frac{(y+3)^2}{25} - \frac{(x-2)^2}{4} = 1$. Bank label: _____
Separate curve membership from traversal multiplicity. domain: $0 \le t \le 2\pi$; rules: x: $5\cos(2t)$; y: $2\sin(2t)$; target: $\frac{x^2}{25} + \frac{y^2}{4} = 1$. Bank label: _____	Let the vertical coordinate be the free parameter. curve: $x = 3y - 5$; domain: y real. Bank label: _____
The formulas are correct but reach only one branch on the student's domain. Repair only the domain so both branches are covered. desired: both complete branches; domain: student used $-\frac{\pi}{2} < t < \frac{\pi}{2}$; implicit curve: $\frac{x^2}{9} - \frac{y^2}{4} = 1$; rules: x: $3\sec t$; y: $2\tan t$. Bank label: _____	Use a free horizontal parameter while retaining the branch endpoints. curve: $y = \sqrt{(9 - x^2)}$; domain: $y \ge 0$; x interval: $-3 \le x \le 3$. Bank label: _____
Use the supplied identity to parametrize the hyperbola. domain: $\cos t \neq 0$; equation: $x^2 - y^2 = 1$; identity: $\sec^2 t - \tan^2 t = 1$. Bank label: _____	Trace the specified lower half exactly once. desired arc: left endpoint to right endpoint through bottom; domain: $\pi \le t \le 2\pi$; equation: $\frac{x^2}{36} + \frac{(y-1)^2}{4} = 1$. Bank label: _____

AP Precalculus

Parametric Conic Sections

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.

Decide whether the pairs trace the same ellipse and relate their parameters. domain: $0 \le$parameter$\le 2\pi$; pair A: x: $3\cos t$; y: $2\sin t$; pair B: x: $3\cos u$; y: $-2\sin u$.	Trace only the component below the center. desired: lower branch; domain: $\frac{\pi}{2} < t < 3\frac{\pi}{2}$; equation: $\frac{(y+1)^2}{16} - \frac{(x-3)^2}{9} = 1$.
Determine whether the enlarged parameter interval changes the branch image. domain: $-\frac{\pi}{2} <$parameter$< \frac{\pi}{2}$; pair A: x: $3\sec t$; y: $2\tan t$; pair B: domain: $-\pi < u < \pi$; x: $3\sec(\frac{u}{2})$; y: $2\tan(\frac{u}{2})$.	Parametrize only the specified quarter arc with both endpoints included. desired arc: from $(7,-2)$ to $(3,1)$ in quadrant relative to center; domain: $0 \le t \le \frac{\pi}{2}$; equation: $\frac{(x-3)^2}{16} + \frac{(y+2)^2}{9} = 1$.
Use y as the free coordinate and preserve its forbidden value. curve: $x = \frac{y+2}{y-1}$; domain: $y \ne 1$.	Describe the traversal produced by this nonstandard one-period interval. domain: $\frac{\pi}{2} \le t \le 5\frac{\pi}{2}$; rules: x: $2 + 6\cos t$; y: $1 + 3\sin t$; target: $\frac{(x-2)^2}{36} + \frac{(y-1)^2}{9} = 1$.

AP Precalculus

Parametric Conic Sections

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 first covers the whole parabola; the second covers only the upper half $y \geq 0$, with each nonvertex point reached by u and $-u$.

Test the proposed assignment against the signed equation. candidate: x: $3\tan t$; y: $4\sec t$; domain: $\cos t \neq 0$; implicit curve: $\frac{x^2}{9} - \frac{y^2}{16} = 1$.

Your response: _____

Incoming: The open arc with angles $\frac{\pi}{3} < t < 2\frac{\pi}{3}$ is omitted; both boundary points at angles $\frac{\pi}{3}$ and $2\frac{\pi}{3}$ are included.

Identify the relative quadrant and endpoint membership. domain: $\frac{\pi}{2} < t < \pi$; rules: x: $2 + 4\cos t$; y: $-1 + 3\sin t$; target: $\frac{(x-2)^2}{16} + \frac{(y+1)^2}{9} = 1$.

Your response: _____

Incoming: x = $3 + 7\cos t, y = -2 - 4\sin t, 0 \leq t \leq \pi$.

Parametrize both branches across one trigonometric period. domain: $0 \leq t \leq 2\pi$ excluding poles; equation: $\frac{(x-1)^2}{9} - \frac{(y+4)^2}{4} = 1$.

Your response: _____

Incoming: x = $-1 + 2\cos t, y = 2 + 5\sin t, 0 \leq t \leq \frac{\pi}{2}$.

Give one rule that follows the specified right-bottom-left route without tracing the upper half. direction: clockwise; domain: half arc; end: $[-4, -2]$; implicit curve: $\frac{(x-3)^2}{49} + \frac{(y+2)^2}{16} = 1$; start: $[10, -2]$; via: $[3, -6]$.

Your response: _____

Incoming: x = $1 + 3\sec t, y = -4 + 2\tan t; 0 \leq t \leq 2\pi$ with $t \neq \frac{\pi}{2}, 3\frac{\pi}{2}$.

Place secant on the coordinate with the positive normalized square. domain: $\cos t \neq 0$; equation: $\frac{y^2}{16} - \frac{x^2}{9} = 1$; identity: $\sec^2 t - \tan^2 t = 1$.

Your response: _____

Incoming: Invalid; it gives $\tan^2 t - \sec^2 t = -1$ instead of 1.

Use the horizontal coordinate while preserving the real-power branch. curve: $y = (x-1)^{\frac{3}{2}}$; domain: $x \geq 1, y \geq 0$.

Your response: _____

AP Precalculus

Parametric Conic Sections

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.

Change the minimum necessary component to fit the ellipse. domain: t real; student pair: $x:\ 5\cos t$; $y:\ 5\sin t$; target: $\frac{x^2}{25}+\frac{y^2}{9}=1$.

Fix both the semiaxis error and the excessive trace domain. domain: $0\le t\le 2\pi$; student domain: $0\le t\le 2\pi$; student pair: $x:\ 1+4\cos t$; $y:\ -2+2\sin t$; target: $\frac{(x-1)^2}{25}+\frac{(y+2)^2}{4}=1$, upper half only.

Decide whether the proposed pair remains on the ellipse for every parameter. candidate: $x:\ 3\cos t$; $y:\ 3\sin t$; domain: t real; implicit curve: $\frac{x^2}{9}+\frac{y^2}{4}=1$.

The formulas lie on the ellipse, but the student's interval selects the wrong half. Change only the interval. desired: lower arc from left vertex to right vertex; domain: student used $0\le t\le \pi$; implicit curve: $\frac{(x-1)^2}{25}+\frac{(y-2)^2}{4}=1$; rules: $x:\ 1+5\cos t$; $y:\ 2+2\sin t$.

Parametric Conic Sections

Full Worked Solutions - excerpt

Worked example

Problem. Use a direct horizontal free parameter. curve: $y = -3x + 7$; domain: x real.

Answer. x = t, $y = -3t + 7$, for all real t.

Explanation and check.

Each real input is represented once and its output follows the explicit rule.

Worked example

Problem. Factor the relation and use the coordinate that keeps the formula simplest. curve: $xy + y = 4$; domain: $y \neq 0$.

Answer. x = $\frac{4}{t} - 1$, $y = t$, with $t \neq 0$.

Explanation and check.

The relation is $y(x + 1) = 4$, so choosing $y = t$ gives the stated reciprocal and excludes zero.