Sets & Steps
Math Practice & Worked Solutions

Precalculus

Parametric Curves and Vector Motion

10-topic bundle | 960 problems | Four activity formats

Included topics

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

Suggested learning sequence

1. Parametric representations and curves
2. Motion, intersections and speed
3. Vector components and velocity

In every topic

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

Product previews

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

80 PDFs and 10 READMEs; 1,205 buyer PDF pages across the 10 products.

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

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

10-topic bundle | 960 problems | Four activity formats

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01 **Parametric Tables and Curve Tracing**

View individual product and its full preview

02 **Eliminating Parameters and Reparameterizing Curves**

View individual product and its full preview

03 **Parametric Equations of Lines**

View individual product and its full preview

04 **Parametric Circles**

View individual product and its full preview

05 **Parametric Motion and Intersections**

View individual product and its full preview

06 **Average Rates and Speed in Parametric Motion**

View individual product and its full preview

07 **Vector Components and Direction**

View individual product and its full preview

08 **Vector Operations and Magnitude**

View individual product and its full preview

09 **Velocity Vector Applications**

View individual product and its full preview

10 **Vector-Valued Functions: Operations and Motion**

View individual product and its full preview

10 included resources | Complete resource previews follow this guide.

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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.

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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 $y = \frac{1}{t-1}$.

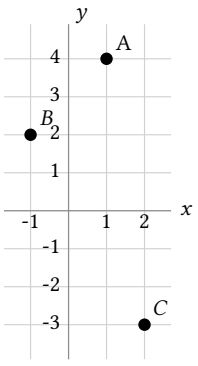
Bank label: _____

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

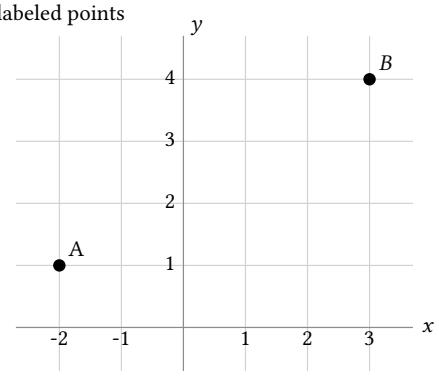
Name: _____ **Date:** _____ **Class:** _____

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.

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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

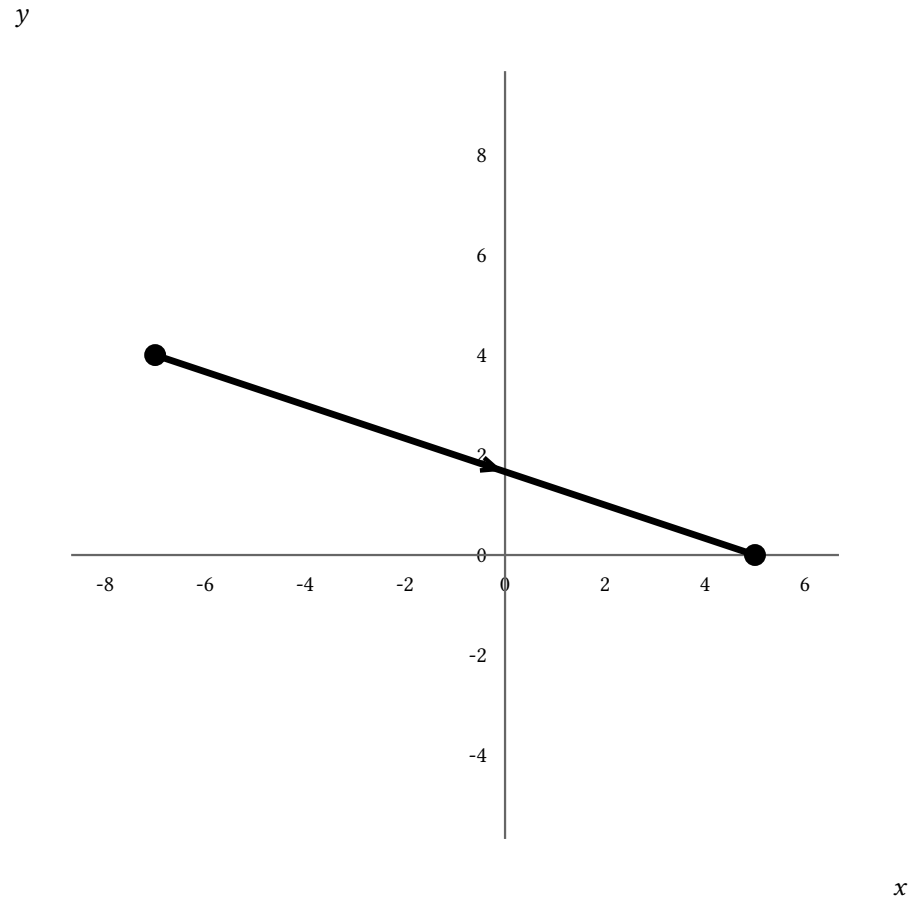
Parametric Equations of Lines

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: _____

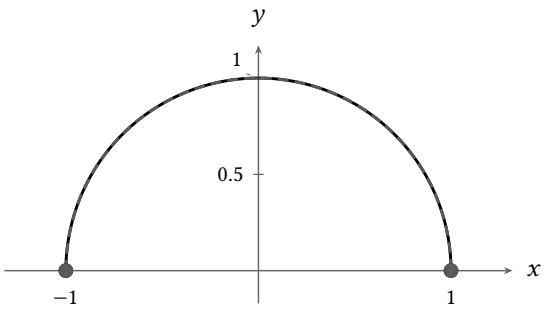
Model the ninety-second clockwise revolution from the delayed leftmost start.

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

Parametric Motion and Intersections

Parametric Motion and Intersections | APPC-U04-P03

96 problems · Four activity formats

Topic focus

Across 96 tasks this topic asks for all extrema with times and points, rightmost and highest positions, feasible interval, paired rules, paired model and all times and positions.

8 PDFs and a README; 149 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 Motion and Intersections

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.

Do the robots collide during the observation window?

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

Condition or evidence	Supplied value
Original time range or clock definition	$0 \le t \le 3$ seconds
Robot A	**X** t **Y** $2t$
Robot B	**X** $6 - 2t$ **Y** $8 - 2t$

Bank label: _____

AP Precalculus

Parametric Motion and Intersections

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.

Interpret the vehicle's location at $t = 4$ under the stated coordinate convention.

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

Condition or evidence	Supplied value
Coordinate direction convention	positive x west, positive y north
Original time range or clock definition	$0 \le t \le 5$ minutes
Time to evaluate	4
Given $x(t)$	$x = 6 - 2t$ kilometers
Given $y(t)$	$y = 1\text{-}t$ kilometers

Where is the object at the final modeled time?

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

Condition or evidence	Supplied value
Coordinate direction convention	positive x east, positive y upward
Original time range or clock definition	$0 \le t \le 5$ seconds
Time to evaluate	5
Given $x(t)$	$x = 1 - 2t$ meters
Given $y(t)$	$y = (t - 3)^2$ meters

Write the position model for the four-second interval.

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

Condition or evidence	Supplied value
Original time range or clock definition	$0 \le t \le 4$ seconds
Horizontal change	2 meters west each second
Initial horizontal coordinate	7
Vertical rule	$y = 3 + (t - 1)^2$ meters

List every ground event in the time window and the position at each one.

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

Condition or evidence	Supplied value
Original time range or clock definition	$0 \le t \le 5$ seconds
Given $x(t)$	$x = 2t - 3$ meters
Given $y(t)$	$y = (t - 1)(t - 4)$ meters

AP Precalculus

Parametric Motion and Intersections

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: At t = 4 seconds, at $(4, 3)$.

When is the object inside the corridor and at nonnegative height?

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
Conditions	$-2 \le x \le 4$ $y \ge 0$
Original time range or clock definition	$0 \le t \le 8$ seconds
Given $x(t)$	$x = t - 3$ meters
Given $y(t)$	$y = 12 - 2t$ meters

Your response: _____

Incoming: Leftmost and highest occur at t = 0, 4, both at $(0, 3)$. Rightmost and lowest occur at $t = 2$ at $(4, -1)$.

When does the object cross the x-axis?

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 time range or clock definition	$0 \le t \le 4$ seconds
Given $x(t)$	$x = \frac{1}{t+2}$ meters
Given $y(t)$	$y = t - 1$ meters

Your response: _____

Incoming: $t \in [0, 2] \cup [4, 5]$.

Find the position at $t = 3$ seconds.

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 time range or clock definition	$0 \le t \le 6$ seconds
Time to evaluate	3
Given $x(t)$	$x = t - 4$ meters
Given $y(t)$	$y = 2t + 1$ meters

Your response: _____

Incoming: At t = 1 the position is $(0, 0)$, and at the included endpoint $t = 3$ it is $(0, 2)$.

When is the object both on or right of the y-axis and at nonnegative height?

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
Conditions	$x \ge 0$ $y \ge 0$
Original time range or clock definition	$0 \le t \le 6$ seconds
Given $x(t)$	$x = t^2 - 1$ meters
Given $y(t)$	$y = 5\text{-}t$ meters

Your response: _____

AP Precalculus

Parametric Motion and Intersections

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 claim using the two supplied times.

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

Condition or evidence	Supplied value
Comparison times	2 3
Original time range or clock definition	$0 \le t \le 6$ seconds
Student claim to examine	At $t = 2$ the cart is moving left because $x(2) < 0$.
Given $x(t)$	$x = -5 + t$ meters
Given $y(t)$	$y = 2$ meters

A student claims the motion never reaches the y-axis during $0 \le t \le 3$ because the event would occur only after the interior of the interval. Identify the error, then give the correct event time and position.

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

Condition or evidence	Supplied value
Original time range or clock definition	$0 \le t \le 3$ seconds
Event	y-axis means $x = 0$
Given $x(t)$	$x = 3\text{-}t$ meters
Given $y(t)$	$y = t^2 + 1$ meters

Parametric Motion and Intersections

Full Worked Solutions - excerpt

Worked example

Problem. When does the object cross the y-axis?

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

Condition or evidence	Supplied value
Original time range or clock definition	$0 \le t \le 4$ seconds
Given $x(t)$	$x = 3t - 6$ meters
Given $y(t)$	$y = t^2$ meters

Answer. At t = 2 seconds, at $(0, 4)$ meters.

Explanation and check.

Set $x = 0$ to get $t = 2$, then evaluate y at that same time.

Worked example

Problem. List every ground event in the time window and the position at each one.

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

Condition or evidence	Supplied value
Original time range or clock definition	$0 \le t \le 5$ seconds
Given $x(t)$	$x = 2t - 3$ meters
Given $y(t)$	$y = (t - 1)(t - 4)$ meters

Answer. At t = 1 the position is $(-1, 0)$, and at $t = 4$ it is $(5, 0)$.

Explanation and check.

The height factors vanish at $t = 1$ and $t = 4$; the horizontal coordinate must be evaluated separately at each event time.

Sets & Steps
Math Practice & Worked Solutions

AP Precalculus

Average Rates and Speed in Parametric Motion

Average Rates and Speed in Parametric Motion | APPC-U04-P04

96 problems · Four activity formats

Topic focus

Across 96 tasks this topic asks for classification and slope, classification, slope, and orientation, slope status, slope status and direction, two ordered pairs and two rate pairs and scale factor.

8 PDFs and a README; 141 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

Average Rates and Speed in Parametric 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.

Find the average horizontal and vertical rates over the interval.

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

t	x	y
1	2	−1
3	8	5

Condition or evidence	Supplied value
Original interval or clock definition	$1 \le t \le 3$ seconds
Units	meters

Bank label: _____

AP Precalculus

Average Rates and Speed in Parametric 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.

Find average speed and average-velocity magnitude.

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

t	x	y
0	0	0
2	8	0
5	3	0

Condition or evidence	Supplied value
Original interval or clock definition	$0 \le t \le 5$ seconds
Segments	straight between rows
Units	meters

Find the endpoint after the stated interval.

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

Condition or evidence	Supplied value
Given component averages	-4 5
Original interval or clock definition	three-parameter-unit interval
Start	8 -1

Compute both exact average coordinate rates.

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

Condition or evidence	Supplied value
Original interval or clock definition	$3 \le t \le 8$ seconds
X rule	$x = \sqrt{t+1}$ meters
Y rule	$y = \frac{1}{t}$ meters

Determine the endpoint-secant slope from the exact rates.

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

Condition or evidence	Supplied value
Given average x-rate	$\frac{1}{3}$
Given average y-rate	0
Original interval or clock definition	common nonzero interval

AP Precalculus

Average Rates and Speed in Parametric 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: Average speed 2 meters per second; average-velocity magnitude $\frac{1}{2}$ meter per second.

Reconstruct the initial position that is compatible with the endpoint and both average rates.

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 component averages	-2 3
Original interval or clock definition	four-second observation window
End	5 8

Your response: _____

AP Precalculus

Average Rates and Speed in Parametric 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.

Diagnose and repair the student's calculation.

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

Condition or evidence	Supplied value
Original interval or clock definition	$2 \le t \le 5$ seconds
End point	7 11
Start point	1 2
Student claim to examine	The average vertical rate is $\frac{\Delta y}{\Delta x} = \frac{9}{6} = \frac{3}{2}$ meters per second.

A student claims: "The endpoint displacement is right and down, so the object moves right and down throughout the sampled interval." Diagnose the first invalid step or assumption, give the corrected conclusion, and justify the correction. Then complete the stated task: Use all rows, not just the endpoints, to describe net direction and any observed reversals.

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

t	x	y
0	−2	6
1	−5	4
3	−1	4
4	2	1

Condition or evidence	Supplied value
Original interval or clock definition	$0 \le t \le 4$ seconds
Student claim to examine	The endpoint displacement is right and down, so the object moves right and down throughout the sampled interval.

Average Rates and Speed in Parametric Motion

Full Worked Solutions - excerpt

Worked example

Problem. Determine the endpoint-secant slope from the exact rates.

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

Condition or evidence	Supplied value
Given average x-rate	$\frac{1}{3}$
Given average y-rate	0
Original interval or clock definition	common nonzero interval

Answer. 0

Explanation and check.

The nonzero horizontal rate permits division, and 0 divided by $\frac{1}{3}$ is 0.

Worked example

Problem. Determine the two finite coordinate rates across the entire parameter interval.

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 interval or clock definition	$1 \le t \le 4$
X	$3t - 2$
Y	$t^2 - 5$

Answer. $(3, 5)$

Explanation and check.

The endpoints change from $(1, -4)$ to $(10, 11)$, giving changes 9 and 15 over an interval of length 3.

Sets & Steps
Math Practice & Worked Solutions

AP Precalculus

Vector Components and Direction

Vector Components and Direction | APPC-U04-P10

96 problems · Four activity formats

Topic focus

Across 96 tasks this topic asks for classification with decisive evidence, vector, components, relations with components, equal, opposite, and non-equivalent relations and components and relation.

8 PDFs and a README; 146 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.

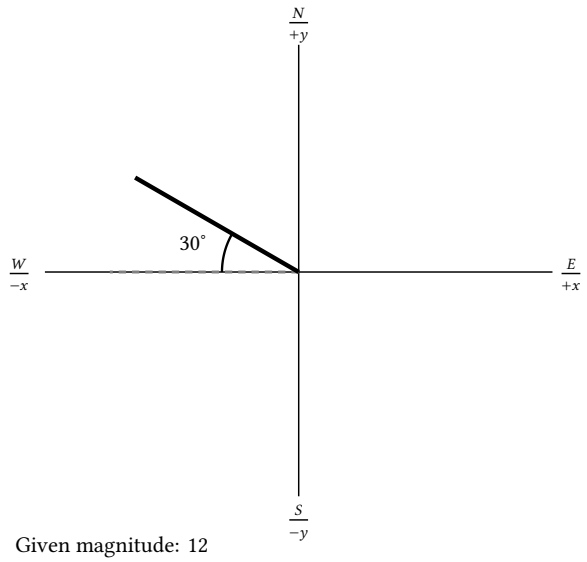
AP Precalculus

Vector Components and Direction

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.

Resolve the west-based heading into east and north components.



Given magnitude: 12

Bank label: _____

Find the directed component changes.

Domain: Cartesian plane; Head: $(2, 1)$; Tail: $(5, 5)$

Bank label: _____

AP Precalculus

Vector Components and Direction

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.

Do the two directed segments represent the same free vector even though they start at different points?

Required response

Arrow	Tail (x, y)	Head (x, y)
A	$1, 2$	$5, 5$
B	$-3, 0$	$1, 3$

State the magnitude and standard-position direction of the vector.

Components: $(0, 7)$; Domain: Cartesian plane; angles in degrees when stated

AP Precalculus

Vector Components and Direction

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 vector directed from the stated tail to the stated head.

Domain: Cartesian plane; angles in degrees when stated; Head: $(7, 1)$; Tail: $(2, 3)$

Your response: _____

AP Precalculus

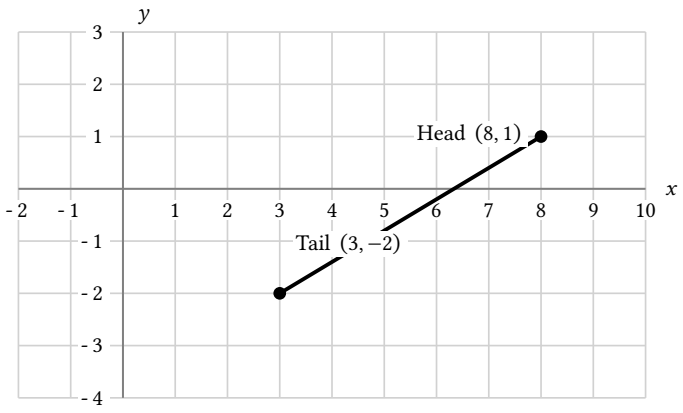
Vector Components and Direction

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.

Explain why the student's ordered pair is not the vector and give the correct components.

Domain: Cartesian plane; angles in degrees when stated; Head: $(8, 1)$; Student claim: The vector is $\langle 8, 1 \rangle$.; Tail: $(3, -2)$



Given arrow

Vector Components and Direction

Full Worked Solutions - excerpt

Worked example

Problem. Find the vector directed from the stated tail to the stated head.

Domain: Cartesian plane; angles in degrees when stated; Head: $(7, 1)$; Tail: $(2, 3)$

Answer. $\langle 5, -2 \rangle$

Explanation and check.

Subtracting tail coordinates from head coordinates gives horizontal change 5 and vertical change -2.

Worked example

Problem. Find the terminal point of the directed segment.

Domain: Cartesian plane; angles in degrees when stated; Tail: $(-2, 5)$; Vector: $(4, -3)$

Answer. The head is $(2, 2)$.

Explanation and check.

The head equals the tail plus the displacement, giving $(-2 + 4, 5 - 3) = (2, 2)$.

Sets & Steps
Math Practice & Worked Solutions

AP Precalculus

Vector Operations and Magnitude

Vector Operations and Magnitude | APPC-U04-P11

96 problems · Four activity formats

Topic focus

Across 96 tasks this topic asks for components, components of u+v, resultant and endpoint, resultant and final head, squared norms and longer expression and longer derived vector and exact squared norms.

8 PDFs and a README; 97 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

Vector Operations and Magnitude

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.

Combine the three displacements u, v, and w. Use the expression $u + v + w$. $u = \langle 1,\ 4 \rangle$ $v = \langle -3,\ 2 \rangle$ $w = \langle 5,\ -1 \rangle$ Bank label: _____	Multiply each component by the scalar. Use the expression $3u$. $u = \langle -2,\ 3 \rangle$ Bank label: _____
Compute the vector obtained by reversing u and multiplying its length by four. Use the expression $-4u$. $u = \langle -1,\ 2 \rangle$ Bank label: _____	Construct the unit vector preserving the direction. The given vector is $\langle -7,\ 24 \rangle$. Bank label: _____
Scale the direction to length 5 without rounding. The required magnitude is 5. Use the same direction as the given vector. The given vector is $\langle 12,\ -5 \rangle$. Bank label: _____	Construct the requested length without changing the downward direction. The required magnitude is 4. Use the same direction as the given vector. The given vector is $\langle 0,\ -9 \rangle$. Bank label: _____
Undo the subtraction to recover u. Use the equation $u - \langle 2, 7 \rangle = \langle -5, 1 \rangle$. Bank label: _____	Find the missing second summand. Use the equation $u + v =$ resultant. The resultant is $\langle 7,\ 2 \rangle$. $u = \langle -4,\ 9 \rangle$ Bank label: _____

AP Precalculus

Vector Operations and Magnitude

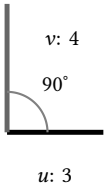
Name: _____ **Date:** _____ **Class:** _____

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.

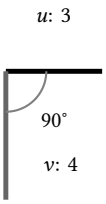
Use the right triangle formed by the two vectors to find the resultant magnitude.

The included angle, in degrees, is 90.

The vector magnitudes are $|u| = 3$ and $|v| = 4$.



One permitted placement



Reflected permitted placement

The two panels show alternative placements of the same data.

No absolute coordinate orientation is specified.

AP Precalculus

Vector Operations and Magnitude

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

Vector v points in the same direction as u and has magnitude $2\sqrt{13}$. Find v.

The magnitude of v is $2\sqrt{13}$.

The relation is v has the same direction as u.

$u = \langle 2,\ -3 \rangle$

Your response: _____

Incoming: v = $\langle 4, -6 \rangle$.

Isolate and determine v from the given scaled difference.

The given linear combination equals $\langle 1,\ -14 \rangle$.

Use the equation $3u - v = \langle 1, -14 \rangle$.

$u = \langle 2,\ -3 \rangle$

Your response: _____

Incoming: v = $\langle 5, 5 \rangle$.

Given $|u| = 5, |v| = 10$, and $u \cdot v = 20$, determine the smaller angle between the vectors.

The dot product $u \cdot v$ is 20.

The magnitude of u is 5.

The magnitude of v is 10.

Your response: _____

Incoming: $\cos\theta = \frac{2}{5}$, so $\theta \approx 66.4^\circ$.

Scale the direction to length 9.

The required magnitude is 9.

Use the same direction as the given vector.

The given vector is $\langle -8,\ -15 \rangle$.

Your response: _____

Incoming: $\langle -\frac{72}{17}, -\frac{135}{17} \rangle$

Undo the vector subtraction and verify the recovered minuend.

Use the equation $u - v = \langle 4, -7 \rangle$.

$v = \langle 2,\ 5 \rangle$

Your response: _____

Incoming: u = $\langle 6, -2 \rangle$; subtracting v returns $\langle 4, -7 \rangle$.

Isolate the unknown vector and check the original equation.

Use the equation $2u - v = w$.

$v = \langle 1,\ 5 \rangle$

$w = \langle 7,\ -3 \rangle$

Your response: _____

AP Precalculus

Vector Operations and Magnitude

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.

Determine whether the scalar relationship gives angle 0° or 180°.

$u = \langle -2,\ 5 \rangle$

$v = \langle -6,\ 15 \rangle$

Vector Operations and Magnitude

Full Worked Solutions - excerpt

Worked example

Problem. Solve the two vector equations simultaneously for u and v.

Use these conditions: $u + v = \langle 1, 9 \rangle,\ 2u - v = \langle 8, 3 \rangle$.

Answer. u = $\langle 3, 4 \rangle$ and $v = \langle -2, 5 \rangle$.

Explanation and check.

Adding the equations eliminates v and gives $3u = \langle 9, 12 \rangle$; substitution into the sum then determines v.

Worked example

Problem. Construct the unit vector preserving the direction.

The given vector is $\langle -7,\ 24 \rangle$.

Answer. $\langle -\frac{7}{25}, \frac{24}{25} \rangle$

Explanation and check.

The component pair has norm 25, so divide both entries by 25.

Sets & Steps
Math Practice & Worked Solutions

AP Precalculus

Velocity Vector Applications

Velocity Vector Applications | APPC-U04-P12

96 problems · Four activity formats

Topic focus

Across 96 tasks this topic asks for elapsed time and endpoint, required component and impossibility proof, final coordinates, exact coordinates, displacement and exact path length and net displacement and exact distance.

8 PDFs and a README; 123 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

Velocity Vector Applications

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

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

An aircraft flies due east at $120\frac{km}{h}$ relative to the air while $a50\frac{km}{h}$ wind blows due north. Find its ground velocity, speed, and course.

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

Condition or evidence	Supplied value
Air velocity ($\frac{km}{h}$)	$\langle 120, 0\rangle$
Coordinate convention	east-north
Given context	aircraft motion
Wind velocity ($\frac{km}{h}$)	$\langle 0, 50\rangle$

Bank label: _____

A boat covers displacement $\langle 24, 8\rangle$ km in 2 hours while its water-relative velocity is $\langle 10, 1\rangle$ $\frac{km}{h}$. Assuming a constant current, find it.

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

Condition or evidence	Supplied value
Coordinate convention	east-north
Boat velocity relative water ($\frac{km}{h}$)	$\langle 10, 1\rangle$
Given context	boat and current
Duration (hours)	2
Observed displacement (km)	$\langle 24, 8\rangle$

Bank label: _____

AP Precalculus

Velocity Vector Applications

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 plane flies at airspeed $200\,\frac{km}{h}$ on heading $N30^\circ E$ while the wind is $\langle -40, 20\rangle\ \frac{km}{h}$. Find the ground velocity and approximate ground course.

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

Condition or evidence	Supplied value
Airspeed ($\frac{km}{h}$)	200
Coordinate convention	east-north
Given context	aircraft navigation
Heading	$N30^\circ E$
Wind ($\frac{km}{h}$)	$\langle -40, 20\rangle$

A person walks at $\langle 1, 2\rangle\ \frac{m}{s}$ relative to a walkway moving at $\langle 3, 0\rangle\ \frac{m}{s}$ relative to the floor. Describe the person's ground motion.

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

Condition or evidence	Supplied value
Coordinate convention	forward-left
Given context	person on moving walkway
Person velocity relative walkway ($\frac{m}{s}$)	$\langle 1, 2\rangle$
Walkway velocity relative ground ($\frac{m}{s}$)	$\langle 3, 0\rangle$

Infer the current independently from each observation row and decide whether the constant-current model is supported.

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

interval	duration h	displacement km
1	2	$\langle 12, 6\rangle$
2	0.5	$\langle 3, 1.5\rangle$

Condition or evidence	Supplied value
Coordinate convention	east-north
Boat velocity relative water ($\frac{km}{h}$)	$\langle 8, 0\rangle$
Given context	repeated boat observations

Convert every duration to seconds before using the velocity table. Then find displacement and distance.

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

stage	duration	velocity
1	30 s	$\langle 2, 0\rangle$
2	1 min	$\langle 0, 1\rangle$
3	0.5 min	$\langle -1, 0\rangle$

Condition or evidence	Supplied value
Given context	stages with mixed time units
Velocity unit	$\frac{m}{s}$

AP Precalculus

Velocity Vector Applications

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

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

Incoming: The stage displacements sum to $\langle 0, 4\rangle$ *km*, whose magnitude is 4 km; the total distance is 20 km.

Find the current that changes water-relative velocity $\langle 10, 0\rangle$ $\frac{m}{s}$ into ground velocity $\langle 6, 8\rangle$ $\frac{m}{s}$.

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
Coordinate convention	east-north
Boat velocity relative water ($\frac{m}{s}$)	$\langle 10, 0\rangle$
Given context	boat velocity frames
Ground velocity ($\frac{m}{s}$)	$\langle 6, 8\rangle$

Your response: _____

AP Precalculus

Velocity Vector Applications

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

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

A student adds the two perpendicular speeds as scalars. Explain the error and correct the ground-speed calculation.

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

Condition or evidence	Supplied value
Coordinate convention	east-north
Given context	drone in wind
Drone air velocity ($\frac{m}{s}$)	$\langle 40, 0\rangle$
Student claim to examine	The ground speed is $40 + 30 = 70\frac{m}{s}$.
Wind ($\frac{m}{s}$)	$\langle 0, 30\rangle$

Infer the current from the two velocities and decide whether it can be due east as claimed.

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

Condition or evidence	Supplied value
Coordinate convention	east-north
Boat velocity relative water ($\frac{m}{s}$)	$\langle 3, 4\rangle$
Claimed current direction to test	due east
Given context	boat observation with directional assumption
Ground velocity ($\frac{m}{s}$)	$\langle 8, 5\rangle$

Velocity Vector Applications

Full Worked Solutions - excerpt

Worked example

Problem. The velocity does not change between the two table rows. Find displacement and distance after all 5 minutes.

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

Duration (min)	Given velocity (m/min)
2	$\langle 3, 0 \rangle$
3	$\langle 3, 0 \rangle$

Condition or evidence	Supplied value
Given context	collinear stages
Units	**Time** min **Given velocity** m/min

Answer. The displacement is $\langle\, 15, 0 \,\rangle\ m$ and the distance is 15 m.

Explanation and check.

The durations combine because the velocity is unchanged, so $5\langle\, 3, 0 \,\rangle$ gives the entire trip.

Worked example

Problem. Find the one-vector displacement and the scalar path length for the three stages.

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

Duration (s)	Given velocity (m/s)
2	$\langle 4, 0 \rangle$
1	$\langle 0, 3 \rangle$
1	$\langle -4, 0 \rangle$

Condition or evidence	Supplied value
Given context	three-sided path
Units	**Time** s **Given velocity** $\frac{m}{s}$

Answer. The net displacement is $\langle\, 4, 3 \,\rangle\ m$, and the distance is 15 m.

Explanation and check.

The displacements $\langle\, 8, 0 \,\rangle$, $\langle\, 0, 3 \,\rangle$, and $\langle\, -4, 0 \,\rangle$ add to the net; their lengths add to 15.

Sets & Steps
Math Practice & Worked Solutions

AP Precalculus

Vector-Valued Functions: Operations and Motion

Vector-Valued Functions: Operations and Motion | APPC-U04-P13

96 problems · Four activity formats

Topic focus

Across 96 tasks this topic asks for direction intervals, axis event, and stop, basis form and vector value, i-j notation, ordered-pair rule, vector table and insufficiency statement and formal component sum and interpretation verdict.

8 PDFs and a README; 65 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

Vector-Valued Functions: Operations and 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.

Use the supplied velocity value to describe the motion at $t = 3s$. Use $v(3) = \langle -2, 0 \rangle$. Velocity components are measured in meters per second.

Bank label: _____

Determine the discrete domain of $3u - 2w$ and evaluate the function everywhere it is defined. The table with inputs $0, 1, 2$ gives $u(t)$. The table with inputs $1, 2, 3$ gives $w(t)$.

Required response

0	$1, 0$
1	$2, 3$
2	$-1, 4$

1	$5, -2$
2	$0, 6$
3	$7, 1$

Bank label: _____

AP Precalculus

Vector-Valued Functions: Operations and 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.

Describe the velocity direction on the interval and identify every stationary time. Use $v(t) = \langle t - 2, (t-2)(t+1) \rangle \frac{m}{s}$. Use the time restriction $0 \le t \le 4$.	Combine the radical interval with the denominator exclusion, then evaluate at the left endpoint. Use $r(t) = \langle \sqrt{(}9\text{-}t^2), \frac{1}{t-1} \rangle$.
Find when the object is at the origin and compare its distances from the origin at $t = 0$ and $t = 2$. Use $p(t) = \langle t - 1, 2t - 2 \rangle$. Position components are measured in meters. Use the time restriction $0 \le t \le 2$.	Derive the speed function, then find the speeds at $t = -1$ and $t = 1$. Use $v(t) = \langle t + 1, -(t+1) \rangle$. Use the times $t = -1, 1$.
Form the resultant velocity and describe its direction for every real t. Use $v_1(t) = \langle t, t^2 \rangle$. Use $v_2(t) = \langle -t, 1 \rangle$. The stated time domain is all real t. Velocity components are measured in meters per second.	Write $d(t)$ in angle-bracket notation and find $d(-1)$. Use $d(t) = -(t-1)i + (2-3t)j$. The specified input is $t = -1$.

AP Precalculus

Vector-Valued Functions: Operations and 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.

START

Describe the motion implied by this supplied velocity function. Use $v(t) = \langle 0, 5 \rangle$. The stated time domain is all t. Velocity components are measured in meters per second.

Your response: _____

Incoming: The object always moves straight upward at $5\,\frac{m}{s}$, with no horizontal motion.

Use both the time restriction and radical condition to find the domain, then evaluate the boundary input. Use $r(t) = \langle \sqrt{(5-t)}, t + 2 \rangle$. Use the time restriction $t \geq 0$.

Your response: _____

Incoming: The domain is $[0, 5]$, and $r(5) = \langle 0, 7 \rangle$.

Build $2u\text{-}v$ componentwise and state every allowed real input. Use $u(t) = \langle \sqrt{t}, t \rangle, t \geq 0$. Use $v(t) = \langle t, \frac{1}{t-1} \rangle, t \neq 1$.

Your response: _____

Incoming: $(2u\text{-}v)(t) = \langle 2\sqrt{t}\text{-}t, 2t - \frac{1}{t-1} \rangle$ on $[0, 1) \cup (1, \infty)$.

Express p in i-j notation and evaluate the same vector function at $t = \frac{\pi}{2}$. Use $p(t) = \langle \cos t, \sin t \rangle$. The specified input is $t = \frac{\pi}{2}$.

Your response: _____

Incoming: $p(t) = (\cos t)i + (\sin t)j$, and $p(\frac{\pi}{2}) = j = \langle 0, 1 \rangle$.

Find the speed function and determine its least value. Use $v(t) = \langle t + 1, t - 1 \rangle$. The stated time domain is all real t. Velocity components are measured in meters per second.

Your response: _____

Incoming: $s(t) = \sqrt{(t+1)^2 + (t-1)^2} = \sqrt{2t^2 + 2}$; its minimum is $\sqrt{2}\,\frac{m}{s}$ at $t = 0$.

Combine the supplied component functions into a single basis-vector rule. Use $x(t) = \sin t$. Use $y(t) = \cos t$.

Your response: _____

AP Precalculus

Vector-Valued Functions: Operations and 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.

Explain what the position value actually tells and why the student's motion claim is unsupported. Use $p(4) = \langle -3, 4 \rangle$ meters. The student claims: The object is moving left and up at $t = 4$.

Vector-Valued Functions: Operations and Motion

Full Worked Solutions - excerpt

Worked example

Problem. Combine the supplied component functions into a single basis-vector rule. Use $x(t) = \sin t$. Use $y(t) = \cos t$.

Answer. $r(t) = (\sin t)i + (\cos t)j$.

Explanation and check.

Both scalar functions use the same input and become the two basis coefficients.

Worked example

Problem. Rewrite $q(t)$ in ordered-pair notation. Use $q(t) = (2 - t)i + (3t + 1)j$.

Answer. $q(t) = \langle 2 - t, 3t + 1 \rangle$.

Explanation and check.

The coefficient of i is the first component and the coefficient of j is the second.