Sets & Steps
Math Practice & Worked Solutions

Precalculus

Vectors & Vector-Valued Motion | 4-Topic Precalculus Bundle

4-topic bundle | 384 problems | Four activity formats

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01 **Vector Components and Direction**

View individual product and its full preview

02 **Vector Operations and Magnitude**

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03 **Velocity Vector Applications**

View individual product and its full preview

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

View individual product and its full preview

In every topic

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

Product previews

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

32 PDFs and 4 READMEs; 431 buyer PDF pages across the 4 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

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.

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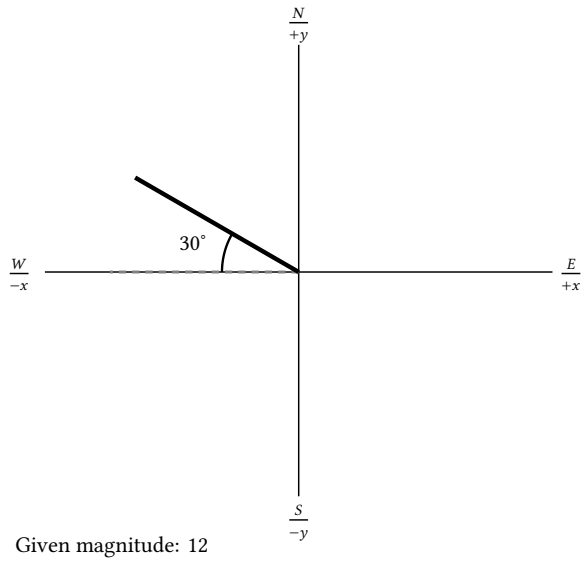
AP Precalculus

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

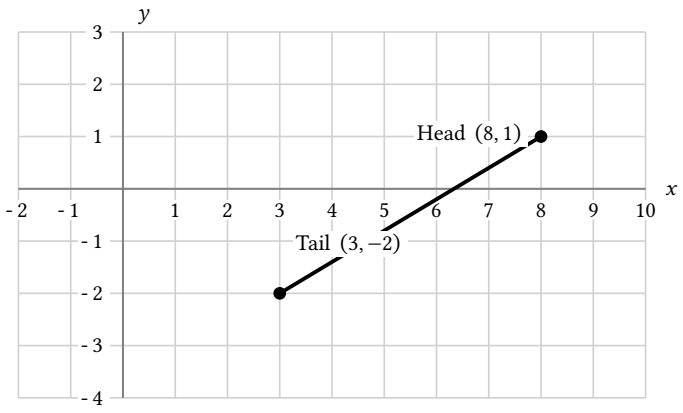
Vector Components and Direction

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.

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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

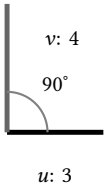
Name: _____ **Date:** _____ **Class:** _____

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.

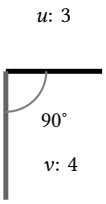
Use the right triangle formed by the two vectors to find the resultant magnitude.

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.

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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.

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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.