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

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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 $t = -1$.

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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: _____

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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 $t = 4$.

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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.