

Precalculus
Sinusoidal Features and Models

6-topic bundle | 576 problems | Four activity formats

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In every topic

Answer Bank Challenge	24 tasks
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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.

48 PDFs and 6 READMEs; 529 buyer PDF pages across the 6 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.

AP Precalculus

Sinusoidal Amplitude and Midline

Sinusoidal Amplitude and Midline | APPC-U03-P08

96 problems · Four activity formats

01	Answer Bank Challenge	24 tasks
02	Grid Rounds	24 tasks
03	Match & Move	24 cards
04	Error Analysis & Strategy	24 tasks
05	Quick Answer Key	96 answers
06	Full Worked Solutions	96 solutions
07	Teacher / Parent Use Guide	included
08	Terms of Use & License	included

Topic focus

Across 96 tasks this topic asks for exact transformed local range, feature comparison and invariant, global pointwise relation and proof, vertical transformation equation, first error and minimal repair and invalid claim or first invalid step, corrected conclusion, brief mathematical reason, and the requested underlying result.

8 PDFs and a README; 70 buyer pages.

AP Precalculus

Sinusoidal Amplitude
and Midline

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 $y = -4 \cos x + 1$, complete the table by applying the vertical output map to each listed parent output. Use the sign of the scale rather than reading a decorative graph height.

Required response

parent output	transformed output
0	_____
1	_____

Bank label: _____

For $y = 2 \cos x + 5$, complete the table by applying the vertical output map to each listed parent output. Use the sign of the scale rather than reading a decorative graph height.

Required response

parent output	transformed output
-1	_____
0	_____
1	_____

Bank label: _____

Under $y = 3 \sin x + 2$, a transformed output $Y = \frac{23}{4}$ is requested. Reverse the output map to find the required parent output, then decide whether that output is available from the sin parent.

Required response

required parent output	transformed output
_____	$\frac{23}{4}$

Bank label: _____

A complete cycle has minimum 2 and maximum 6. For the supplied parent $p(x) = \sin x$, the labeled anchor has parent output -1 and transformed output 6. Recover amplitude, midline, and every coefficient sign supported by this evidence.

Required response

feature	output	model output	parent output
global minimum	2	_____	_____
global maximum	6	_____	_____
anchor $x = 3\frac{\pi}{2}$	_____	6	-1

Bank label: _____

AP Precalculus

Sinusoidal Amplitude and Midline

Name: _____ Date: _____ Class: _____

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

For $y = (-\frac{1}{2})\cos x + 2$, the horizontal rule is fixed as the cos parent. State the amplitude, midline, full-cycle range, and whether the parent output is vertically reflected. 	On the stated x-window $[0, \frac{\pi}{2}]$, the sin parent has certified local output range $[0, 1]$. Under $y = 2\sin x + 1$, determine the transformed range on this same window, preserving open or closed endpoints. Do not substitute the full-cycle range.
For $y = -3\sin x - 2$, the horizontal rule is fixed as the sin parent. State the amplitude, midline, full-cycle range, and whether the parent output is vertically reflected. 	On the stated x-window $[-\frac{\pi}{2}, 0]$, the sin parent has certified local output range $[-1, 0]$. Under $y = 4\sin x + 1$, determine the transformed range on this same window, preserving open or closed endpoints. Do not substitute the full-cycle range.
For $y = 4\sin x - 3$, the horizontal rule is fixed as the sin parent. State the amplitude, midline, full-cycle range, and whether the parent output is vertically reflected. 	Compare $y = 3\cos x - 1$ and $y = -3\cos x - 1$. State amplitudes, midlines, full-cycle ranges, whether the ranges overlap, relative vertical orientation, and the horizontal invariant.

AP Precalculus

Sinusoidal Amplitude
and Midline

Name: _____ Date: _____ Class: _____

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

START

On the stated x -window $[\frac{\pi}{3}, \pi]$, the cos parent has certified local output range $[-1, \frac{1}{2}]$. Under $y = -2 \cos x + 2$, determine the transformed range on this same window, preserving open or closed endpoints. Do not substitute the full-cycle range.

Your response: _____

Incoming: $[1, 4]$; order reversed under the negative scale

Starting from $p(x) = \cos x$, perform this vertical-only task: Translate parent outputs by $\frac{3}{2}$, scale the result by 2, and finally translate by -5 . Write an equation with the same horizontal rule and show how the operation order controls the midline.

Your response: _____

Incoming: $y = 2(\cos x + \frac{3}{2}) - 5$

On the stated x -window $[0, \frac{\pi}{2})$, the cos parent has certified local output range $(0, 1]$. Under $y = 3 \cos x - 1$, determine the transformed range on this same window, preserving open or closed endpoints. Do not substitute the full-cycle range.

Your response: _____

Incoming: $(-1, 2]$; order preserved under the positive scale

A complete cycle has minimum -9 and maximum -1 . For the supplied parent $p(x) = \cos x$, the labeled anchor has parent output 1 and transformed output -1 . Recover amplitude, midline, and every coefficient sign supported by this evidence.

Required response

feature	output	model output	parent output
global minimum	-9	_____	_____
global maximum	-1	_____	_____
anchor $x = 0$	_____	-1	1

Your response: _____

AP Precalculus

Sinusoidal Amplitude
and Midline

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.

Audit the student’s vertical-feature inference using full-cycle extrema, the affine output map, operation order, and visible-window limits as relevant. Identify the first mathematical error and give the smallest sufficient repair. output map: $Y = -2p + 3$; restricted parent range: $[0, 1]$; student range: $[1, 5]$. Identify the error or first invalid step, give the corrected result, and state a brief mathematical reason.

A student claims: “Using the first two rows gives $a = 1$ and $d = 3$, so $Y = \cos x + 3$ fits all three rows.” Diagnose the first invalid step or assumption, give the corrected conclusion, and justify the correction. Then complete or verify the underlying task: Fit $Y = ap + d$ to the first two distinct parent-output rows in the supplied cos table, then audit the third row. State whether one vertical-only sinusoid fits all observations.

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

parent output	target output
−1	−2
0	1
1	4

Sinusoidal Amplitude and Midline

Full Worked Solutions - excerpt

Worked example

Problem. Starting from $p(x) = \cos x$, perform this vertical-only task: First multiply every $\cos$ output by -3 , then translate outputs by -1 . Write an equation with the same horizontal rule and show how the operation order controls the midline.

Answer. $y = -3 \cos x - 1$

Explanation and check.

Apply the actions to the output p in order. $Y = -3p - 1$; hence $y = -3 \cos x - 1$.

Worked example

Problem. Starting from $p(x) = \cos x$, perform this vertical-only task: Reflect the graph $y = \cos x$ across the horizontal line $y = 4$. Write an equation with the same horizontal rule and show how the operation order controls the midline.

Answer. $y = -\cos x + 8$

Explanation and check.

Apply the actions to the output p in order. $Y = 2(4) - p = -p + 8$; hence $y = -\cos x + 8$.

AP Precalculus
Period and Frequency of Sinusoids

Period and Frequency of Sinusoids | APPC-U03-P09

96 problems · Four activity formats

01	Answer Bank Challenge	24 tasks
02	Grid Rounds	24 tasks
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Topic focus

Across 96 tasks this topic asks for period and ordinary frequency, normalized frequencies and comparison, possible b values and verification, complete traversals, residual cycle, ending phase, first error and repair and supported candidates and needed evidence.

8 PDFs and a README; 75 buyer pages.

AP Precalculus

Period and Frequency of Sinusoids

Name: _____ Date: _____ Class: _____

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

For $y = \cos\left(-\frac{\pi}{4}x\right)$, the argument is in radians and x is measured in seconds. Find the smallest positive period and the ordinary frequency in cycles per input unit. Explain why the inside multiplier itself is not generally the ordinary frequency. _____ Bank label: _____	Construct $y = \sin(bx)$ or $y = \cos(bx)$ with period 4π; input is measured in radian units. The parent phase at the origin is fixed. Respect the stated sign information (either) and list every supported b, converting units before using $b = \frac{2\pi}{T}$. _____ Bank label: _____
A sinusoid has period $\frac{4}{3}$ seconds. An inclusive observation window lasts 5 seconds and begins $\frac{1}{2}$ of a cycle after the fixed cycle origin. Count complete cycle traversals within the elapsed window, the residual fraction of a traversal, and the ending phase modulo one cycle. Do not count an endpoint event as an extra traversal. _____ Bank label: _____	For $y = \cos((4)x)$, the argument is in radians and x is measured in seconds. Find the smallest positive period and the ordinary frequency in cycles per input unit. Explain why the inside multiplier itself is not generally the ordinary frequency. _____ Bank label: _____
Construct $y = \sin(bx)$ or $y = \cos(bx)$ with frequency $\frac{1}{8}$ cycles per hour; input is measured in hours. The parent phase at the origin is fixed. Respect the stated sign information (either) and list every supported b, converting units if needed before using $b = \frac{2\pi}{T}$. _____ Bank label: _____	A sinusoid has period 8 seconds. An inclusive observation window lasts 17 seconds and begins $\frac{7}{8}$ of a cycle after the fixed cycle origin. Count complete cycle traversals within the elapsed window, the residual fraction of a traversal, and the ending phase modulo one cycle. Do not count an endpoint event as an extra traversal. _____ Bank label: _____
For $y = \cos\left(3\frac{\pi}{2}x\right)$, the argument is in radians and x is measured in hours. Find the smallest positive period and the ordinary frequency in cycles per input unit. Explain why the inside multiplier itself is not generally the ordinary frequency. _____ Bank label: _____	Construct $y = \sin(bx)$ or $y = \cos(bx)$ with frequency 2 cycles per second; input is measured in seconds. The parent phase at the origin is fixed. Respect the stated sign information (either) and list every supported b, converting units if needed before using $b = \frac{2\pi}{T}$. _____ Bank label: _____

AP Precalculus

Period and Frequency of Sinusoids

Name: _____ Date: _____ Class: _____

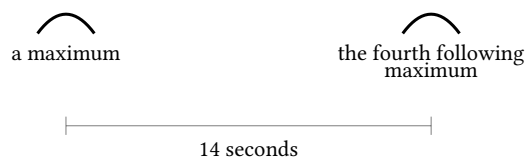
Answer each question and show your reasoning in the workspace. Give exact values rather than decimals unless the question supplies a decimal. A value without its unit is not a complete answer.

Map the listed parent-angle anchors u to the graph of $y = \cos(-3x)$. Complete the transformed x -inputs using $u = bx$, retain each parent output, and state whether left-to-right anchor order is preserved or reversed.

Required response

parent angle	parent output	transformed input
0	1	_____
$\frac{\pi}{2}$	0	_____
π	-1	_____
$3\frac{\pi}{2}$	0	_____
2π	1	_____

A sinusoidal graph labels a maximum and the fourth following maximum 14 seconds apart. The graph explicitly certifies the stated events as consecutive or gives the exact number skipped, and crossing directions are shown. Determine the smallest period and justify the cycle fraction used.



Map the listed parent-angle anchors u to the graph of $y = \cos(\frac{1}{3}x)$. Complete the transformed x -inputs using $u = bx$, retain each parent output, and state whether left-to-right anchor order is preserved or reversed.

Required response

parent angle	parent output	transformed input
0	1	_____
$\frac{\pi}{2}$	0	_____
π	-1	_____
$3\frac{\pi}{2}$	0	_____

Construct $y = \sin(bx)$ or $y = \cos(bx)$ with period 360; input is measured in degrees of physical input. The parent phase at the origin is fixed. Respect the stated sign information (either) and list every supported b , converting units before using $|b| = \frac{2\pi}{T}$.

AP Precalculus

Period and Frequency of Sinusoids

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 sinusoid has period 3 seconds. An inclusive observation window lasts 8 seconds and begins 0 of a cycle after the fixed cycle origin. Count complete cycle traversals within the elapsed window, the residual fraction of a traversal, and the ending phase modulo one cycle. Do not count an endpoint event as an extra traversal. Your response: _____	Incoming: 2 complete cycles; residual $\frac{2}{3}$ cycle; ending phase $\frac{2}{3}$ cycle Construct $y = \sin(bx)$ or $y = \cos(bx)$ with period 5; input is measured in minutes. The parent phase at the origin is fixed. Respect the stated sign information (positive) and list every supported b, converting units before using $b = \frac{2\pi}{T}$. Your response: _____
Incoming: $b = 2\frac{\pi}{5}$ For $y = \cos(\frac{1}{2}x)$, the argument is in radians and x is measured in radian input. Find the smallest positive period and the ordinary frequency in cycles per input unit. Explain why the inside multiplier itself is not generally the ordinary frequency. Your response: _____	Incoming: period 4π; frequency $\frac{1}{4\pi}$ cycles per input unit A sinusoid has period 2 seconds. An inclusive observation window lasts 6 seconds and begins $\frac{1}{4}$ of a cycle after the fixed cycle origin. Count complete cycle traversals within the elapsed window, the residual fraction of a traversal, and the ending phase modulo one cycle. Do not count an endpoint event as an extra traversal. Your response: _____

AP Precalculus

Period and Frequency of Sinusoids

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 supplied cos sample table is finite. Audit the listed candidate rules against every row and decide whether the period is identified. Explain any aliasing and name one minimal additional sample or bound that would resolve or narrow it. Measure the trigonometric arguments in radians. Compare the candidate rules $\cos(2\pi t)$, $\cos(4\pi t)$. Work with sinusoidal recurrence with fixed origin and phase. No additional constraint is supplied. Only the displayed finite samples are given. The supplied samples are (output 1; t_0), (output $-\frac{1}{2}$; $t_{\frac{1}{3}}$), (output $-\frac{1}{2}$; $t_{\frac{2}{3}}$), (output 1; t_1).

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

output	t
1	0
$-\frac{1}{2}$	$\frac{1}{3}$
$-\frac{1}{2}$	$\frac{2}{3}$
1	1

Audit the proposed horizontal-scaling explanation. Check nonconstancy, full-cycle phase change, landmark direction, sampling limits, and input units as relevant. Identify the first error and give the smallest sufficient repair. Work with sinusoidal recurrence with fixed origin and phase. Use $y = \sin(\pi \frac{t}{30})$. A student claims: frequency is $\frac{\pi}{30}$ cycles/s. Measure t in seconds.

Period and Frequency of Sinusoids

Full Worked Solutions - excerpt

Worked example

Problem. For $y = \sin((\pi)x)$, the argument is in radians and x is measured in seconds. Find the smallest positive period and the ordinary frequency in cycles per input unit. Explain why the inside multiplier itself is not generally the ordinary frequency.

Answer. period 2; frequency $\frac{1}{2}$ cycles per input unit

Explanation and check.

For a nonconstant parent, $T = \frac{2\pi}{|b|} = 2$. Then ordinary frequency is $\frac{1}{T} = \frac{1}{2}$; b instead measures radians of phase per input unit.

Worked example

Problem. For $y = \sin((6)x)$, the argument is in radians and x is measured in days. Find the smallest positive period and the ordinary frequency in cycles per input unit. Explain why the inside multiplier itself is not generally the ordinary frequency.

Answer. period $\frac{\pi}{3}$; frequency $\frac{3}{\pi}$ cycles per input unit

Explanation and check.

For a nonconstant parent, $T = \frac{2\pi}{|b|} = \frac{\pi}{3}$. Then ordinary frequency is $\frac{1}{T} = \frac{3}{\pi}$; b instead measures radians of phase per input unit.

AP Precalculus
Phase Shifts of Sine and Cosine

Phase Shifts of Sine and Cosine | APPC-U03-P10

96 problems · Four activity formats

01	Answer Bank Challenge	24 tasks
02	Grid Rounds	24 tasks
03	Match & Move	24 cards
04	Error Analysis & Strategy	24 tasks
05	Quick Answer Key	96 answers
06	Full Worked Solutions	96 solutions
07	Teacher / Parent Use Guide	included
08	Terms of Use & License	included

Topic focus

Across 96 tasks this topic asks for equivalence and canonical representatives, first error and minimal repair, new phase shift and event verification, shifted anchors and window qualification, phase classes or consistency conclusion and phase class and canonical representative.

8 PDFs and a README; 67 buyer pages.

AP Precalculus

Phase Shifts of
Sine and Cosine

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.

Translate every listed landmark of $y = \cos x$ horizontally by $h = 3\frac{\pi}{2}$. Complete the shifted coordinates, retain all y -values, and note that a plotting window may clip a landmark without changing the phase rule.

Required response

parent anchor	shifted x
x $-\pi$	_____
y -1	_____
x $-\frac{\pi}{2}$	_____
y 0	_____
x 0	_____
y 1	_____
x $\frac{\pi}{2}$	_____
y 0	_____

Bank label: _____

Amplitude, midline, family, and period are fixed as shown. Determine whether the observations identify one phase class, leave several, or are inconsistent. Treat a midline or nonextreme level without direction as ambiguous.

Given: domain: phase analysis with amplitude and period fixed; family: sin; midline: 0; observation table: (event: upward midline; x: 1); period: 4; signed amplitude: 1

Required response

event	x
upward midline	1

Bank label: _____

Amplitude, midline, family, and period are fixed as shown. Determine whether the observations identify one phase class, leave several, or are inconsistent. Treat a midline or nonextreme level without direction as ambiguous.

Given: domain: phase analysis with amplitude and period fixed; family: cos; midline: 0; observation table: (event: minimum; x: 7); period: 10; signed amplitude: 1

Required response

event	x
minimum	7

Bank label: _____

Amplitude, midline, family, and period are fixed as shown. Determine whether the observations identify one phase class, leave several, or are inconsistent. Treat a midline or nonextreme level without direction as ambiguous.

Given: domain: phase analysis with amplitude and period fixed; family: sin; midline: 0; observation table: (event: downward midline; x: 5); period: 8; signed amplitude: 1

Required response

event	x
downward midline	5

Bank label: _____

AP Precalculus

Phase Shifts of
Sine and Cosine

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.

Translate every listed landmark of $y = \sin x$ horizontally by $h = 13\frac{\pi}{4}$. Complete the shifted coordinates, retain all y -values, and note that a plotting window may clip a landmark without changing the phase rule.

Required response

parent anchor	shifted x
x $-\pi$ y 0	_____
x 0 y 0	_____
x π y 0	_____
x 2π y 0	_____

Amplitude, midline, family, and period are fixed as shown. Determine whether the observations identify one phase class, leave several, or are inconsistent. Treat a midline or nonextreme level without direction as ambiguous.

Given: domain: phase analysis with amplitude and period fixed; family: cos; midline: 0; observation table: (direction: not specified; level: midline; x: 3); period: 8; signed amplitude: 1

Required response

direction	level	x
not specified	midline	3

Translate every listed landmark of $y = \cos x$ horizontally by $h = -4\frac{\pi}{3}$. Complete the shifted coordinates, retain all y -values, and note that a plotting window may clip a landmark without changing the phase rule.

Required response

parent anchor	shifted x
x $-\pi$ y -1	_____
x $-\frac{\pi}{2}$ y 0	_____
x 0 y 1	_____
x $\frac{\pi}{2}$ y 0	_____

For $y = -\cos(2\pi(x-h)/10)$, amplitude sign and period are fixed. A labeled maximum occurs at $x=7$. Find h modulo the period and give the representative in $[0,10)$.

AP Precalculus

Phase Shifts of
Sine and Cosine

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: First issue: a positive-sine peak occurs a quarter period after h, so $h = 0$; repair/defense: subtract $\frac{T}{4}$ from the peak location. Rewrite the radian argument of $y = \cos((7/3)x - 14\pi/9)$ in the form $b(x-h)$. State h in x-units and distinguish it from the angular constant $-14\pi/9$. Your response: _____	Incoming: not equivalent; representatives $\frac{9}{2}$ and 2 differ modulo 5 Two sine rules have the same signed amplitude and period 7, with shifts $h_1 = -2$ and $h_2 = 12$. Decide whether they define the same graph. Reduce each shift modulo the period; a half-period difference does not count as equivalent when the amplitude sign is fixed. Your response: _____
Incoming: $h \equiv \frac{3}{2} \pmod{5}$; canonical $h = \frac{3}{2}$ Rewrite the radian argument of $y = \sin((-4/3)x + 10\pi/9)$ in the form $b(x-h)$. State h in x-units and distinguish it from the angular constant $10\pi/9$. Your response: _____	Incoming: equivalent; difference $12 = 1$ period(s); common representative 7 For $y = \sin(2\pi(x-h)/(5/2))$, amplitude sign and period are fixed. A labeled minimum occurs at $x = 19/8$. Find h modulo the period and give the representative in $[0, 5/2)$. Your response: _____
Incoming: argument $\frac{7}{3}(x - 2\frac{\pi}{3})$; $h = 2\frac{\pi}{3}$ Rewrite the radian argument of $y = \sin((-9/4)x - 27\pi/8)$ in the form $b(x-h)$. State h in x-units and distinguish it from the angular constant $-27\pi/8$. Your response: _____	Incoming: argument $10(x - 3\frac{\pi}{10})$; $h = 3\frac{\pi}{10}$ Rewrite $y = 2 \cos(2\pi \frac{x - \frac{3}{10}}{9})$ using the sin reference while holding period and midline fixed. Track the signed coefficient and explain the quarter-cycle phase convention; for advanced cases give both same-sign and opposite-sign target representatives. Your response: _____

AP Precalculus

Phase Shifts of Sine and Cosine

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.

Audit the proposed phase-shift claim. Normalize the argument, use the named event and signed family, and reduce representatives modulo the fixed period. Identify the first error or defend a valid noncanonical shift.

Given: domain: phase analysis with amplitude and period fixed; rule: $y = \sin(2x - \pi)$; student claim: shift right π

A student applies the horizontal shift to output values instead of translating the input landmarks with the stated sign. Diagnose the first mathematical error and state the correction. Then complete the original task: Translate every listed landmark of $y = \sin x$ horizontally by $h = \frac{\pi}{2}$. Complete the shifted coordinates, retain all y -values, and note that a plotting window may clip a landmark without changing the phase rule.

Required response

parent anchor	shifted x
x 0 y 0	_____
x $\frac{\pi}{2}$ y 1	_____
x π y 0	_____

Phase Shifts of Sine and Cosine

Full Worked Solutions - excerpt

Worked example

Problem. Rewrite the radian argument of $y = \cos((-7/2)x + 21\pi/4)$ in the form $b(x-h)$. State h in x -units and distinguish it from the angular constant $21\pi/4$.

Answer. argument $-\frac{7}{2}(x - 3\frac{\pi}{2})$; $h = 3\frac{\pi}{2}$

Explanation and check.

Solve $-\frac{7}{2}(x - h) = (-\frac{7}{2})x + 21\frac{\pi}{4}$. Since $h = -\frac{c}{b}$, $h = 3\frac{\pi}{2}$; the inside constant itself is not the displacement unless $b = -1$.

Worked example

Problem. Rewrite the radian argument of $y = \cos(10x - 3\pi)$ in the form $b(x-h)$. State h in x -units and distinguish it from the angular constant -3π .

Answer. argument $10(x - 3\frac{\pi}{10})$; $h = 3\frac{\pi}{10}$

Explanation and check.

Solve $10(x - h) = 10x - 3\pi$. Since $h = -\frac{c}{b}$, $h = 3\frac{\pi}{10}$; the inside constant itself is not the displacement unless $b = -1$.

AP Precalculus
Writing Sinusoidal Equations from Features

Writing Sinusoidal Equations from Features | APPC-U03-P11

96 problems · Four activity formats

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Topic focus

Across 96 tasks this topic asks for existence decision and first contradiction, equivalence decision and decisive normalized evidence, one compatible rule and sufficiency explanation, one complete rule and parameter verification, one example rule or impossibility proof and one sine rule with directional check.

8 PDFs and a README; 152 buyer pages.

AP Precalculus

Writing Sinusoidal Equations
from Features

Name: _____ Date: _____ Class: _____

Answer each question and record the matching bank letter. Give exact values. Give the whole requested response, including any reasoning the question asks for.

A nonconstant sinusoid has the exact global features shown. The timed events are consecutive. Construct one cosine rule, allowing a negative cosine coefficient when convenient, and verify the range, period, and event times.

Required response

event	value	x
global minimum	-3	$-\frac{5}{2}$
next global maximum	1	$\frac{5}{2}$

Bank label: _____

Determine which sinusoidal parameters are forced by the partial exact features and which remain free. Demonstrate any nonuniqueness by checking the two explicit candidate constructions, or replace either if it fails.

The first proposed rule is $y = 3 \cos(2\pi \frac{x+\frac{5}{2}}{6})$.

The second proposed rule is $y = 3 \cos(2\pi \frac{x+\frac{5}{2}}{3})$.

The global range is $[-3, 3]$.

The two stated maxima are not specified to be consecutive.

Maxima occur at $x = -\frac{5}{2}$ and $x = \frac{7}{2}$.

Bank label: _____

A nonconstant sinusoid has the exact global features shown. The timed events are consecutive. Construct one cosine rule, allowing a negative cosine coefficient when convenient, and verify the range, period, and event times.

Required response

event	value	x
global minimum	-3	$\frac{3}{2}$
next global maximum	3	$\frac{21}{2}$

Bank label: _____

Two rules are proposed as constructions for the same feature data. Decide whether they define the same function for every real x . Normalize sign, period, family, and phase; agreement at one landmark alone is not sufficient.

The claimed period is 10.

The claimed range is $[-4, 4]$.

The reference input is $x = -\frac{3}{2}$.

The first proposed rule is $y = 4 \sin(2\pi \frac{x+\frac{3}{2}}{10})$.

The second proposed rule is $y = 4 \cos(2\pi \frac{x-1}{10})$.

Bank label: _____

AP Precalculus

Writing Sinusoidal Equations from Features

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.

An exact partial graph is supplied with its global range, labeled events and directions, and the stipulation that the curve continues sinusoidally. Construct one compatible cosine rule and explain why clipping does or does not hide needed information.

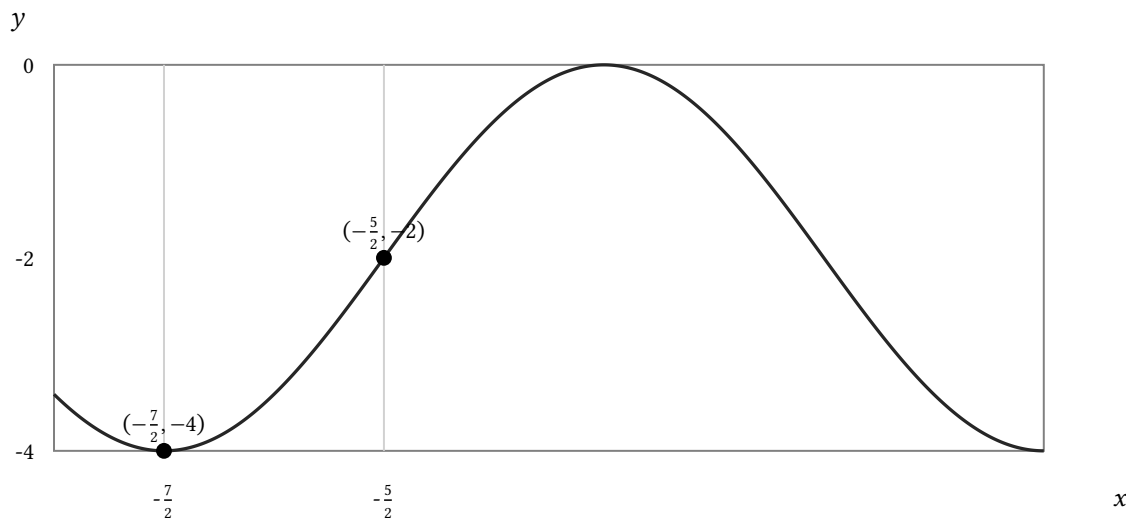
The curve continues sinusoidally beyond the displayed interval.

The global range is $[-4, 0]$.

The labeled minimum is $(-\frac{7}{2}, -4)$.

The labeled upward midline is $(-\frac{5}{2}, -2)$.

The displayed x -interval is $[-4, \frac{1}{2}]$.



event	x	y
minimum	$-\frac{7}{2}$	-4
upward midline	$-\frac{5}{2}$	-2

AP Precalculus

Writing Sinusoidal Equations from Features

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: No compatible sinusoidal function exists: the range forces midline $\frac{-2+2}{2} = 0$, not 1.
A nonconstant sinusoid has the exact global features shown. The timed events are consecutive. Construct one cosine rule, allowing a negative cosine coefficient when convenient, and verify the range, period, and event times.



event	value	x
global maximum	0	$\frac{21}{2}$
next global maximum	0	$\frac{57}{2}$
global minimum	-6	not specified

Your response: _____

AP Precalculus

Writing Sinusoidal Equations from Features

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.

Audit the student's multi-parameter reconstruction against every exact feature. Identify the earliest failed parameter relation, retain valid deductions, give a corrected complete rule, and verify the repaired model.

Preserve the valid deductions when repairing the model.

The supplied features are: range $[0, 6]$, period 4, upward midline at $x = 1$.

The student proposes $y = 3 + 3 \sin(2\pi \frac{x-1}{8})$.

Two rules are proposed as constructions for the same feature data. Decide whether they define the same function for every real x . Normalize sign, period, family, and phase; agreement at one landmark alone is not sufficient.

The claimed period is 14.

The claimed range is $[-3, 1]$.

The reference input is $x = \frac{11}{2}$.

The first proposed rule is $y = -1 + 2 \sin(2\pi \frac{x-\frac{11}{2}}{14})$.

The second proposed rule is $y = -1 + 2 \sin(2\pi \frac{x-9}{14})$.

Writing Sinusoidal Equations from Features

Full Worked Solutions - excerpt

Worked example

Problem. Test whether one nonconstant sinusoidal function can have every exact feature shown. Check range, recurrence, event direction, and single-valuedness before attempting a formula.

The claimed midline is $y = 1$.

The global range is $[-2, 2]$.

Answer. No compatible sinusoidal function exists: the range forces midline $\frac{-2+2}{2} = 0$, not 1 .

Explanation and check.

The first decisive contradiction is that the range forces midline $\frac{-2+2}{2} = 0$, not 1 . Therefore the feature set is inconsistent.

Worked example

Problem. Test whether one nonconstant sinusoidal function can have every exact feature shown. Check range, recurrence, event direction, and single-valuedness before attempting a formula.

The claimed midline is $y = -1$.

The global range is $[-4, 0]$.

Answer. No compatible sinusoidal function exists: the range forces midline $\frac{-4+0}{2} = -2$, not -1 .

Explanation and check.

The first decisive contradiction is that the range forces midline $\frac{-4+0}{2} = -2$, not -1 . Therefore the feature set is inconsistent.

AP Precalculus
Interpreting Sinusoidal Transformations

Interpreting Sinusoidal Transformations | APPC-U03-P13

96 problems · Four activity formats

01	Answer Bank Challenge	24 tasks
02	Grid Rounds	24 tasks
03	Match & Move	24 cards
04	Error Analysis & Strategy	24 tasks
05	Quick Answer Key	96 answers
06	Full Worked Solutions	96 solutions
07	Teacher / Parent Use Guide	included
08	Terms of Use & License	included

Topic focus

Across 96 tasks this topic asks for changed and invariant physical features, relevant common-scale comparison, first misleading claim and corrected quantitative statement, phase event and initial-value qualification, contextual attained range and boundary status and parameter meanings and derived features.

8 PDFs and a README; 85 buyer pages.

AP Precalculus

Interpreting Sinusoidal Transformations

Name: _____ Date: _____ Class: _____

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

Rewrite the supplied model in the requested input/output units or datum. Convert the input coordinate inside the argument and the output coordinate outside it, then verify one named physical event in both systems. conversion: $u = \frac{t}{60}$ minutes and $R = \frac{Q}{100}$ meters; input unit before: seconds; named event: cosine maximum; original model: $Q(t) = 230 + 40 \cos(2\pi \frac{t-90}{300})$; output unit before: centimeters. _____ Bank label: _____	Interpret every relevant coefficient of the supplied model in complete contextual sentences. Normalize an expanded argument before reading phase, distinguish signed coefficient from amplitude, and attach output or time units correctly. argument form: factored argument; input unit: hours; output unit: degrees; supplied formula: $Q(t) = 11 + 3 \cos(2\pi \frac{t-3}{16})$; valid window: 0, 64. _____ Bank label: _____
Rewrite the supplied model in the requested input/output units or datum. Convert the input coordinate inside the argument and the output coordinate outside it, then verify one named physical event in both systems. conversion: $R = \frac{Q}{100}$ meters; input unit before: seconds; named event: cosine maximum; original model: $Q(t) = 210 + 40 \cos(2\pi \frac{t-30}{360})$; output unit before: centimeters. _____ Bank label: _____	Interpret every relevant coefficient of the supplied model in complete contextual sentences. Normalize an expanded argument before reading phase, distinguish signed coefficient from amplitude, and attach output or time units correctly. argument form: factored argument; input unit: hours; output unit: degrees; supplied formula: $Q(t) = 9 + 5 \cos(2\pi \frac{t-4}{8})$; valid window: 0, 32. _____ Bank label: _____

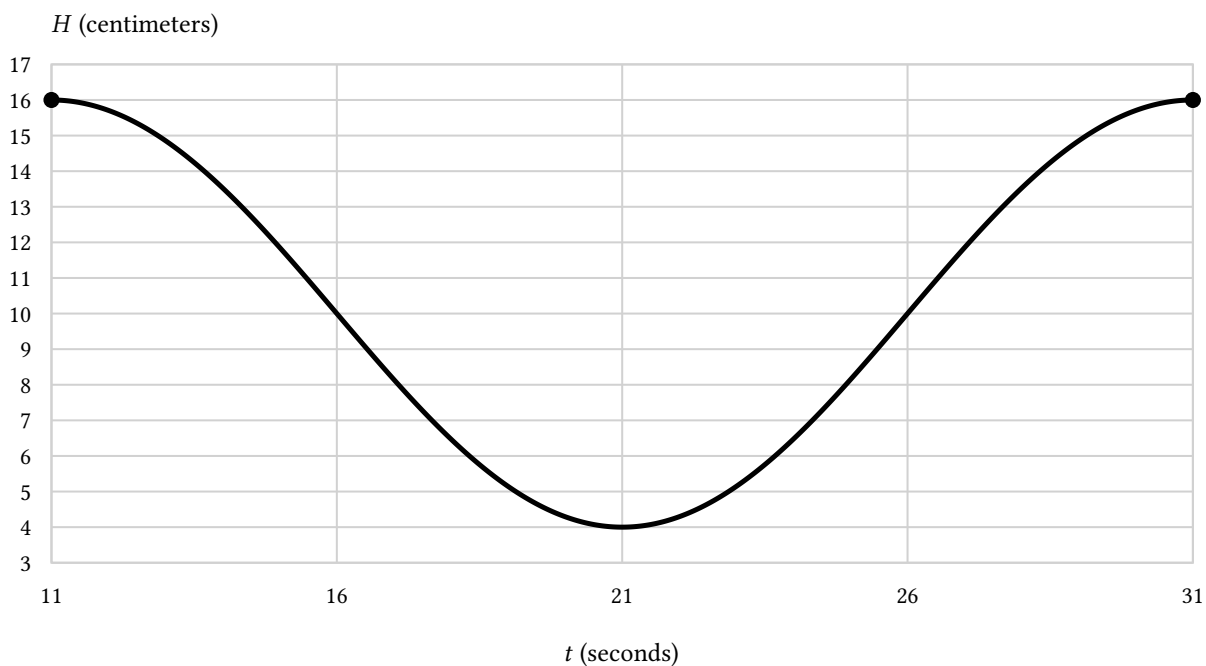
AP Precalculus

Interpreting Sinusoidal Transformations

Name: _____ Date: _____ Class: _____

Answer each question and show your reasoning in the workspace. Give exact values rather than decimals unless the question supplies a decimal. A value without its unit is not a complete answer.

Interpret the supplied graph only on its physical operating window. State the attainable output interval, midline meaning, and whether displayed boundaries are attained; do not substitute the full mathematical range when the window clips an extremum.



AP Precalculus

Interpreting Sinusoidal Transformations

Name: _____ Date: _____ Class: _____

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

START Compare the supplied original and changed models. Explain the physical consequence of the one parameter category that changed and explicitly name the range, recurrence, or event features that remain invariant. changed formula: $P_2(t) = 7 + 4 \sin(2\pi \frac{t-7}{16})$; only changed category: period; original formula: $P(t) = 7 + 4 \sin(2\pi \frac{t-7}{8})$; output unit: units; time unit: hours. Your response: _____	Incoming: period doubles from 8 to 16 time units, so recurrence halves; range and the anchor at $t = \frac{7}{2}$ stay fixed. Rewrite the supplied model in the requested input/output units or datum. Convert the input coordinate inside the argument and the output coordinate outside it, then verify one named physical event in both systems. conversion: new datum is 52 cm above the old datum, so $R = Q - 52$; input unit before: seconds; named event: cosine maximum; original model: $Q(t) = 220 + 60 \cos(2\pi \frac{t-60}{240})$; output unit before: centimeters. Your response: _____
Incoming: $R(t) = 168 + 60 \cos(2\pi \frac{t-60}{240})$; event times are unchanged while every height label decreases by 52 cm. Interpret every relevant coefficient of the supplied model in complete contextual sentences. Normalize an expanded argument before reading phase, distinguish signed coefficient from amplitude, and attach output or time units correctly. argument form: factored argument; input unit: hours; output unit: meters; supplied formula: $Q(t) = 10 + 4 \sin(2\pi \frac{t+\frac{3}{2}}{10})$; valid window: 0, 40. Your response: _____	Incoming: amplitude 4 meters; midline 10 meters; period 10 hours; frequency $\frac{1}{10}$ cycle per hour; $h = -\frac{3}{2}$ hours labels an upward midline crossing. Compare the two supplied contextual models on a common unit scale. Address only the feature relevant to the stated practical measure—range, recurrence, baseline, or phase equivalence—and identify what cannot distinguish the models. common units: input: hours; output: units; formula pair: $A(t) = 6 + 5 \sin(2\pi \frac{t-\frac{3}{2}}{12})$, $B(t) = 8 + 5 \sin(2\pi \frac{t-\frac{3}{2}}{12})$; practical measure: same-period. Your response: _____
Incoming: same period 12 hours and same spread 10, but B's baseline and range are 2 units higher. Compare the supplied original and changed models. Explain the physical consequence of the one parameter category that changed and explicitly name the range, recurrence, or event features that remain invariant. changed formula: $P_2(\tau) = 8 + 5 \sin(2\pi \frac{\tau}{10})$; only changed category: clock; original formula: $P(t) = 8 + 5 \sin(2\pi \frac{t-4}{10})$; output unit: units; time unit: hours. Your response: _____	Incoming: with $t = \tau + 4$, the same physical anchor is labeled $\tau = 0$ rather than $t = 4$; range and physical period are unchanged. Rewrite the supplied model in the requested input/output units or datum. Convert the input coordinate inside the argument and the output coordinate outside it, then verify one named physical event in both systems. conversion: $u = \frac{t}{60}$ minutes; input unit before: seconds; named event: cosine maximum; original model: $Q(t) = 200 + 40 \cos(2\pi \frac{t}{360})$; output unit before: centimeters. Your response: _____

AP Precalculus**Interpreting Sinusoidal Transformations****Name:** _____ **Date:** _____ **Class:** _____

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

Test the student's contextual parameter statement against the supplied model. Identify the first misleading claim and replace it with a quantitatively correct statement including units or window limits where relevant. context units: stated in formula or prompt; student statement: The period is 4π .; supplied model: $Q(t) = 4 + 3 \sin(4\pi(t - 2))$. Identify the error or first invalid step, give the corrected result, and state a brief mathematical reason.

Interpreting Sinusoidal Transformations

Full Worked Solutions - excerpt

Worked example

Problem. Compare the two supplied contextual models on a common unit scale. Address only the feature relevant to the stated practical measure—range, recurrence, baseline, or phase equivalence—and identify what cannot distinguish the models. common units: input: hours; output: units; formula pair: $A(t) = 5 + 2 \sin(2\pi \frac{t+2}{8})$, $B(t) = 5 + 2 \sin(2\pi \frac{t+2}{16})$; practical measure: same-range.

Answer. same range $[3, 7]$, but B recurs every 16 rather than 8 hours.

Explanation and check.

Normalize the ranges, periods, and reference families. The decisive result is: same range $[3, 7]$, but B recurs every 16 rather than 8 hours.

Worked example

Problem. Compare the two supplied contextual models on a common unit scale. Address only the feature relevant to the stated practical measure—range, recurrence, baseline, or phase equivalence—and identify what cannot distinguish the models. common units: input: hours; output: units; formula pair: $A(t) = 5 + 4 \sin(2\pi \frac{t-1}{10})$, $B(t) = 5 + 4 \sin(2\pi \frac{t-1}{20})$; practical measure: same-range.

Answer. same range $[1, 9]$, but B recurs every 20 rather than 10 hours.

Explanation and check.

Normalize the ranges, periods, and reference families. The decisive result is: same range $[1, 9]$, but B recurs every 20 rather than 10 hours.

AP Precalculus

Sinusoidal Modeling

Sinusoidal Modeling | APPC-U03-P12

96 problems · Four activity formats

01	Answer Bank Challenge	24 tasks
02	Grid Rounds	24 tasks
03	Match & Move	24 cards
04	Error Analysis & Strategy	24 tasks
05	Quick Answer Key	96 answers
06	Full Worked Solutions	96 solutions
07	Teacher / Parent Use Guide	included
08	Terms of Use & License	included

Topic focus

Across 96 tasks this topic asks for family decision with evidentiary limit, model recommendation or insufficiency conclusion, invalid claim or first invalid step, corrected conclusion, brief mathematical reason, and the requested underlying result, invalid assumption and actionable repair, plausible fitted rule and uncertainty statement and signed-residual diagnosis and revision recommendation.

8 PDFs and a README; 80 buyer pages.

AP Precalculus

Sinusoidal Modeling

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 accepted model to locate the requested contextual event. Screen solutions by the closed time window and crossing direction; the second occurrence of a level is not automatically the first upward occurrence. Use the accepted model $y = 10 + 3 \sin(2\pi \frac{t+\frac{5}{2}}{8})$. The event level is $y = 10$. Find the first upward midline crossing in the window. Time is measured in hours. Use the time window $[-\frac{31}{6}, \frac{27}{2}]$.

Bank label: _____

The contextual extrema are exact and the cycle is stipulated stationary only on the feasible time domain. Construct one sinusoidal model in the stated time unit, explain which events determine a full or half cycle, and retain the domain restriction. The feasible time domain is $[8, 80]$. Time is measured in days.

Required response

event	time	value
minimum	8	11
next minimum	26	11

Bank label: _____

Evaluate the accepted fitted rule at the target time, then classify the use relative to the sample window. Report the contextual unit and state whether stationarity evidence supports the prediction or only makes it conditional. The supplied fitted formula is $y = 20 + 3 \cos(2\pi \frac{t+3}{8})$. The response is measured in units. The sample time window is $[-11, 13]$. Stationarity has been verified only within the sample window. Evaluate the requested prediction at $t = -3$. Time is measured in hours.

Bank label: _____

Use the accepted model to locate the requested contextual event. Screen solutions by the closed time window and crossing direction; the second occurrence of a level is not automatically the first upward occurrence. Use the accepted model $y = 12 + 3 \sin(2\pi \frac{t-\frac{11}{2}}{14})$. The event level is $y = 12$. Find the first upward midline crossing in the window. Time is measured in hours. Use the time window $[\frac{5}{6}, \frac{67}{2}]$.

Bank label: _____

AP Precalculus

Sinusoidal Modeling

Name: _____ Date: _____ Class: _____

Answer each question and show your reasoning in the workspace. Give exact values rather than decimals unless the question supplies a decimal. A value without its unit is not a complete answer.

Compare the fitted sinusoids for the stated use case. Weigh observed-window error, physical range, prediction horizon, and divergence. If the evidence cannot distinguish them for the intended decision, recommend a specific validation measurement. The intended decision is at $t = 34$. The observed time window is $[0, 13]$. The response tolerance is 1 unit.

Required response

future prediction	model	observed window RMSE	period
21	A	0.43	11
26	B	0.45	14

The dataset and fully specified candidate regression outputs are supplied. Select every usable model in the stated angle mode. Verify at least one observed or held-out landmark and do not infer software behavior that is not shown. Use radians mode on the calculator.

Required response

formula	label	t	y
$y = 3 + 2 \cos(2\pi \frac{t-10}{8})$	A	10	5
$y = 3 + 2 \sin(2\pi \frac{t-8}{8})$	B	14	1
		18	5

Use the signed residual definition shown. Assess both the pattern across phases and the held-out observation; a small total error does not excuse a systematic pattern. Recommend retention, revision, or investigation. The absolute tolerance is 0.75. At held-out time $t = 5$, the signed residual is 0.11.

Required response

observed minus predicted	t
0.11	0
-0.11	1
0.0	2
0.11	3
-0.11	4

Use several measurements rather than a single high or low value to estimate a stationary sinusoid. Give a plausible rule, identify the approximate baseline, amplitude, period, and phase, and state what the finite noisy sampling cannot establish exactly. The measured response is in units. Time is measured in hours.

Required response

measurement	time
24.2	$\frac{13}{2}$
19.8	$\frac{23}{2}$
20.2	$\frac{43}{2}$
23.8	$\frac{53}{2}$

AP Precalculus

Sinusoidal Modeling

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 Evaluate the accepted fitted rule at the target time, then classify the use relative to the sample window. Report the contextual unit and state whether stationarity evidence supports the prediction or only makes it conditional. The supplied fitted formula is $y = 23 + 4 \cos(2\pi \frac{t-4}{12})$. The response is measured in units. The sample time window is $[-8, 28]$. Stationarity has been verified only within the sample window. Evaluate the requested prediction at $t = 13$. Time is measured in hours. Your response: _____	Incoming: Prediction 8: 23 units; interpolation inside the sampled window. Use the accepted model to locate the requested contextual event. Screen solutions by the closed time window and crossing direction; the second occurrence of a level is not automatically the first upward occurrence. Use the accepted model $y = 12 + 4 \sin(2\pi \frac{t-5}{8})$. The event level is $y = 12$. Find the second occurrence of the midline level in the window, counting either direction. Time is measured in hours. Use the time window $[\frac{5}{2}, \frac{21}{2}]$. Your response: _____
Incoming: Event case 6: $t = \frac{13}{2}$ (downward). A point rotates uniformly on the mechanism described. Model its height above the stated datum over the operating window. Use the start position and motion direction to choose the sign and reference family, and verify the geometric range. The center height above the datum is 9. Initially the point is initial vertical velocity zero, then downward. Use seconds as the time unit for t. The operating window is $\frac{1}{2} \leq t \leq \frac{85}{2}$. The radius is 6. The starting position is top. The starting time is $t = \frac{1}{2}$. One uniform rotation takes 14 seconds. Your response: _____	Incoming: $y = 9 + 6 \cos(2\pi \frac{t-\frac{1}{2}}{14})$ Audit the modeling claim separately from algebraic curve fit. Identify the physical, unit, or evidence assumption that fails and state a revision that changes the model or restricts its use. Evaluate this claim: Treat negative depth as physically valid. A fitted water-depth sinusoid has range $[-2, 8]$ meters. Your response: _____
Incoming: Water depth in $[-2, 8]$ meters includes negative depth. Restrict use to nonnegative depths or refit with a nonnegative constrained model. Use the accepted model to locate the requested contextual event. Screen solutions by the closed time window and crossing direction; the second occurrence of a level is not automatically the first upward occurrence. Use the accepted model $y = 10 + 6 \sin(2\pi \frac{t-\frac{1}{2}}{14})$. The event level is $y = 10$. Find the all upward midline crossings in the window. Time is measured in hours. Use the time window $[\frac{1}{2}, \frac{57}{2}]$. Your response: _____	Incoming: Event case 4: $t = \frac{1}{2}, \frac{29}{2}, \frac{57}{2}$. A point rotates uniformly on the mechanism described. Model its height above the stated datum over the operating window. Use the start position and motion direction to choose the sign and reference family, and verify the geometric range. The center height above the datum is 7. Initially the point is initial vertical velocity zero, then upward. Use seconds as the time unit for t. The operating window is $-\frac{5}{2} \leq t \leq \frac{43}{2}$. The radius is 3. The starting position is bottom. The starting time is $t = -\frac{5}{2}$. One uniform rotation takes 8 seconds. Your response: _____

AP Precalculus**Sinusoidal Modeling****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.

Audit the modeling claim separately from algebraic curve fit. Identify the physical, unit, or evidence assumption that fails and state a revision that changes the model or restricts its use. Evaluate this claim: Combine times without a common clock origin. Tidal observations are in hours after midnight on different dates.

Audit the modeling claim separately from algebraic curve fit. Identify the physical, unit, or evidence assumption that fails and state a revision that changes the model or restricts its use. Evaluate this claim: Repair only the phase of a stationary sinusoid. A sensor baseline rises steadily while residuals alternate.

Sinusoidal Modeling

Full Worked Solutions - excerpt

Worked example

Problem. Audit the modeling claim separately from algebraic curve fit. Identify the physical, unit, or evidence assumption that fails and state a revision that changes the model or restricts its use. Evaluate this claim: Use $T = 3$ with t measured in seconds. The fitted period is 3 minutes but t is entered in seconds.

Answer. Assumption repair 3: convert the period to 180 seconds, or convert every input to minutes.

Explanation and check.

The claim fails because the stated context does not support its physical or unit assumption. The actionable revision is to convert the period to 180 seconds, or convert every input to minutes.

Worked example

Problem. Audit the modeling claim separately from algebraic curve fit. Identify the physical, unit, or evidence assumption that fails and state a revision that changes the model or restricts its use. Evaluate this claim: Extrapolate the fitted cycle indefinitely. Seasonal data cover one year during an unusual shutdown.

Answer. Assumption repair 4: limit claims to the observed window and gather ordinary-year validation data.

Explanation and check.

The claim fails because the stated context does not support its physical or unit assumption. The actionable revision is to limit claims to the observed window and gather ordinary-year validation data.