

Sinusoidal Modeling

State the modeling assumptions, identify amplitude, midline, period and phase, then answer the contextual query with units.

1. Use the displayed graph of water depth against time. Build a sine model on $2 \leq t \leq 9$ hours and interpret its amplitude, midline, period, and angular frequency.

Assumptions: The tide data are noiseless and exactly periodic on the bounded interval $2 \leq t \leq 9$ hours; no regression or extrapolation is intended.

2. Use the displayed graph of rider height against time. Build a cosine model on $0 \leq t \leq 6$ seconds and interpret its amplitude, midline, period, and angular frequency.

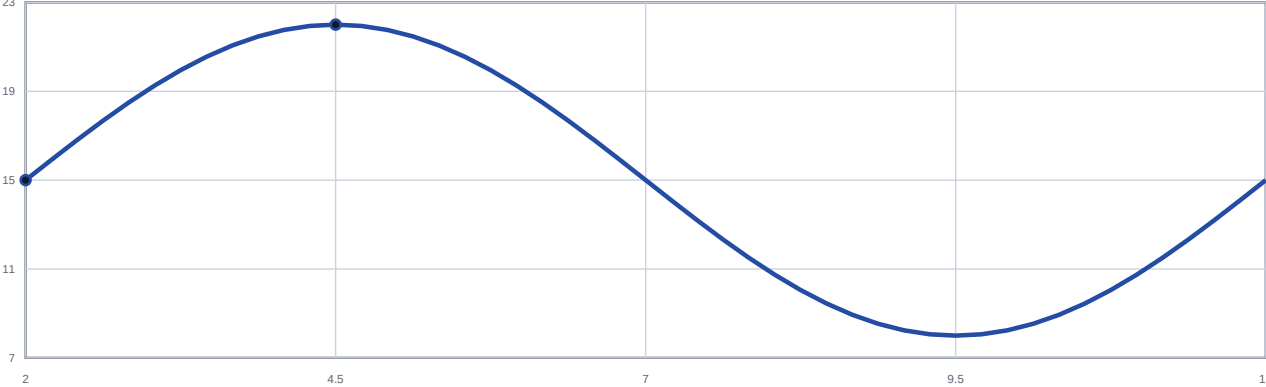
Assumptions: The circular motion data are noiseless and exactly periodic on the bounded interval $0 \leq t \leq 6$ seconds; no regression or extrapolation is intended.

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State the modeling assumptions, identify amplitude, midline, period and phase, then answer the contextual query with units.

3. Use the displayed graph of rider height against time. Build a sine model on $2 \leq t \leq 12$ seconds and find the rider height at $t=4.5$ seconds.

Assumptions: The circular motion data are noiseless and exactly periodic on the bounded interval $2 \leq t \leq 12$ seconds; no regression or extrapolation is intended.



4. The rider height ranges from 5 to 17 meters, repeats every 6 seconds, and at $t=1$ crosses the midline while increasing. Build a sine model on $1 \leq t \leq 7$ seconds and find the first maximum with $t>1$.

Assumptions: The circular motion data are noiseless and exactly periodic on the bounded interval $1 \leq t \leq 7$ seconds; no regression or extrapolation is intended.

Math Sheet

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Sinusoidal Modeling

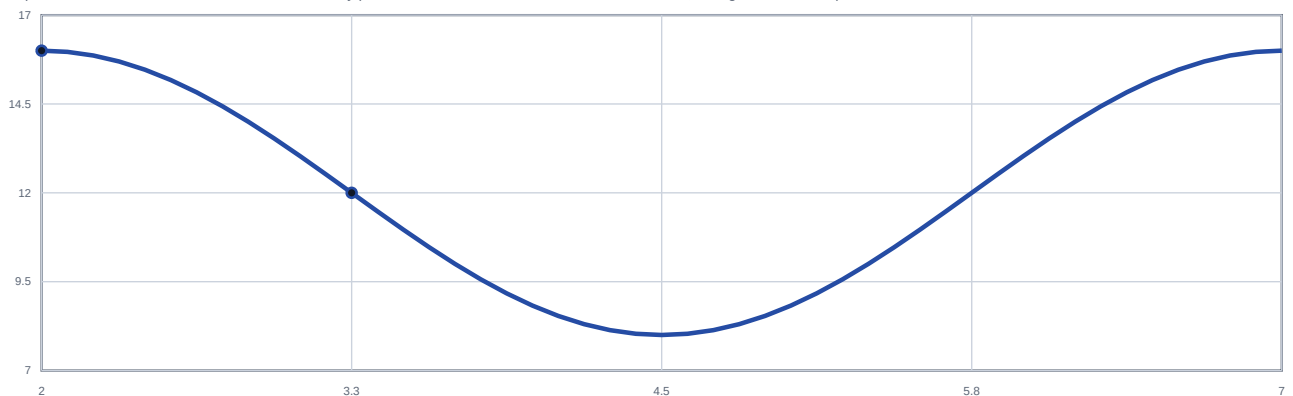
State the modeling assumptions, identify amplitude, midline, period and phase, then answer the contextual query with units.

5. The average temperature ranges from 3 to 11 degrees Celsius, repeats every 5 months, and at $t=0$ is at a maximum. Build a cosine model on $0 \leq t \leq 5$ months and find the average temperature at $t=1.25$ months.

Assumptions: The seasonal data are noiseless and exactly periodic on the bounded interval $0 \leq t \leq 5$ months; no regression or extrapolation is intended.

6. Use the displayed graph of average temperature against time. Build a cosine model on $2 \leq t \leq 7$ months and interpret its amplitude, midline, period, and angular frequency.

Assumptions: The seasonal data are noiseless and exactly periodic on the bounded interval $2 \leq t \leq 7$ months; no regression or extrapolation is intended.

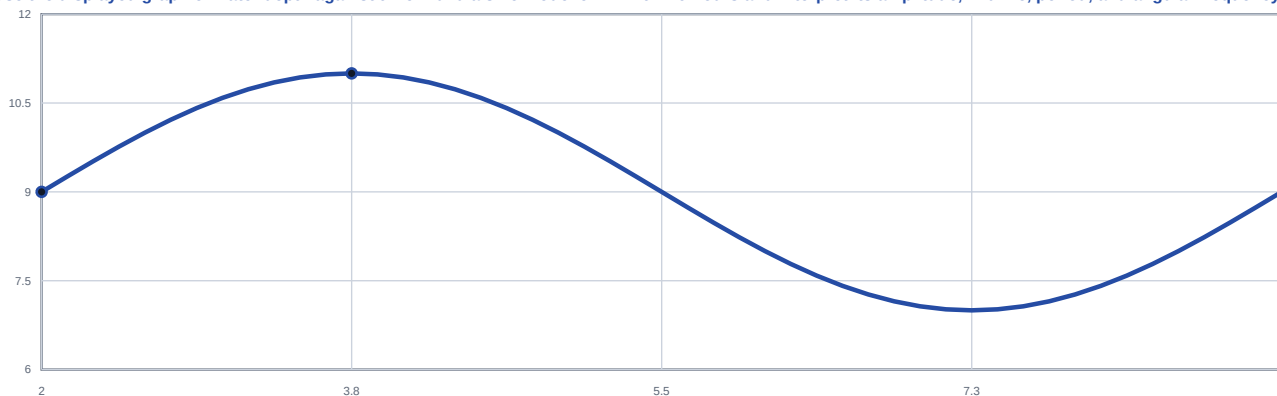


Sinusoidal Modeling

Worked Answer Key

State the modeling assumptions, identify amplitude, midline, period and phase, then answer the contextual query with units.

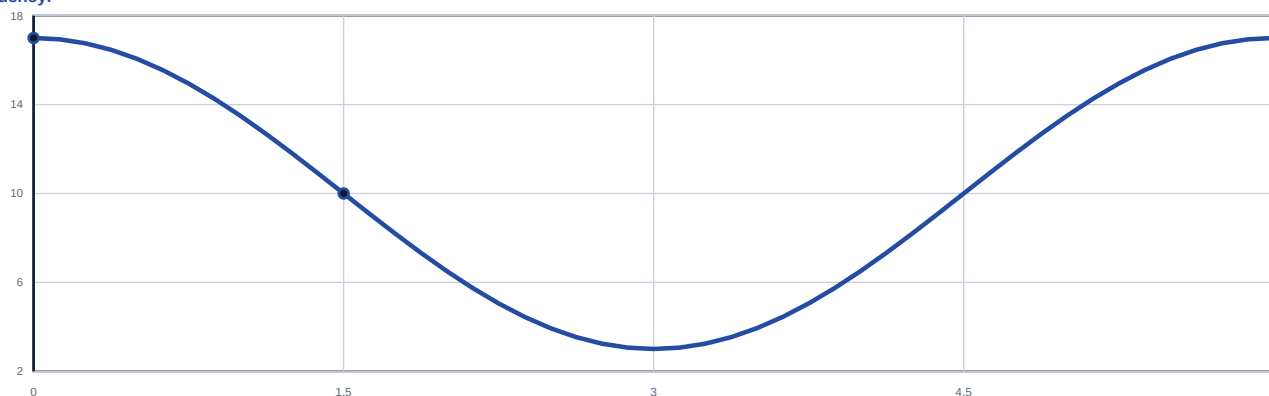
1. Use the displayed graph of water depth against time. Build a sine model on $2 \leq t \leq 9$ hours and interpret its amplitude, midline, period, and angular frequency.



Answer: $y = 2\sin\left(\frac{2\pi}{7}(t-2)\right) + 9$; amplitude 2 meters, midline 9 meters, period 7 hours, angular frequency $2\pi/7$ radians per time unit

1. Read maximum 11 and minimum 7 from the graph; amplitude = $(11-7)/2 = 2$.
2. Midline = $(11+7)/2 = 9$; one complete repeat gives period 7 hours.
3. The stated maximum or increasing midline crossing fixes the sine phase at $t=2$; angular frequency is $2\pi/7$ radians per time unit.
4. Use the model only on $2 \leq t \leq 9$ and report meters or hours as appropriate.

2. Use the displayed graph of rider height against time. Build a cosine model on $0 \leq t \leq 6$ seconds and interpret its amplitude, midline, period, and angular frequency.



Answer: $y = 7\cos\left(\frac{\pi}{3}t\right) + 10$; amplitude 7 meters, midline 10 meters, period 6 seconds, angular frequency $\pi/3$ radians per time unit

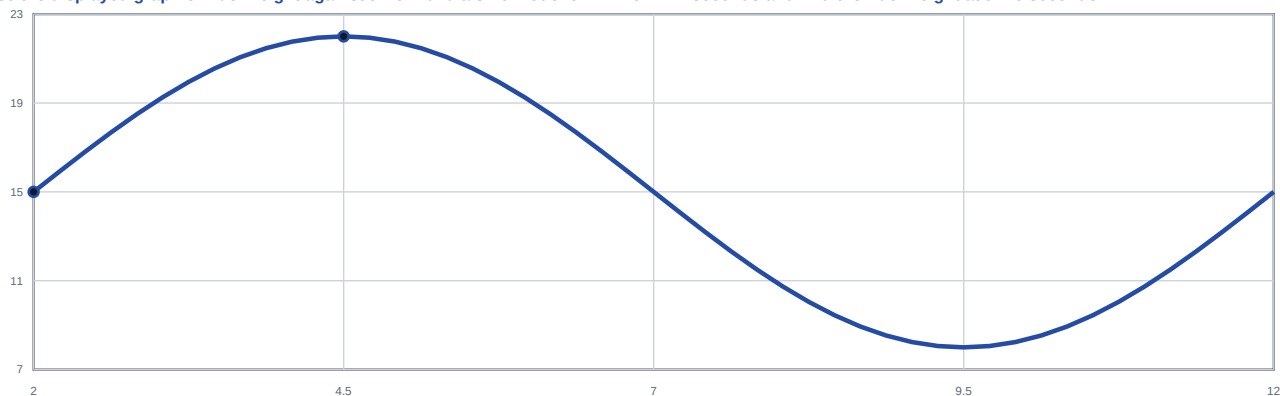
1. Read maximum 17 and minimum 3 from the graph; amplitude = $(17-3)/2 = 7$.
2. Midline = $(17+3)/2 = 10$; one complete repeat gives period 6 seconds.
3. The stated maximum or increasing midline crossing fixes the cosine phase at $t=0$; angular frequency is $\pi/3$ radians per time unit.
4. Use the model only on $0 \leq t \leq 6$ and report meters or seconds as appropriate.

Sinusoidal Modeling

Worked Answer Key

State the modeling assumptions, identify amplitude, midline, period and phase, then answer the contextual query with units.

3. Use the displayed graph of rider height against time. Build a sine model on $2 \leq t \leq 12$ seconds and find the rider height at $t=4.5$ seconds.



Answer: $y = 7\sin((\pi/5)(t-2)) + 15$; rider height = 22 meters

1. Read maximum 22 and minimum 8 from the graph; amplitude = $(22-8)/2 = 7$.
2. Midline = $(22+8)/2 = 15$; one complete repeat gives period 10 seconds.
3. The stated maximum or increasing midline crossing fixes the sine phase at $t=2$; angular frequency is $\pi/5$ radians per time unit.
4. Use the model only on $2 \leq t \leq 12$ and report meters or seconds as appropriate.

4. The rider height ranges from 5 to 17 meters, repeats every 6 seconds, and at $t=1$ crosses the midline while increasing. Build a sine model on $1 \leq t \leq 7$ seconds and find the first maximum with $t>1$.

Answer: $y = 6\sin((\pi/3)(t-1)) + 11$; first maximum after the reference is $t=2.5$ seconds

1. Read maximum 17 and minimum 5 from the extrema and period; amplitude = $(17-5)/2 = 6$.
2. Midline = $(17+5)/2 = 11$; one complete repeat gives period 6 seconds.
3. The stated maximum or increasing midline crossing fixes the sine phase at $t=1$; angular frequency is $\pi/3$ radians per time unit.
4. Use the model only on $1 \leq t \leq 7$ and report meters or seconds as appropriate.

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Sinusoidal Modeling

Worked Answer Key

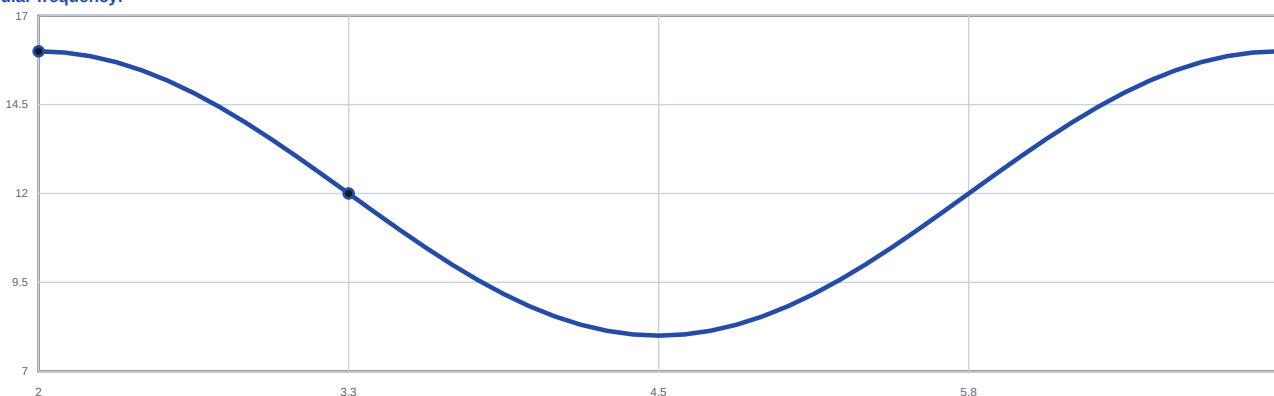
State the modeling assumptions, identify amplitude, midline, period and phase, then answer the contextual query with units.

5. The average temperature ranges from 3 to 11 degrees Celsius, repeats every 5 months, and at $t=0$ is at a maximum. Build a cosine model on $0 \leq t \leq 5$ months and find the average temperature at $t=1.25$ months.

Answer: $y = 4\cos((2\pi/5)t) + 7$; average temperature = 7 degrees Celsius

1. Read maximum 11 and minimum 3 from the extrema and period; amplitude = $(11-3)/2 = 4$.
2. Midline = $(11+3)/2 = 7$; one complete repeat gives period 5 months.
3. The stated maximum or increasing midline crossing fixes the cosine phase at $t=0$; angular frequency is $2\pi/5$ radians per time unit.
4. Use the model only on $0 \leq t \leq 5$ and report degrees Celsius or months as appropriate.

6. Use the displayed graph of average temperature against time. Build a cosine model on $2 \leq t \leq 7$ months and interpret its amplitude, midline, period, and angular frequency.



Answer: $y = 4\cos((2\pi/5)(t-2)) + 12$; amplitude 4 degrees Celsius, midline 12 degrees Celsius, period 5 months, angular frequency $2\pi/5$ radians per time unit

1. Read maximum 16 and minimum 8 from the graph; amplitude = $(16-8)/2 = 4$.
2. Midline = $(16+8)/2 = 12$; one complete repeat gives period 5 months.
3. The stated maximum or increasing midline crossing fixes the cosine phase at $t=2$; angular frequency is $2\pi/5$ radians per time unit.
4. Use the model only on $2 \leq t \leq 7$ and report degrees Celsius or months as appropriate.