

3.6B Sinusoidal Functions Transformations

AP Precalculus

Solutions

3.6B Practice

Identify the following attributes of each function.

1. $f(x) = 13 \sin\left(4\left(x + \frac{\pi}{11}\right)\right) - 7$

Amp: 13 Period: $\frac{2\pi}{4} = \frac{\pi}{2}$

Phase Shift: left $\frac{\pi}{11}$

Vertical Shift: down 7

2. $f(\theta) = 2 \sin\left(\frac{\theta}{2} - \frac{\pi}{5}\right) - 5$

Amp: 2 Period: $\frac{2\pi}{\frac{1}{2}} = 4\pi$

Phase Shift: right $\frac{2\pi}{5}$

Vertical Shift: down 5

3. $f(x) = 6 \cos\left(3x + \frac{\pi}{6}\right) + 11$

Amp: 6 Period: $\frac{2\pi}{3}$

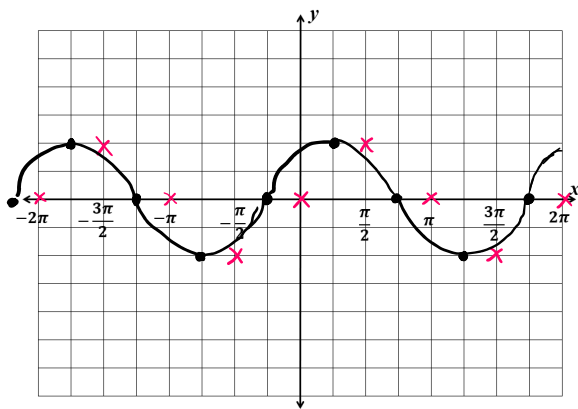
Phase Shift: left $\frac{\pi}{6}$

Vertical Shift: up 11

Graph the trig function.

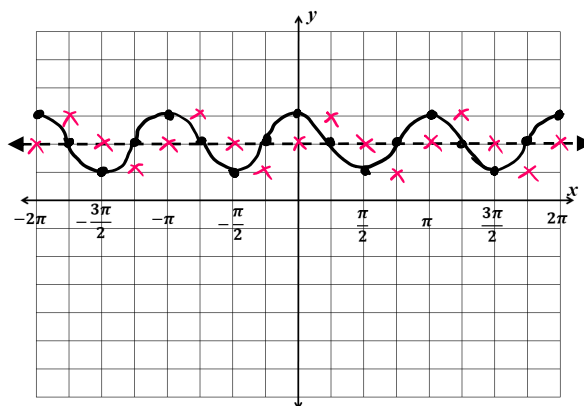
4. $y = 2 \sin\left(x + \frac{\pi}{4}\right)$

Period = 2π
left $\frac{\pi}{4}$



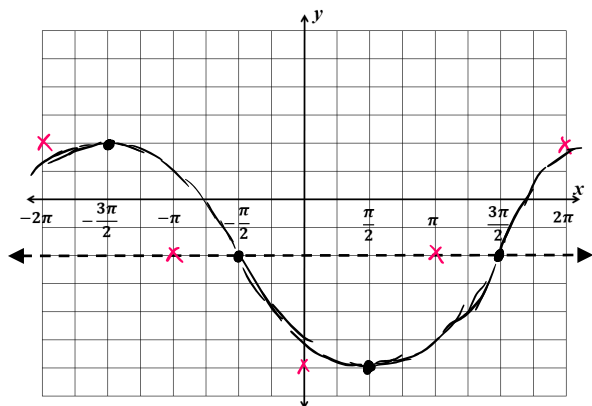
5. $y = 2 + \sin\left(2\left(x + \frac{\pi}{4}\right)\right)$

Period: $2\frac{2\pi}{2} = \pi$
left $\frac{\pi}{4}$
up 2



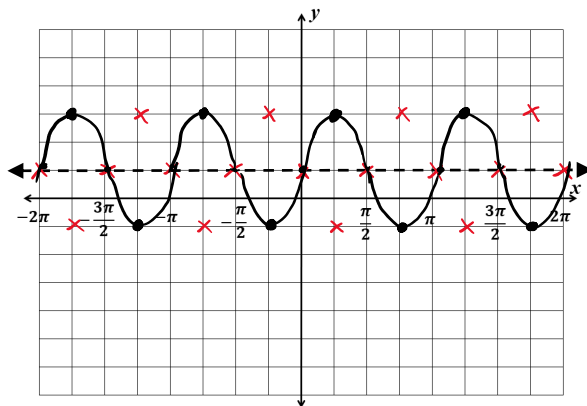
6. $y = -4 \cos\left(\frac{1}{2}\left(x - \frac{\pi}{2}\right)\right) - 2$

Period: $2\frac{2\pi}{\frac{1}{2}} = 4\pi$
right $\frac{\pi}{2}$
down 2

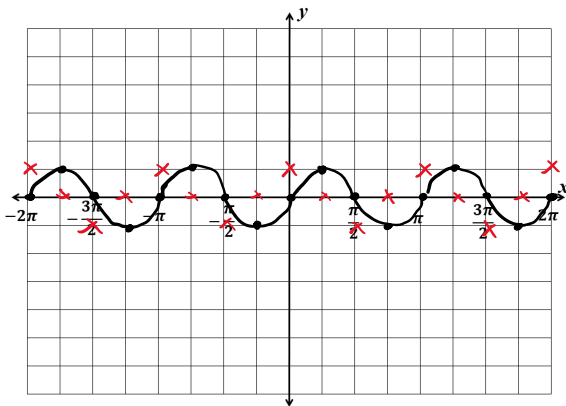


7. $y = -2 \sin(2x + \pi) + 1$

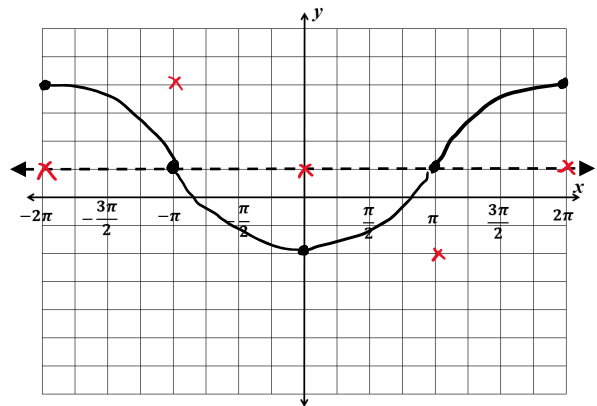
Period $2\frac{2\pi}{2} = \pi$
left $\frac{\pi}{2}$ up 1



8. $y = \cos\left(2x - \frac{\pi}{2}\right)$
 $2\left[x - \frac{\pi}{4}\right]$ right $\frac{\pi}{4}$
 Period $\frac{2\pi}{2} = \pi$



9. $y = -3 \sin\left(\frac{x}{2} + \frac{\pi}{2}\right) + 1$
 $\frac{1}{2}\left[x + \pi\right]$ left π
 Period: $\frac{2\pi}{\frac{1}{2}} = 4\pi$ up 1



Create a sine function that matches the following attributes.

10. Amplitude: 2
 Period: $\frac{3\pi}{2}$
 Phase Shift: left $\frac{5\pi}{9}$
 Vertical Shift: down 14

$\frac{2\pi}{b} = \frac{3\pi}{2}$
 $2\pi \cdot \frac{2}{3\pi} = b$
 $\frac{4}{3} = b$
 $y = 2 \sin\left(\frac{4}{3}\left[x + \frac{5\pi}{9}\right]\right) - 14$

$y = 2 \sin\left(\frac{4}{3}x + \frac{20\pi}{27}\right) - 14$

11. Amplitude: 5
 Period: $\frac{\pi}{6}$
 Phase Shift: right $\frac{\pi}{24}$
 Vertical Shift: up 8

$\frac{2\pi}{b} = \frac{\pi}{6}$
 $2\pi \cdot \frac{6}{\pi} = b$
 $12 = b$
 $y = 5 \sin\left(12\left[x - \frac{\pi}{24}\right]\right) + 8$

$y = 5 \sin\left(12x - \frac{\pi}{2}\right) + 8$

12. Amplitude: 1
 Period: 6
 Phase Shift: left $\frac{6\pi}{7}$
 Vertical Shift: up 2

$\frac{2\pi}{b} = 6$
 $\frac{\pi}{3} = b$
 $y = \sin\left(\frac{\pi}{3}\left[x + \frac{6\pi}{7}\right]\right) + 2$

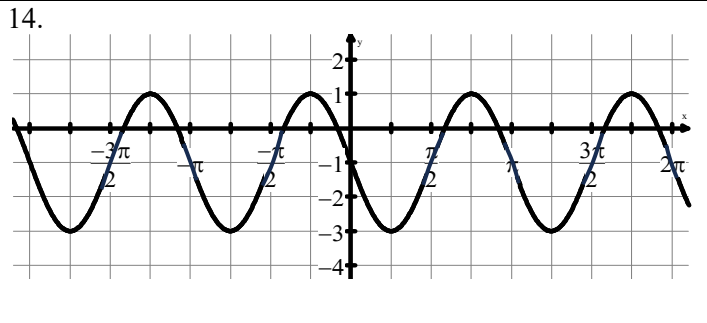
$y = \sin\left(\frac{\pi}{3}x + \frac{2\pi^2}{7}\right) + 2$

13. Amplitude: 8
 Period: $\frac{2\pi}{3}$
 Phase Shift: right $\frac{\pi}{21}$
 Vertical Shift: up 5

$\frac{2\pi}{b} = \frac{2\pi}{3}$
 $b = 3$
 $y = 8 \sin\left(3\left[x - \frac{\pi}{21}\right]\right) + 5$

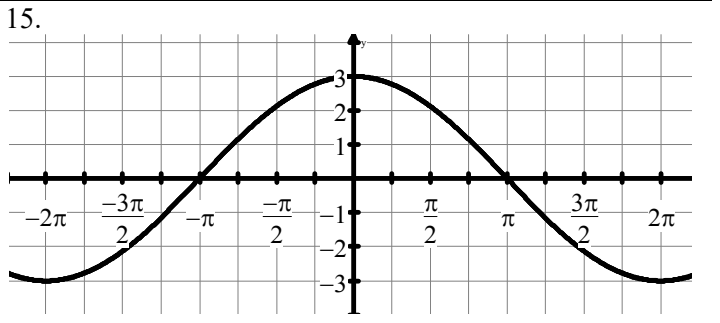
$y = 8 \sin\left(3x - \frac{\pi}{7}\right) + 5$

Write a sine AND cosine function for the following curves. Use a positive leading coefficient and the closest phase shift possible (left or right). For some problems, it may be equal to move left or right.



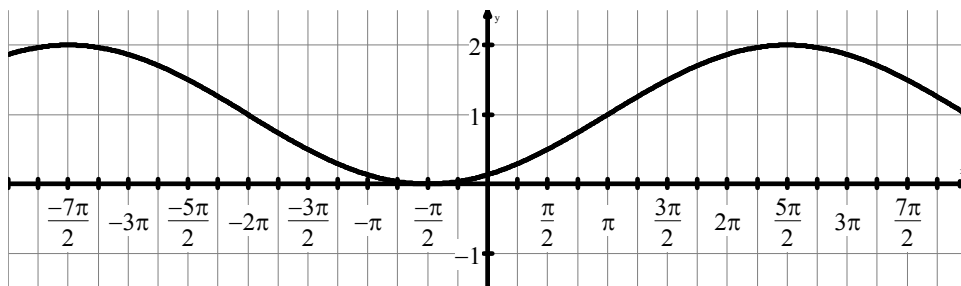
Sine equation: $y = 2 \sin(2x + \pi) - 1$ or
 $y = 2 \sin(2x - \pi) - 1$

Cosine equation: $y = 2 \cos\left(2x + \frac{\pi}{2}\right) - 1$



Sine equation: $y = 3 \sin\left(\frac{x}{2} + \frac{\pi}{2}\right)$

Cosine equation: $y = 3 \cos\left(\frac{x}{2}\right)$



Sine equation: $y = \sin\left(\frac{x}{3} - \frac{\pi}{3}\right) + 1$

Cosine equation: $y = \cos\left(\frac{x}{3} - \frac{5\pi}{6}\right) + 1$

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3.6B Test Prep

17. Suppose you are riding a Ferris wheel. After everyone is loaded, the wheel starts to turn and the ride lasts 180 seconds. Your height h (in feet) above the ground at any time t (in seconds) can be modeled by the equation

$$h(t) = 85 \sin\left[\frac{\pi}{20}(t - 6)\right] + 90.$$

- a. What is the period?

$$\frac{2\pi}{\frac{\pi}{20}} = 40$$

- b. What does the period represent?

It takes 40 seconds to complete one circle on the ride.

- c. What is the frequency?

$$\frac{1}{40}$$

- d. What does the frequency represent?

The wheel turns $\frac{1}{40}$ for a circle every

- e. What is your maximum height?

$$\text{Midline} = 90. \text{ Max is } 90 + 85 = 175$$

- f. What is your minimum height?

$$\text{Midline} = 90. \text{ Min is } 90 - 85 = 5 \text{ feet.}$$

- g. How many circles will the Ferris Wheel make during the ride?

$$\begin{aligned} \text{Total time of ride} \times \text{Frequency} \\ = 180 \times \left(\frac{1}{40}\right) \end{aligned}$$

4.5 turns

OR

$$\text{Total Time} \div \text{Period} = \frac{180}{40}$$

- h. **Calculator active.** How high are you when the ride begins? (Remember, you are not at ground level because the people in line behind you had to get on the ride.)

$$h(0) = 21.2 \text{ feet}$$

- i. **calculator active.** How far off the ground are you when the ride stops?

$$h(180) = 158.8 \text{ feet}$$

