

3.1 - Radian Measure

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Warmup

Express each degree measure in radians. Leave your answer in terms of π .

1. 45° $\frac{\pi}{4}$

2. 60° $\frac{\pi}{3}$

3. -120° $-\frac{2\pi}{3}$

4. 150° $\frac{5\pi}{6}$

5. -330° $-\frac{11\pi}{6}$

6. -315° $-\frac{7\pi}{4}$

Express each radian measure in degrees.

7. $\frac{\pi}{6}$ 30°

8. $\frac{\pi}{3}$ 60°

9. $\frac{4\pi}{3}$ 240°

10. $-\frac{7\pi}{6}$ -210°

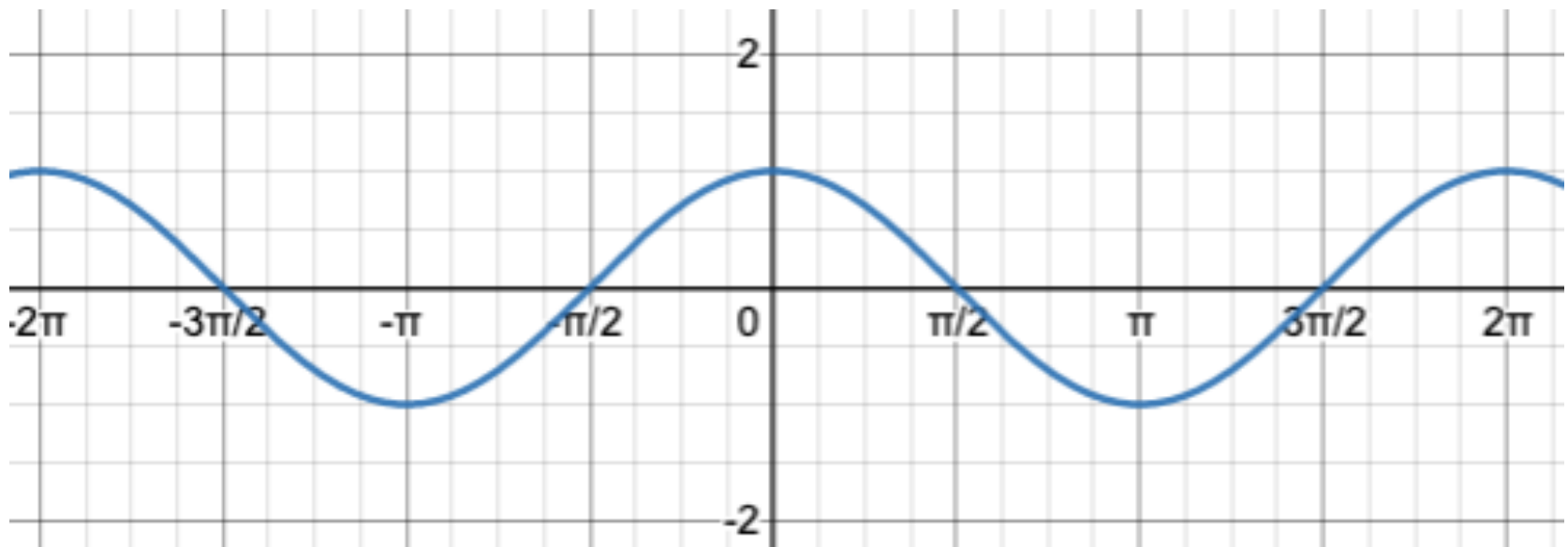
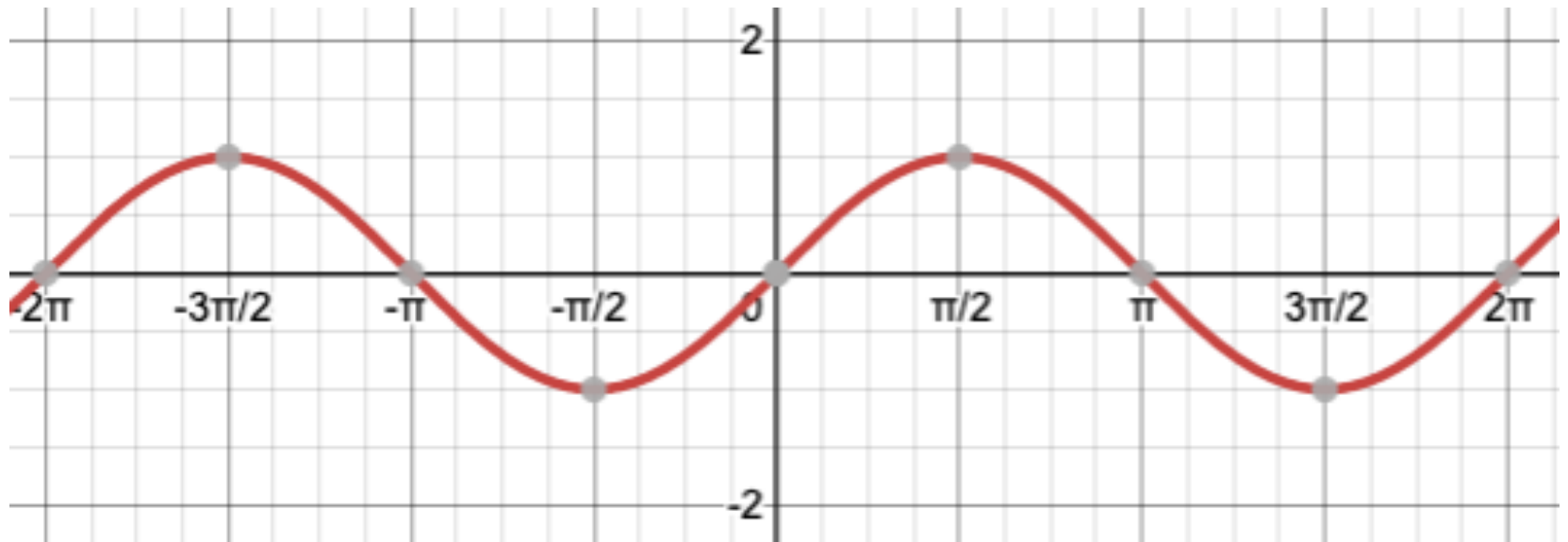
11. 3π 540°

12. $-\frac{7\pi}{2}$ -630°

4.1 - Graphing Sine and Cosine

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Which is sine or cosine? How can you tell?



4.1 - Graphing Sine and Cosine

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Periodic function

$$\sin(\pi n) = 0$$

x	$y = \sin x$	(x, y)
0	$\sin 0 = 0$	(0, 0)
π	$\sin \pi = 0$	(π , 0)
2π	$\sin(2\pi) = 0$	(2π , 0)
3π	$\sin(3\pi) = 0$	(3π , 0)
4π	$\sin(4\pi) = 0$	(4π , 0)
...		
$n\pi$	$\sin(n\pi) = 0$	($n\pi$, 0)

4.1 - Graphing Sine and Cosine

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Periodic function

$$\sin(\pi n) = 0$$

$$\sin\left(\frac{\pi}{2} + \pi n\right) = \{1, -1\}$$

x	$y = \sin x$	(x, y)
$\frac{\pi}{2}$	$\sin\left(\frac{\pi}{2}\right) = 1$	$\left(\frac{\pi}{2}, 1\right)$
$\frac{3\pi}{2}$	$\sin\left(\frac{3\pi}{2}\right) = -1$	$\left(\frac{3\pi}{2}, -1\right)$
$\frac{5\pi}{2}$	$\sin\left(\frac{5\pi}{2}\right) = 1$	$\left(\frac{5\pi}{2}, 1\right)$
$\frac{7\pi}{2}$	$\sin\left(\frac{7\pi}{2}\right) = -1$	$\left(\frac{7\pi}{2}, -1\right)$
...		
$\frac{(2n+1)\pi}{2}$	$\sin\left(\frac{(2n+1)\pi}{2}\right) = \pm 1$	$\left(\frac{(2n+1)\pi}{2}, \pm 1\right)$

4.1 - Graphing Sine and Cosine

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Periodic function

$$\sin(\pi n) = 0$$

$$\sin\left(\frac{\pi}{2} + \pi n\right) = \{1, -1\}$$

Function $f(x) = \sin(x)$

Domain $-\infty < x < \infty$

Range $-1 \leq y \leq 1$

Odd $\sin(-x) = -\sin(x)$

4.1 - Graphing Sine and Cosine

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Periodic function

$$\sin(\pi n) = 0$$

$$\sin\left(\frac{\pi}{2} + \pi n\right) = \{1, -1\}$$

$$\cos\left(\frac{\pi}{2} + \pi n\right) = 0$$

$$\cos(\pi n) = \{-1, 1\}$$

Function $f(x) = \sin(x)$

Domain $-\infty < x < \infty$

Range $-1 \leq y \leq 1$

Odd $\sin(-x) = -\sin(x)$

Function $f(x) = \cos(x)$

Domain $-\infty < x < \infty$

Range $-1 \leq y \leq 1$

Even $\cos(-x) = \cos(x)$

4.1 - Graphing Sine and Cosine

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“**Sinusoidal**” means resembling the sine function.

“**Amplitude**” of a periodic function is half the distance between the maximum and minimum values of the function.

$$f(x) = A \sin(x)$$

$$\text{Amplitude} = |A|$$

“**Period**” of a periodic function is the horizontal distance between the closest points that repeat in the function.

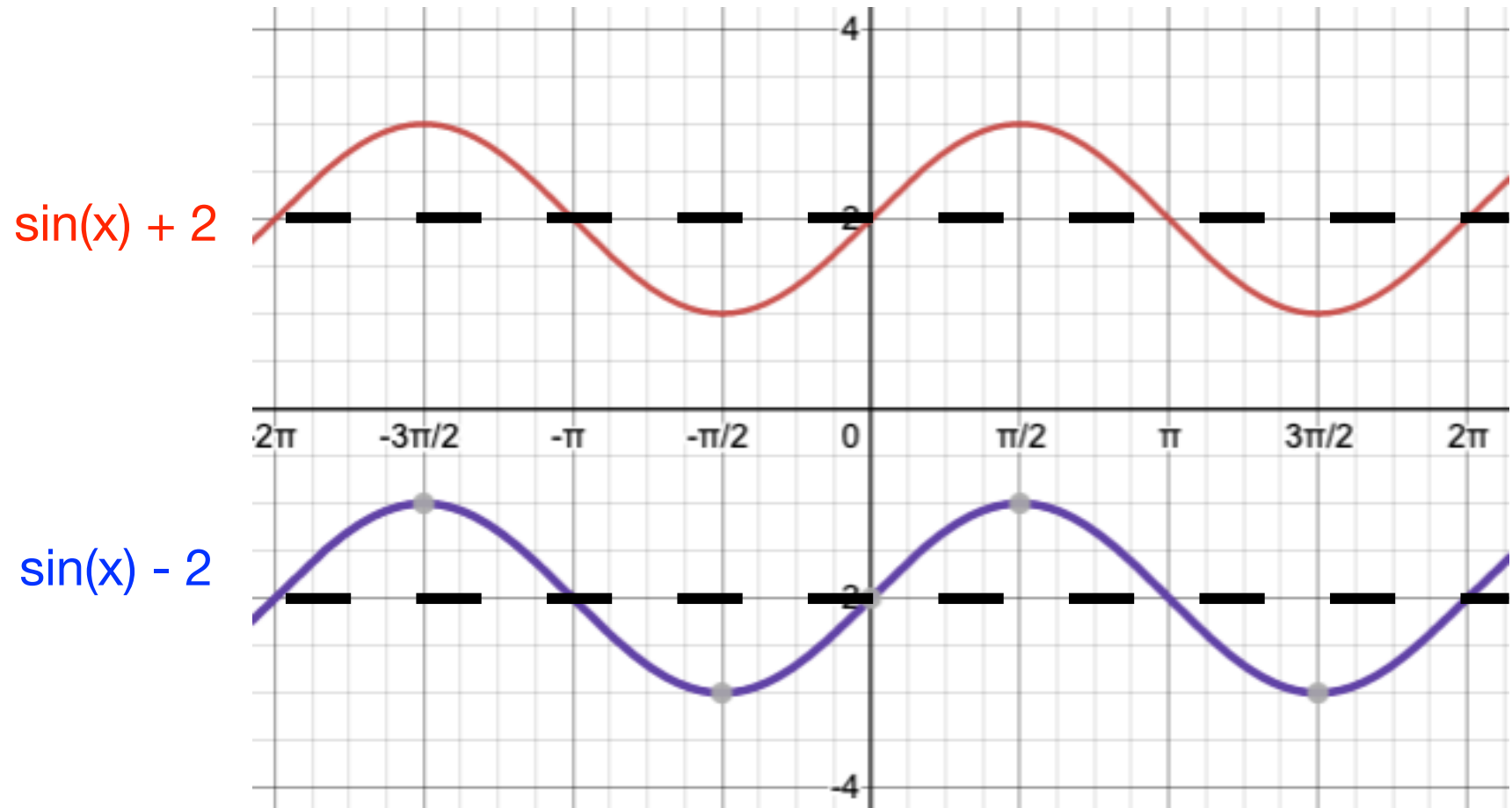
$$f(x) = A \sin(Bx)$$

$$\text{Period} = \frac{2\pi}{B}$$

4.1 - Graphing Sine and Cosine

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Does period change? Does amplitude change?



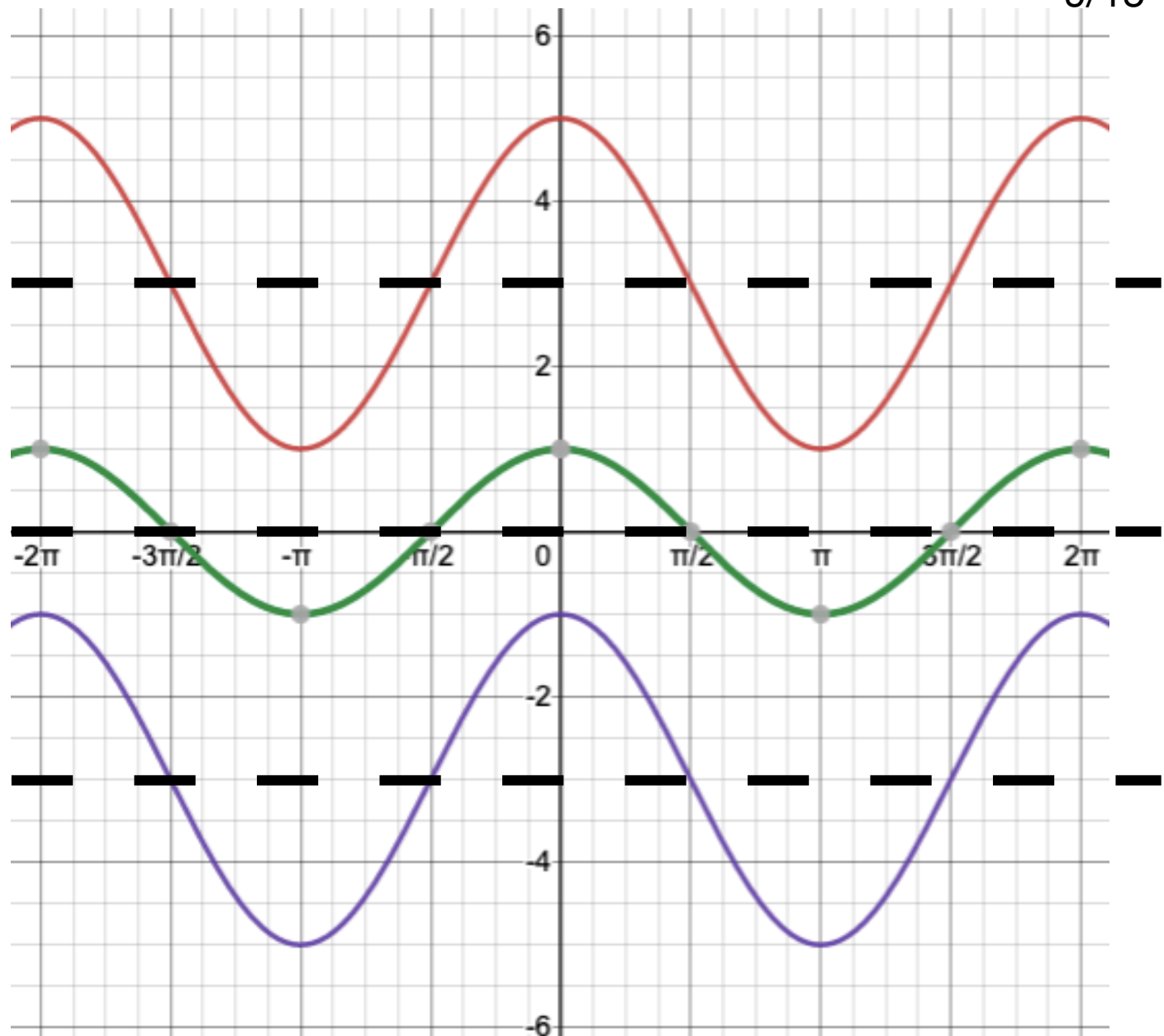
4.1 - Graphing Sine and Cosine

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$$2\cos(x) + 3$$

$$\cos(x)$$

$$2\cos(x) - 3$$



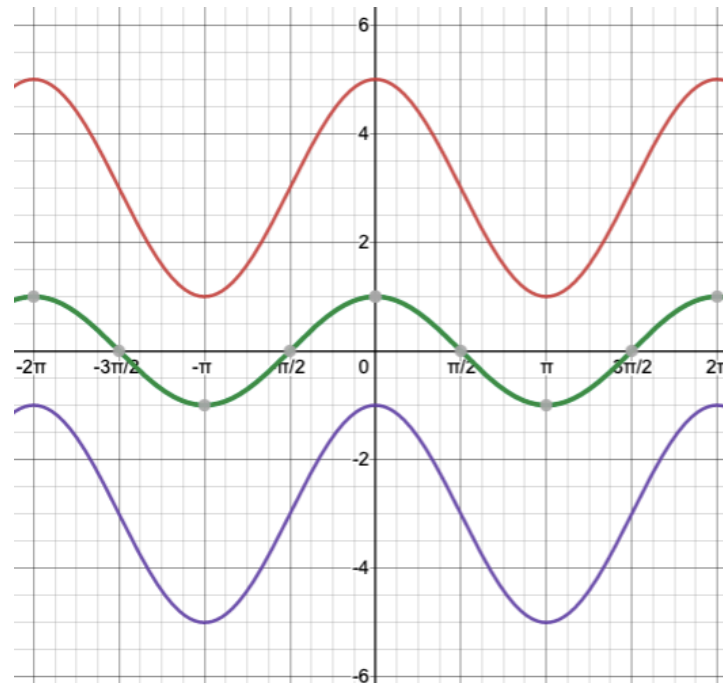
4.1 - Graphing Sine and Cosine

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$$2\cos(x) + 3$$

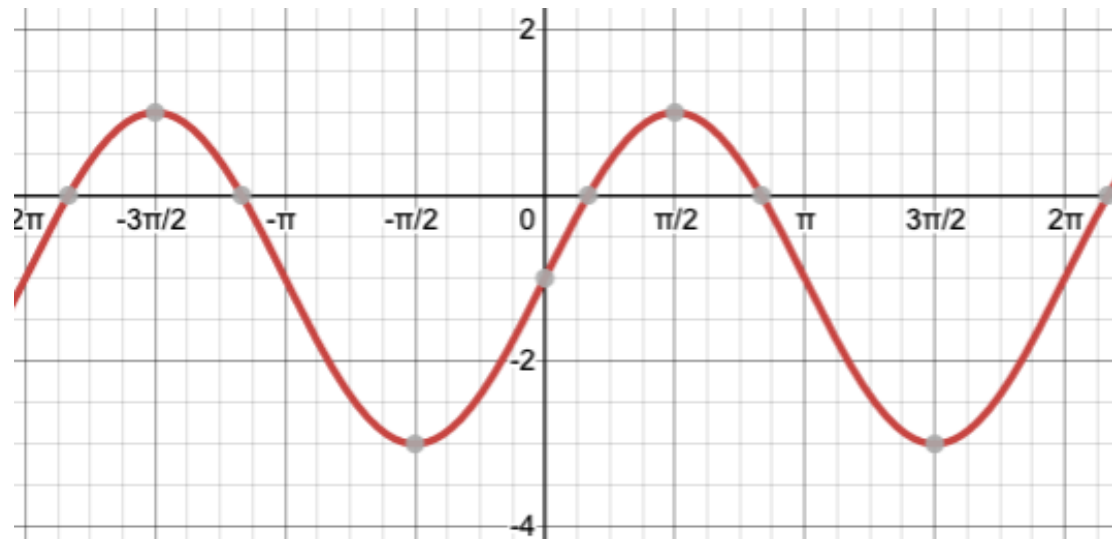
$$\cos(x)$$

$$2\cos(x) - 3$$



Practice

$$1) y = 2\sin(\theta) - 1$$

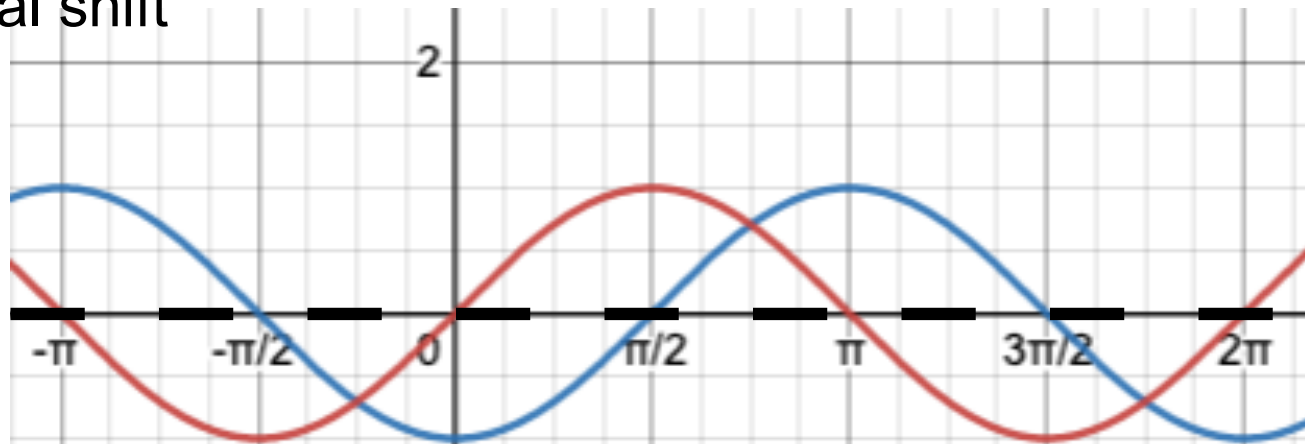


4.1 - Graphing Sine and Cosine

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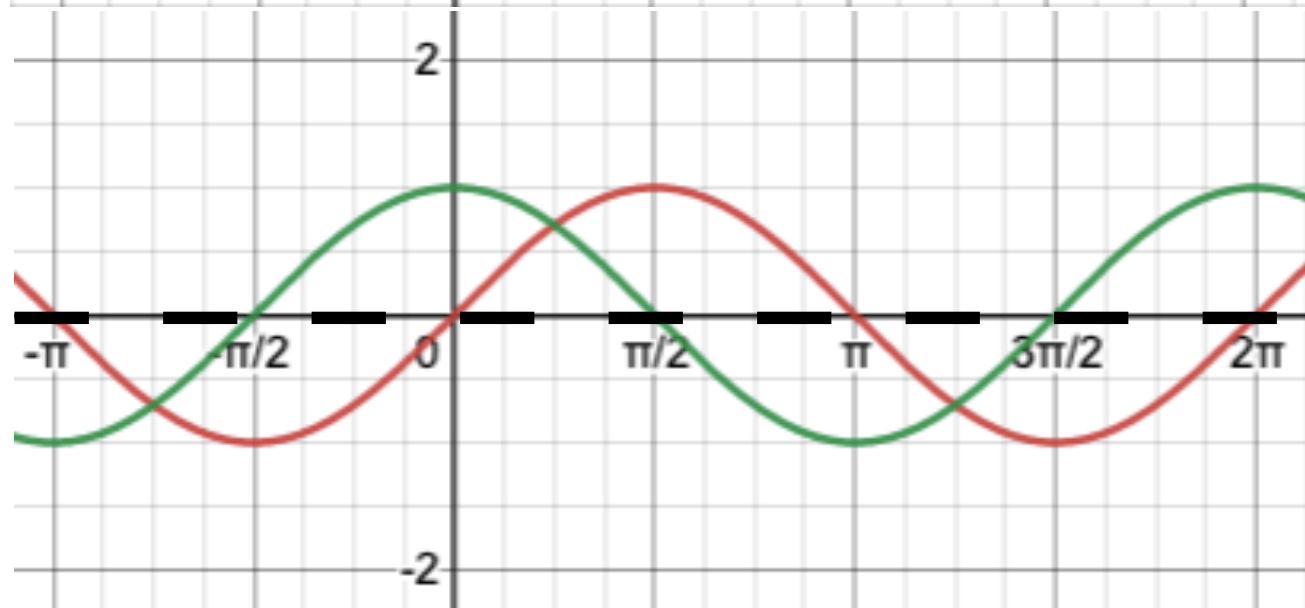
Horizontal shift

$\sin(x-90^\circ)$



$\sin(x)$

$\sin(x+90^\circ)$

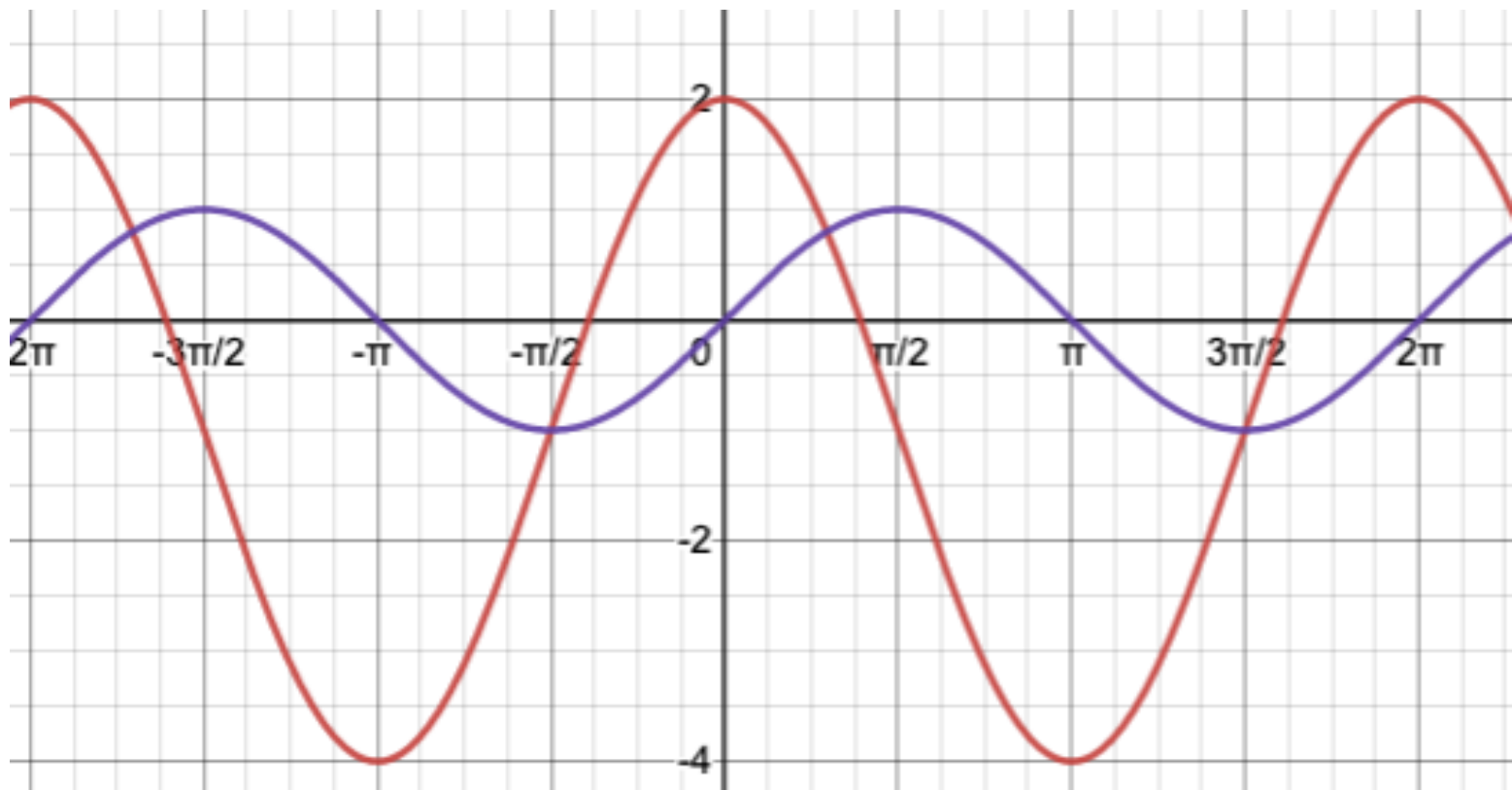


4.1 - Graphing Sine and Cosine

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Practice - Graph without a table of values.

$$1) y = 3 \sin \left(\theta + \frac{\pi}{2} \right) - 1$$



4.1 - Graphing Sine and Cosine

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What is the period?

$$\sin(2x)$$

$$\pi$$

$$\cos(-3x)$$

$$\frac{2\pi}{3}$$

$$\sin\left(\frac{x}{2}\right)$$

$$4\pi$$

$$\cos(\pi x)$$

$$2 \text{ radians}$$

4.1 - Graphing Sine and Cosine

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Write the sine function

$$2 \sin(2x - \pi) + 3$$

Phase shift of $\frac{\pi}{2}$

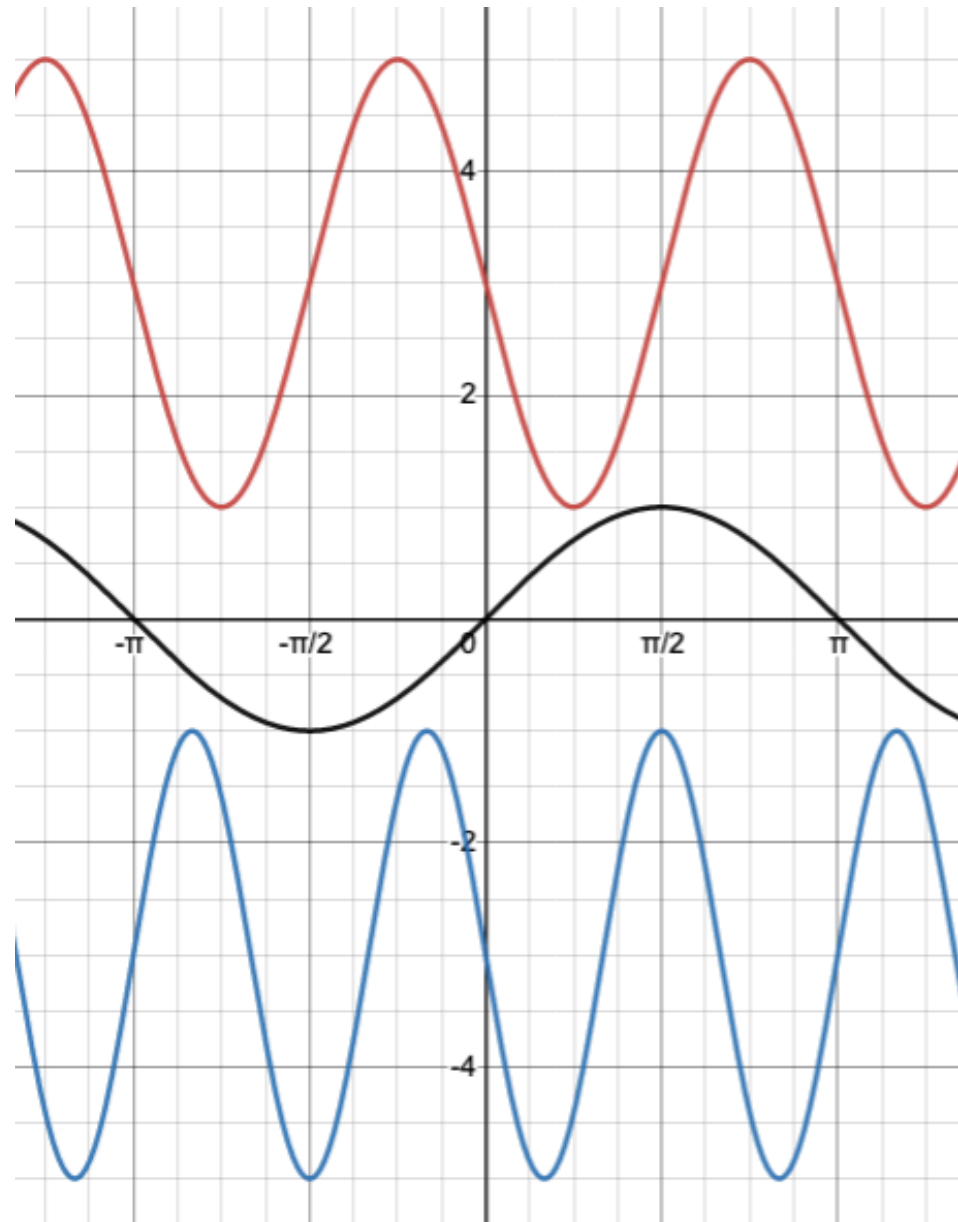
Vertical translation of 3

$\sin(x)$

$$2 \sin(3x + \pi) - 3$$

Phase shift of $-\frac{\pi}{3}$

Vertical translation of -3



4.1 - Graphing Sine and Cosine

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Describe the transformation from $\cos(x)$

1) $2 \cos(x + \pi) - 1$

Left π

Vertical stretch by 2

Down 1

2) $-2 \cos(2x - \pi) - 1$

Horz shrink 1/2

Right $\pi/2$

Vertical stretch by 2

Reflect on x-axis

Down 1

3) $-2 \cos(-2x + \pi) - 1$

Horz shrink 1/2

Reflect on y-axis

Right $\pi/2$

Vertical stretch by 2

Reflect on x-axis

Down 1

