

**Goal:** Extend the transformations of graphs of trigonometric functions to include horizontal and vertical translations.



### Questions

**Review:** Describe the transformations from the parent functions.

a.  $y = 2\left(\frac{x}{3}\right)^2$       b.  $y - 6 = (x + 3)^2$       c.  $y = 15 \sin(-2x)$

Function Form:  $\frac{y-k}{a} = f\left(\frac{x-h}{b}\right)$  or  
 $y = af\left(\frac{x-h}{b}\right) + k$

### Phase Shift

In the lovely world of trigonometric functions, \_\_\_\_\_  
 \_\_\_\_\_ are called *phase shifts*.

Example 1: What is the phase shift of each function?

a.  $y = \cos\left(x + \frac{\pi}{4}\right)$       b.  $y = \sin(x - 36^\circ)$       c.  $y = \cos\left(x - \frac{\pi}{4}\right)$

Part a in transformation terms:

Example 2: What is the vertical shift of each function?

a.  $y = \cos x + 4$       b.  $y + 2 = \sin x$       c.  $y = \cos x + 15$

Part a in transformation terms:

**Questions**

Example 3: Consider the function  $f(x) = \cos\left(x - \frac{7\pi}{3}\right) - 2$ . Find the

following:

- phase shift from parent function:
- vertical shift from parent function:
- the period:
- the amplitude:
- the maximum and minimum values:
- Transformation form

Example 3: Consider the function  $f(x) = 2\sin\left(x - \frac{3\pi}{4}\right) + 4$ . Find the

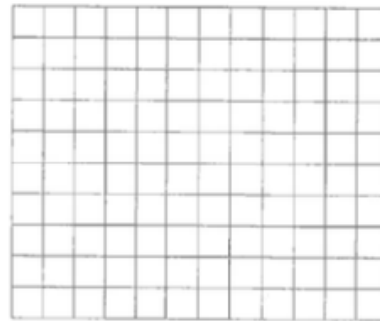
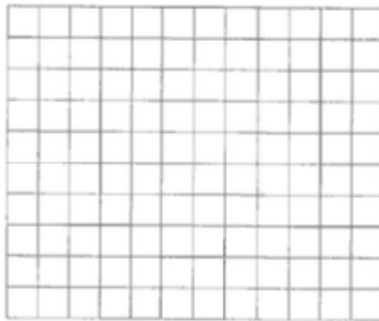
following:

- phase shift from parent function:
- vertical shift from parent function:
- the period:
- the amplitude:
- the maximum and minimum values:
- Transformation form:

Example 4: Sketch the graph of each function.

a.  $f(x) = \sin\left(2x + \frac{\pi}{3}\right) + 1$

b.  $y - 3 = \cos\left(x - \frac{\pi}{4}\right)$



**Summary:**

Graph the following functions. Identify the amplitude, period, and translation.

5.  $y = \sin x + 2$

6.  $y = \cos x - 3$

7.  $y = \tan x + 4$



8.  $y = 3 \sin x - 1$

9.  $y = -2 \cos x + 3$

10.  $y = \frac{1}{2} \cos x - 1$



11.  $y = 3 \tan x + 2$

12.  $y = -\frac{1}{4} \sin x + 4$

13.  $y = -\cos x - 3$

