## Lesson 12.4: Translating Trig Functions

$$y = a\sin[b(x-h)] + k$$

$$y = a\cos[b(x-h)] + k$$

$$y = a\tan[b(x-h)] + k$$

$$h = horizontal\ shift\ (opposite\ direction)$$

Also called Phase Shift

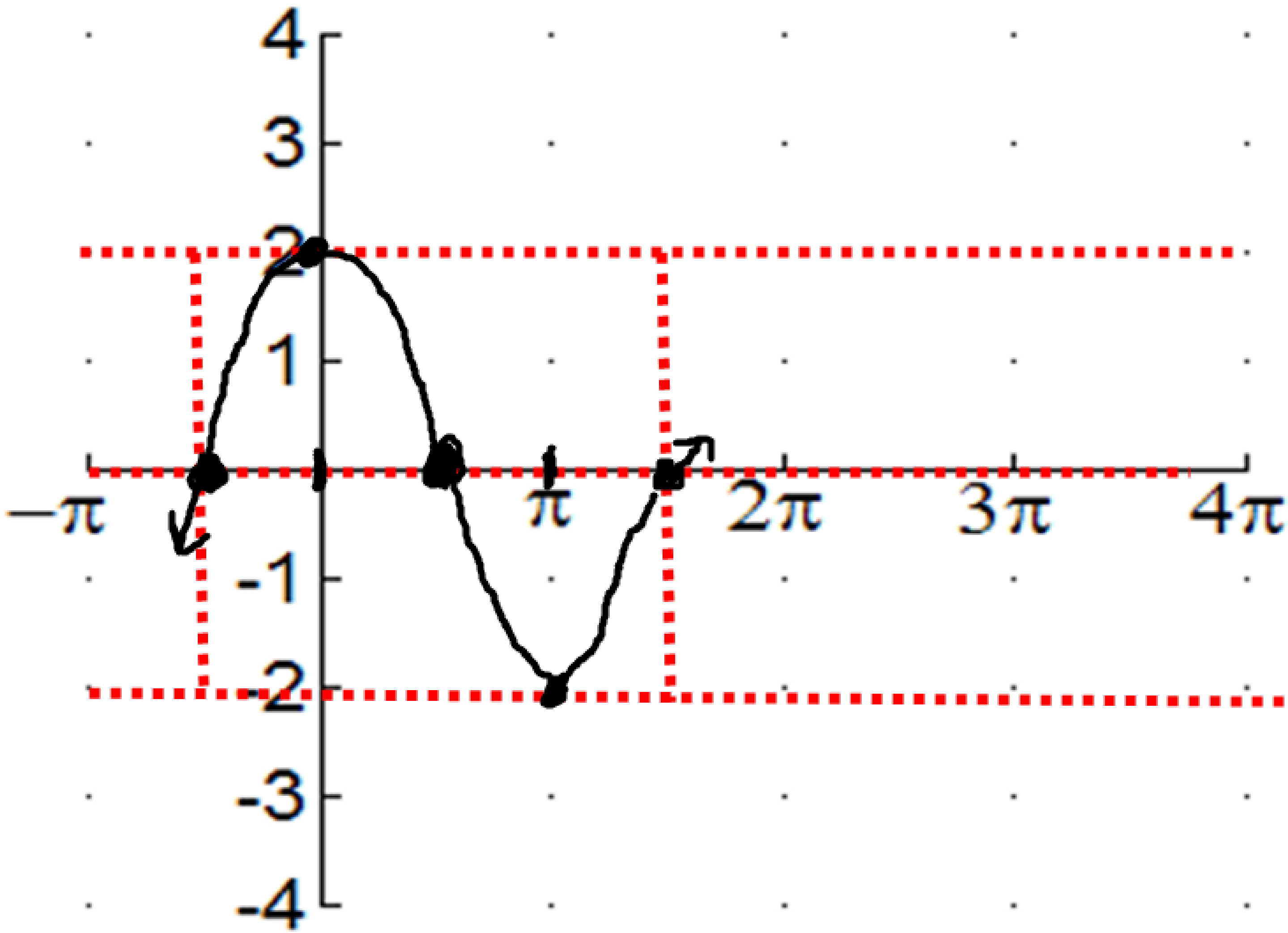
$$y = a\sin[b(x-h)] + k$$

$$y = a\cos[b(x-h)] + k$$

$$y = a\tan[b(x-h)] + k$$

| | Sin/Cos | Tan |
|---|---|---|
| Midline | K | K |
| Amplitude | $\lvert a \rvert$ | Vertical Stretch ( a ) |
| Period | $\frac{2\pi}{b}$ | $\frac{\pi}{b}$ |
| Phase Shift | h | h |

$$y = \underline{2}\sin\left(1x + \frac{\pi}{2}\right)$$




Mid: 0

Amp: 2

Per: $\frac{2\pi}{1} = 2\pi$

Phase: $-\frac{\pi}{2}$

or

L $\frac{\pi}{2}$

Start

$y = -\sin(\underline{x - \pi}) - 1$

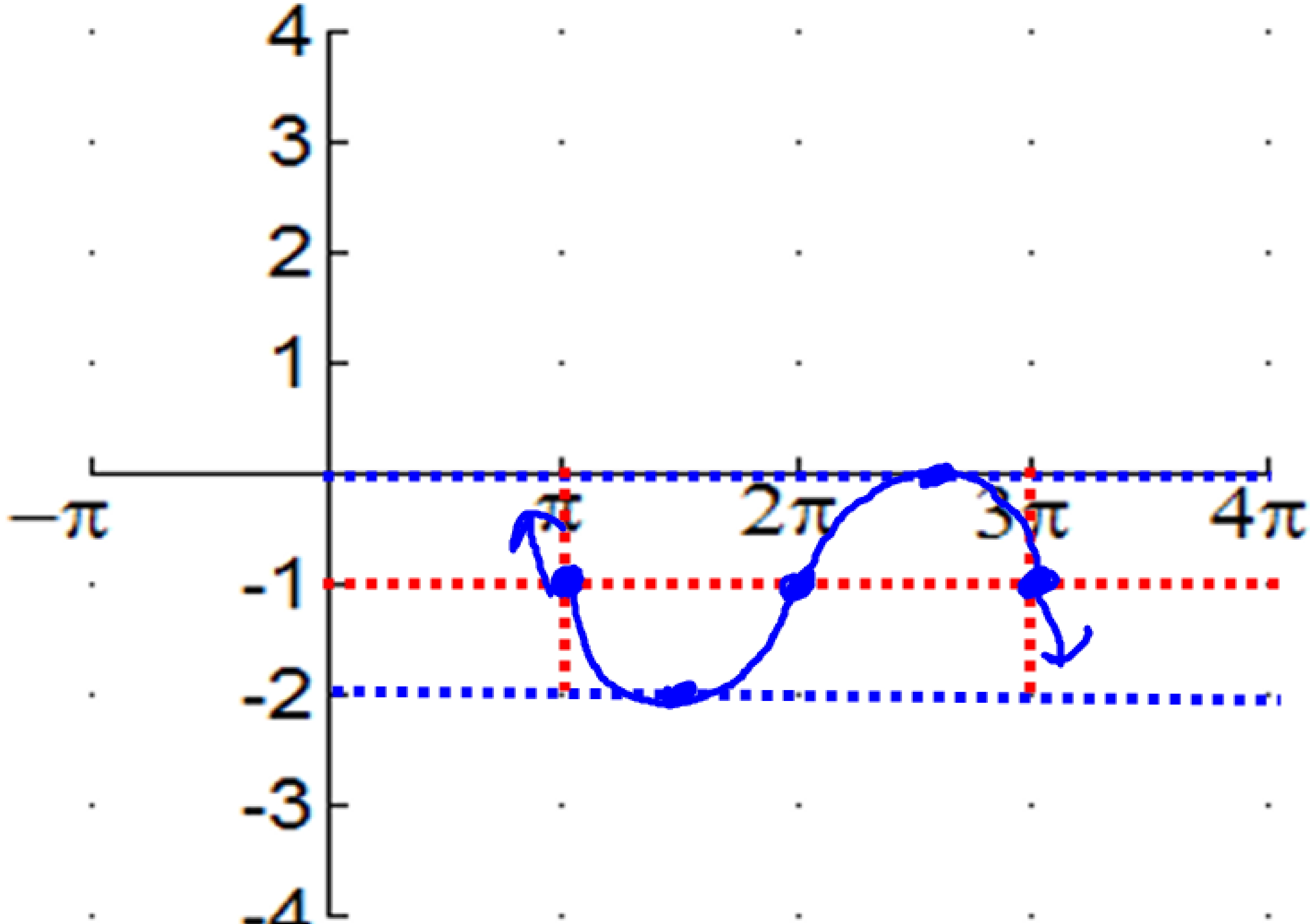
Mid: $-1$

Amp: $1$ ($\downarrow$ 1st)

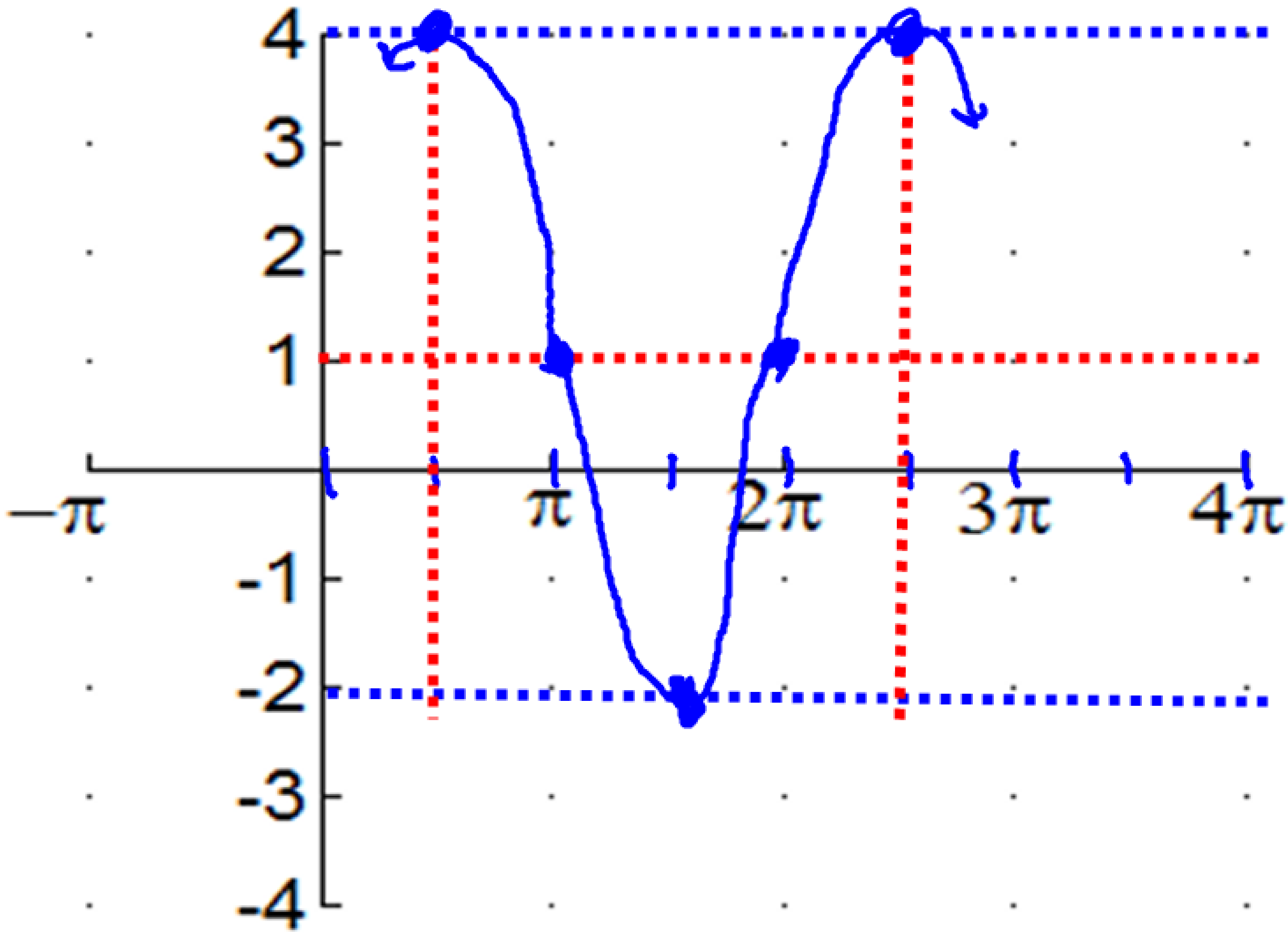
Per: $2\pi$

Phase: $+\pi$

R $\pi$



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



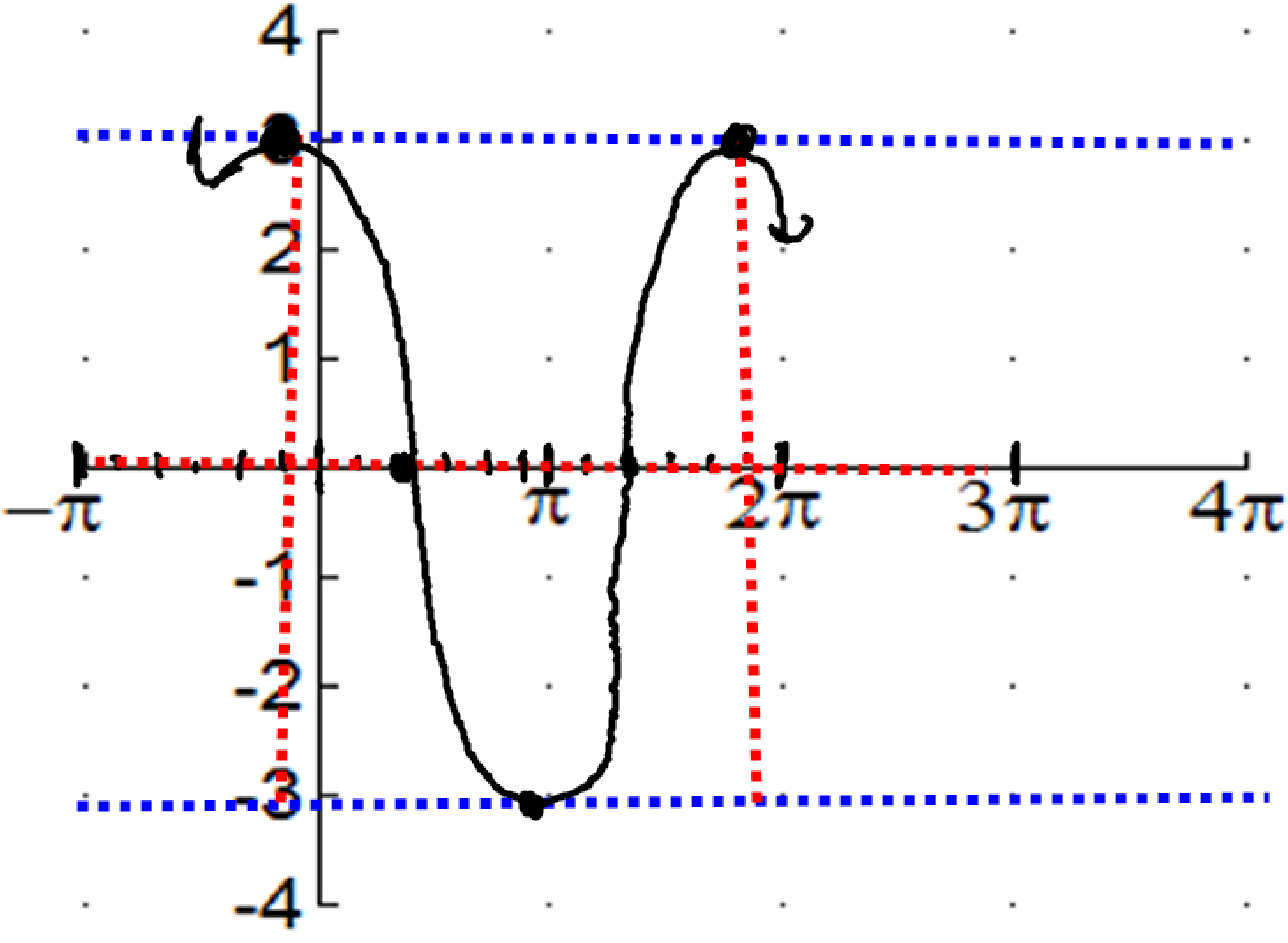

Midi: 1

Amp: 3

Per: 2π

Phase: + $\frac{\pi}{2}$

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



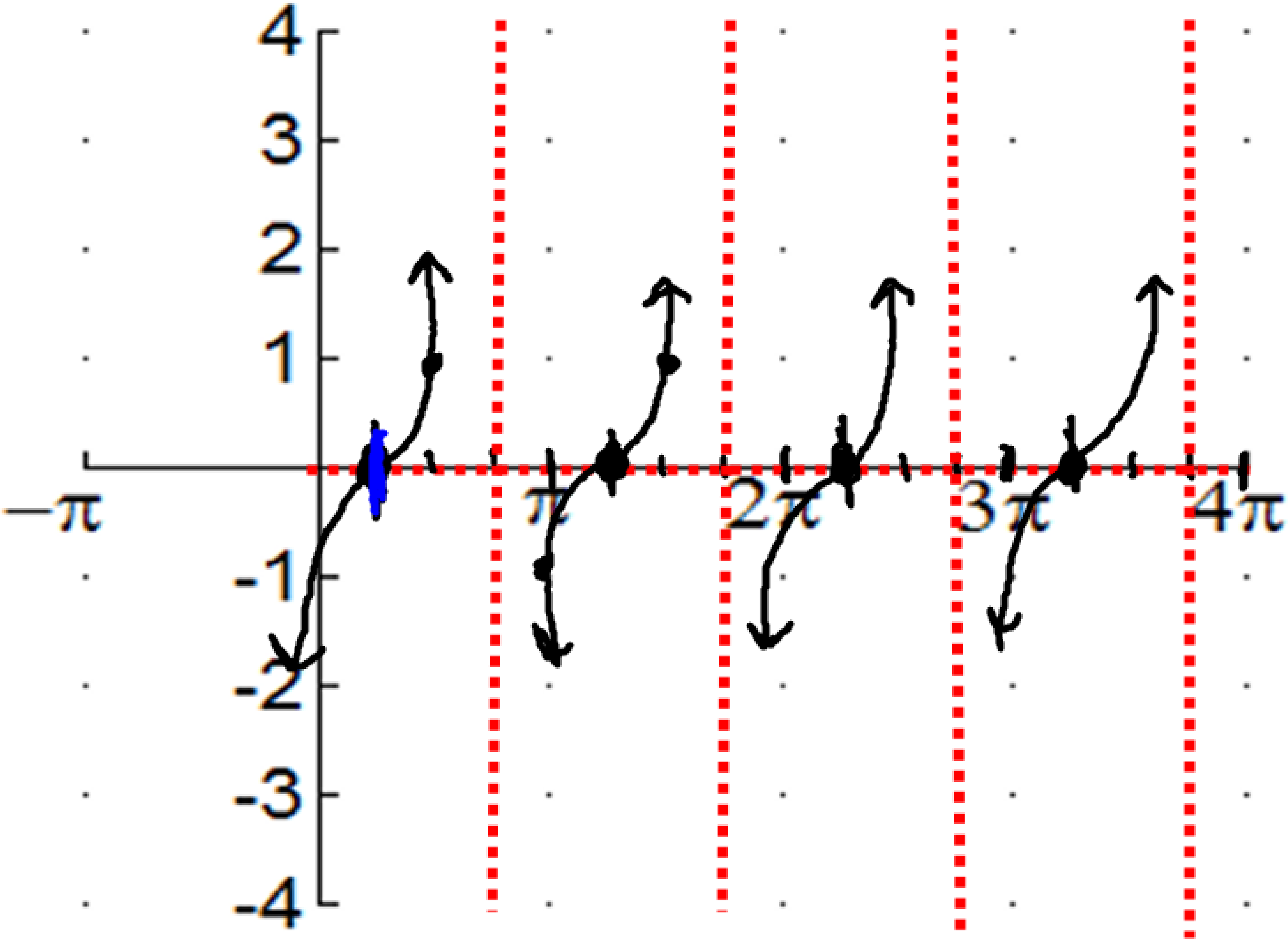

Mid: 0

Amp: 3

Per: $2\pi$

Phase: $-\frac{\pi}{6}$

$$y = \text{tan}\left(x - \frac{\pi}{4}\right)$$



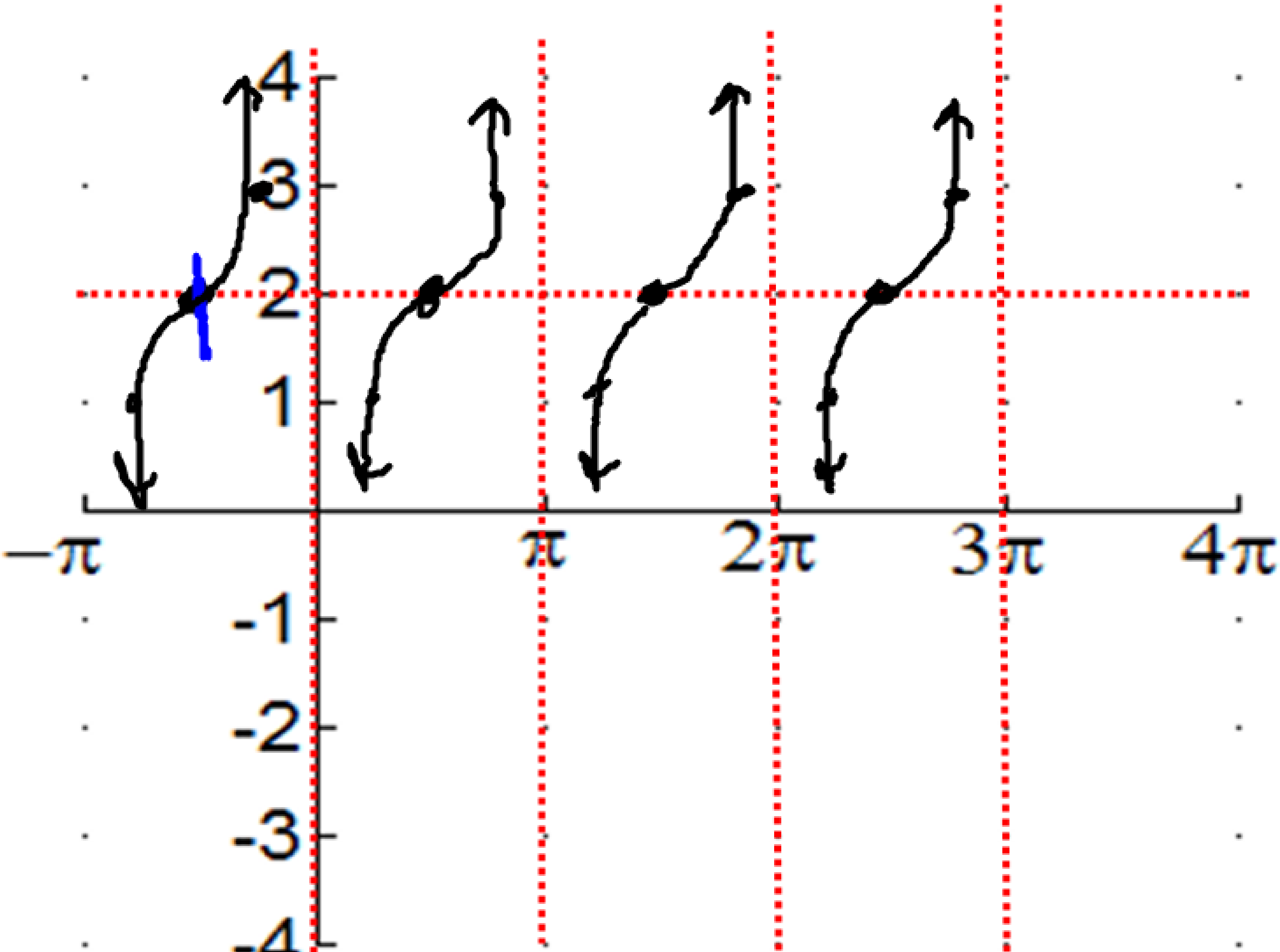

Mid: 0

a = 1

Per: $\pi$

Phase: $+\frac{\pi}{4}$

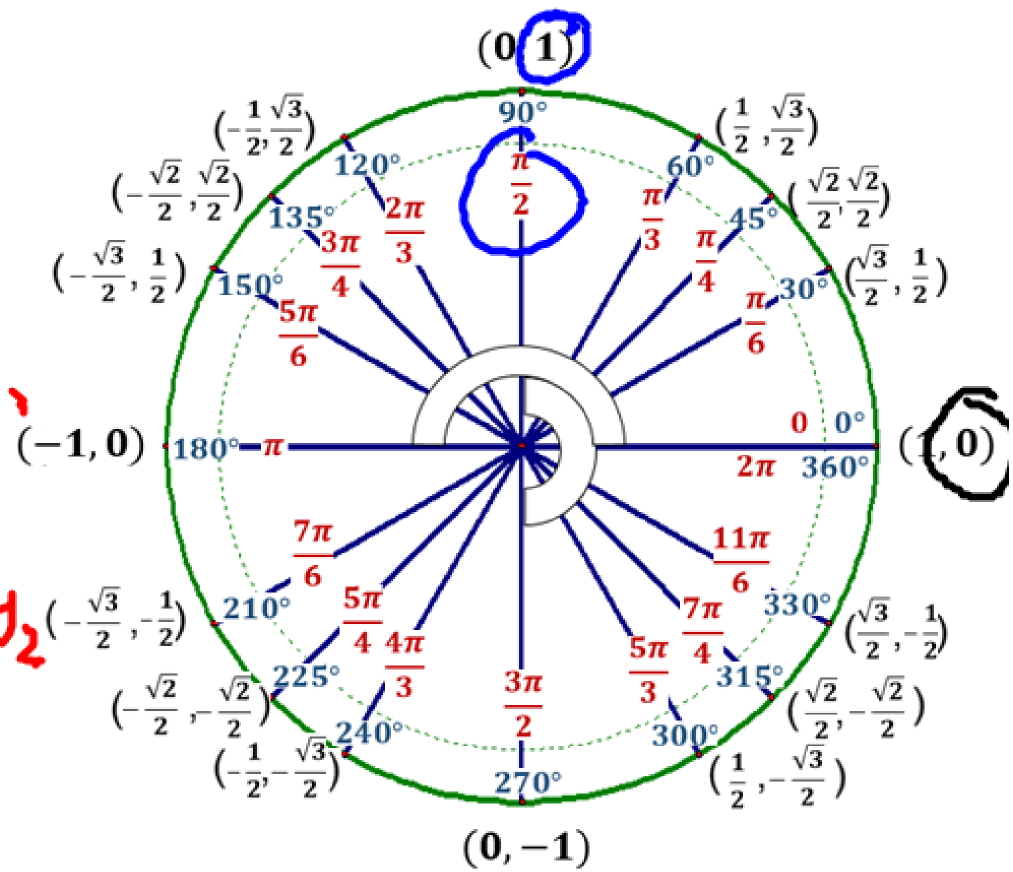
$$y = \tan\left(x + \frac{\pi}{2}\right) + 2$$



Find the average rate of change for $f(x) = \sin(2x)$.

From 0 to $\frac{\pi}{4}$

$x_1 \quad x_2$




$f(0) = \sin(2 \cdot 0) = \sin(0) = 0 = y_1$

$f(\frac{\pi}{4}) = \sin(2 \cdot \frac{\pi}{4}) = \sin(\frac{\pi}{2}) = 1 = y_2$

$$\frac{y_2 - y_1}{x_2 - x_1} = \frac{1 - 0}{\frac{\pi}{4} - 0}$$

$$= \frac{1}{\frac{\pi}{4}} = \boxed{\frac{4}{\pi}}$$

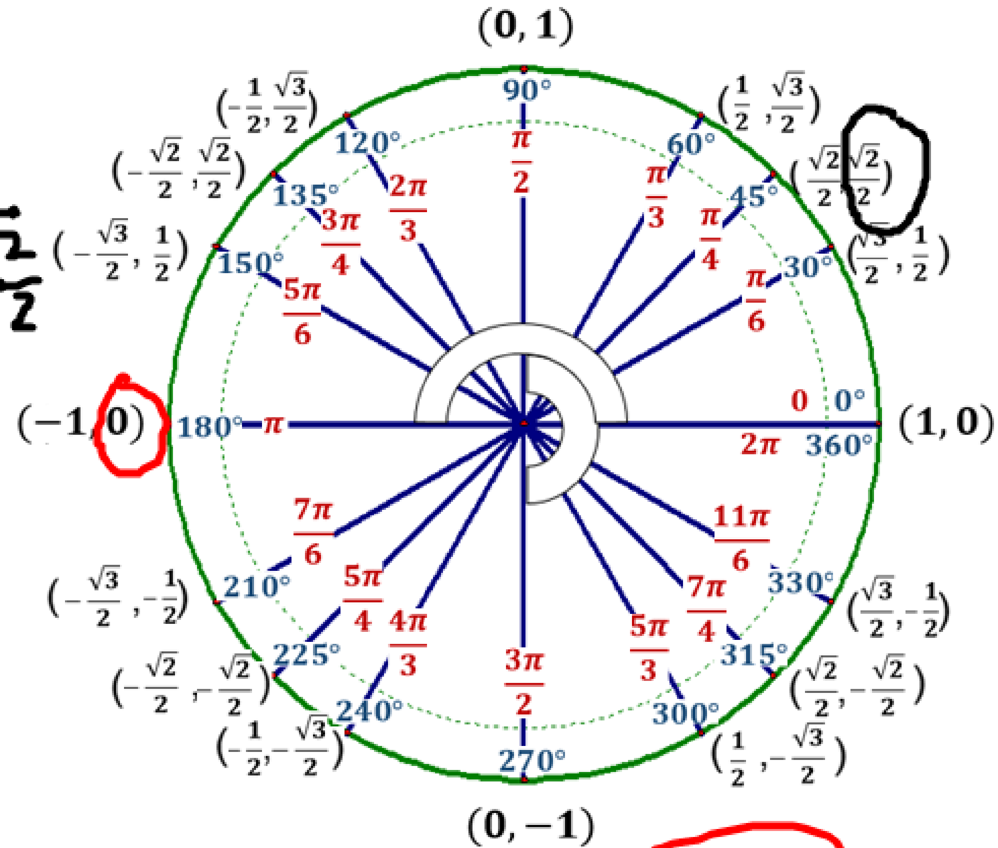
Find the average rate of change for $f(x) = \sin(2x)$.

From $\frac{\pi}{8}$ to $\frac{\pi}{2}$

$x_1 \quad x_2$

$f\left(\frac{\pi}{8}\right) = \sin\left(2 \cdot \frac{\pi}{8}\right) = \sin\left(\frac{\pi}{4}\right) = \frac{\sqrt{2}}{2}$

$f\left(\frac{\pi}{2}\right) = \sin\left(2 \cdot \frac{\pi}{2}\right) = \sin(\pi) = 0$




$$\frac{y_2 - y_1}{x_2 - x_1} = \frac{0 - \frac{\sqrt{2}}{2}}{\frac{\pi}{2} - \frac{\pi}{8}} = \frac{-\frac{\sqrt{2}}{2}}{\frac{3\pi}{8}} = -\frac{\sqrt{2}}{2} \cdot \frac{8}{3\pi} = \boxed{\frac{-4\sqrt{2}}{3\pi}}$$