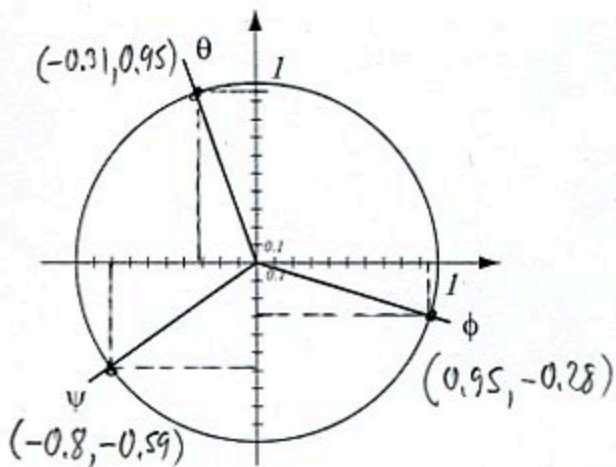


1. (12pts) Use the unit circle to estimate the values of the trigonometric functions of the angles drawn.



$$\cos \theta = x = -0.31 \quad \tan \theta = \frac{y}{x} = \frac{0.95}{-0.31} = -3.06$$

$$\sin \psi = y = -0.59 \quad \cot \psi = \frac{x}{y} = \frac{-0.8}{-0.59} = 1.36$$

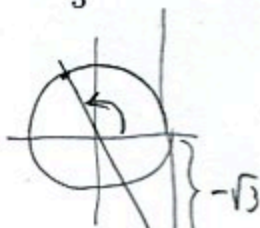
$$\sin \phi = y = -0.28 \quad \sec \phi = \frac{1}{\cos \phi} = \frac{1}{x} = \frac{1}{0.95} = 1.05$$

2. (18pts) For each of the following, draw the unit circle and the appropriate angle in order to infer from the picture the exact values of the trigonometric functions.

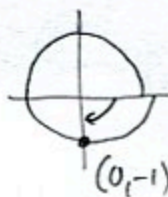
$$\sin 210^\circ = -\frac{1}{2}$$



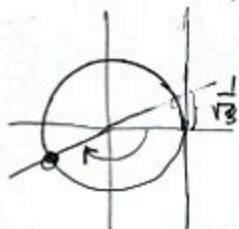
$$\tan \frac{2\pi}{3} = -\sqrt{3}$$



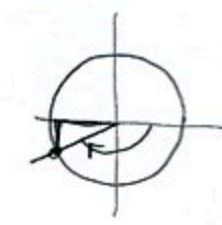
$$\csc(-90^\circ) = \frac{1}{\sin(-90^\circ)} = \frac{1}{-1} = -1$$



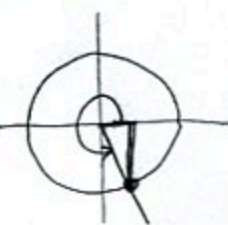
$$\cot(-150^\circ) = \frac{1}{\tan(-150^\circ)} = \frac{1}{-\frac{1}{\sqrt{3}}} = -\sqrt{3}$$



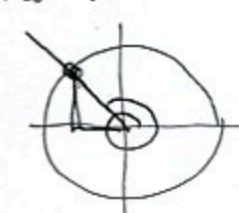
$$\sec\left(-\frac{5\pi}{6}\right) = \frac{1}{\cos\left(-\frac{5\pi}{6}\right)} = \frac{1}{-\frac{\sqrt{3}}{2}} = -\frac{2}{\sqrt{3}}$$



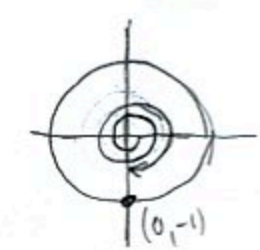
$$\cos \frac{5\pi}{3} = \frac{1}{2}$$



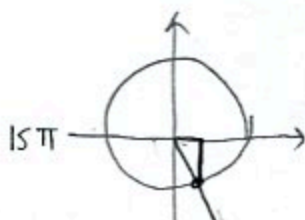
$$\sec 495^\circ = \frac{1}{\cos 495^\circ} = \frac{1}{-\frac{\sqrt{2}}{2}} = -\frac{2}{\sqrt{2}} = -\sqrt{2}$$



$$\tan\left(-\frac{9\pi}{2}\right) = \frac{-1}{0} = \text{not def.}$$



$$\sin \frac{47\pi}{3} = -\frac{\sqrt{3}}{2}$$



$$= -\frac{2}{\sqrt{2}}$$

$$= -\sqrt{2}$$

$$\frac{9\pi}{2} = 4\frac{1}{2}\pi$$

$$\frac{47\pi}{3} = 15\frac{2}{3}\pi$$

3. (10pts) Draw two periods of the graph of  $y = 2 \sin(4x)$ .

What is the amplitude? The period?

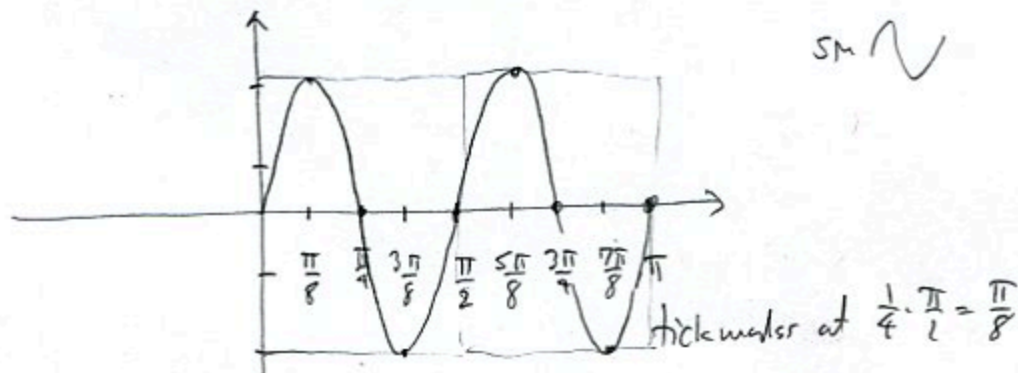
For each period, indicate x-coordinates of the five special points (middle, peaks, valleys).

$$\text{Amplitude} = 2$$

$$\text{Period} = \frac{2\pi}{4} = \frac{\pi}{2}$$

$$-\frac{c}{b} = -\frac{0}{4} = 0$$

$$-\frac{c}{b} + \frac{2\pi}{b} = 0 + \frac{\pi}{2} = \frac{\pi}{2}$$



4. (10pts) Draw two periods of the graph of  $y = -3 \cos(2x + \frac{\pi}{3})$ .

What is the amplitude? The period?

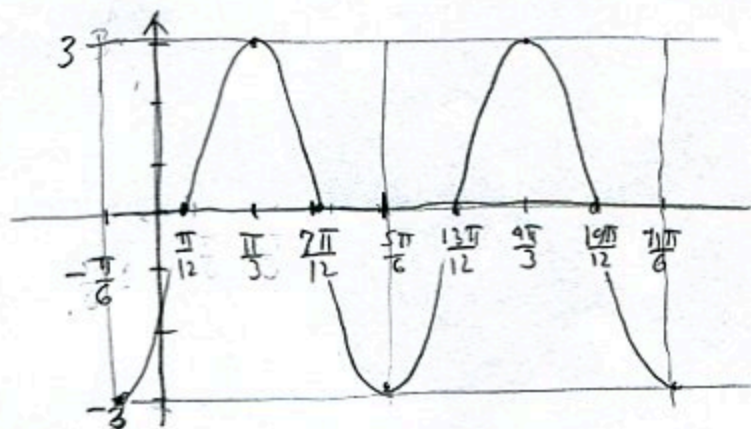
For each period, indicate x-coordinates of the five special points (middle, peaks, valleys).

$$\text{Amplitude} = 3$$

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

$$-\frac{c}{b} = -\frac{\pi/3}{2} = -\frac{\pi}{6}$$

$$-\frac{c}{b} + \frac{2\pi}{b} = -\frac{\pi}{6} + \pi = \frac{5\pi}{6}$$



5. (10pts) Draw two periods of the graph of  $y = \sin(-2x + \frac{\pi}{2}) + 1$ .

What is the amplitude? The period?

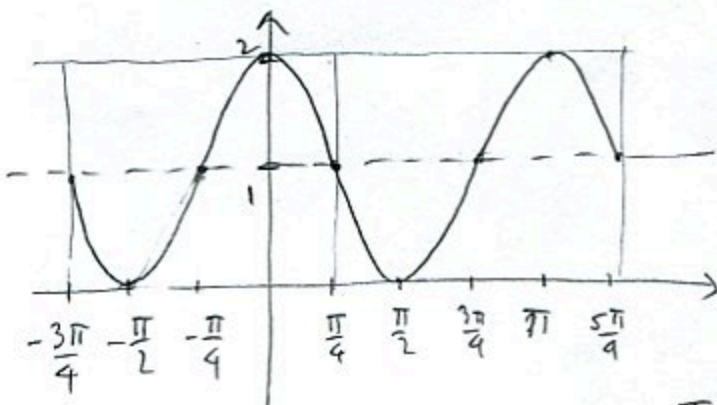
For each period, indicate x-coordinates of the five special points (middle, peaks, valleys).

$$\text{Amplitude} = 1$$

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

$$-\frac{c}{b} = -\frac{\pi/2}{-2} = \frac{\pi}{4}$$

$$-\frac{c}{b} + \frac{2\pi}{b} = \frac{\pi}{4} + \frac{2\pi}{-2} = -\frac{3\pi}{4}$$



Ticks at  $\frac{\pi}{4}$

$$\begin{array}{|c|} \hline 1 \\ \hline 0 \\ \hline -1 \\ \hline \end{array} + \begin{array}{|c|} \hline 1 \\ \hline 0 \\ \hline -1 \\ \hline \end{array} = \begin{array}{|c|} \hline 2 \\ \hline 1 \\ \hline 0 \\ \hline -1 \\ \hline \end{array}$$